



**SAHYADRI**  
COLLEGE OF ENGINEERING & MANAGEMENT  
MANGALURU  
(An Autonomous Institution)

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

**Scheme of Teaching, Examination and Syllabus**

**B.E. Computer Science & Engineering**

**III – VII SEMESTER (2024 SCHEME & SYLLABUS)**

**(Effective from Academic Year 2025-26)**





**SAHYADRI**  
COLLEGE OF ENGINEERING & MANAGEMENT  
An Autonomous Institution  
MANGALURU

## B.E. in COMPUTER SCIENCE & ENGINEERING

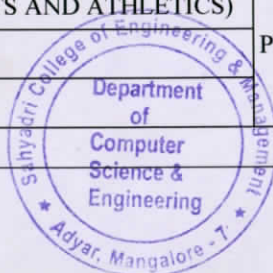
SCHEME OF TEACHING AND EVALUATION 2024

OUTCOME BASED EDUCATION (OBE) AND CHOICE BASED CREDIT SYSTEM (CBCS)

(2024 SCHEME: EFFECTIVE FROM THE ACADEMIC YEAR 2025 - 26)

### III SEMESTER

| Sl. No. | Course       | Course Code | Course Title                                                         | Teaching Department (TD)   | Question Paper Setting Board (PSB) | Teaching Hours/ Week |          |                    |            | Examination                                                                                                               |           |           |             | Credits |
|---------|--------------|-------------|----------------------------------------------------------------------|----------------------------|------------------------------------|----------------------|----------|--------------------|------------|---------------------------------------------------------------------------------------------------------------------------|-----------|-----------|-------------|---------|
|         |              |             |                                                                      |                            |                                    | Theory Lecture       | Tutorial | Practical/ Drawing | Self-Study | Duration in hours                                                                                                         | CIA Marks | SEE Marks | Total Marks |         |
|         |              |             |                                                                      |                            |                                    | L                    | T        | P                  | S          |                                                                                                                           |           |           |             |         |
| 1       | PCC/BSC      | BMA301TC    | COMPUTATIONAL DISCRETE MATHEMATICS                                   | BSC                        | BSC                                | 03                   | 00       | 00                 | 03         | 3                                                                                                                         | 50        | 50        | 100         | 03      |
| 2       | IPCC         | BCS302G     | DIGITAL DESIGN AND COMPUTER ORGANIZATION                             | CSE                        | CSE                                | 03                   | 00       | 02                 | 03         | 3                                                                                                                         | 50        | 50        | 100         | 04      |
| 3       | IPCC         | BCS303G     | OPERATING SYSTEMS                                                    | CSE                        | CSE                                | 03                   | 00       | 02                 | 03         | 3                                                                                                                         | 50        | 50        | 100         | 04      |
| 4       | PCC          | BCS304T     | DATA STRUCTURES AND ALGORITHMS                                       | CSE                        | CSE                                | 03                   | 00       | 00                 | 03         | 3                                                                                                                         | 50        | 50        | 100         | 03      |
| 5       | PCCL         | BCS305L     | DATA STRUCTURES AND ALGORITHMS LABORATORY                            | CSE                        | CSE                                | 00                   | 00       | 02                 | 00         | 3                                                                                                                         | 50        | 50        | 100         | 01      |
| 6       | ESC/ ETC/PLC | BCS306Wx    | ENGINEERING SCIENCE/EMERGING TECHNOLOGY/PROGRAMMING LANGUAGE COURSES | CSE                        | CSE                                | 03                   | 00       | 00                 | 03         | 3                                                                                                                         | 50        | 50        | 100         | 03      |
| 7       | UHV          | BHU307TK    | UHV-1: SOCIAL CONNECT AND RESPONSIBILITIES                           | BSC                        | BSC                                | 01                   | 00       | 00                 | 01         | 1                                                                                                                         | 50        | 50        | 100         | 01      |
| 8       | AEC/SEC      | BCS308Ax    | ABIILITY ENHANCEMENT COURSE – I/<br>SKILL ENHANCEMENT COURSE - I     | CSE                        | CSE                                | 00<br>01             | 00<br>00 | 02<br>00           | 00         | 1                                                                                                                         | 50        | 50        | 100         | 01      |
| 9       | NCMC         | BNS309NK    | NATIONAL SERVICE SCHEME (NSS)                                        | NSS /<br>PED / Yoga/ Music |                                    | 00                   | 00       | 02                 | 00         | Registrations to any one of the courses be completed (as per the choice of the student) and activities to be carried out. |           |           |             | 00      |
|         |              | BPE309NK    | PHYSICAL EDUCATION (PE) (SPORTS AND ATHLETICS)                       |                            |                                    |                      |          |                    |            |                                                                                                                           |           |           |             |         |
|         |              | BYO309NK    | YOGA                                                                 |                            |                                    |                      |          |                    |            |                                                                                                                           |           |           |             |         |
|         |              | BMU309NK    | MUSIC                                                                |                            |                                    |                      |          |                    |            |                                                                                                                           |           |           |             |         |
| TOTAL   |              |             |                                                                      |                            |                                    |                      |          |                    |            |                                                                                                                           | 400       | 400       | 800         | 20      |





| ESC/ETC/PLC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |                                      |                          |  |  |          |     |                         |    |    |    |    |    |    |     |   |
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| BCS306W1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     | OBJECT ORIENTED PROGRAMMING WITH C++ |                          |  |  | BCS306W2 |     | PROGRAMMING WITH JAVA   |    |    |    |    |    |    |     |   |
| ABILITY ENHANCEMENT COURSE I / SKILL ENHANCEMENT COURSE - I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |                                      |                          |  |  |          |     |                         |    |    |    |    |    |    |     |   |
| BCS308A1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     | MOBILE APPLICATION DEVELOPMENT       |                          |  |  | BCS308A3 |     | GAME DEVELOPMENT        |    |    |    |    |    |    |     |   |
| BCS308A2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     | UI/UX DESIGN                         |                          |  |  | BCS308A4 |     | COMPETITIVE PROGRAMMING |    |    |    |    |    |    |     |   |
| COURSE PRESCRIBED TO LATERAL ENTRY DIPLOMA HOLDERS ADMITTED TO III SEMESTER OF THE B.E. PROGRAMS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |                                      |                          |  |  |          |     |                         |    |    |    |    |    |    |     |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | BSC | BMA310NK                             | ADDITIONAL MATHEMATICS I |  |  | BSC      | BSC | 03                      | 00 | 00 | 01 | 03 | 50 | 50 | 100 | 0 |
| <p><b>Note:</b> <b>BSC:</b> Basic Science Course, <b>IPCC:</b> Integrated Professional Core Course, <b>PCC:</b> Professional Core Course, <b>PCCL:</b> Professional Core Course Laboratory, <b>AEC:</b> Ability Enhancement Courses. <b>UHV:</b> Universal Human Value Course, <b>SEC:</b> Skill Enhancement Course, <b>ESC:</b> Engineering Science Course, <b>ETC:</b> Emerging Technology Course, <b>PLC:</b> Programming Language Course, <b>MC:</b> Mandatory Course</p> <p><b>L</b> – Lecture, <b>T</b> – Tutorial, <b>P-</b> Practical/ Drawing, <b>S</b> – Self -Study Component, <b>CIA:</b> Continuous Internal Assessment, <b>SEE:</b> Semester End Examination, <b>TD-</b> Teaching Department, <b>PSB:</b> Paper Setting Board.</p> <p><b>Integrated Professional Core Course (IPCC):</b> Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L: T: P) can be considered as (3: 0: 2) or (2: 2: 2). The theory part of the IPCC shall be evaluated both by CIA and SEE. The practical part shall be evaluated by only CIA (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.</p> <p><b>National Service Scheme (NSS)/ Physical Education (PE)/ Yoga/ Music:</b> All the students have to register for any one of the courses namely NSS/ PE/ Yoga/Music with the concerned coordinator of the course during the first week of the III semester. Activities shall be carried out between the III semester and VI semester (4 Semesters). The events shall be appropriately scheduled and the same shall be reflected in the Institute Academic and Activity Calendar. The course will be evaluated only for the CIA marks and will not have SEE component. The students who successfully complete the registered course will be awarded with “PP” grade and the students not completing the same will be awarded with “NP” grade. The marks and the grade obtained by the student will be included in the SIXTH semester grade card. The course will not be considered for the SGPA and CGPA calculations and Vertical Progression, however, completion of the course is mandatory for the award of the Degree.</p> <p><b>Non–Credit Mandatory Courses (NCMC):</b></p> <p><b>A. Additional Mathematics I:</b></p> <ol style="list-style-type: none"><li>1) This course is prescribed in the III semester to the lateral entry Diploma holders admitted to the second year of the B.E., programs.</li><li>2) They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Assessment (CIA).</li><li>3) This course is slated for both CIA and SEE.</li><li>4) This course shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.</li><li>5) Successful completion of the course shall be indicated with Pass (PP) grade in the grade card. Non-completion of the courses will lead to the award of Not Pass (NP) Grade.</li><li>6) In case, any student fails to register for the said course/fails to secure the minimum 40% of the prescribed CIA marks, 35% of the prescribed SEE marks and a overall of 40% of Total Marks, shall be deemed to have secured an NP grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s.</li></ol> <p><b>B. National Service Scheme (NSS) / Physical Education (Sport and Athletics) (PED) / Yoga/ Music:</b></p> <ol style="list-style-type: none"><li>1) Securing 50% or more in CIA leads to successful completion of the registered course.</li></ol> |     |                                      |                          |  |  |          |     |                         |    |    |    |    |    |    |     |   |



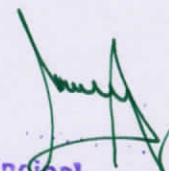
- 2) In case, any student fails to register for NSS, PE, Yoga or Music/ fails to secure the minimum requirements as mentioned in (B).1, they shall be awarded with NP Grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s.
- 3) Securing 50% or more in CIA leads to successful completion of the registered course.
- 4) In case, any student fails to register for NSS, PE, Yoga or Music /fails to secure the minimum requirements as mentioned in B.1), they shall be awarded with NP Grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s.
- 5) Successful completion of the course shall be indicated with a PP Grade in the grade card.
- 6) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.



**Chairperson**  
**Board of Studies (BoS)**  
**Computer Science & Engineering**  
**Sahyadri College of Engineering & Management**



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## B.E. in COMPUTER SCIENCE & ENGINEERING

SCHEME OF TEACHING AND EVALUATION 2024

OUTCOME BASED EDUCATION(OBE) AND CHOICE BASED CREDIT SYSTEM (CBCS)

(2024 SCHEME: EFFECTIVE FROM THE ACADEMIC YEAR 2025 - 26)

### IV SEMESTER

| Sl. No. | Course          | Course Code | Course Title                                                       | Teaching Department (TD)   | Question Paper Setting Board (PSB)                                     | Teaching Hours/ Week |          |                    |            | Examination                                                                |           |           |             | Credits |
|---------|-----------------|-------------|--------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------|----------------------|----------|--------------------|------------|----------------------------------------------------------------------------|-----------|-----------|-------------|---------|
|         |                 |             |                                                                    |                            |                                                                        | Theory Lecture       | Tutorial | Practical/ Drawing | Self-Study | Duration in hours                                                          | CIA Marks | SEE Marks | Total Marks |         |
|         |                 |             |                                                                    |                            |                                                                        | L                    | T        | P                  | S          |                                                                            |           |           |             |         |
| 1       | IPCC            | BCS401G     | COMPUTER COMMUNICATION AND NETWORKS                                | CSE                        | CSE                                                                    | 03                   | 00       | 02                 | 03         | 03                                                                         | 50        | 50        | 100         | 04      |
| 2       | IPCC            | BCS402G     | MICROPROCESSOR AND EMBEDDED SYSTEMS                                | CSE                        | CSE                                                                    | 03                   | 00       | 02                 | 03         | 03                                                                         | 50        | 50        | 100         | 04      |
| 3       | PCC             | BCS403T     | SOFTWARE ENGINEERING                                               | CSE                        | CSE                                                                    | 03                   | 00       | 00                 | 03         | 03                                                                         | 50        | 50        | 100         | 03      |
| 4       | PCC             | BCS404T     | DESIGN AND ANALYSIS OF ALGORITHMS                                  | CSE                        | CSE                                                                    | 03                   | 00       | 00                 | 03         | 03                                                                         | 50        | 50        | 100         | 03      |
| 5       | PCCL            | BCS405L     | DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY                       | CSE                        | CSE                                                                    | 00                   | 00       | 02                 | 00         | 03                                                                         | 50        | 50        | 100         | 01      |
| 6       | ESC/<br>ETC/PLC | BCS406Wx    | MATHEMATICS COURSE SPECIFIC TO THE PROGRAM                         | BSC                        | BSC                                                                    | 03                   | 00       | 00                 | 03         | 03                                                                         | 50        | 50        | 100         | 03      |
| 7       | UHV             | BHU407TK    | UHV-2: UNDERSTANDING HARMONY AND ETHICAL CONDUCT                   | BSC                        | BSC                                                                    | 01                   | 00       | 00                 | 01         | 03                                                                         | 50        | 50        | 100         | 01      |
| 8       | AEC/SEC         | BCS408Ax    | ABIILITY ENHANCEMENT COURSE – II/<br>SKILL ENHANCEMENT COURSE - II | CSE                        | CSE                                                                    | 00<br>01             | 00<br>00 | 02<br>00           | 0          | 01                                                                         | 50        | 50        | 100         | 01      |
| 9       | BSC             | BBS409TC    | BIOLOGY FOR ENGINEERS (CSE & Allied)                               | BSC                        | BSC                                                                    | 02                   | 00       | 00                 | 02         | 02                                                                         | 50        | 50        | 100         | 02      |
| 10      | NCMC            | BNS410NK    | NATIONAL SERVICE SCHEME (NSS)                                      | NSS /<br>PED / Yoga/ Music | Department<br>of<br>Computer<br>Science &<br>Engineering<br>Management | 00                   | 00       | 02                 | 00         | Activities to be carried out by<br>the student in the registered<br>course |           |           |             | 00      |
|         |                 | BPE410NK    | PHYSICAL EDUCATION (PE) (SPORTS AND ATHLETICS)                     |                            |                                                                        |                      |          |                    |            |                                                                            |           |           |             |         |
|         |                 | BYO410NK    | YOGA                                                               |                            |                                                                        |                      |          |                    |            |                                                                            |           |           |             |         |
|         |                 | BMU410NK    | MUSIC                                                              |                            |                                                                        |                      |          |                    |            |                                                                            |           |           |             |         |
| TOTAL   |                 |             |                                                                    |                            |                                                                        |                      |          |                    |            |                                                                            | 450       | 450       | 900         | 22      |



**ESC/ETC/PLC**

|          |                |          |                         |
|----------|----------------|----------|-------------------------|
| BCS406W1 | GRAPH THEORY   | BCS406W3 | METRIC SPACES           |
| BCS406W2 | LINEAR ALGEBRA | BCS406W4 | OPTIMIZATION TECHNIQUES |

**ABILITY ENHANCEMENT COURSE IV / SKILL ENHANCEMENT COURSE - II**

|          |                                    |          |                              |
|----------|------------------------------------|----------|------------------------------|
| BCS408A1 | ADVANCED JAVA AND SPRING FRAMEWORK | BCS408A3 | PROGRAMMING FOR DATA SCIENCE |
| BCS408A2 | AUTOMATED SOFTWARE TESTING         | BCS408A4 | WEB APPLICATION DEVELOPMENT  |

**COURSE PRESCRIBED TO LATERAL ENTRY DIPLOMA HOLDERS ADMITTED TO III SEMESTER B.E. PROGRAMS**

|   |     |          |                           |     |     |    |    |    |    |    |    |    |     |   |
|---|-----|----------|---------------------------|-----|-----|----|----|----|----|----|----|----|-----|---|
| 1 | BSC | BMA411NK | ADDITIONAL MATHEMATICS II | BSC | BSC | 02 | 00 | 00 | 01 | 03 | 50 | 50 | 100 | 0 |
|---|-----|----------|---------------------------|-----|-----|----|----|----|----|----|----|----|-----|---|

**Note:** **BSC:** Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PCCL:** Professional Core Course Laboratory, **AEC:** Ability Enhancement Courses, **UHV:** Universal Human Value Course, **SEC:** Skill Enhancement Course, **ESC:** Engineering Science Course, **ETC:** Emerging Technology Course, **PLC:** Programming Language Course, **MC:** Mandatory Course

**L** – Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self -Study Component, **CIA:** Continuous Internal Assessment, **SEE:** Semester End Examination, **TD-** Teaching Department, **PSB:** Paper Setting Board.

**Integrated Professional Core Course (IPCC):** Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L: T: P) can be considered as (3: 0: 2) or (2: 2: 2). The theory part of the IPCC shall be evaluated both by CIA and SEE. The practical part shall be evaluated by only CIA (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

**National Service Scheme (NSS)/ Physical Education (PE)/ Yoga/ Music:** All the students have to register for any one of the courses namely NSS/ PE/ Yoga with the concerned coordinator of the course during the first week of the III semester. Activities shall be carried out between the III semester and VI semester (4 Semesters). The events shall be appropriately scheduled and the same shall be reflected in the Institute Academic and Activity Calendar. The course will be evaluated only for the CIA marks and will not have SEE component. The students who successfully complete the registered course will be awarded with “PP” grade and the students not completing the same will be awarded with “NP” grade. The marks and the grade obtained by the student will be included in the SIXTH semester grade card. The course will not be considered for the SGPA and CGPA calculations and Vertical Progression, however, completion of the course is mandatory for the award of the Degree.

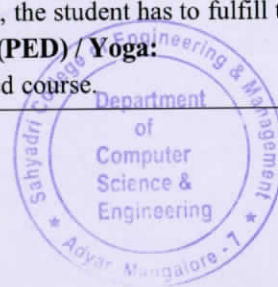
**Non–Credit Mandatory Courses (NCMC):**

**A. Additional Mathematics II:**

- 1) This course is prescribed in the IV semester to the lateral entry Diploma holders admitted to the second year of the B.E., programs.
- 2) They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Assessment (CIA).
- 3) This course is slated for both CIA and SEE.
- 4) The course shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.
- 5) Successful completion of the course shall be indicated with Pass (PP) grade in the grade card. Non-completion of the courses will lead to the award of Not Pass (NP) Grade.
- 6) In case, any student fails to register for the said course/fails to secure the minimum 40% of the prescribed CIA marks, 35% of the prescribed SEE marks and a overall of 40% of Total Marks, shall be deemed to have secured an NP grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s

**B. National Service Scheme (NSS) / Physical Education (Sport and Athletics) (PED) / Yoga:**

- 1) Securing 50% or more in CIA leads to successful completion of the registered course.



- 2) In case, any student fails to register for NSS, PE, Yoga or Music/ fails to secure the minimum requirements as mentioned in B.1), they shall be awarded with NP Grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s.
- 3) Securing 50% or more in CIA leads to successful completion of the registered course.
- 4) In case, any student fails to register for NSS, PE, Yoga or Music /fails to secure the minimum requirements as mentioned in B.1), they shall be awarded with NP Grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s.
- 5) Successful completion of the course shall be indicated with a PP Grade in the grade card.
- 6) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.



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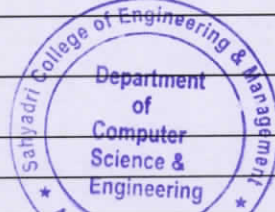
SCHEME OF TEACHING AND EVALUATION 2024

OUTCOME BASED EDUCATION(OBE) AND CHOICE BASED CREDIT SYSTEM (CBCS)

(2024 SCHEME: EFFECTIVE FROM THE ACADEMIC YEAR 2026 - 27)

### V SEMESTER

| Sl. No. | Course | Course Code | Course Title                                   | Teaching Department (TD) | Question Paper Setting Board (PSB) | Teaching Hours/ Week |          |                    |                                                                      | Examination       |           |           |             | Credits |
|---------|--------|-------------|------------------------------------------------|--------------------------|------------------------------------|----------------------|----------|--------------------|----------------------------------------------------------------------|-------------------|-----------|-----------|-------------|---------|
|         |        |             |                                                |                          |                                    | Theory Lecture       | Tutorial | Practical/ Drawing | Self-Study                                                           | Duration in hours | CIA Marks | SEE Marks | Total Marks |         |
|         |        |             |                                                |                          |                                    | L                    | T        | P                  | S                                                                    |                   |           |           |             |         |
| 1       | IPCC   | BCS501G     | ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING   | CSE                      | CSE                                | 03                   | 00       | 02                 | 03                                                                   | 03                | 50        | 50        | 100         | 04      |
| 2       | IPCC   | BCS502G     | CLOUD COMPUTING AND SECURITY                   | CSE                      | CSE                                | 03                   | 00       | 02                 | 03                                                                   | 03                | 50        | 50        | 100         | 04      |
| 3       | PCC    | BCS503T     | THEORY OF COMPUTATION                          | CSE                      | CSE                                | 03                   | 00       | 00                 | 03                                                                   | 03                | 50        | 50        | 100         | 03      |
| 4       | PCC    | BCS504T     | DATABASE MANAGEMENT SYSTEMS                    | CSE                      | CSE                                | 03                   | 00       | 00                 | 03                                                                   | 03                | 50        | 50        | 100         | 03      |
| 5       | PCCL   | BCS505L     | DATABASE MANAGEMENT SYSTEMS LABORATORY         | CSE                      | CSE                                | 00                   | 00       | 02                 | 00                                                                   | 03                | 50        | 50        | 100         | 01      |
| 6       | PEC    | BCS506Ex    | PROFESSIONAL ELECTIVE COURSE - I               | CSE                      | CSE                                | 03                   | 00       | 00                 | 03                                                                   | 03                | 50        | 50        | 100         | 03      |
| 7       | PROJ   | BCS507P     | MINI PROJECT WORK                              | CSE                      | CSE                                | 00                   | 00       | 04                 | 00                                                                   | 03                | 100       | --        | 100         | 02      |
| 8       | AEC    | BBS508AK    | RESEARCH METHODOLOGY AND IPR                   | CSE                      | CSE                                | 01                   | 00       | 00                 | 01                                                                   | 02                | 50        | 50        | 100         | 01      |
| 9       | BSC    | BBS509TK    | ENVIRONMENTAL STUDIES                          | BSC                      | BSC                                | 01                   | 00       | 00                 | 01                                                                   | 01                | 50        | 50        | 100         | 01      |
| 10      | NCMC   | BNS510NK    | NATIONAL SERVICE SCHEME (NSS)                  | NSS / PED / Yoga/ Music  | 00                                 | 00                   | 02       | 00                 | Activities to be carried out by the student in the registered course |                   |           |           | 00          |         |
|         |        | BPE510NK    | PHYSICAL EDUCATION (PE) (SPORTS AND ATHLETICS) |                          |                                    |                      |          |                    |                                                                      |                   |           |           |             |         |
|         |        | BYO510NK    | YOGA                                           |                          |                                    |                      |          |                    |                                                                      |                   |           |           |             |         |
|         |        | BMU510NK    | MUSIC                                          |                          |                                    |                      |          |                    |                                                                      |                   |           |           |             |         |
| TOTAL   |        |             |                                                |                          |                                    |                      |          |                    |                                                                      |                   | 500       | 400       | 900         | 22      |





## PROFESSIONAL ELECTIVE COURSE I

|          |                                  |          |                                |
|----------|----------------------------------|----------|--------------------------------|
| BCS506E1 | CYBER SECURITY AND SECURE CODING | BCS506E3 | INFORMATION STORAGE MANAGEMENT |
| BCS506E2 | INTERNET OF THINGS               | BCS506E4 | SOCIAL AND WEB ANALYTICS       |

**Note:** **HSMC:** Humanities Science & Management Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PCCL:** Professional Core Course Laboratory, **AEC:** Ability Enhancement Courses, **PEC:** Professional Elective Course, **MC:** Mandatory Course, **PROJ:** Project Work  
**L** – Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIA:** Continuous Internal Assessment, **SEE:** Semester End Examination, **TD-** Teaching Department, **PSB:** Paper Setting Board.

**Integrated Professional Core Course (IPCC):** Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L: T: P) can be considered as (3: 0: 2) or (2: 2: 2). The theory part of the IPCC shall be evaluated both by CIA and SEE. The practical part shall be evaluated by only CIA (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

**National Service Scheme (NSS)/ Physical Education (PE)/ Yoga/ Music:** All the students have to register for any one of the courses namely NSS/ PE/ Yoga/ Music with the concerned coordinator of the course during the first week of the III semester. Activities shall be carried out between the III semester and VI semester (4 Semesters). The events shall be appropriately scheduled and the same shall be reflected in the Institute Academic and Activity Calendar. The course will be evaluated only for the CIA marks and will not have SEE component. The students who successfully complete the registered course will be awarded with “PP” grade and the students not completing the same will be awarded with “NP” grade. The marks and the grade obtained by the student will be included in the SIXTH semester grade card. The course will not be considered for the SGPA and CGPA calculations and Vertical Progression, however, completion of the course is mandatory for the award of the Degree.

**Professional Elective Course (PEC):** A Professional Elective Course (PEC) is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses are added to supplement the learning with the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students’ strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

**Mini Project (PROJ):** Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

### Non–Credit Mandatory Courses (NCMC):

**National Service Scheme (NSS)/Physical Education (Sport and Athletics) (PED)/ Yoga/ Music:**

- 1) Securing 50% or more in CIA leads to successful completion of the registered course.
- 2) In case, any student fails to register for NSS, PE, Yoga or Music/ fails to secure the minimum requirements as mentioned in Sl. No. 1) above, they shall be awarded with NP Grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s.
- 3) Securing 50% or more in CIA leads to successful completion of the registered course.
- 4) In case, any student fails to register for NSS, PE, Yoga or Music /fails to secure the minimum requirements as mentioned in B.1), they shall be awarded with NP Grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s.
- 5) Successful completion of the course shall be indicated with a PP Grade in the grade card.
- 6) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

*[Signature]*  
 Computer Science & Engineering  
 Sahyadri College of Engineering & Management

*[Signature]*  
 Dean-Academics  
 Sahyadri College of Engineering & Management  
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 Mangaluru

*[Signature]*  
 Principal  
 Sahyadri College of Engineering & Management  
 An Autonomous Institution  
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## B.E. in COMPUTER SCIENCE & ENGINEERING

SCHEME OF TEACHING AND EVALUATION 2024

OUTCOME BASED EDUCATION(OBE) AND CHOICE BASED CREDIT SYSTEM (CBCS)

(2024 SCHEME: EFFECTIVE FROM THE ACADEMIC YEAR 2026 - 27)

### VI SEMESTER

| VI SEMESTER |           |             |                                                                     |                               |                                    |                      |          |                    |            |                                                                     |           |           |             |         |
|-------------|-----------|-------------|---------------------------------------------------------------------|-------------------------------|------------------------------------|----------------------|----------|--------------------|------------|---------------------------------------------------------------------|-----------|-----------|-------------|---------|
| Sl. No.     | Course    | Course Code | Course Title                                                        | Teaching Department (TD)      | Question Paper Setting Board (PSB) | Teaching Hours/ Week |          |                    |            | Examination                                                         |           |           |             | Credits |
|             |           |             |                                                                     |                               |                                    | Theory Lecture       | Tutorial | Practical/ Drawing | Self-Study | Duration in hours                                                   | CIA Marks | SEE Marks | Total Marks |         |
|             |           |             |                                                                     |                               |                                    | L                    | T        | P                  | S          |                                                                     |           |           |             |         |
| 1           | HSMC/ PCC | BBA601TC    | FINANCIAL MANAGEMENT AND TAXATION                                   | MBA                           | MBA                                | 03                   | 00       | 00                 | 03         | 03                                                                  | 50        | 50        | 100         | 03      |
| 2           | IPCC      | BCS602G     | COMPILER DESIGN                                                     | CSE                           | CSE                                | 03                   | 00       | 02                 | 03         | 03                                                                  | 50        | 50        | 100         | 04      |
| 3           | PCC       | BCS603T     | DEEP LEARNING                                                       | CSE                           | CSE                                | 03                   | 00       | 00                 | 03         | 03                                                                  | 50        | 50        | 100         | 03      |
| 4           | PEC       | BCS604Ex    | PROFESSIONAL ELECTIVE COURSE - II                                   | CSE                           | CSE                                | 03                   | 00       | 00                 | 03         | 03                                                                  | 50        | 50        | 100         | 03      |
| 5           | OEC       | BCS605Qx    | OPEN ELECTIVE COURSE - I                                            | CSE                           | CSE                                | 03                   | 00       | 00                 | 03         | 03                                                                  | 50        | 50        | 100         | 03      |
| 6           | PROJ      | BCS606P     | PROJECT WORK PHASE I                                                | CSE                           | CSE                                | 00                   | 00       | 04                 | 00         | 03                                                                  | 100       | --        | 100         | 02      |
| 7           | PCCL      | BCS607L     | DEEP LEARNING LABORATORY                                            | CSE                           | CSE                                | 00                   | 00       | 02                 | 00         | 03                                                                  | 50        | 50        | 100         | 01      |
| 8           | AEC       | BCS608Ax    | ABILITY ENHANCEMENT COURSE - III/<br>SKILL ENHANCEMENT COURSE - III | CSE                           | CSE                                | 00<br>01             | 00<br>00 | 02<br>00           | 00         | 03                                                                  | 50        | 50        | 100         | 01      |
| 9           | NCMC      | BNS609NK    | NATIONAL SERVICE SCHEME (NSS)                                       | NSS /<br>PED / Yoga/<br>Music |                                    | 00                   | 00       | 02                 | 00         | Completed during the<br>intervening period of III<br>and V Semester |           |           |             | 00      |
|             |           | BPE609NK    | PHYSICAL EDUCATION (PE) (SPORTS AND ATHLETICS)                      |                               |                                    |                      |          |                    |            |                                                                     |           |           |             |         |
|             |           | BYO609NK    | YOGA                                                                |                               |                                    |                      |          |                    |            |                                                                     |           |           |             |         |
|             |           | BMU609NK    | MUSIC                                                               |                               |                                    |                      |          |                    |            |                                                                     |           |           |             |         |
| TOTAL       |           |             |                                                                     |                               |                                    |                      |          |                    |            |                                                                     | 450       | 350       | 800         | 20      |





### PROFESSIONAL ELECTIVE COURSE - II

|          |                                      |          |                                        |
|----------|--------------------------------------|----------|----------------------------------------|
| BCS604E1 | NATURAL LANGUAGE PROCESSING          | BCS604E3 | CRYPTOGRAPHY AND NETWORK SECURITY      |
| BCS604E2 | FOUNDATIONS OF BLOCKCHAIN TECHNOLOGY | BCS604E4 | FUNDAMENTALS OF FOG AND EDGE COMPUTING |

### OPEN ELECTIVE COURSE - I

|          |                                |          |                                  |
|----------|--------------------------------|----------|----------------------------------|
| BCS605Q1 | INTRODUCTION TO CYBER SECURITY | BCS605Q3 | INTRODUCTION TO JAVA PROGRAMMING |
| BCS605Q2 | INTRODUCTION TO DATA STRUCTURE | BCS605Q4 | FUNDAMENTALS OF WEB TECHNOLOGY   |

### ABILITY ENHANCEMENT COURSE III / SKILL ENHANCEMENT COURSE - III

|          |                                                |          |                                      |
|----------|------------------------------------------------|----------|--------------------------------------|
| BCS608A1 | MONGODB                                        | BCS608A3 | DEVOPS                               |
| BCS608A2 | VULNERABILITY ANALYSIS AND PENETRATION TESTING | BCS608A4 | GENERATIVE AI AND PROMPT ENGINEERING |

**Note:** **BS:** Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PCCL:** Professional Core Course Laboratory, **AEC:** Ability Enhancement Courses, **UHV:** Universal Human Value Course, **SEC:** Skill Enhancement Course, **ESC:** Engineering Science Course, **ETC:** Emerging Technology Course, **PLC:** Programming Language Course, **MC:** Mandatory Course

**L** – Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIA:** Continuous Internal Assessment, **SEE:** Semester End Examination, **TD-** Teaching Department, **PSB:** Paper Setting Board.

**Integrated Professional Core Course (IPCC):** Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L: T: P) can be considered as (3: 0: 2) or (2: 2: 2). The theory part of the IPCC shall be evaluated both by CIA and SEE. The practical part shall be evaluated by only CIA (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

**Professional Elective Course (PEC):** A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 20. However, this conditional shall not be applicable to cases where the admission to the program is less than 20.

**Open Elective Courses (OEC):** Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.

Selection of an Open Elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the program.
- The syllabus content of open electives is similar to that of the Departmental core courses or Professional Elective courses.
- A similar course, under any category, is prescribed in the higher semesters of the program.
- In case, if any department is interested in offering courses from streams such as Law, Business (MBA), Medicine, Arts, Commerce etc. need to get the necessary approval from the respective Board of Studies and the Academic Council.
- The minimum numbers of students' strength for offering Open Elective Course is 20. However, this condition shall not be applicable to class where the admission to the program is less than 20.

**Project Work Phase I (PW):** Students have to discuss with their mentors/guides and with their help has to complete the Literature Review, define the problem statement for the Project Work, and submit appropriate report. The guidelines and the evaluation process will be defined by the Project Evaluation Committee (PEC) of the department and approved by the Board of Studies and the Academic Council of SCEM.

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## B.E. in COMPUTER SCIENCE & ENGINEERING

SCHEME OF TEACHING AND EVALUATION 2024

OUTCOME BASED EDUCATION(OBE) AND CHOICE BASED CREDIT SYSTEM (CBCS)

(2024 SCHEME: EFFECTIVE FROM THE ACADEMIC YEAR 2027 - 28)

### VII SEMESTER

| Sl. No.      | Course | Course Code | Course Title                                            | Teaching Department (TD) | Question Paper Setting Board (PSB) | Teaching Hours/ Week |          |                    |            | Examination       |            |            |             | Credits   |
|--------------|--------|-------------|---------------------------------------------------------|--------------------------|------------------------------------|----------------------|----------|--------------------|------------|-------------------|------------|------------|-------------|-----------|
|              |        |             |                                                         |                          |                                    | Theory Lecture       | Tutorial | Practical/ Drawing | Self-Study | Duration in hours | CIA Marks  | SEE Marks  | Total Marks |           |
|              |        |             |                                                         |                          |                                    | L                    | T        | P                  | S          |                   |            |            |             |           |
| 1            | IPCC   | BCS701G     | HIGH PERFORMANCE COMPUTING                              | CSE                      | CSE                                | 03                   | 00       | 02                 | 03         | 03                | 50         | 50         | 100         | 04        |
| 2            | PCC    | BCS702T     | DIGITAL IMAGE PROCESSING AND COMPUTER VISION            | CSE                      | CSE                                | 03                   | 00       | 00                 | 03         | 03                | 50         | 50         | 100         | 03        |
| 3            | PEC    | BCS703Ex    | PROFESSIONAL ELECTIVE COURSE - III                      | CSE                      | CSE                                | 03                   | 00       | 00                 | 03         | 03                | 50         | 50         | 100         | 03        |
| 4            | OEC    | BCS704Qx    | OPEN ELECTIVE COURSE - II                               | CSE                      | CSE                                | 03                   | 00       | 00                 | 03         | 03                | 50         | 50         | 100         | 03        |
| 5            | PCCL   | BCS705L     | DIGITAL IMAGE PROCESSING AND COMPUTER VISION LABORATORY | CSE                      | CSE                                | 00                   | 00       | 02                 | 00         | 03                | 50         | 50         | 100         | 01        |
| 6            | PROJ   | BCS706P     | PROJECT WORK PHASE - II                                 | CSE                      | CSE                                | 00                   | 00       | 12                 | 00         | 03                | 50         | 50         | 100         | 06        |
| <b>TOTAL</b> |        |             |                                                         |                          |                                    |                      |          |                    |            |                   | <b>300</b> | <b>300</b> | <b>600</b>  | <b>20</b> |

### PROFESSIONAL ELECTIVE COURSE - III

|          |                    |          |                                  |
|----------|--------------------|----------|----------------------------------|
| BCS703E1 | BIG DATA ANALYTICS | BCS703E3 | ROBOTIC PROCESS AUTOMATION       |
| BCS703E2 | ETHICAL HACKING    | BCS703E4 | QUANTUM COMPUTING & APPLICATIONS |

### OPEN ELECTIVE COURSE - II

|          |                            |          |                                            |
|----------|----------------------------|----------|--------------------------------------------|
| BCS704Q1 | INTRODUCTION TO ALGORITHMS | BCS704Q3 | FUNDAMENTALS OF OPERATING SYSTEMS          |
| BCS704Q2 | SOFTWARE ENGINEERING       | BCS704Q4 | INTRODUCTION TO DATABASE MANAGEMENT SYSTEM |

**Note:** BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PCCL: Professional Core Course Laboratory, AEC: Ability Enhancement Courses, UHV: Universal Human Value Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course, MC: Mandatory Course  
L – Lecture, T – Tutorial, P- Practical/ Drawing, S – Self -Study Component, CIA: Continuous Internal Assessment, SEE: Semester End Examination, TD- Teaching Department, PSB: Paper Setting Board.



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**Open Elective Courses (OEC):** Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.

Selection of an Open Elective shall not be allowed if,

- i. The candidate has studied the same course during the previous semesters of the program.
- ii. The syllabus content of open electives is similar to that of the Departmental core courses or Professional Elective courses.
- iii. A similar course, under any category, is prescribed in the higher semesters of the program.
- iv. In case, if any department is interested in offering courses from streams such as Law, Business (MBA), Medicine, Arts, Commerce etc. need to get the necessary approval from the respective Board of Studies and the Academic Council.
- v. The minimum numbers of students' strength for offering Open Elective Course is 20. However, this condition shall not be applicable to class where the admission to the program is less than 20.

**Project Work Phase II (PW):** The objective of the Project Work is to

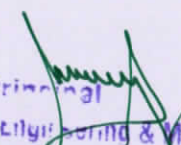
- i. Encourage independent learning and the innovative attitude of the students
- ii. Develop interactive attitude, communication skills, Organization, Time Management and Presentation Skills.
- iii. Impart Flexibility and Adaptability
- iv. Inspire Team working
- v. Expand Intellectual capacity, credibility, judgment and intuition
- vi. Adhere to Punctuality, setting and meeting deadlines
- vii. Install responsibilities to oneself and others
- viii. Train students to present the topic of Project work without any fear, face the audience confidently, enhance communication skills, involve in group discussions to present and exchange ideas.

The evaluation of the Project Work Phase II shall contain both Continuous Internal Assessment (CIA) and Semester End Examination (SEE). The guidelines and the evaluation process will be defined by the Project Evaluation Committee (PEC) of the department and approved by the Board of Studies and the Academic Council of SCEM.

  
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OUTCOME BASED EDUCATION(OBE) AND CHOICE BASED CREDIT SYSTEM (CBCS)  
(2024 SCHEME: EFFECTIVE FROM THE ACADEMIC YEAR 2027 - 28)

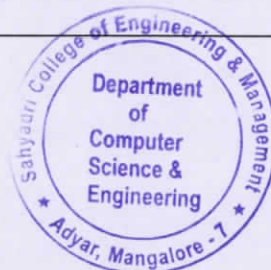
### VIII SEMESTER

| Sl. No. | Course | Course Code | Course Title                                                                              | Teaching Department (TD) | Question Paper Setting Board (PSB) | Teaching Hours/ Week |          |                    |            | Examination                |           |           |             | Credits |
|---------|--------|-------------|-------------------------------------------------------------------------------------------|--------------------------|------------------------------------|----------------------|----------|--------------------|------------|----------------------------|-----------|-----------|-------------|---------|
|         |        |             |                                                                                           |                          |                                    | Theory Lecture       | Tutorial | Practical/ Drawing | Self-Study | Duration in hours          | CIA Marks | SEE Marks | Total Marks |         |
|         |        |             |                                                                                           |                          |                                    | L                    | T        | P                  | S          |                            |           |           |             |         |
| 1       | PEC    | BCS801Ex    | PROFESSIONAL ELECTIVE COURSE- IV (12 WEEKS NPTEL) *                                       | NPTEL                    |                                    | 00                   | 00       | 00                 | 06         | AS PER GUIDELINES OF NPTEL |           |           |             | 03      |
| 2       | OEC    | BCS802Qx    | OPEN ELECTIVE COURSE- III (12 WEEKS NPTEL) *                                              | NPTEL                    |                                    | 00                   | 00       | 00                 | 06         | AS PER GUIDELINES OF NPTEL |           |           |             | 03      |
| 3       | INT    | BCS803I     | INTERNSHIP (14-20 WEEKS)<br>RESEARCH INTERNSHIP/ INDUSTRY INTERNSHIP/<br>RURAL INTERNSHIP | CSE                      | CSE                                | 00                   | 00       | 00                 | 18         | 03                         | 50        | 50        | 100         | 09      |
| 4       | SEM    | BCS804S     | RESEARCH ORIENTED TECHNICAL SEMINAR                                                       | CSE                      | CSE                                | 00                   | 00       | 00                 | 02         | 03                         | 50        | --        | 50          | 01      |
| TOTAL   |        |             |                                                                                           |                          |                                    |                      |          |                    |            | 100                        | 50        | 150       | 16          |         |

**\*To be published by the Board of Studies of Department of Computer Science & Engineering**

**Note:** BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PCCL: Professional Core Course Laboratory, AEC: Ability Enhancement Courses. UHV: Universal Human Value Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course, MC: Mandatory Course

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**Professional Elective Course (PEC):** A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course.

1. The PEC-IV shall be completed by the student in the form of online course, offered by NPTEL (STRICTLY) only
2. The courses shall be identified and approved by the BoS. In the case of modification, the chairperson of the BoS shall notify the updated course(s) to the concerned appropriately
3. The chosen course should not have been completed either in the MINORS or HONORS degree. If chosen and completed, then such course(s) shall automatically be cancelled and the candidates shall have to opt other courses from the BoS published list of course(s)
4. The student shall complete the course at any time between the FIFTH semester and the SEVENTH semester
5. The student has to provide the evidences for registering to the course, assignment submission, attending the examination and the certificate provided by the course provider indicating the clearance of the course by the candidate.
6. Only on submitting the valid documents, the student will be awarded with the credits mentioned against the course(s) and the same shall be reflected in the EIGHTH semester grade card
7. The EIGHTH semester marks card shall be provided to the student only on the completion of all the course(s) mentioned in the Eighth semester of the 2024-Scheme of Teaching and Evaluations.

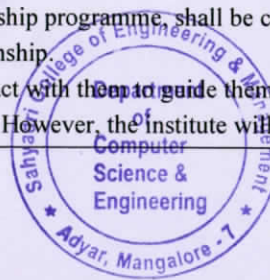
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Selection of an Open Elective shall not be allowed if,

1. The candidate has studied the same course during the previous semesters of the program
2. The syllabus content of open electives is similar to that of the Departmental core courses or Professional Elective courses
3. The courses shall be identified and approved by the BoS. In the case of modification, the chairperson of the BoS shall notify the updated course(s) to the concerned appropriately
4. The chosen course should not have been completed either in the MINORS or HONORS degree. If chosen and completed, then such course(s) shall automatically be cancelled and the candidates shall have to opt other courses from the BoS published list of course(s)
5. The student shall complete the course at any time between the FIFTH semester and the SEVENTH semester
6. The student has to provide the evidences for registering to the course, assignment submission, attending the examination and the certificate provided by the course provider indicating the clearance of the course by the candidate
7. Only on submitting the valid documents, the student will be awarded with the credits mentioned against the course(s) and the same shall be reflected in the EIGHTH semester grade card
8. The EIGHTH semester marks card shall be provided to the student only on the completion of all the course(s) mentioned in the Eighth semester of the 2024-Scheme of Teaching and Evaluations.

**Research Internship/ Industry Internship/ Rural Internship**

- **Research Internship:** This is intended to offer the flavor of current research happening in the Research fields. It helps students to get familiarize with the field and imparts the skill required for carrying out research.
- **Industry Internship:** An extended period of work experience undertaken by the students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate the organizations, perspectives and cultures. Dealing with contingencies helps the students recognize, appreciate and adapt to the organizational realities by tempering their knowledge with practical constraints.
- **Rural Internship:** A long term goal, as proposed under the AICTE rural internship programme, shall be counted as rural internship activity.
- The student may take up Interdisciplinary Research Internship or Industry Internship
- The Faculty Mentor need to monitor the student's internship progress and interact with them to guide them for the successful completion of the internship requirements
- The students are permitted to carry out internship anywhere in India or Abroad. However, the Institute will not bear any expenses incurred with respect to the internship.





**Research Oriented Technical Seminar:** In order to make the student aware of the technological and research application in various domains of the society, a comprehensive presentation need to be provided with all the supporting evidences for the claims in the presentation.

- The objective of the Technical Seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas.
- Each student, under the guidance of a Faculty, shall choose a topic, preferably a recent topic in their interested specializations.
- The student has to
  - i. Carry out a detailed Literature survey, systematically organize the content
  - ii. Prepare the report as per their own intuition, without cut-paste activities.
  - iii. Use tools for writing equations, drawings etc. and gain proficiency of the tools used.
  - iv. Present the topics effectively through appropriate digital media.
  - v. Answer the queries posed and involve in healthy debates/discussions
  - vi. Submit a report in an error-free and professional way
  - vii. Present the findings of the seminar in the reputed Conferences/Journals for possible publications (desirable).
- The evaluation procedure for the Research oriented Technical Seminar will be as provided by the Board of Studies and approved by the Academic Council of SCEM.

  
**Chairperson**  
**Board of Studies (BoS)**  
**Computer Science & Engineering**  
**Sahyadri College of Engineering & Management,**

  
**Dean-Academics**  
**Sahyadri College of Engineering & Management**  
**An Autonomous Institution**  
**Mangaluru**



  
**Principal**  
**Sahyadri College of Engineering & Management**  
**An Autonomous Institution**  
**Mangaluru**



**COMPUTATIONAL DISCRETE MATHEMATICS**

(Effective from the Academic year 2025 - 2026)

**III SEMESTER**

|                                        |                 |            |         |
|----------------------------------------|-----------------|------------|---------|
| Course Code                            | <b>BMA301TC</b> | CIA Marks  | 50      |
| Number of Contact Hours/Week (L:T:P:S) | 3:0:0:0         | SEE Marks  | 50      |
| Total Hours of Pedagogy                | <b>40L</b>      | Exam Hours | 3 Hours |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Basics of Permutation and combination and Set theory

**COURSE OBJECTIVES:**

- Enable the students to apply basic concepts of Logic on developing algorithms.
- Understand the Principle of Inclusion and Exclusion in solving combinatorial counting problems.
- Develop a strong conceptual understanding of relations and functions, enabling their application in computer science.
- Apply the knowledge of modular arithmetic to computer algorithms and to learn about vector spaces.

**TEACHING - LEARNING STRATEGY:**

These are some sample strategies; which course faculty members can incorporate in the Teaching Learning Process:

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE I**

|                                                                                                                                                                                                                                                  |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Fundamentals of Logic:</b> Basic Connectives and Truth Tables, Logic Equivalence – The Laws of Logic, Logical Implication – Rules of Inference. Quantifiers, Logical implication involving Quantifiers and Methods of the Proof and Disproof. | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

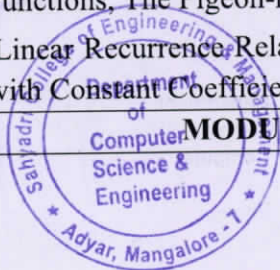
**MODULE II**

|                                                                                                                                                                                                                                                                                      |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Properties of the Integers:</b> The Well Ordering Principle–Mathematical Induction.<br><b>The Principle of Inclusion and Exclusion:</b> The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements–Nothing is in its Right Place, Rook Polynomials. | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE III**

|                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Relations:</b> Cartesian Products and Relations, Properties of Relations, Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders–Hasse Diagrams, Equivalence Relations and Partitions. Review of Functions, The Pigeon-hole Principle.<br><b>Recurrence Relations:</b> First Order Linear Recurrence Relation, The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE IV**







**Modular Arithmetic:** Introduction to Congruence, Linear Congruence, The Remainder theorem, Solving Polynomials, Linear Diophantine Equation, System of Linear Congruence, Euler's Theorem, Wilson Theorem and Fermat's little theorem. Applications of Congruences-RSA algorithm.

**10 Hours**

### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                             | Bloom's Taxonomy Level |
|--------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Apply logic principles and quantifiers to solve complex problems in computer science.                                                  | CL3                    |
| CO2    | Make use of counting techniques to solve diverse combinatorial problems, demonstrating advanced analytical and problem-solving skills. | CL3                    |
| CO3    | Develop understanding of relations to apply on data modelling and optimization of algorithms.                                          | CL3                    |
| CO4    | Solve linear congruences, polynomials, and linear Diophantine equations and apply them in coding theory and cryptography.              | CL3                    |

### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

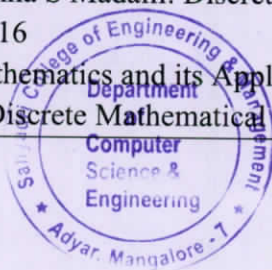
| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### SEE QUESTION PAPER PATTERN:

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

### REFERENCE BOOKS:

1. Ralph Grimaldi: Discrete and Combinatorial Mathematics, 5<sup>th</sup> Edition, Pearson Education.2004.
2. Basavaraj S Anami and Venakanna S Madalli: Discrete Mathematics – A Concept based approach, Universities Press, 2016
3. Kenneth H. Rosen: Discrete Mathematics and its Applications,6<sup>th</sup> Edition, McGrawHill,2007.
4. Jayant Ganguly: A Treatise on Discrete Mathematical Structures, Sanguine-Pearson, 2010.





5. D.S. Malik and M.K. Sen: Discrete Mathematical Structures: Theory and Applications, Thomson, 2004.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):**

1. <https://www.youtube.com/watch?v=8Kg2IjBCm-k>
2. <https://www.youtube.com/watch?v=Wa6kaCwyYRk>
3. <http://nptel.ac.in/courses.php?disciplineID=111>
4. [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
5. <http://academicearth.org/>
6. <http://www.bookstreet.in>







**DIGITAL DESIGN AND COMPUTER ORGANIZATION**

**(Effective from the Academic Year 2025 - 2026)**

**III SEMESTER**

|                                           |                  |            |    |
|-------------------------------------------|------------------|------------|----|
| Course Code                               | <b>BCS302G</b>   | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:2:0          | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L + 20P</b> | Exam Hours | 03 |

**CREDITS – 4**

**COURSE PREREQUISITES:**

- Basics of number system and fundamentals of digital computers

**COURSE OBJECTIVES:**

- Introduce the fundamentals of digital logic design
- Familiarize students with sequential logic components
- Develop the ability to implement and analyze register-transfer operations
- Provide a comprehensive understanding of computer organization
- Equip students with knowledge of memory hierarchy and organization

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**COURSE CONTENTS**

**MODULE - I**

**Introduction to Digital Design:** Karnaugh Map, Minimization of two, three and four variable K-Map, Determination of Minimum SOP using essential prime implicants.

**Combinational Logic:** Multiplexer, Demultiplexer, Decoders and Encoders, Programmable Logic devices, Read-Only Memories, Three state buffers.

**10 Hours**

**MODULE - II**

**Sequential Logic:** Introduction, Set-Reset Latches, Gated Latches, D-Flip-Flops, Edge triggered D Flip-Flops, Master slave S-R Flip-Flops. J-K Flip-Flop. T Flip-Flops

**Design of Binary Counter:** Synchronous Counter, Asynchronous counter, Registers and Register transfer, Parallel adder with accumulator, Shift Registers.

**10 Hours**





**MODULE - III**

**Basic Structure of Computers:** Functional Units, Basic Operational Concepts, Bus structure, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.

**10 Hours**

**Arithmetic:** Carry look ahead adder, Array multiplier, Sequential binary multiplier.

**MODULE - IV**

**Basic Processing Unit:** Fundamental Concepts, Execution of a Complete Instruction, Hardwired control, Microprogrammed control, Virtual Memory, Memory translation Mechanism, Cache Memories.

**10 Hours**

**Pipelining:** Basic concepts, Pipeline Performance.

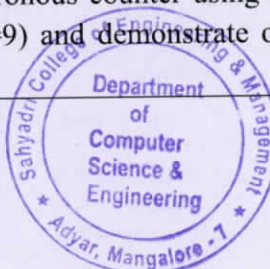
**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                    | Bloom's Taxonomy Level |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Apply Karnaugh maps to minimize Boolean functions and design combinational circuits using multiplexers, demultiplexers, decoders, encoders, PLDs, and ROMs.                   | CL3                    |
| CO2    | Design and implement sequential logic circuits using various types of flip-flops for digital system applications.                                                             | CL3                    |
| CO3    | Develop an understanding of computer functional units, performance measures, and arithmetic circuits to evaluate system efficiency and implement fast adders and multipliers. | CL3                    |
| CO4    | Implement instruction execution, control unit organization, memory hierarchy, and pipelining concepts to analyze the performance of processing units.                         | CL2                    |

**LABORATORY COMPONENTS**

| Exp. No. | Experiment Description                                                                                                                              | CO No. | Bloom's Taxonomy Level |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------|
| 1        | Realization of Half Adder and Full Adder Using Logic Gates                                                                                          | CO1    | CL3                    |
| 2        | Prime Number Detection Using Karnaugh Map Simplification and Circuit Implementation with Logic Gates                                                | CO1    | CL3                    |
| 3        | Design and implement code converter I) Binary to Gray (II) Gray to Binary Code.                                                                     | CO1    | CL3                    |
| 4        | Given a 4-variable logic expression, simplify it using appropriate technique and realize the simplified logic expression using 8:1 multiplexer IC.  | CO1    | CL3                    |
| 5        | Realize RS, D, JK, T flip flops.                                                                                                                    | CO2    | CL3                    |
| 6        | Design and implement a mod-n ( $n < 8$ ) synchronous up counter using J-K Flip-Flop ICs and demonstrate its working.                                | CO2    | CL3                    |
| 7        | Design and implement an asynchronous counter using decade counter IC to count up from 0 to n ( $n \leq 9$ ) and demonstrate on a 7-segment display. | CO2    | CL3                    |







|    |                                                                              |     |     |
|----|------------------------------------------------------------------------------|-----|-----|
| 8  | Synthesis of Combinational Multipliers to multiply two 4-bit binary numbers. | CO3 | CL3 |
| 9  | Design and simulate 4x4 RAM                                                  | CO4 | CL3 |
| 10 | Simulation and Analysis of ALU Operations.                                   | CO4 | CL3 |

#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                                     | Weightage(%) | Max. Marks |
|---------|------------------------------------------------------------|--------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b>                | <b>100 %</b> | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)                       | 30 %         | 15         |
|         | Activity Based Assessment (As suggested by the BoS)        | 20 %         | 10         |
|         | Laboratory Continuous Assessment                           | 30 %         | 15         |
|         | Laboratory Test (After the completion of all experiments*) | 20 %         | 10         |
| 2       | <b>Semester End Examination (SEE)</b>                      | <b>100 %</b> | <b>50</b>  |

*Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.*

#### SEE QUESTION PAPER PATTERN:

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

#### REFERENCE BOOKS:

1. Charles H Roth and Larry L Kinney, Analog and Digital Electronics, Cengage Learning, 2019.
2. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th Edition, Tata McGraw Hill
4. Digital Principles and Design, Donald D. Givone, 1st Edition, 2002, Tata McGraw-Hill Publishers.
5. David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2008

#### REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (If Any):

1. <https://nptel.ac.in/courses/108105132>
2. <https://archive.nptel.ac.in/courses/106710618/>





**OPERATING SYSTEMS**

**(Effective from the Academic Year 2025 - 2026)**

**III SEMESTER**

|                                           |                  |            |    |
|-------------------------------------------|------------------|------------|----|
| Course Code                               | <b>BCS303G</b>   | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:2:0          | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L + 20P</b> | Exam Hours | 03 |

**CREDITS – 4**

**COURSE PREREQUISITES:**

- Programming (C/C++), Data Structures, Computer Organization

**COURSE OBJECTIVES:**

- Obtain awareness on concepts of operating systems and structures.
- Understand and implement the concept of Process and threads
- Demonstrate the common synchronization problems arising in the Operating systems and provide solutions to them
- Demonstrate the issue of deadlock and handle them effectively.
- Understand the concept of Memory and demonstrate its management using various strategies.
- Know the various storage mechanisms available and discuss the management of storage space.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

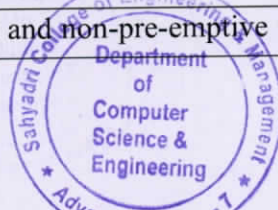
**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Operating Systems and Structures:</b> Introduction, user view, system view, single processor systems, multiprocessors systems, clustered systems, multiprogramming and multitasking, dual mode and multimode operations, Distributed systems, Computing environments, Operating System services, System Calls, Linkers and Loader, Operating system design and implementation, Operating System Structures<br><b>Process Management:</b> Process concept, process state, process control block, context switch; operations on processes, inter process communication.<br><b>Multi-Threaded Programming:</b> Overview of threads, multithreading models, thread libraries, threading issues. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                            |                 |
|--------------------------------------------------------------------------------------------|-----------------|
| <b>CPU Scheduling:</b> Schedulers, Pre-emptive and non-pre-emptive scheduling, dispatcher; | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------|-----------------|







|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                      |  |                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------|
| <p>Scheduling Criteria.</p> <p><b>Scheduling Algorithms:</b> FCFS, SJF, SRTF, RR, Priority, HRRN, multi-level feedback Queue scheduling, Multiprocessor scheduling.</p> <p><b>Process Synchronization:</b> Background, critical section problem, Peterson's solution; synchronization hardware- mutex, semaphores, monitors.</p>                                                                                                                                                                      |                                                                                                                                                                      |  |                               |
| <b>MODULE - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                      |  |                               |
| <p><b>Deadlocks:</b> System model, necessary conditions for deadlocks, methods for handling deadlocks, deadlock prevention, deadlock avoidance -resource allocation graph algorithm, banker's algorithm, deadlock detection, recovery from deadlock.</p> <p><b>Memory Management:</b> Background, contiguous memory allocation, paging, swapping.</p> <p><b>Virtual Memory Management:</b> Background; demand paging: copy-on-write; page replacement algorithms - FIFO, Optimal, LRU; thrashing.</p> |                                                                                                                                                                      |  | <b>10 Hours</b>               |
| <b>MODULE - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                      |  |                               |
| <p><b>File System Interface and Operations:</b> Access methods, Directory structures, Protection, File system structure, Directory implementation, Allocation methods, Free space management.</p> <p><b>Storage Management and Security:</b> Mass storage structures; Disk scheduling algorithms, Swap space management.</p> <p><b>Protection:</b> Goals, Principles and Domains of protection, Access matrix, Implementation of access matrix, Revocation of access rights, Access control.</p>      |                                                                                                                                                                      |  | <b>10 Hours</b>               |
| <b>COURSE OUTCOMES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                      |  |                               |
| Upon completion of this course, the students will be able to:                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                      |  |                               |
| <b>CO No.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Course Outcome Description</b>                                                                                                                                    |  | <b>Bloom's Taxonomy Level</b> |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Understand and apply operating system concepts, including design, process management, multithreading, and system structures, in computing environments.              |  | CL3                           |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Apply CPU scheduling algorithms and synchronization techniques to address process management challenges in operating systems.                                        |  | CL3                           |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Demonstrate deadlock handling techniques and memory management strategies, including virtual memory and page replacement algorithms, to optimize system performance. |  | CL3                           |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Implement file system operations, storage management techniques, and access control mechanisms to ensure efficient and secure data handling in operating systems.    |  | CL3                           |
| <b>LABORATORY COMPONENTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                      |  |                               |
| <p><b>Mandatory Experiment (for practice only, not to be included for exam):</b></p> <ol style="list-style-type: none"><li>1. Demonstrate the system assembly and disassembly of computer hardware components</li><li>2. Demonstrate the OS installation with Multi Booting and Virtual Machine platform.</li></ol>                                                                                                                                                                                   |                                                                                                                                                                      |  |                               |







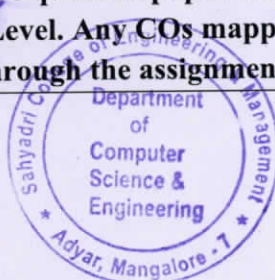
| Exp. No. | Experiment Description                                                                                                                                                                    | CO No. | Bloom's Taxonomy Level |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------|
| 1        | Write C programs to implement basic UNIX system calls - read(), write(), open(), close(), lseek(), create().                                                                              | CO1    | CL3                    |
| 2        | Write C programs to implement UNIX Directory API's - opendir, closedir, readdir, mkdir.                                                                                                   | CO1    | CL3                    |
| 3        | Demonstrate the Process creation and Termination using System calls -fork (), vfork (), getpid (), waitpid (), exec, exit (), return 0.                                                   | CO1    | CL3                    |
| 4        | Write C programs to simulate Inter - Process Communication (IPC) techniques: Pipes, Messages Queues, and Shared Memory.                                                                   | CO1    | CL3                    |
| 5        | Simulate the following CPU scheduling algorithms (i). FCFS (ii). SJF (iii). Priority. Calculate Average Waiting Time, Average Turn-Around Time, Average Response time for each algorithm. | CO2    | CL3                    |
| 6        | Simulate the following CPU scheduling algorithms 1. Round Robin 2. HRRN. Calculate Average Waiting Time, Average Turn-Around Time, Average Response time for each algorithm.              | CO2    | CL3                    |
| 7        | Demonstrate the following Classical problems of synchronization using semaphores.<br>a. Producer-Consumer b. Dining Philosopher                                                           | CO3    | CL3                    |
| 8        | Write a C program to implement the Banker's Algorithm for resource allocation to prevent deadlocks.                                                                                       | CO3    | CL3                    |
| 9        | Demonstrate following page replacement algorithms:<br>(i). FIFO (ii). LRU (iii). OPTIMAL.                                                                                                 | CO4    | CL3                    |
| 10       | Analyze the seek time for the following Disk scheduling algorithms:<br>(i). FCFS (ii). SCAN (iii). LOOK                                                                                   | CO4    | CL3                    |

#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                                     | Weightage (%) | Max. Marks |
|---------|------------------------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b>                | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)                       | 30 %          | 15         |
|         | Activity Based Assessment (As suggested by the BoS)        | 20 %          | 10         |
|         | Laboratory Continuous Assessment                           | 30 %          | 15         |
|         | Laboratory Test (After the completion of all experiments*) | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>                      | <b>100%</b>   | <b>50</b>  |

**Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.**







**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Principles", 10<sup>th</sup> edition, Wiley-India, 2021
2. M. Morris Mano, "Computer System Architecture", PHI, 5<sup>th</sup> Edition, 2017.
3. Ann McHoes, Ida M Fylnn, "Understanding Operating System", Cengage Learning, 6<sup>th</sup> Edition
4. D.M Dhamdhare, "Operating Systems: A Concept Based Approach", 3<sup>rd</sup> Edition, McGraw- Hill, 2013.
5. P.C.P. Bhatt, "An Introduction to Operating Systems: Concepts and Practice", 4<sup>th</sup> Edition, PHI(EEE), 2014.
6. William Stallings, "Operating Systems: Internals and Design Principles", 6<sup>th</sup> Edition, Pearson..

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):**

1. <https://www.geeksforgeeks.org/operating-systems/>
2. [https://www.youtube.com/watch?v=RozoeWzT7IM&list=PLdo5W4Nhv31a5ucW\\_S1K3-x6ztBRD-PNa](https://www.youtube.com/watch?v=RozoeWzT7IM&list=PLdo5W4Nhv31a5ucW_S1K3-x6ztBRD-PNa)
3. [https://en.wikipedia.org/wiki/Operating\\_system](https://en.wikipedia.org/wiki/Operating_system)
4. <https://www.youtube.com/watch?v=By6lWjiPpVI&list=PLG9aCp4uEs17rFjWM8KchGlffXgOzzVP>
5. <https://www.youtube.com/watch?v=bkSWJJZNgf8&list=PLxCzCOWd7aiGz9donHRrE9I3Mwn6XdP8>





**DATA STRUCTURES AND ALGORITHMS**  
**(Effective from the Academic Year 2025 - 2026)**  
**III SEMESTER**

|                                           |                |            |    |
|-------------------------------------------|----------------|------------|----|
| Course Code                               | <b>BCS304T</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0        | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>     | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Programming Fundamentals
- Memory Concepts
- Mathematical Foundations
- Problem Solving

**COURSE OBJECTIVES:**

- Understand and analyze the fundamental concepts of algorithms, including problem-solving strategies, time and space complexity, and asymptotic notations.
- Implement and evaluate linear data structures such as arrays, stacks, and queues, including their dynamic representations and applications in expression evaluation and memory management.
- Design and manipulate linked data structures including singly, doubly, and circular linked lists for efficient data management and representation.
- Apply appropriate nonlinear data structures such as trees and graphs for solving hierarchical and network-based problems, including traversal and search operations.
- Explore advanced data structure concepts such as hashing techniques and optimal binary search trees to enhance performance in data retrieval and storage applications.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

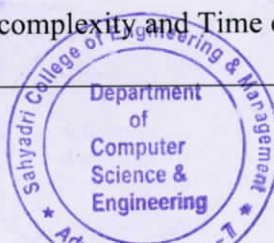
**Introduction:** Data Structures, Classifications (Primitive and Non-Primitive), Data structure Operations.

**Arrays and Structures:** Arrays, Dynamic Allocated Arrays, Polynomials, Sparse Matrices, representation of Multidimensional Arrays, Strings

**Algorithms-** Properties, Specification, Fundamentals of Algorithmic Problem solving, Analysis Framework.

**Performance Analysis:** Estimating Space complexity and Time complexity of algorithms. Asymptotic Notations with examples

**10 Hours**







**MODULE - II**

|                                                                                                                                                                           |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Stacks:</b> Stack Definition and Operations, Stacks Using Dynamic Arrays, Evaluation and conversion of Expressions: Infix to Postfix, Evaluation of Postfix Expression | <b>10 Hours</b> |
| <b>Queues:</b> Queue Definition and Operations, Circular Queues, Using Dynamic Arrays, Multiple Stacks and queues. Double ended Queue, Priority Queues.                   |                 |

**MODULE - III**

|                                                                                                                                                                                                                                |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Linked Lists:</b> Singly Linked Lists and Chains, Representing Chains in C, Linked Stacks and Queues, Polynomials, Additional List Operations, Doubly Linked List, Circular Singly Linked List, Circular Doubly Linked List | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - IV**

|                                                                                                                                                                                                                             |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Trees:</b> Introduction, Binary Trees, Binary Tree Traversals, Threaded Binary Trees. Binary Search trees, Selection Trees, Forests, Representation of Disjoint sets, Counting Binary Trees, Optimal Binary Search Trees | <b>10 Hours</b> |
| <b>Graphs:</b> The Graph Abstract Data Types, Elementary Graph Operations: BFS, DFS                                                                                                                                         |                 |
| <b>Hashing:</b> Introduction, Hash Table organizations, Hashing Functions, Collision Resolution Techniques, Static and Dynamic Hashing.                                                                                     |                 |

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                              | Bloom's Taxonomy Level |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Apply the fundamental concepts of data structures and algorithm analysis, including time and space complexity, to develop efficient problem-solving approaches.         | CL3                    |
| CO2    | Implement and utilize linear data structures such as stacks, queues, and circular queues for expression evaluation and other problem-solving tasks.                     | CL3                    |
| CO3    | Apply operations such as insertion, deletion, and searching on various linked list structures including singly, doubly, and circular linked lists.                      | CL3                    |
| CO4    | Develop and traverse hierarchical and network data structures using trees and graphs, and apply appropriate hashing techniques for efficient data access and retrieval. | CL3                    |

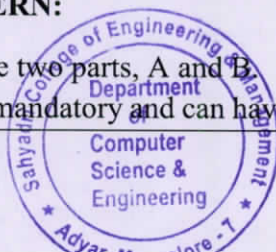
**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40%           | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks





totaling to 20 covering all the four modules.

- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2<sup>nd</sup> Ed, Universities Press, 2008.
2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised Edition, McGraw Hill, 2017.
3. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2<sup>nd</sup> Ed, Cengage Learning, 2019.
4. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2<sup>nd</sup> Ed, McGraw Hill, 2013
5. A M Tenenbaum, Data Structures using C, PHI, 1989.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):**

1. <https://nptel.ac.in/courses/106106182>
2. <https://www.udemy.com/topic/data-structures/>
3. <https://www.youtube.com/watch?v=O9v10jQkm5c>
4. <https://www.youtube.com/watch?v=-D5u5HJbISc&list=PLqleLpAMfxGAf5rrWdm92WMK3-gsrXgZ>







**DATA STRUCTURES AND ALGORITHMS LABORATORY**

**(Effective from the Academic Year 2025 - 2026)**

**SEMESTER - III**

|                                           |                |            |    |
|-------------------------------------------|----------------|------------|----|
| Course Code:                              | <b>BCS305L</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0        | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>     | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Programming Fundamentals
- Memory Concepts
- Mathematical Foundations
- Problem Solving

**COURSE OBJECTIVES:**

- Design and implement C++ programs that allocate, deallocate, and manage memory dynamically for both linear (arrays, stacks, queues) and linked (SLL, DLL) data structures.
- Develop and test applications that employ linear data structures—stacks, queues (standard, circular, priority), and their variants—for expression conversion/evaluation, palindrome checking, and queue-management scenarios.
- Construct, traverse, and manipulate non-linear data structures—binary search trees and graphs—using standard traversal algorithms (DFS, BFS) and evaluate their correctness for typical search-and-reachability tasks.
- Apply hashing techniques (remainder method with linear probing) to store and retrieve keyed data efficiently, and analyze collision-resolution performance.

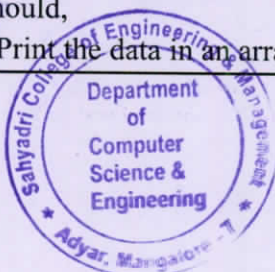
**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Demonstration
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies

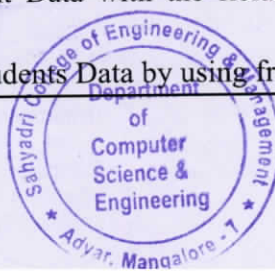
**LIST OF EXPERIMENTS**

| Exp. No. | Description                                                                                                                                                                                                                             | CO No. | Bloom's Taxonomy Level |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------|
| 1        | Design and implement a program in C++ on Frequency Histogram, which builds a frequency array for data values in the range 1 to n and then prints their histogram. The program should,<br>a. Read, Store and Print the data in an array. | CO1    | CL3                    |





|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |     |  |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|--|
|   | <p>b. Analyze the data in the array, one element at a time. Add 1 to the corresponding element in a frequency array based on the data value.</p> <p>c. Print a histogram using asterisks for each occurrence of an element.</p>                                                                                                                                                                                                                                                                     |     |     |  |
| 2 | <p>Develop a Program in C++ for the following operations on Strings.</p> <p>a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP)</p> <p>b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR. Support the program with functions for each of the above operations. (Refrain from using Built-in functions.)</p>                                | CO1 | CL3 |  |
| 3 | <p>Develop a menu driven Program in C++ for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX)</p> <p>a. Push an Element on to Stack</p> <p>b. Pop an Element from Stack</p> <p>c. Demonstrate how Stack can be used to check Palindrome</p> <p>d. Demonstrate Overflow and Underflow situations on Stack</p> <p>e. Display the status of Stack</p> <p>f. Exit Support the program with appropriate functions for each of the above operations</p> | CO1 | CL3 |  |
| 4 | <p>Develop a Program in C++ for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.</p>                                                                                                                                                                                                                                      | CO1 | CL3 |  |
| 5 | <p>Develop a Program in C++ for the following Stack Applications: Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^</p>                                                                                                                                                                                                                                                                                                                                    | CO1 | CL3 |  |
| 6 | <p>Develop a menu driven Program in C++ for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX)</p> <p>a. Insert an Element on to Circular QUEUE</p> <p>b. Delete an Element from Circular QUEUE</p> <p>c. Demonstrate Overflow and Underflow situations on Circular QUEUE</p> <p>d. Display the status of Circular QUEUE</p> <p>e. Exit Support the program with appropriate functions for each of the above operations</p>             | CO1 | CL3 |  |
| 7 | <p>Develop a menu driven Program in C++ for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, Programme, Sem, PhNo</p> <p>a. Create a SLL of N Students Data by using front insertion.</p>                                                                                                                                                                                                                                                           | CO2 | CL3 |  |





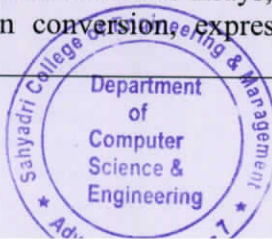


|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
|    | <ul style="list-style-type: none"><li>b. Display the status of SLL and count the number of nodes in it</li><li>c. Perform Insertion / Deletion at End of SLL</li><li>d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack)</li><li>e. Exit</li></ul>                                                                                                                                                                                                                                                                                                                                        |     |     |
| 8  | <p>Develop a menu driven Program in C++ for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Sal, PhNo</p> <ul style="list-style-type: none"><li>a. Create a DLL of N Employees Data by using end insertion.</li><li>b. Display the status of DLL and count the number of nodes in it</li><li>c. Perform Insertion and Deletion at End of DLL</li><li>d. Perform Insertion and Deletion at Front of DLL</li><li>e. Demonstrate how this DLL can be used as Double Ended Queue.</li><li>f. Exit</li></ul>                                  | CO2 | CL3 |
| 9  | <p>Develop a menu driven Program in C++ for the following operations on Binary Search Tree (BST) of Integers.</p> <ul style="list-style-type: none"><li>a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2</li><li>b. Traverse the BST in Inorder, Preorder and Post Order</li><li>c. Search the BST for a given element (KEY) and report the appropriate message</li><li>d. Exit</li></ul>                                                                                                                                                                                                 | CO3 | CL3 |
| 10 | <p>Develop a Program in C++ for the following operations on Graph (G) of Cities</p> <ul style="list-style-type: none"><li>a. Create a Graph of N cities using Adjacency Matrix.</li><li>b. Print all the nodes reachable from a given starting node in a digraph using DFS and BFS method</li></ul>                                                                                                                                                                                                                                                                                                           | CO3 | CL3 |
| 11 | <p>Given a File of N employee records with a set K of Keys (4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Develop a Program in C++ that uses Hash function <math>H: K \rightarrow L</math> as <math>H(K) = K \bmod m</math> (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.</p> | CO4 | CL3 |

#### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                        | Bloom's Taxonomy Level |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Design and implement linear data structures such as arrays, stacks, and queues to solve problems including expression conversion, expression evaluation, and palindrome checking. | CL3                    |





|     |                                                                                                                                                                                                                     |     |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| CO2 | Apply and implement operations on singly and doubly linked lists for insertion, deletion, searching, and data organization in real-time applications.                                                               | CL3 |
| CO3 | Construct and traverse non-linear data structures such as binary search trees and graphs using appropriate traversal techniques (inorder, preorder, postorder, DFS, BFS) to solve search and connectivity problems. | CL3 |
| CO4 | Implement hashing techniques using remainder method and linear probing to store and retrieve records efficiently, and analyze collision scenarios with appropriate resolution strategies.                           | CL3 |

### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### ASSESSMENT STRATEGY:

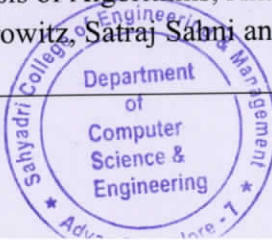
- In Laboratory Courses where component (C) is not a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have 50% weightage (25 Marks). In such cases,
  - The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
  - One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.
  - The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) and component (B).
- The course instructor will design the rubrics for component (C).

### SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

### REFERENCE BOOKS:

- Introduction to the Design and Analysis of Algorithms, Anany Levitin: 3<sup>rd</sup> Edition, Pearson.
- Computer Algorithms/C++, Ellis Horowitz, Satrajit Sahoo and Rajasekaran, 2<sup>nd</sup> Edition, Universities Press.







3. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2<sup>nd</sup> Ed, Universities Press, 2018.
4. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1<sup>st</sup> Ed, McGraw Hill, 2018.
5. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2<sup>nd</sup> Ed, McGraw Hill, 2013

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):**

1. <https://nptel.ac.in/courses/106106182>
2. <https://www.udemy.com/topic/data-structures/>
3. <https://www.youtube.com/watch?v=O9v10jQkm5c>
4. <https://www.youtube.com/watch?v=-D5u5HJbISc&list=PLqleLpAMfxGAf5rrWdm92WMK3-gSRXgZ>





**OBJECT ORIENTED PROGRAMMING WITH C++**

(Effective from the Academic Year 2025 - 2026)

**III SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS306W1</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Programming Fundamentals
- Memory and Pointers
- Modular Programming
- Logic and Problem Solving

**COURSE OBJECTIVES:**

- Understand the foundational principles of object-oriented programming and C++ syntax, including program structure, control statements, and memory management.
- Apply object-oriented programming concepts such as classes, objects, constructors, destructors, and operator overloading to develop modular and reusable code.
- Demonstrate the use of advanced OOP features including inheritance, polymorphism, virtual functions, and dynamic binding to build flexible and extensible programs.
- Implement function and class templates to support generic programming and apply exception handling techniques for robust application development.
- Develop real-world applications using file handling operations and standard C++ libraries while adhering to good programming practices and design principles.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

**Introduction to Object Oriented Programming:** C++ Program Structure, Character Set and Tokens, Data Type, Type Conversion, Preprocessor Directives, Namespace, Input/Output Streams and Manipulators, Dynamic Memory Allocation with new and delete, Control Statements.

**Functions:** Function Overloading, Inline Functions, Default Argument, Pass by Reference, Return by Reference, Scope and Storage Class.

**10 Hours**







**MODULE - II**

**Classes & Objects:** Accessing members of class, Constructor and its types, Destructors, Objects as Function Arguments, Returning Objects from Functions, Structures and Classes, Memory allocation for Objects, Static members, Member functions defined outside the class.

**10 Hours**

**Operator Overloading:** Restriction on operator overloading, Operator functions as a class member, Overloading unary and binary operator, Data Conversion.

**MODULE - III**

**Inheritance:** Derived Class and Base Class, Access Specifiers, Types of inheritance, Public and Private Inheritance, Constructor and Destructor in derived classes, Aggregation, Virtual Function.

**10 Hours**

**Polymorphism:** Concept of Virtual functions, Late Binding, Abstract class and pure virtual functions, Virtual Destructors, Virtual base class, Friend function and Static function, Assignment and copy initialization, This pointer, Concrete classes, Polymorphism and its roles.

**MODULE - IV**

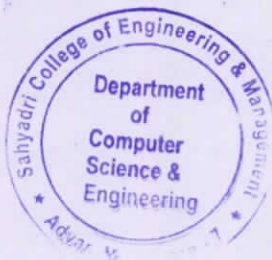
**Function Templates and Exception Handling:** Function templates with multiple arguments, Class templates, templates and inheritance, Exceptional Handling, Use of exceptional handling. File handling Concepts.

**10 Hours**

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                             | Bloom's Taxonomy Level |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Apply object-oriented programming fundamentals in C++, including classes, objects, functions, pointers, and memory management, to write modular and efficient programs.                | CL3                    |
| CO2    | Implement class-based programming concepts such as constructors, destructors, static members, and operator overloading to develop flexible and reusable code in C++.                   | CL3                    |
| CO3    | Apply principles of inheritance and polymorphism, including the use of virtual functions, abstract classes, and dynamic binding, to enable code extensibility and runtime flexibility. | CL3                    |
| CO4    | Develop generic and robust applications using function and class templates, exception handling mechanisms, and file I/O operations for effective data management in C++.               | CL3                    |





### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### SEE QUESTION PAPER PATTERN:

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Module 1 and 2, however, will have choice in Modules 3 and 4.

### REFERENCE BOOKS:

1. Bhushan Trivedi, "Programming with ANSI C++", Oxford Press, 2<sup>nd</sup> Edition, 2019.
2. Balagurusamy E, Object Oriented Programming with C++, Tata McGraw Hill Education Pvt.Ltd , 7<sup>th</sup> Edition, 2017

### REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):

1. Basics of C++ - <https://www.youtube.com/watch?v=BCIS40yzssA>
2. Functions of C++ - <https://www.youtube.com/watch?v=p8ehAjZWjPw>







**PROGRAMMING WITH JAVA**  
(Effective from the Academic Year 2025 - 2026)

**III SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS306W2</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Programming Fundamentals (Preferably in C/C++ or Python)
- Basic Object-Oriented Programming Concepts
- Basic Understanding of Memory and Execution
- Problem Solving and Algorithmic Thinking

**COURSE OBJECTIVES:**

- Understand the foundational concepts of object-oriented programming (OOP) and Java syntax, including data types, operators, control structures, and memory management.
- Apply object-oriented principles such as classes, objects, constructors, inheritance, and method overriding to develop modular and reusable Java programs.
- Implement exception handling mechanisms, abstract classes, and interfaces to build robust and error-resilient applications.
- Utilize Java packages, collections framework, enumerations, and generics to effectively manage data and develop scalable applications.
- Develop, compile, and debug Java programs using standard tools (JDK, IDEs), demonstrating an ability to write, test, and troubleshoot object-oriented code in a standalone or modular environment.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses

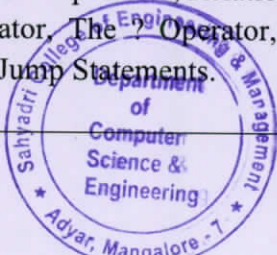
**COURSE CONTENTS**

**MODULE – I**

**An Overview of Java:** A Simple Program, Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries, Data Types, Variables, and Arrays, Literals, Type Conversion and Casting, Automatic Type Promotion in Expressions,

**Operators:** Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Selection Statements, Iteration Statements, Jump Statements.

**10 Hours**







**MODULE – II**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introducing Classes:</b> Class Fundamentals, Declaring Objects, Introducing Methods, Constructors, The this Keyword, Garbage Collection, The finalize( ) Method, A Stack Class, Overloading Methods, Using Objects as Parameters, Recursion, Introducing Access Control, Understanding static, Introducing final<br><b>Inheritance:</b> Inheritance, Using super, Creating a Multilevel Hierarchy, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – III**

|                                                                                                                                                                                                                                                                                                                                                                                               |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Packages and Interfaces:</b> Packages, Access Protection, Importing Packages, Interfaces, Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Using Exceptions. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – IV**

|                                                                                                                                                                                                                                                                                                           |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Enumerations :</b> Fundamentals, values() and valueof() method, inherit enum, example.<br><b>Collection Framework:</b> Overview,, Collection interface, Collection Classes, Accessing a Collection via an iterator, Storing user defined classes in Collection, Maps. Comparators, Generic Collection. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                          | Bloom's Taxonomy Level |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Describe the key features of Java as an object-oriented programming language, including its syntax, data types, control structures, and memory management concepts. | CL2                    |
| CO2    | Develop and execute Java programs using classes, methods, operators, and control statements to solve basic computational problems.                                  | CL3                    |
| CO3    | Apply object-oriented principles such as inheritance and polymorphism to create reusable and maintainable Java applications.                                        | CL3                    |
| CO4    | Implement Java packages, interfaces, exception handling mechanisms, and utilize collections and generics to build robust, modular applications.                     | CL3                    |

**ASSESSMENT STRATEGY**

Assessment through CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

**Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.**







**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

- Herbert Schildt, Java The Complete Reference, 12<sup>th</sup> Edition, Tata McGraw Hill, 2024. (Chapters 2, 3, 4, 5, 6,7, 8, 9,10, 12,13,15)

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):**

1. <https://nptel.ac.in/courses/106105191>
2. [https://onlinecourses.nptel.ac.in/noc22\\_cs47/preview](https://onlinecourses.nptel.ac.in/noc22_cs47/preview)





**UHV -1: SOCIAL CONNECT & RESPONSIBILITIES**

**(Effective from the Academic Year 2025 - 2026)**

**III SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BHU307TK</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 1:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>15L</b>      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Have/Develop the critical analysis of the day today happenings.

**COURSE OBJECTIVES:**

This course will enable students to:

- Enable the student to do a deep drive into societal challenges being addressed by NGO(s), social enterprises & The government and build solutions to alleviate these complex social problems through immersion, design & technology.
- Provide a formal platform for students to communicate and connect to their surroundings.
- Enable to create a responsible connection with society

**TEACHING - LEARNING STRATEGY:**

These are some sample strategies, which course faculty members can incorporate in the Teaching Learning Process:

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

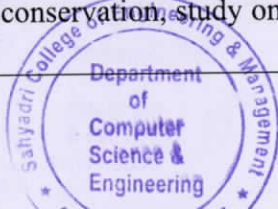
|                                                                                                                                                                                                                                                                                                                           |                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Connectivity with Nature:</b> Importance of plants, Plantation process.<br><b>Plant Development:</b> Sequence of Plant Development, Factors affecting Plant Development, Practice Problems.<br>Activity: Self-study on selected plant's origin, its usage in daily life and its appearance in folklore and literature. | <b>4 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                      |                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Heritage walk and Regional Crafts:</b> An overview of Heritage, Awareness on Indian Cultural Heritages, Crafts & Heritage, Protective measures for the survival of handicrafts.<br>Activity: Self-study on selected Heritage and its Inheritance. | <b>3 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|

**MODULE – III**

|                                                                                                                                                                                                                                                                                         |                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Organic farming and waste management:</b> Introduction of organic farming, study on wet waste Management, Effects of organic farming on crop productivity.<br><b>Water Conservation:</b> Necessity of water conservation, study on water reuse, an overview on rainwater harvesting. | <b>4 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|







Activity: Documentary or photo blog presenting the current practices.

**MODULE - IV**

|                                                                                                                                                                                                                                                            |                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Food Practices:</b> Comparative study of traditional food and fast food. Food-lore and indigenous materials of the region used in cooking. Cultural Significance of Meal Times, The Role of Spices and Herbs in Global Cuisines. Food as a Celebration. | <b>4 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                | Bloom's Taxonomy Level |
|--------|-----------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | To understand the social responsibility of individual-Adaptation and Plantation of Tree                   | CL3                    |
| CO2    | To know the heritage and holistic places - Heritage walk and crafts corner                                | CL3                    |
| CO3    | To understand the importance of Organic farming and waste management & Water Conservation                 | CL3                    |
| CO4    | To understand diverse food practices, cultural significance, and food traditions across different regions | CL3                    |

**ASSESSMENT STRATEGY**

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

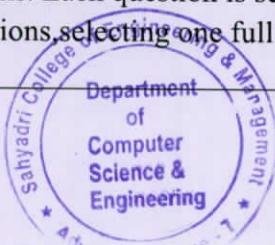
**CO - ASSESSMENT MAPPING**

| Course Outcomes | Continuous Internal Assessment (CIA)<br>(50%) |      |     |                                    | Semester End Exam (SEE)<br>(50%) |
|-----------------|-----------------------------------------------|------|-----|------------------------------------|----------------------------------|
|                 | Continuous Internal<br>Evaluation (CIE) (60%) |      |     | Assignment/<br>Activities<br>(40%) |                                  |
|                 | I                                             | II   | III |                                    |                                  |
|                 | Syllabus Coverage                             |      |     |                                    |                                  |
|                 | 40%                                           | 30%  | 30% | 100%                               | 100%                             |
| CO1             | MI                                            |      |     | MI                                 | MI                               |
| CO2             | MII                                           | MII  |     | MII                                | MII                              |
| CO3             |                                               | MIII |     | MIII                               | MIII                             |
| CO4             |                                               |      | MIV | MIV                                | MIV                              |

**Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.**

**SEE QUESTION PAPER PATTERN:**

- Theory SEE will be conducted, with common question papers for the subject (Duration 01 hour)
- The question paper will have 50 questions. Each question is set for 02 marks.
- The student have to answer all the questions, selecting one full question from each module.





**REFERENCE BOOKS:**

1. Organic Farming for Sustainable Agriculture by Saravanan Raj & S. Karthikeyan, Scientific Publishers.
2. Human values and Professional Ethics by R R Gaur, R Sangal ,G P Bagaria, Exel books ,New Delhi 2010
3. The Story Of My Experiments with Truth - by Mohandas Karamchand Gandhi
4. Human Values, A.N Tripathi, New Age Intl.Publishers,New Delhi,2004.
5. Small is Beautiful-E F Suchumacher.
6. The Story of Stuff (Book)

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):**

1. <https://www.youtube.com/user/ccrtdelhi>
2. <https://www.eatrightindia.gov.in/>
3. <https://www.intach.org/>







**MOBILE APPLICATION DEVELOPMENT**  
**(Effective from the Academic Year 2025 - 2026)**

**III SEMESTER**

|                                           |          |            |    |
|-------------------------------------------|----------|------------|----|
| Course Code                               | BCS308A1 | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0  | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | 24P      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Basic knowledge of Java programming, including classes, objects, and event handling
- Familiarity with XML layout design for UI development
- Basic understanding of Android Studio, including installation, emulator configuration, and project creation
- Fundamental concepts of mobile devices and operating systems

**COURSE OBJECTIVES:**

- Introduce students to Android development tools and application architecture using Android Studio.
- Develop the ability to design interactive and responsive user interfaces using built-in UI components and layouts.
- Enable students to implement core Android features such as activity lifecycle management, event handling, data storage, and multimedia support.
- Explore the usage of APIs and services for data sharing, user authentication, and background task handling.
- Provide hands-on experience in building real-time Android applications that address user interactions and system-level integration.

**TEACHING - LEARNING STRATEGY:**

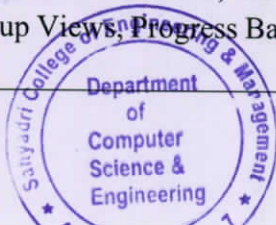
Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**COURSE CONTENTS**

**Theory**

**Getting Started with Android Programming:** Features of Android, Android Architecture, obtaining the required tools, launching your first android application Activities. Designing User Interface with Views: Using Basic Views: Reference View view – Button, Image Button, Edit Reference, Checkbox, Toggle Button, Radio Button and Radio Group Views, Progress Bar View. Using Picker Views: Time Picker View, Date Picker View.



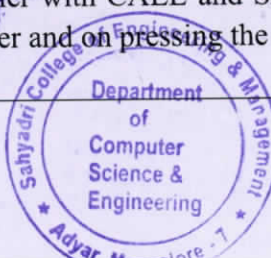




**LIST OF EXPERIMENTS**

**Develop the below requirements in Android Studio**

| Exp. No. | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | <p>a. Create an application to design a Visiting Card. The Visiting card should have a company logo at the top right corner. The company name should be displayed in Capital letters, aligned to the center. Information like the name of the employee, job title, phone number, address, email, fax and the website address is to be displayed. Insert a horizontal line between the job title and the phone number</p> <p>b. Develop an android application to design a student ID card for the students of a College as per the below requirements. The ID card should have two virtual partitions divided by a horizontal divider. In the first partition, the institute logo should be placed at the top aligned to the center. Institute name should be displayed below the logo in capital letters. In the next level the students department must appear in capital letters. The second partition should begin with students photo aligned to the center. Student Name, USN, Phone Number and Address should appear below the photo in a uniform order. Design the UI according to the requirements defined. Also write the corresponding java program.</p> |
| 2        | Develop an Android application using controls like Button, Text View, Edit Text for designing a calculator having basic functionality like Addition, Subtraction, Multiplication and Division.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 3        | <p>Create a SIGN Up activity with Username and Password. Validation of password should happen based on the following rules:</p> <ul style="list-style-type: none"><li>• Minimum length of the password is 8</li><li>• Password should contain letters, numbers and special characters.</li><li>• Password should contain minimum one uppercase letter, lowercase letter, number and special character</li></ul> <p>On successful SIGN UP proceed to the next Login activity. Here the user should SIGN IN using the Username and Password created during signup activity. If the Username and Password are matched then navigate to the next activity which displays a message saying "Successful Login" or else display a toast message saying "Login Failed". The user is given only two attempts and after that display a toast message saying "Failed Login Attempts" and disable the SIGN IN button. Use Bundle to transfer information from one activity to another.</p>                                                                                                                                                                                      |
| 4        | Develop an application to set an image as wallpaper. On click of a button, the wallpaper image should start to change randomly every 30 seconds..                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 5        | Write a program to create an activity with two buttons START and STOP. On pressing of the START button, the activity must start the counter by displaying the numbers from One and the counter must keep on counting until the STOP button is pressed. Display the counter value in a Text View control.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 6        | Create two files of XML and JSON type with values for City Name, Latitude, Longitude, Temperature and Humidity. Develop an application to create an activity with two buttons to parse the XML and JSON files which when clicked should display the data in their respective layouts side by side.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 7        | Develop a simple application with one Edit Text so that the user can write some text in it. Create a button called "Convert Text to Speech" that converts the user input text into voice.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 8        | Create an activity like a phone dialer with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phone contacts.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |







Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                 | Bloom's Taxonomy Level |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Set up the Android development environment using Android Studio and Virtual Device Manager, and build simple applications for UI-based tasks.                              | CL4                    |
| CO2    | Design and implement user authentication features using event-driven programming, input validation, and inter-activity communication via Bundles.                          | CL4                    |
| CO3    | Develop adaptive and responsive user interfaces for varied screen sizes and utilize appropriate APIs for interaction, media handling, and telephony services. Applications | CL3                    |
| CO4    | Implement and evaluate the use of Android APIs for persistent storage, file parsing (XML/JSON), voice features, and system-level tasks like wallpaper                      | CL5                    |

#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

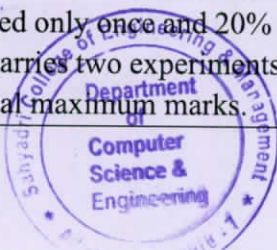
| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |

#### ASSESSMENT STRATEGY:

- In Laboratory Courses where component (C) is not a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have 50% weightage (25 Marks). In such cases,
  - The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
  - One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.
  - The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) and component (B).
- The course instructor will design the rubrics for component (C).

#### SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.



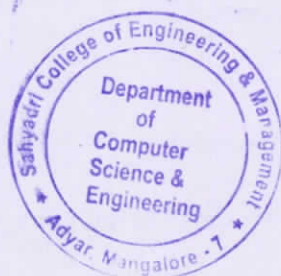


**REFERENCE BOOKS:**

1. J. F. DiMarzio, Beginning Android Programming with Android Studio, 4<sup>th</sup> Edition, 2017.
2. Google Developer Training, "Android Developer Fundamentals Course-Concept Reference", Google Developer Training Team, 2017.
3. <https://www.gitbook.com/book/googledeveloper-training/android-developer-fundamentals-course-concepts/details>.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):**

1. <https://youtu.be/qJM8UTiAnQI?si=XxYWjKGZNwY-Nnep>
2. <https://youtu.be/ALJZGfPiFnA>







**UI/UX DESIGN**

**(Effective from the Academic Year 2025 - 2026)**

**III SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code :                             | <b>BCS308A2</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Basic understanding of Graphical User Interface (GUI) design principles
- Familiarity with design software such as Canva, PowerPoint, or any basic graphic editor
- Exposure to web or mobile interface elements like menus, buttons, icons, forms
- Creative thinking and problem-solving mindset

**COURSE OBJECTIVES:**

- Introduce the principles of user-centered design and the emotional and functional aspects of user experience in digital products.
- Explore various stages of the UI/UX design process including user research, requirement gathering, prototyping, and testing.
- Develop hands-on skills in wireframing, prototyping, and visual design using industry-standard UI/UX tools such as Figma, InVision, Adobe XD, and Thunkable.
- Enable students to design intuitive, aesthetic, and functional interfaces for web and mobile platforms that align with real-world application needs.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**CONTENTS**

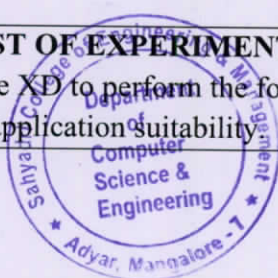
**Introduction to UI/UX Design**

**Introduction :** Usability to user experience, Emotional impact as part of user experience, User experience needs a business case.

**Extracting Interaction Design Requirements:** Needs & Requirements, Formal requirement extraction, Methods for requirement extraction.

**LIST OF EXPERIMENTS**

Use InVision, Figma, Thunkable, or Adobe XD to perform the following experiments. Each tool should be utilized based on its specific features and application suitability.







| Exp. No. | Description                                                                                                                                                                                                 |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | Develop a prototype for an interactive photo gallery application, incorporating advanced design elements and functionality to enhance user experience and showcase intuitive navigation.                    |
| 2        | Design a profile card layout that includes unique user attributes, visual elements, and interactive components to provide a seamless user experience.                                                       |
| 3        | Develop a well-structured and engaging web page design for a fictional e-commerce website, emphasizing user-friendly navigation and visually appealing elements to optimize the shopping experience.        |
| 4        | Develop a visually attractive and easy-to-navigate food delivery app interface, prioritizing seamless user experience and intuitive design elements for efficient ordering.                                 |
| 5        | Design a minimalistic and efficient calculator app, focusing on a clean layout, user-friendly interface, and smooth interaction for quick and accurate calculations.                                        |
| 6        | Develop an intuitive and visually appealing user interface for a calendar application, prioritizing easy navigation, clear date organization, and seamless event management for an optimal user experience. |
| 7        | Design a travel application with smooth animations between screens, emphasizing an attractive layout, easy navigation, and an engaging user experience for efficient trip planning and browsing.            |
| 8        | Design a weather app interface with a visually appealing layout, easy-to-read forecast details, and interactive elements such as location search and weather animations.                                    |
| 9        | Design an educational website for an online course platform, focusing on intuitive navigation, organized course listings, and interactive features for course registration and user profiles.               |
| 10       | Design a booking and reservation website for a hotel, emphasizing user-friendly navigation, room selection, booking forms, and responsive layouts.                                                          |
| 11       | Develop a real estate website with property listings, interactive maps, search filters, and contact forms, designed to help users easily find and inquire about properties.                                 |
| 12       | Design a pet adoption website with interactive search features for finding pets, detailed profiles of available animals, and a smooth process for submitting adoption applications.                         |

#### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                   | Bloom's Taxonomy Level |
|--------|------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Demonstrate the ability to create effective and engaging screen-based experiences by applying UI/UX design principles.       | CL4                    |
| CO2    | Design and evaluate visual interface components with a focus on layout, color, typography, and interactive elements.         | CL4                    |
| CO3    | Apply user-centered design processes and utilize wireframing and prototyping tools to develop user interfaces.               | CL4                    |
| CO4    | Design and implement responsive web interfaces with navigation, search features, and content layouts tailored to user needs. | CL4                    |







### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### ASSESSMENT STRATEGY:

- In Laboratory Courses where component (C) is not a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have 50% weightage (25 Marks). In such cases,
  - The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
  - One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.
  - The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) and component (B).
- The course instructor will design the rubrics for component (C).

### SEE QUESTION PAPER PATTERN:

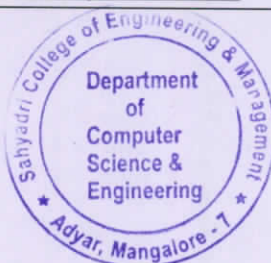
- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

### REFERENCE BOOKS:

- REX HARTSON AND PARDHA S PYLA, The UX book process and guidelines for ensuring a quality user experience 2012

### REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):

- <https://nptel.ac.in/courses/106106182>
- [https://www.youtube.com/watch?v=HZuk6Wkx\\_Eg](https://www.youtube.com/watch?v=HZuk6Wkx_Eg)
- <https://www.youtube.com/watch?v=dXQ7IHkTiMM>





**GAME DEVELOPMENT**

**(Effective from the Academic Year 2025 - 2026)**

**III SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS308A3</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Basic knowledge of programming concepts including variables, loops, and functions
- Familiarity with Object-Oriented Programming (OOP) principles
- Understanding of 2D coordinate geometry and simple math operations
- Exposure to basic computer graphics concepts (sprites, frames, assets)
- Prior experience with any IDE or software installation would be helpful (e.g., installing Unity, Visual Studio Code)

**COURSE OBJECTIVES:**

- Introduce students to the Unity game engine and its editor for creating 2D game environments.
- Enable students to implement core 2D game development concepts such as character control, camera tracking, and scene interaction.
- Familiarize students with collision detection, animation, visual effects, scoring, and health systems in game logic.
- Equip learners with practical skills to design, test, and build a fully functional 2D game by integrating various game elements.

**TEACHING - LEARNING STRATEGY:**

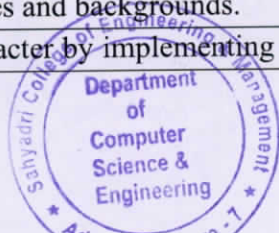
Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**LIST OF EXPERIMENTS**

**Design, develop, and implement the specified GAME DEVELOPMENT programs using Unity software in a Windows environment with C# programming.**

| Exp. No. | Description                                                                                                                                           |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | Set up Unity, configure the editor, and design a basic 2D game environment by creating a scene with a layout and assets like sprites and backgrounds. |
| 2        | Design a controllable player character by implementing horizontal and vertical movements using                                                        |







|    |                                                                                                                                                       |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | Unity's input system.                                                                                                                                 |
| 3  | Configure a follow camera that tracks the player's movement across the game world, maintaining a fixed distance and smooth transitions.               |
| 4  | Create boundary constraints to ensure the player remains within the designated game area by detecting and managing edge collisions.                   |
| 5  | Experiment with rotation and transformation mechanics, allowing objects in the game to spin, resize, or move dynamically.                             |
| 6  | Create trigger zones to detect player interactions with objects, such as collectible items, portals, or hazards, and implement corresponding actions. |
| 7  | Develop a fully interactive game world, including platforms, enemies, and collectible items, to create engaging gameplay scenarios.                   |
| 8  | Design and implement systems to track the player's health and score, displaying these metrics on the game interface dynamically.                      |
| 9  | Add animations and visual effects to player characters, enemies, and collectibles to enhance the game's visual appeal.                                |
| 10 | Finalize the game by compiling all features, testing functionality, and exporting the game as a playable build.                                       |

#### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                 | Bloom's Taxonomy Level |
|--------|----------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Demonstrate understanding of Unity's interface, tools, and workflow to design a functional 2D game scene.                  | CL3                    |
| CO2    | Implement player controls, camera behavior, boundary limits, and collision detection for smooth gameplay mechanics.        | CL3                    |
| CO3    | Apply game object transformations, trigger interactions, and animations to create dynamic and engaging game experiences.   | CL3                    |
| CO4    | Integrate core mechanics including score, health systems, and visual effects to develop a complete and exportable 2D game. | CL3                    |

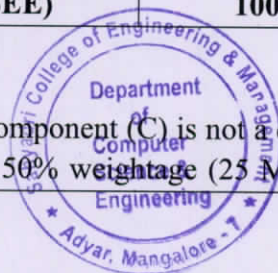
#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

#### ASSESSMENT STRATEGY:

- i. In Laboratory Courses where component (C) is not a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have





50% weightage (25 Marks). In such cases,

- a) The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
- b) One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.
- c) The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) and component (B).

ii. The course instructor will design the rubrics for component (C).

**SEE QUESTION PAPER PATTERN:**

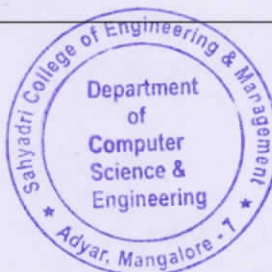
- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

**REFERENCE BOOKS:**

- Game Development with Unity Paperback – Import, 2011 by Michelle Menard

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):**

1. <https://unity.com/games>







**COMPETITIVE PROGRAMMING**

**(Effective from the Academic Year 2025 - 2026)**

**III SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS308A4</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Basic knowledge of C programming language
- Familiarity with data structures like arrays, stacks, queues, and linked lists
- Understanding of basic algorithmic concepts such as sorting, searching, recursion
- Logical reasoning and interest in problem solving

**COURSE OBJECTIVES:**

- Build foundational skills in writing efficient and optimized C++ code for problem solving.
- Introduce standard templates and libraries in C++ (STL) commonly used in competitive programming.
- Develop logical and algorithmic thinking for solving real-time challenges under constraints.
- Familiarize students with coding platforms like Codeforces, LeetCode, and HackerRank.
- Enable students to apply backtracking, recursion, and STL features to solve diverse problems.

**TEACHING - LEARNING STRATEGY:**

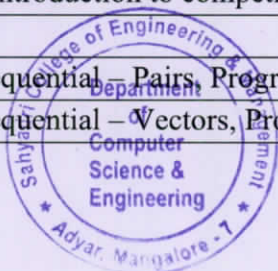
Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**LIST OF EXPERIMENTS**

**Design, develop, and implement the specified algorithms using C++ Programming under LINUX/Windows environment.**

| Exp. No. | Description                                                                                                                                                   |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | Introduction to programming in C++: input/output, variables, datatypes, operators (Arithmetic, Assignment, Logical, comparison, Bitwise, operator precedence) |
| 2        | Conditions, Loop, Functions, Introduction to competitive programming- sample programs                                                                         |
| 3        | Simple programs in C++                                                                                                                                        |
| 4        | Standard Template Library: Sequential – Pairs, Programs                                                                                                       |
| 5        | Standard Template Library: Sequential – Vectors, Programs                                                                                                     |





|    |                                                                   |
|----|-------------------------------------------------------------------|
| 6  | Standard Template Library: Sequential- Stacks, Programs           |
| 7  | Standard Template Library: Sequential- Queue, Programs            |
| 8  | Standard Template Library: Ordered and Unordered Maps, Programs   |
| 9  | Standard Template Library: Ordered and Unordered – Sets, Programs |
| 10 | Recursion, backtracking, Upper Bound, Lower Bound                 |
| 11 | Introduction to Classes and objects in C++, Programs              |

### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                               | Bloom's Taxonomy Level |
|--------|--------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Write and test simple C++ programs using fundamental syntax and problem-solving approaches on competitive platforms.     | CL2                    |
| CO2    | Apply Standard Template Library (STL) containers like pairs and vectors to solve basic algorithmic problems efficiently. | CL3                    |
| CO3    | Implement and utilize stacks and queues from the STL to solve structured programming problems.                           | CL3                    |
| CO4    | Demonstrate the use of STL containers such as maps and sets (ordered/unordered) in solving constraint-based problems.    | CL3                    |

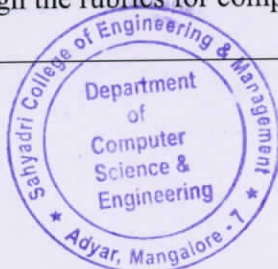
### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### ASSESSMENT STRATEGY:

- In Laboratory Courses where component (C) is not a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have 50% weightage (25 Marks). In such cases,
  - The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
  - One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.
  - The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) and component (B).
- The course instructor will design the rubrics for component (C).







**SEE QUESTION PAPER PATTERN:**

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

**REFERENCE BOOKS:**

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin: 3<sup>rd</sup> Edition, Pearson.
2. Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2<sup>nd</sup> Edition, Universities Press.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):**

1. <https://nptel.ac.in/courses/106106182>





**ADDITIONAL MATHEMATICS-I**  
(Effective from the Academic year 2025-2026)  
**III - SEMESTER**

|                                        |                 |            |         |
|----------------------------------------|-----------------|------------|---------|
| Course Code                            | <b>BMA310NK</b> | CIA Marks  | 50      |
| Number of Contact Hours/Week (L:T:P:S) | 2:0:0:1         | SEE Marks  | 50      |
| Total Hours of Pedagogy                | <b>24L</b>      | Exam Hours | 3 Hours |

**CREDITS – 0**

**COURSE PREREQUISITES:**

- Basics of Differentiation and Integration

**Course Objectives:**

- Enable the students to use the concepts of Vector and Vector Differentiation
- Study the various methods Solving first order Linear Differential Equations.
- Understand the Basic Concept of Partial Differentiation

**Teaching - Learning Strategy:**

These are some sample strategies, which course faculty members can incorporate in the Teaching Learning Process:

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses

**COURSE CONTENTS**

**MODULE I**

|                                                                                                                     |                |
|---------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Vector Algebra</b> -Basic Properties, Dot product and Cross Product of two vectors,-Problems.                    | <b>6 Hours</b> |
| <b>Complex Numbers:</b> Polar form, Amplitude and Modulus of a complex number. De-movire's theorem, Argand Diagram. |                |

**MODULE II**

|                                                                                                                                                                                                                                             |                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Differential calculus:</b> Review of elementary differential calculus, nth derivative of elementary functions, Leibnitz Rule, Polar curves - the angle between the radius vector and tangent, Angle between Two curves, Pedal equations. | <b>6 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|

**MODULE III**

|                                                                                                                                                                                |                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Differential Equations:</b> Solving first order Linear differential equations using Variable separable method, Exact Differential Equations, Linear Differential Equations. | <b>6 Hours</b> |
| <b>Partial differentiation:</b> Total derivatives- differentiation of composite functions. Euler's Theorem-Problems. Jacobians-simple problems.                                |                |

**MODULE IV**

|                                                                                                                                                                                                         |                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Vector Differentiation:</b> Scalar and vector fields. Gradient, directional derivative; curl and divergence-physical interpretation; solenoidal and irrotational vector fields-Illustrative problems | <b>6 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|







### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                            | Bloom's Taxonomy Level |
|--------|-------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Apply the basic concept of vectors, complex numbers to solve engineering problems.                    | CL3                    |
| CO2    | Apply the knowledge of calculus to solve problems related to polar curves and their applications.     | CL3                    |
| CO3    | Solve first order differential equation and understand the concepts of partial differentiation        | CL3                    |
| CO4    | Illustrate the applications of vector calculus and understand the solenoidal and irrotational vectors | CL3                    |

### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### SEE QUESTION PAPER PATTERN:

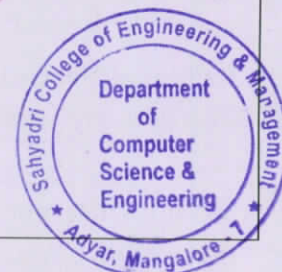
- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

### REFERENCE BOOKS:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43<sup>rd</sup> Ed., 2015.
2. B.V Ramana: "Higher Engineering Mathematics" 11<sup>th</sup> Edition, Tata McGraw-Hill,
3. H.K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics", S.Chand Publication 2014.

### REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):

1. [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
2. <http://academicearth.org/>
3. <http://www.bookstreet.in>
4. VTU e-Shikshana Program



Dean-Academics  
Chairperson  
Board of Studies (BoS)  
Computer Science & Engineering  
Sahyadri College of Engineering & Management  
Principal  
Sahyadri College of Engineering & Management  
An Autonomous Institution  
Mangaluru



**COMPUTER COMMUNICATION AND NETWORKS**

(Effective from the Academic Year 2025 - 2026)

**IV SEMESTER**

|                                           |                  |            |    |
|-------------------------------------------|------------------|------------|----|
| Course Code                               | <b>BCS401G</b>   | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:2:0          | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L + 20P</b> | Exam Hours | 03 |

**CREDITS – 4**

**COURSE PREREQUISITES:**

- Basic computer knowledge (hardware/software fundamentals)
- Mathematical foundations (binary systems, logic, etc.)
- Basics of programming (preferably C or Python)

**COURSE OBJECTIVES:**

- Provide an understanding of the evolution and history of networking and the Internet.
- Develop knowledge of data communication principles, network types, standards, and hardware/software interaction.
- Explore various network architectures, protocols, and their functioning across OSI and TCP/IP layers.
- Examine the functioning of application, transport, network, and data link layers in modern communication.
- Enable learners to understand routing algorithms, error control mechanisms, and access protocols used in communication networks.

**TEACHING - LEARNING STRATEGY:**

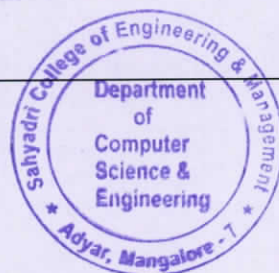
Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                           |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction:</b> Data Communications, Networks, Network Types, Standards, and Administration, Network hardware, Network Software, Reference models, Comparison of OSI and TCP/IP Models, Network Topologies, Connection-oriented and Connectionless services, Network Switching, Transmission Medium. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







**MODULE – II**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Application Layer</b><br><b>Principles of Network Applications:</b> Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the Internet, Application-Layer Protocols.<br><b>The Web and HTTP:</b> Overview of HTTP, Non-persistent and Persistent Connections, HTTP Message Format, User- Server Interaction: Cookies, Web Caching, The Conditional GET.<br><b>File Transfer:</b> FTP Commands and Replies.<br><b>Electronic Mail in the Internet:</b> SMTP, Comparison with HTTP, Mail Message Format, Mail Access Protocols, DNS; The Internet's Directory Service: Services Provided by DNS, Overview of How DNS Works, DNS Records and Messages | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – III**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Transport Layer</b><br><b>Introduction and Transport-Layer Services:</b> Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing: Connectionless Transport: UDP, UDP Segment Structure, UDP Checksum.<br><b>Principles of Reliable Data Transfer:</b> Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N, Selective repeat, Connection-Oriented Transport TCP: The TCP Connection, TCP Segment Structure, Roundtrip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

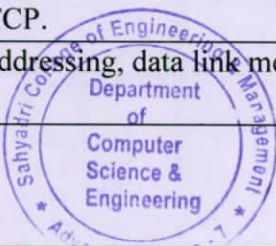
**MODULE – IV**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Routing:</b> Switching, Output Processing, Queuing, IPv6, A Brief foray into IP Security, Routing Algorithms: The Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm, Hierarchical Routing, Routing in the Internet, Intra-AS Routing in the Internet: RIP and OSPF. Inter/AS Routing: BGP, Broadcast Routing Algorithms and Multicast.<br><b>The Data link layer:</b> Design issues of DLL, Error detection and correction, Elementary data link protocols, Sliding window protocols. The medium access control sublayer: The channel allocation problem, Multiple access protocols. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| <b>CO No.</b> | <b>Course Outcome Description</b>                                                                        | <b>Bloom's Taxonomy Level</b> |
|---------------|----------------------------------------------------------------------------------------------------------|-------------------------------|
| CO1           | Understand the core concepts of data communication, OSI/TCP-IP models, switching, and services.          | CL2                           |
| CO2           | Discuss application-layer protocols like HTTP, DNS, SMTP, and their role in client-server communication. | CL2                           |
| CO3           | Analyze transport-layer functionalities and compare reliable/unreliable communication using UDP and TCP. | CL4                           |
| CO4           | Examine routing algorithms, IP addressing, data link mechanisms, and MAC protocols in networked systems. | CL3                           |







**LABORATORY COMPONENTS**

| Exp. No. | Experiment Description                                                                                                                                                                                                      | CO. No. | Bloom's Taxonomy Level |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------------------------|
| 1.       | Implement Three nodes point – to – point network with duplex links between them for different topologies. Set the queue size, vary the bandwidth, and find the number of packets dropped for various iterations using GNS3. | CO1     | CL3                    |
| 2.       | Write a Socket Programming in 'JAVA' using UDP and Network Monitoring and Analysis with Wireshark.                                                                                                                          | CO2     | CL3                    |
| 3.       | Analyze the Network Data Analysis using tcpdump using GNS3                                                                                                                                                                  | CO3     | CL3                    |
| 4.       | Analyze the Computer Network Design using SWITCH and ROUTERS in GNS3                                                                                                                                                        | CO3     | CL3                    |
| 5.       | Analyze the Dynamic Host Configuration Protocol (DHCP) using GNS3.                                                                                                                                                          | CO3     | CL3                    |
| 6.       | Implement transmission of ping messages/traceroute over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion in the network                                                    | CO3     | CL3                    |
| 7.       | Write a program takes 4 data bits from the user and returns a 7-bit Hamming Code with parity bits calculated at the appropriate positions.                                                                                  | CO3     | CL3                    |
| 8.       | Write a program for congestion control using a leaky bucket algorithm using the JAVA program.                                                                                                                               | CO4     | CL3                    |
| 9.       | Analyze the design of VLANs Using GNS3.                                                                                                                                                                                     | CO4     | CL3                    |
| 10       | Connect two different networks using two Cisco routers and verify connectivity.                                                                                                                                             | CO4     | CL3                    |

**ASSESSMENT STRATEGY**

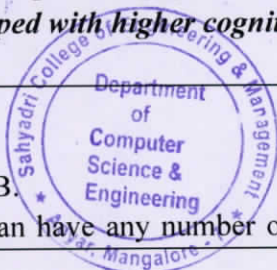
Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                                     | Weightage (%) | Max. Marks |
|---------|------------------------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b>                | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)                       | 30 %          | 15         |
|         | Activity Based Assessment (As suggested by the BoS)        | 20 %          | 10         |
|         | Laboratory Continuous Assessment                           | 30 %          | 15         |
|         | Laboratory Test (After the completion of all experiments*) | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>                      | <b>100 %</b>  | <b>50</b>  |

**Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.**

**SEE QUESTION PAPER PATTERN**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 mark







totaling to 20 covering all the four modules.

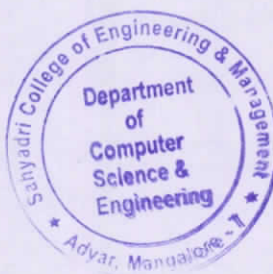
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Behrouz A Forouzan, Data and Communications and Networking, 5<sup>th</sup> Edition, McGraw Hill, Indian Edition, 2013
2. Larry L Peterson and Bruce S Davie, Computer Networks, 5<sup>th</sup> edition, ELSEVIER, 2021
3. Andrew S Tanenbaum, Computer Networks, 5<sup>th</sup> edition, Pearson, 2019
4. Mayank Dave, Computer Networks, Second edition, Cengage Learning
5. James F Kurose and Keith W Ross, Computer Networking, A Top-Down Approach, 6<sup>th</sup> Edition, Pearson, 2017.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (If Any):**

1. <https://youtu.be/O--rkQNKqls?si=hDsc3rLgoZaIGP-w>
2. [Data Communication Networks | Coursera](#)
3. <https://youtu.be/fErDcUtd8fA?si=TPFqetvgWMHoDrPa>





**MICROPROCESSOR AND EMBEDDED SYSTEMS**  
(Effective from the Academic Year 2025 - 2026)  
**IV SEMESTER**

|                                           |                  |            |    |
|-------------------------------------------|------------------|------------|----|
| Course Code:                              | <b>BCS402G</b>   | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:2:0          | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L + 20P</b> | Exam Hours | 03 |

**CREDITS – 4**

**COURSE PREREQUISITES:**

- C Programming and Assembly Language Programming
- Digital Logic Design (Gates, Flip-flops, Counters, etc.)
- Computer Organization and Architecture (memory, buses, registers, etc.)

**COURSE OBJECTIVES:**

- Understand the architecture and operational modes of microprocessors and microcontrollers used in embedded systems.
- Develop low-level programming skills in C and Assembly for interfacing hardware with software.
- Interface and control peripherals and embedded system components such as sensors, motors, displays, and communication modules.
- Design functional embedded applications for real-time problem solving.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**COURSE CONTENTS**

**MODULE – I**

**The microprocessor and its Architecture:** Internal Microprocessor Architecture, Real Mode Memory Addressing

**10  
Hours**

**Addressing Modes:** Data Addressing modes, Program Memory addressing mode, stack Memory Addressing

**MODULE – II**

**Data Movement Instructions:** MOV, PUSH/POP, Load Effective Address, String Data Transfer, XCHG, LAHF, XLAT Assembler Details: Directives, Memory Organization and Sample Programs

**10  
Hours**

**Arithmetic Instructions:** Addition, Subtraction, Comparison, BCD and ASCII arithmetic







**MODULE – III**

|                                                                                                                                                                                                                                       |                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>Logic Instructions:</b> Logic Instructions, Shift and Rotate instructions.<br><b>Program Control Instructions:</b> Jump loops, Controlling the flow of Programs, Procedure, Introduction to Interrupts, Miscellaneous Instructions | <b>10<br/>Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|

**MODULE – IV**

|                                                                                                                                                                                                                                                                                              |                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>Embedded System Components:</b><br><b>Core of an Embedded System</b> including all types of processor/controllers, Memory, Sensors, Relay, ADC, LED, LCD display, Stepper motor, Keyboard, UART, USB, SPI, I2C, (onboard and external types), Embedded firmware, other system components. | <b>10<br/>Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                      | Bloom's Taxonomy Level |
|--------|-----------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Discuss the architecture of microprocessors and illustrate different memory addressing modes.                   | CL2                    |
| CO2    | Apply data movement, arithmetic, and assembler-level instructions to develop practical microprocessor programs. | CL3                    |
| CO3    | Apply logic, shift/rotate, and control instructions to manage program execution and handle interrupts.          | CL3                    |
| CO4    | Analyze components and communication protocols of embedded systems to design basic embedded applications.       | CL3                    |

**LABORATORY COMPONENTS**

| Exp. No. | Experiment Description                                                                                                                                                                                                                   | CO No. | Bloom's Taxonomy Level |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------|
| 1.       | Write an assembly language program (ALP) to swap the contents of two registers, AX and BX, without using a temporary register. Illustrate the sequence of instructions used to perform the swap and explain the role of each instruction | CO1    | CL3                    |
| 2.       | Write an assembly language program (ALP) to calculate the average of an array of numbers. The program should iterate through the array, sum the elements, and then divide by the number of elements to find the average                  | CO2    | CL3                    |
| 3.       | Write an assembly language program (ALP) to add and subtract two multi-byte numbers (16 OR 32) stored in memory                                                                                                                          | CO2    | CL3                    |
| 4.       | Write an assembly language program (ALP) to sort an array using the Bubble Sort algorithm.                                                                                                                                               | CO2    | CL3                    |
| 5.       | Write an assembly language program (ALP) to compare two null-terminated strings and reverse a given string                                                                                                                               | CO3    | CL3                    |
| 6.       | Interface Relay to LPC2148 Arm Processor Kit and implement automatic light turn ON/OFF System.                                                                                                                                           | CO3    | CL3                    |
| 7.       | Write an assembly program to send the message "Hello World" via UART on a microcontroller.                                                                                                                                               | CO4    | CL3                    |
| 8.       | Write an assembly language program to read values from a 8x3 key                                                                                                                                                                         | CO4    | CL3                    |







|     |                                                                                                                                            |     |     |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
|     | matrix. The program should simulate keypresses, store the values in memory, and display a success message after the matrix is filled.      |     |     |
| 9.  | Interface (a) Stepper motor (b) DC motor to rotate it in a clockwise and anti-clockwise direction. (c) Relay To LPC2148 Arm Processor Kit. | CO4 | CL3 |
| 10. | Write an ALP to Interface ADC To LPC2148 Arm Processor Kit.                                                                                | CO4 | CL3 |

#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                                     | Weightage (%) | Max. Marks |
|---------|------------------------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b>                | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)                       | 30 %          | 15         |
|         | Activity Based Assessment (As suggested by the BoS)        | 20 %          | 10         |
|         | Laboratory Continuous Assessment                           | 30 %          | 15         |
|         | Laboratory Test (After the completion of all experiments*) | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>                      | <b>100 %</b>  | <b>50</b>  |

*Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.*

#### SEE QUESTION PAPER PATTERN:

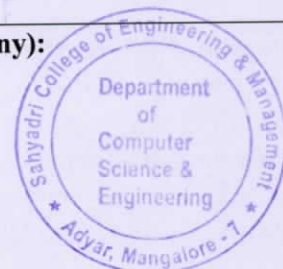
- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from the first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

#### REFERENCE BOOKS:

1. Brey, Barry B. "The Intel microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit extensions: architecture, programming, and interfacing.", 8<sup>th</sup> edition, 2013
2. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2<sup>nd</sup> Edition, 2017.
3. Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2<sup>nd</sup> Edition, 2008.
4. Raghunandan.G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication, 2019

#### REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (If Any):

1. <https://nptel.ac.in/courses/108/105/108105132/>
2. <https://nptel.ac.in/courses/106/103/106103068/>
3. [https://onlinecourses.nptel.ac.in/noc22\\_cs93/unit?unit=17&lesson=18](https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=17&lesson=18)
4. [https://onlinecourses.nptel.ac.in/noc22\\_cs93/unit?unit=26&lesson=27](https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=26&lesson=27)
5. [https://onlinecourses.nptel.ac.in/noc22\\_cs93/unit?unit=43&lesson=44](https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=43&lesson=44)







**SOFTWARE ENGINEERING**

(Effective from the Academic Year 2025 - 2026)

**IV SEMESTER**

|                                           |         |            |    |
|-------------------------------------------|---------|------------|----|
| Course Code                               | BCS403T | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0 | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | 40L     | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Basic knowledge of software development principles
- Familiarity with programming languages and development environments
- Foundational understanding of management or organizational behavior

**COURSE OBJECTIVES:**

- Introduce the fundamental principles and models of software engineering.
- Understand the requirement engineering process and the role of use cases and modeling.
- Explain object-oriented development, including class and component-level design.
- Explore agile methodologies and modern software development frameworks.
- Introduce software testing techniques, from unit to integration levels.
- Understand software project management activities including estimation, planning, risk management, and SPI (Software Process Improvement).

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

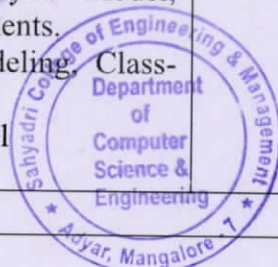
**MODULE - I**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Software and Software Engineering:</b> Nature of Software, The Software Process, Software Engineering Practice.<br><b>Processes Models:</b> A Generic Process Model, Process Assessment and Improvement, Perspective Process Models – The Waterfall Model, Prototyping Process Model, Evolutionary Process Model, Unified Process Model. Product and Process<br><b>Agility and Process:</b> Agility and cost of Change, Agile Process, Scrum -Scrum Teams and Artifacts, Sprint planning Meeting, Daily Scrum meeting, Sprint Review meeting, Sprint Retrospective. Other Agile Frameworks – The XP Framework, Kanban, DevOps | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Understanding Requirements:</b> Requirement Engineering, Establishing the Groundwork, Requirements Gathering, Developing Use Cases, Building the Analysis Model, Negotiating Requirements, Requirements Monitoring, Validating Requirements.<br><b>Requirements Modeling:</b> Requirements Analysis, Scenario-Based Modeling, Class-Based Modeling, Functional Modeling, Behavioral Modeling.<br><b>Software Design:</b> The Design Process, Design concepts, The Design Model | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**







|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Component-Level Design:</b> Component Views, Designing Class-based Components.<br><b>User Experience Design:</b> User Experience Design Elements, Use Interface Analysis and Design, Use Experience Analysis, User Experience Design.<br><b>Pattern-based Design:</b> Design Patterns, Pattern-Based Software Design.<br><b>Software Testing -Component Level:</b> A strategic Approach to Software Testing, Test-Case Design, White-Box Testing, Black-Box Testing, Object-Oriented Testing.<br><b>Software Testing -Integration Level:</b> Integration Testing, Artificial Intelligence and Regression Testing, Integration Testing in the OO Context, Validation Testing, Testing Patterns | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - IV**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Project Management Concepts:</b> The Management Spectrum, People, Product, Process, Project<br><b>Creating Viable Software Plan:</b> The Project Planning Process, Resources, Data Analytics and Software Estimation, Decomposition and Estimation Techniques, Project Scheduling, Defining a Project Task Set.<br><b>Risk Management:</b> Software Risks; Risk Identification; Risk Projection; Risk Refinement; Risk Mitigation, Monitoring and Management.<br><b>Software Process Improvement:</b> The SPI Process, The CMMI, Other SPI Frameworks – SPICE, TickIT Plus | <b>10 Hours</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                                      | Bloom's Taxonomy Level |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Discuss the nature of software, software engineering practices, various software process models, and demonstrate an understanding of Agile frameworks including Scrum, XP, Kanban, and DevOps.  | CL2                    |
| CO2    | Identify and analyze software requirements using modeling techniques such as use case, scenario-based, class-based, functional, and behavioral models; and apply principles of software design. | CL3                    |
| CO3    | Design component-level solutions and user experiences using UI/UX principles and design patterns; and apply various software testing methods at both component and integration levels.          | CL3                    |
| CO4    | Apply project management concepts including planning, estimation, scheduling, risk analysis, and understand the use of process improvement frameworks like CMMI, SPICE, and TickIT Plus.        | CL3                    |

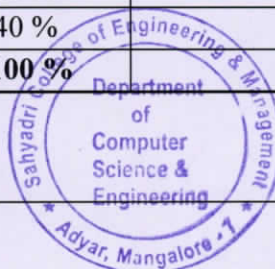
**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.







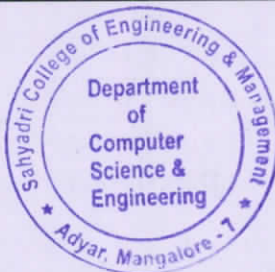
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from the first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, they will have a choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Pressman R. S., Software Engineering A practitioner's approach, 9<sup>th</sup> Edition, McGraw Hill, 2014.
2. Somerville Ian, Software engineering, 10<sup>th</sup> Edition, Pearson Education, 2015.
3. Booch G., Rumbaugh J., Jacobson I., The Unified Modelling Language User Guide, 2<sup>nd</sup> Edition, Pearson, 2017.
4. Rajib Mall, Fundamentals of Software Engineering, 5<sup>th</sup> Edition, PHI Learning, 2018

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):**

1. [https://youtu.be/ilHPCbkZLV4?si=GKjuOnWhmd\\_nkjan](https://youtu.be/ilHPCbkZLV4?si=GKjuOnWhmd_nkjan)
2. [Software Engineering: Software Design and Project Management | Coursera](#)
3. <https://youtu.be/b6mcMkQONic?si=ETFzx1Z5q01zJ9Nb>





**DESIGN AND ANALYSIS OF ALGORITHMS**

**(Effective from the Academic Year 2025 - 2026)**

**IV SEMESTER**

|                                           |                |            |    |
|-------------------------------------------|----------------|------------|----|
| Course Code                               | <b>BCS404T</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0        | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>     | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Basic Programming Constructs (loops, functions, recursion) – ideally in C/C++.
- Data Structures – including arrays, stacks, queues, linked lists, trees, and graphs.
- Discrete Mathematics – understanding of logic, sets, relations, functions, and proof techniques.

**COURSE OBJECTIVES:**

- Introduce the fundamentals of algorithm design and mathematical tools for analyzing time and space complexity.
- Explore classical algorithmic paradigms such as brute force, divide-and-conquer, greedy methods, dynamic programming, and backtracking.
- Apply graph algorithms and optimization techniques to solve real-world computational problems.
- Understand computational complexity theory and classify problems into P, NP, NP-complete, and NP-hard categories.
- Equip students with problem-solving strategies for designing efficient algorithms and critically analyzing their performance.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

Fundamentals of Algorithmic Problem Solving, Important Problem Types.

**Brute Force Approaches:** Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching. Exhaustive Search (Travelling Salesman problem and Knapsack Problem).

**Decrease-and-Conquer:** Insertion Sort, Topological Sorting.

**Divide and Conquer:** Merge Sort, Quick Sort, Multiplication of Large Integers and Strassen's Matrix Multiplication.

**10  
Hours**

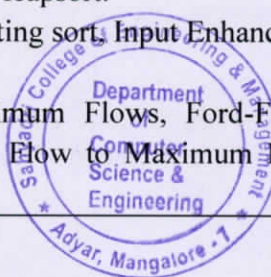
**MODULE - II**

**Transform-And-Conquer:** Balanced Search Trees, Heaps and Heapsort.

**Space-Time Tradeoffs:** Sorting by Counting: Comparison counting sort, Input Enhancement in String Matching: Horspool's Algorithm.

**Graph Algorithms:** Network Flows, Flow Networks, Maximum Flows, Ford-Fulkerson, Edmond-Karp, Push Re-label Algorithm, Application of Max Flow to Maximum Matching Problem.

**10  
Hours**







**MODULE - III**

**Dynamic Programming:** Three basic examples, The Knapsack Problem and Memory Functions, Warshall's and Floyd's Algorithms. Travelling Salesperson problem. Multistage Graphs  
**The Greedy Method:** Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and Codes.

**10  
Hours**

**MODULE - IV**

**Backtracking:** General method, N-Queens problem, Sum of subsets problem, Hamiltonian cycles Problems.  
**Branch and Bound:** Basic concepts, Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem.  
**Np-Complete and Np-Hard Problems:** Basic concepts, Non- deterministic algorithms, P, NP, NP-Complete, and NP-Hard classes.

**10  
Hours**

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                                 | Bloom's Taxonomy Level |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Apply brute force, divide-and-conquer, and decrease-and-conquer strategies to solve basic computational problems involving sorting, searching, and classical problems.                     | CL3                    |
| CO2    | Implement transform-and-conquer techniques, heaps, and graph flow algorithms to solve real-world optimization and network problems.                                                        | CL3                    |
| CO3    | Apply dynamic programming and greedy methods for optimization problems like knapsack, shortest path, and minimum spanning tree.                                                            | CL3                    |
| CO4    | Illustrate solutions for constraint-based problems using backtracking and branch-and-bound methods, and classify problems based on computational complexity (P, NP, NP-complete, NP-hard). | CL3                    |

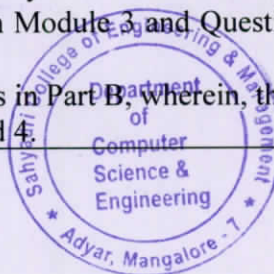
**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage(%) | Max. Marks |
|---------|---------------------------------------------|--------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %         | 30         |
|         | Assignments                                 | 40 %         | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b> | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.





**REFERENCE BOOKS:**

1. Introduction to the Design and Analysis of Algorithms, By Anany Levitin, 3rd Edition (Indian), 2017, Pearson.
2. Introduction to Algorithms, by Cormen, Leiserson, Rivest, and Stein, MIT Press, 3<sup>rd</sup> Edition, 2009.
3. Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, 2014, Universities Press.
4. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
5. Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if any):**

1. Design and Analysis of Algorithms: <https://nptel.ac.in/courses/106/101/106101060/>







**DESIGN AND ANALYSIS OF ALGORITHMS LAB**

**(Effective from the Academic Year 2025 - 2026)**

**IV SEMESTER**

|                                           |                |            |    |
|-------------------------------------------|----------------|------------|----|
| Course Code                               | <b>BCS405L</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0        | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>     | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Basic Programming Constructs (loops, functions, recursion) – ideally in C/C++.
- Data Structures – including arrays, stacks, queues, linked lists, trees, and graphs.
- Discrete Mathematics – understanding of logic, sets, relations, functions, and proof techniques.

**COURSE OBJECTIVES:**

This course will enable students to:

- To design and implement various algorithms in Java programming using suitable development tools to address different computational challenges. Make use of different algorithmic design techniques to solve problems.
- Measure, record, and visualize empirical performance (time and, where appropriate, memory) to validate theoretical complexity claims.
- Compare alternative algorithmic solutions for the same problem, explain trade-offs, and justify the most suitable choice under real-world constraints. Document the complete problem-solving workflow (problem statement → design rationale → implementation → test data → results → conclusions) in a clear, reproducible format suitable for technical reporting.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Demonstration
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies

**LIST OF EXPERIMENTS**

**Design, develop, and implement the specified algorithms using Java Programming under LINUX/Windows environment.**

| Exp. No. | Description                                                                                                                                                                                                                                                                                                                                              | CO No. | Bloom's Taxonomy Level |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------|
| 1        | Design and implement a Program to sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n > 5000, and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. | CO1    | CL3                    |
| 2        | Design and implement a Program to sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n > 5000 and record the time taken to sort. Plot a graph of the                                                                                                                   | CO1    | CL3                    |





|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |     |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
|    | time taken versus n. The elements can be read from a file or can be generated using the random number generator.                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |
| 3  | Design and implement a Program to solve discrete Knapsack and continuous Knapsack problems using greedy approximation method.                                                                                                                                                                                                                                                                                                                                                                                                                  | CO2 | CL3 |
| 4  | Design an application for a thermal power station and electrical lines that are connected among various power stations. The costs of electrification involved appear as weights on the edges. Obtain the minimum possible connection among the thermal stations so that any two thermal stations can be linked with the minimum cost involved. Apply Prim's algorithm to solve the problem.                                                                                                                                                    | CO2 | CL3 |
| 5  | Design and implement a Program to obtain the Topological ordering of vertices in a given digraph.                                                                                                                                                                                                                                                                                                                                                                                                                                              | CO2 | CL3 |
| 6  | Design and implement a Program to find shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm.                                                                                                                                                                                                                                                                                                                                                                                          | CO3 | CL3 |
| 7  | a. Design and implement a Program to solve All-Pairs Shortest Paths problem using Floyd's algorithm.<br>b. Design and implement a Program to find the transitive closure using Warshal's algorithm.                                                                                                                                                                                                                                                                                                                                            | CO3 | CL3 |
| 8  | The owner of a gourmet coffee shop wishes to mix a 10-pound bag of coffee using various types of coffee beans in such a way to produce the coffee blend at the maximum cost. The weights of the objects in the problem correspond to the quantity in pounds available of each type of coffee bean. The value of each quantity of coffee beans is the total cost of that quantity in rupees. Apply the Knapsack algorithm to maximize the profit.                                                                                               | CO3 | CL3 |
| 9  | Design an application for drilling an optimal printed circuit board. To drill two holes of different diameters consecutively, the head of the machine has to move to a toolbox and change the drilling equipment. This is quite time consuming. Thus, it is clear that one has to choose some diameter, drill all holes of the same diameter, change the drill, drill the holes of the next diameter, etc. Thus, this drilling problem has to minimize the travel time for the machine head. Find the optimal time to drill the circuit board. | CO4 | CL3 |
| 10 | Design and implement for a given chess board having $N \times N$ cells, place N queens on the board in such a way that no queen attacks any other queen. If it is possible to place all the N queens in such a way that no queen attacks another queen, then print N lines having N Queens. If there is more than one solution of placing the queens, print all of them. If it is not possible to place all N queens in the desired way, then print "Not possible".                                                                            | CO4 | CL3 |

#### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                       | Bloom's Taxonomy Level |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Implement and demonstrate algorithmic solutions using appropriate programming languages for a variety of computational problems.                 | CL3                    |
| CO2    | Compare and analyze empirical performance (execution time, iterations, etc.) of algorithms across varying input sizes.                           | CL3                    |
| CO3    | Apply different algorithm design techniques such as greedy, dynamic programming, divide and conquer, backtracking, and branch and bound to solve | CL3                    |





|     |                                                                                                                           |     |
|-----|---------------------------------------------------------------------------------------------------------------------------|-----|
|     | problems.                                                                                                                 |     |
| CO4 | Evaluate and choose optimal algorithms for specific problems by considering constraints such as complexity and resources. | CL3 |

#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

#### ASSESSMENT STRATEGY:

- i. In Laboratory Courses where component (C) is not a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have 50% weightage (25 Marks). In such cases,
  - a) The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
  - b) One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.
  - c) The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) and component (B).
- ii. The course instructor will design the rubrics for component (C).

#### SEE QUESTION PAPER PATTERN:

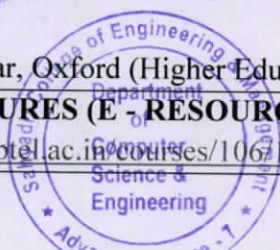
- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

#### REFERENCE BOOKS:

1. Introduction to the Design and Analysis of Algorithms, By Anany Levitin, 3rd Edition (Indian), 2017, Pearson.
2. Introduction to Algorithms by Cormen, Leiserson, Rivest, and Stein, MIT Press, 3<sup>rd</sup> Edition, 2009.
3. Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Press.
4. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
5. Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

#### REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):

1. Design and Analysis of Algorithms: <https://nptel.ac.in/courses/1067101/106101060/>







**GRAPH THEORY**

(Effective from the Academic year 2025-2026)

**IV SEMESTER**

|                                        |                 |            |         |
|----------------------------------------|-----------------|------------|---------|
| Course Code                            | <b>BCS406W1</b> | CIA Marks  | 50      |
| Number of Contact Hours/Week (L:T:P:S) | 3:0:0:0         | SEE Marks  | 50      |
| Total Hours of Pedagogy                | <b>40L</b>      | Exam Hours | 3 Hours |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Basic knowledge of Graph Theory.

**COURSE OBJECTIVES:**

- To learn fundamental concepts and to explore modern applications of Graph Theory for problem-solving and network analysis
- Apply the concepts of a planar graph, matching and coloring in computer science engineering.

**TEACHING - LEARNING STRATEGY:**

These are some sample strategies, which course faculty members can incorporate in the Teaching Learning Process:

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE I**

|                                                                                                                                                                                                                                                                           |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Graphs and Subgraphs:</b> Definitions and Examples of Graphs, Subgraphs, walks, paths and circuits. Operations on graphs, Connected and Disconnected Graphs, Complements, Graph Isomorphism, Vertex Degree, Euler Trails and Circuits, Hamiltonian paths and circuits. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE II**

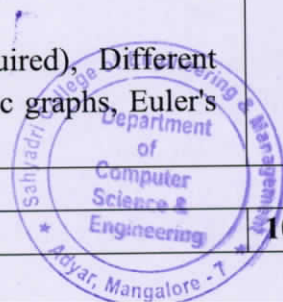
|                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Trees and Connectivity Graphs</b><br><b>Trees:</b> Definitions, properties, pendant vertex, Distance and centres in a tree - Rooted and binary trees, , weighted trees, spanning trees, Sorting, Prefix codes, optimal tree.<br><b>Connectivity Graphs:</b> Vertex Connectivity, Edge Connectivity, Cut set and Cut Vertices, Fundamental circuits. Network Flows- Max- flow Min-cut Theorem (Statement only and problems). | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE III**

|                                                                                                                                                                                                                                                                                                                                                                                                             |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Graph Representations and Planar Graphs .</b><br><b>Graph Representations:</b> Matrix representation of graphs-Adjacency matrix, Incidence Matrix, Circuit Matrix, Path Matrix.<br><b>Planar Graphs:</b> Planar graphs, Kuratowski's theorem (proof not required), Different representations of planar graphs, Detection of planar graphs, Homeomorphic graphs, Euler's theorem, Dual of a planar graph. | <b>10 Hours</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE IV**

|                                                                     |                 |
|---------------------------------------------------------------------|-----------------|
| Colouring, Matching, Dominating sets and Graph Theoretic Algorithms | <b>10 Hours</b> |
|---------------------------------------------------------------------|-----------------|







**Coloring and Matching:** Graph Coloring, Chromatic Polynomial, Chromatic Partitioning, Matching, Covering - Related Theorems.

**Dominating sets:** Dominating set. Minimal Dominating set. Domination number. Independent dominating set. Finding minimal dominating sets.

**Graph Theoretic Algorithms:** Computer representation of a graph. Algorithm on spanning trees: Kruskal's and Prim's Algorithm (Problems) ,Graphs in switching theory-Contact networks, analysis of contact networks.

### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                         | Bloom's Taxonomy Level |
|--------|----------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Apply the fundamental concepts and properties of graphs and subgraphs.                             | CL3                    |
| CO2    | Solve complex problems using properties of trees and connectivity graphs in Computer science.      | CL3                    |
| CO3    | Apply the concepts of planar graph and graph representations to solve the given problem            | CL3                    |
| CO4    | Develop graph algorithms to solve problems in network analysis, optimization, and decision-making. | CL3                    |

### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

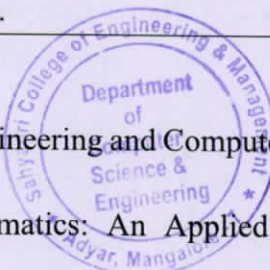
| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### SEE QUESTION PAPER PATTERN:

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

### REFERENCE BOOKS:

1. Narsingh Deo, "Graph Theory with Application to Engineering and Computer Science", Printice Hall of India Private Limited, 2009.
2. Grimaldi R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", Pearson Addison Wesley, 5<sup>th</sup> edition, 2006.
3. Bondy, J. A. and Murty, U.S.R., "Graph Theory with Applications", North Holland Publication, 2008.





4. West, D. B., —Introduction to Graph Theory, Pearson Education, 2011.
5. John Clark, Derek Allan Holton, —A First Look at Graph Theory, World Scientific Publishing Company, 1991.
6. Rosen K.H., “Discrete Mathematics and Its Applications”, Mc Graw Hill, 2007.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):**

1. <http://users.utu.fi/harju/graphtheory/graphtheory.pdf>.
2. <https://www.maths.ed.ac.uk/~v1ranick/papers/wilsongraph.pdf>
3. [https://www.academia.edu/35284015/Graph\\_Theory\\_With\\_Applications\\_To\\_Engineering\\_And\\_Computer\\_Science\\_by\\_Narsingh\\_Deo](https://www.academia.edu/35284015/Graph_Theory_With_Applications_To_Engineering_And_Computer_Science_by_Narsingh_Deo)
4. [https://onlinecourses.nptel.ac.in/noc22\\_ma10/preview#:~:text=Graph%20theory%20is%20the%20core,primary%20methods%20in%20Graph%20Theory.](https://onlinecourses.nptel.ac.in/noc22_ma10/preview#:~:text=Graph%20theory%20is%20the%20core,primary%20methods%20in%20Graph%20Theory.)







**LINEAR ALGEBRA**  
(Effective from the Academic year 2025-2026)  
**IV - SEMESTER**

|                                        |                 |            |         |
|----------------------------------------|-----------------|------------|---------|
| Course Code                            | <b>BCS406W2</b> | CIA Marks  | 50      |
| Number of Contact Hours/Week (L:T:P:S) | 3:0:0:1         | SEE Marks  | 50      |
| Total Hours of Pedagogy                | 40 L            | Exam Hours | 3 Hours |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Applied Mathematics-I, Applied Mathematics-II

**COURSE OBJECTIVES:**

- To equip the students with standard concepts and tools in Linear algebra which will find them useful in their disciplines.
- Gain the knowledge of linear algebra tools and concepts to implement them in their core domain.
- Improve their mathematical thinking and acquire skills required for sustained lifelong learning..

**TEACHING - LEARNING STRATEGY:**

These are some sample strategies, which course faculty members can incorporate in the Teaching Learning Process:

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**COURSE CONTENTS**

**MODULE I**

|                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>VECTOR SPACES:</b> Introduction, Vector spaces, Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence, Basis and Dimension, Coordinates.<br><b>LINEAR TRANSFORMATIONS:</b> Introduction, Linear Mappings, Geometric linear transformation of $\mathbb{R}^2$ , Kernel and Image of a linear transformations, Rank-Nullity Theorem (No proof) | <b>10 Hours</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE II**

|                                                                                                                                                                                                                                                |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>EIGENVALUES AND EIGENVECTORS:</b> Introduction, Polynomials of Matrices, Applications of Cayley-Hamilton Theorem, Eigen spaces of a linear transformation, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE III**

|                                                                                                                                                                                            |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>INNER PRODUCT SPACES:</b> Inner products, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt process, QR-factorization, least squares | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|



problem and least square error.

#### MODULE IV

|                                                                                                                                                                                                                                                                                                            |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>OPTIMIZATION TECHNIQUES IN LINEAR ALGEBRA:</b> Diagonalization and Orthogonal diagonalization of real symmetric matrices, quadratic forms and their classifications, Hessian Matrix, Method of steepest descent, Singular value decomposition. Dimensionality reduction – Principal component analysis. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

#### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                                | Bloom's Taxonomy Level |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Apply the concepts of vector spaces, subspaces, linear dependence/independence, and basis, and apply them to solve problems related to linear transformations and matrix spaces.          | CL3                    |
| CO2    | Analyze eigenvalues, eigenvectors, and the structure of matrices using tools such as the Cayley-Hamilton theorem, characteristic and minimal polynomials, and Jordan canonical form.      | CL3                    |
| CO3    | Apply inner product space theory to orthogonalization, projections, and least squares problems using methods like Gram-Schmidt process and QR factorization.                              | CL3                    |
| CO4    | Evaluate and implement optimization techniques in linear algebra including diagonalization, PCA, SVD, and the method of steepest descent for applications in engineering and data science | CL3                    |

#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

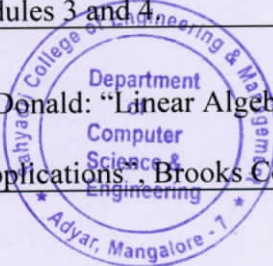
| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

#### SEE QUESTION PAPER PATTERN:

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from the first and second module.
- In Part B, the Question 4 and 5 will be from Module 3 and Question 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, they will have a choice in Modules 3 and 4.

#### REFERENCE BOOKS:

1. David C. Lay, Steven R. Lay, Judi J Mc. Donald: "Linear Algebra and its applications", Pearson Education, 6<sup>th</sup> Edition, 2021.
2. Gilbert Strang: "Linear Algebra and its applications", Brooks Cole, 4<sup>th</sup> edition, 2005.







**SAHYADRI**

COLLEGE OF ENGINEERING & MANAGEMENT

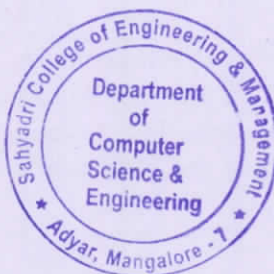
An Autonomous Institution

MANGALURU

3. Richard Bronson & Gabriel B. Costa: "Linear Algebra: An Introduction", 2<sup>nd</sup> edition. Academic Press, 2014.
4. Seymour Lipschutz, Marc Lipson: "Theory and problems of linear algebra" Schaum's outline series 6<sup>th</sup> edition, 2017, McGraw-Hill Education.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):**

1. <https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm>
2. <https://www.math.ucdavis.edu/~linear/linear.pdf>
3. <https://www.coursera.org/learn/linear-algebra-machine-learning>
4. <https://nptel.ac.in/syllabus/111106051/>
5. <http://nptel.ac.in/courses.php?disciplineID=111>
6. [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
7. <http://academicearth.org/>
8. VTU e-Shikshana Program
9. VTU EDUSAT Program .





**METRIC SPACES**

(Effective from the Academic Year 2025 - 2026)

**IV SEMESTER**

|                                           |          |            |    |
|-------------------------------------------|----------|------------|----|
| Course Code                               | BCS406W3 | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0  | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | 40L      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Basic knowledge of Set theory and Group theory

**COURSE OBJECTIVES:**

- Introduce computer engineering students to metric theory, emphasizing its application in analyzing and optimizing data structures, algorithms, and network performance.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                  |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to Metric Spaces:</b> Definition of metric space. Examples of metric spaces. Metrics and Distance Functions: Properties of metrics. Common distance functions. Open and Closed Sets, Definitions and properties. | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

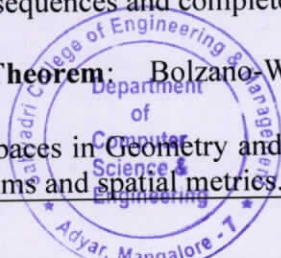
|                                                                                                                                                                                                                                                                                                                                                                                  |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Topology of a Metric Space:</b> Topological concepts, Convergence and Limit Points, Convergence of sequences and series. Limit points, limit set.<br><b>Continuity in Metric Spaces:</b> Continuous functions in metric spaces. Properties of continuous functions.<br><b>Applications:</b> Routing algorithms using metrics. Latency and distance metrics in network design. | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                                                                                                                                                              |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Compactness and Completeness:</b> Connectedness, separated sets, Connected and disconnected sets, Components of metric spaces, Connectedness of product of connected metric spaces. Bounded sets and Compactness, Other Characterizations of Compactness, Continuous Functions on Compact Spaces, Locally Compact Spaces. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - IV**

|                                                                                                                                                                                                                                                                                                                                                                                                        |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Cauchy Sequences and Completeness:</b> Cauchy sequences and completeness. Applications in analysis.<br><b>Compactness and Bolzano-Weierstrass Theorem:</b> Bolzano-Weierstrass theorem. Compactness and its applications.<br><b>Applications in Computer Networks:</b> Metric Spaces in Geometry and Graphics: Geometric interpretations of metric spaces. Graphics algorithms and spatial metrics. | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                 | Bloom's Taxonomy Level |
|--------|----------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Use Metric space concepts in computer science engineering, enhancing problem-solving skills and algorithm optimization.    | CL3                    |
| CO2    | Apply topological concepts and continuous functions in metric spaces to enhance problem-solving skills in computer science | CL3                    |
| CO3    | Demonstrate compactness and apply concepts of Metric space to optimize network design and data compression.                | CL3                    |
| CO4    | Apply Cauchy sequences, completeness, and compactness to solve problems in mathematical analysis and optimization."        | CL3                    |

### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### SEE QUESTION PAPER PATTERN:

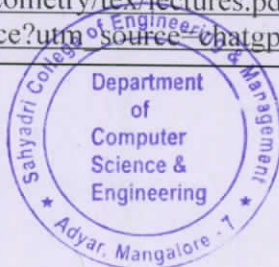
- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

### REFERENCE BOOKS:

1. Metric Spaces by Satish Shirali and Harikrishan L Vasudeva Springer, (2006)
2. Metric Spaces by P.K. Jain and Khalil Ahmad, Alpha Science International, (2004)
3. Elements of Metric spaces by M.N. Mukherjee, Academic Publishers (2005)

### REFERENCE WEB LINKS AND VIDEO LECTURES (E – RESOURCES)

1. [https://ocw.mit.edu/courses/18-s190-introduction-to-metric-spaces-january-iap2023/?utm\\_source=chatgpt.com](https://ocw.mit.edu/courses/18-s190-introduction-to-metric-spaces-january-iap2023/?utm_source=chatgpt.com)
2. [https://anton-petrinin.github.io/metric-geometry/tex/lectures.pdf?utm\\_source=chatgpt.com](https://anton-petrinin.github.io/metric-geometry/tex/lectures.pdf?utm_source=chatgpt.com)
3. [https://en.wikipedia.org/wiki/Metric\\_space?utm\\_source=chatgpt.com](https://en.wikipedia.org/wiki/Metric_space?utm_source=chatgpt.com)





**OPTIMIZATION TECHNIQUES**

(Effective from the Academic Year 2025 - 2026)

**IV SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS406W4</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Basics of Statistics, Probability distributions. Multiple integration

**COURSE OBJECTIVES:**

- Understand the concept of probability and enable the students to predict the outcome of simple experiments
- To introduce the fundamental concepts of statistical estimation, including point and interval estimation, and equip students with tools to estimate population parameters using sample data.
- Understand the concept of optimization techniques

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**COURSE CONTENTS**

**MODULE – I**

**Joint Probability Distribution Functions and Stochastic Process:** Discrete and Continuous Random variables, Probability mass function, Probability density functions. Cumulative distribution functions. Regular stochastic matrices. Transition Probability matrices. Markov Process. **10 Hours**

**MODULE – II**

**Estimation:** Estimation of Parameters, Interval Estimation, Central Limit Theorem. Maximum Likelihood functions. **10 Hours**  
**Game Theory:** Introduction of game theory, Two-person zero sum game with two or more number of players. Payoff matrix. Optimal strategy. Minimax-Maxmin Principle. Games with and without Saddle point.

**MODULE – III**

**Linear Programming Problem:** Components of LPP, Characteristics of LPP Advantages of LPP Simplex method, Big M method, Duality in LPP, Lab Components: Solving LPP using R-software **10 Hours**

**MODULE IV**







|                                                                                                                                                                                  |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Transportation and Assignment Problem:</b> Balanced TP. Components of TP, Northwest corner method. Least. cost cell method. Objectives of AP. Hungarian method of solving AP. | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                               | Bloom's Taxonomy Level |
|--------|------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Utilize theoretical knowledge of joint distributions and stochastic processes to solve practical problems in fields such as engineering, | CL3                    |
| CO2    | Explore the intersection of estimation theory and game theory to solve problems in decision-making.                                      | CL3                    |
| CO3    | Solve Linear Programming Problem to get optimal solutions of a Mathematical model.                                                       | CL3                    |
| CO4    | Ability to solve balanced Transportation and Assignment problems                                                                         | CL3                    |

**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

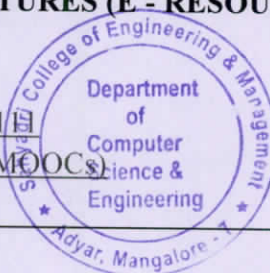
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- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with c in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 a however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. V.K Kapoor and S.C Gupta "Mathematical Statistics" 11<sup>th</sup> edition, S. Chand Publications
2. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
3. C Ray Wylie, Louis C Barrett: "Advanced Engineering Mathematics", 6th Edition,
4. B.V Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill,

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if any):**

1. <http://academicearth.org/>
2. <http://nptel.ac.in/courses.php?disciplineID=1>
3. [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
4. <http://www.bookstreet.in>





**ADVANCED JAVA AND SPRING FRAMEWORK**  
**(Effective from the Academic Year 2025 - 2026)**  
**IV SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS408A1</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Basic knowledge of Java programming.
- Understanding of JDBC (Java Database Connectivity).
- SQL knowledge for database operations

**COURSE OBJECTIVES:**

- To provide students with a solid understanding of advanced Java concepts, including collections, error handling, multi-threading, and file management.
- To enable students to build dynamic web applications using Java Servlets, JSP, and integrate them with databases for efficient data management.
- To introduce students to the Spring Framework, empowering them to develop efficient and interactive web applications with Spring MVC, Spring Boot, and RESTful services.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**CONTENTS**

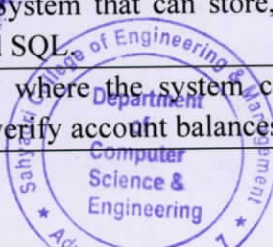
**Introduction**

JDBC fundamentals, Java Servlets, Servlet lifecycle, Role of JSP, Spring Framework, Spring Boot, Spring JDBC, Reactive programming, Spring MVC Framework, REST services.

**LIST OF EXPERIMENTS**

**Design, develop, and implement the specified programs using Advanced Java and Spring Framework under Linux/Windows environment.**

| Exp. No. | Description                                                                                                                                                                             |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | Create a simple Library Management System that can store, retrieve, update, and delete book records from a database using JDBC and SQL.                                                 |
| 2        | Design a simple bank account system where the system can create bank accounts, perform transactions (deposit, withdrawal), and verify account balances, using SQL stored procedures and |







|    |                                                                                                                                                                                                                                                      |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | JDBC for Java-database interaction.                                                                                                                                                                                                                  |
| 3  | Design a Java Application to Store and Retrieve Images in a Database using JDBC                                                                                                                                                                      |
| 4  | Design and Implement a Java Servlet Program for Employee Payroll Management                                                                                                                                                                          |
| 5  | Design and Implement a Java Servlet Program for a Calculator Application                                                                                                                                                                             |
| 6  | Design and Implement a Login Page and Validate the Existing User for a Webpage Using Java Servlets and JSP                                                                                                                                           |
| 7  | Design and implement a Student Management System using Spring Boot and EJB, which supports CRUD operations such as adding, updating, deleting, and searching student records.                                                                        |
| 8  | Design and implement a Healthcare Management System using Spring MVC to manage patient records, schedule appointments, and view/update medical history, using JSP for the user interface and a relational database (such as MySQL) for data storage. |
| 9  | Design and implement a Restaurant Menu Application using Spring MVC to perform CRUD operations (add, update, delete, and view) on menu items, including dish name, description, and price, stored in a relational database.                          |
| 10 | Design and implement a reactive RESTful API using Spring WebFlux to fetch a list of products with their names and prices, returning the data as a non-blocking stream using Flux.                                                                    |

#### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                         | Bloom's Taxonomy Level |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Apply the fundamentals of collections and string handling to create efficient Java applications that manage data and optimize performance.         | CL4                    |
| CO2    | Demonstrate the ability to build dynamic web applications using servlets and JSP for processing user input and generating dynamic content.         | CL4                    |
| CO3    | Develop database-driven applications using JDBC and Spring Data JPA to perform CRUD operations and interact with relational databases effectively. | CL4                    |
| CO4    | Implement web-based applications using the Spring Framework, designing interactive, user-friendly interfaces with the MVC architecture.            | CL4                    |

#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

#### ASSESSMENT STRATEGY:

- In Laboratory Courses where component (C) is not a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have 50% weightage (25 Marks). In such cases,
  - The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).



- b) One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.
- c) The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) and component (B).
- ii. The course instructor will design the rubrics for component (C).

**SEE QUESTION PAPER PATTERN:**

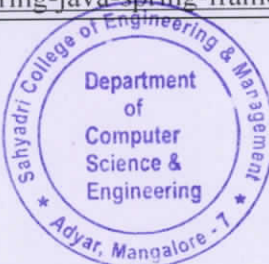
- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

**REFERENCE BOOKS:**

1. Uttam K Roy, Advanced JAVA programming, Oxford University press, 2015.
2. Spring in Action, 6th edition, Craig walls

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):**

1. <https://www.edureka.co/spring-certification-course>
2. <https://www.coursera.org/learn/advanced-java-certification-course>
3. <https://www.udemy.com/course/mastering-java-spring-framework>







**AUTOMATED SOFTWARE TESTING**  
(Effective from the Academic Year 2025 - 2026)

**IV SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS408A2</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Familiarity with basic programming concepts and logic.

**COURSE OBJECTIVES:**

- Understand fundamental concepts and objectives of software testing.
- Develop the skills to design and execute effective test cases for various types of software testing.
- Learn and apply industry-standard testing techniques such as Boundary Value Analysis (BVA) and Equivalence Class Partitioning (ECP).
- Acquire hands-on experience with industry tools like Selenium, JIRA, and JMeter for test automation and performance testing.

**TEACHING - LEARNING STRATEGY:**

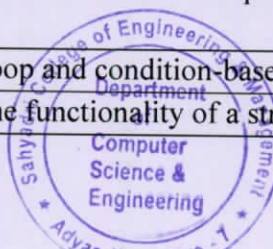
Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**LIST OF EXPERIMENTS**

**Design, develop, and implement the specified algorithms using Python Programming under LINUX/Windows environment.**

| Exp. No. | Description                                                                                                                                                                                                            |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | a) Install and Explore Selenium for Automated Testing.<br>b) Write a simple program in JavaScript and perform testing using Selenium.<br>c) Develop test cases for the above Containerized Application using Selenium. |
| 2        | Write unit tests for basic mathematical operations (addition, subtraction, multiplication, division) using JUnit.                                                                                                      |
| 3        | Apply Boundary Value Analysis to test if an age is valid for voting (between 18 and 100 years).                                                                                                                        |
| 4        | Apply Equivalence Partitioning to test an email validation program for different types of valid and invalid email addresses.                                                                                           |
| 5        | Use code coverage tools to analyze a loop and condition-based program for test coverage.                                                                                                                               |
| 6        | Perform black box testing to validate the functionality of a string reversal program.                                                                                                                                  |





|    |                                                                                                                          |
|----|--------------------------------------------------------------------------------------------------------------------------|
| 7  | Perform regression testing on a list sorting program to ensure that changes do not break existing functionality.         |
| 8  | Inject faults into a string length calculation program and test its error handling when the input is null.               |
| 9  | Perform White Box Testing on a factorial calculation program by checking the program's internal logic and code coverage. |
| 10 | Perform Load Testing to simulate multiple users logging into a system and measure performance.                           |

#### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                   | Bloom's Taxonomy Level |
|--------|--------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Understand the concept of automated testing using Selenium in JavaScript to validate web applications.       | CL2                    |
| CO2    | Apply boundary value analysis and equivalence partitioning to test age and email validation functionalities. | CL3                    |
| CO3    | Illustrate the use of JUnit to write and execute unit tests for basic mathematical operations.               | CL3                    |
| CO4    | Demonstrate load testing and white-box testing techniques to ensure system performance and code reliability. | CL3                    |

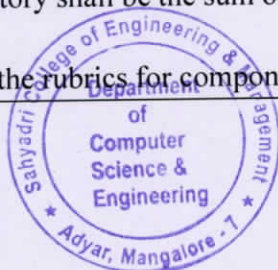
#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

#### ASSESSMENT STRATEGY:

- In Laboratory Courses where component (C) is not a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have 50% weightage (25 Marks). In such cases,
  - The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
  - One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.
  - The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) and component (B).
- The course instructor will design the rubrics for component (C).







**SEE QUESTION PAPER PATTERN:**

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

**REFERENCE BOOKS:**

1. Paul C. Jorgensen: Software Testing, A Craftsman's Approach, 3rd Edition, Auerbach Publications, 2008.
2. Herbert Schildt, C: Java The Complete Reference, McGraw Hill, 7<sup>th</sup> Edition

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):**

1. Introduction to Selenium - <https://www.youtube.com/watch?v=FRn5J31eAMw>
2. Introduction to programming - [https://www.youtube.com/watch?v=2Xa3Y4xz8\\_s](https://www.youtube.com/watch?v=2Xa3Y4xz8_s)
3. Introduction to OOPS - <https://www.youtube.com/watch?v=pBIH24tFRQk>
4. Introduction to Java - <https://www.youtube.com/watch?v=mAtkPQO1FcA>
5. Software Testing Courses Online- <https://www.coursera.org/courses?query=software%20testing>





**PROGRAMMING FOR DATA SCIENCE**  
**(Effective from the Academic Year 2025 - 2026)**  
**IV SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS408A3</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITE:**

- Basic knowledge of programming in C and Python.
- Familiarity with fundamental programming constructs such as variables, control structures, functions, and data structures.

**COURSE OBJECTIVES:**

- Acquire hands-on experience in writing Python programs for data analysis and visualization.
- Utilize data science libraries such as NumPy, Pandas, Matplotlib, and Seaborn for handling and visualizing datasets.
- Explore and analyze datasets using exploratory data analysis (EDA) techniques.
- Understand and implement basic machine learning algorithms including regression techniques.
- Develop mini-projects that demonstrate real-world data science applications.

**TEACHING - LEARNING STRATEGY:**

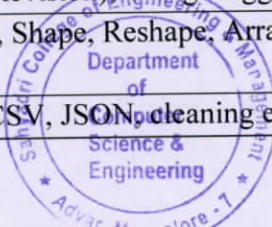
Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**LIST OF EXPERIMENTS**

**Introduction to the data science process and the value of learning data science. Provide a brief background in python, Jupyter and NumPy, Pandas, Visualization, Working with Text and Databases.**

| Exp. No. | Description                                                                                             |
|----------|---------------------------------------------------------------------------------------------------------|
| 1        | Basics of Python Programming (revision)                                                                 |
| 2        | Basics of Python Programming (Revision), Using Kaggle                                                   |
| 3        | NumPy: Creating Arrays, Slicing, Shape, Reshape, Array iteration, joining splitting, searching, sorting |
| 4        | Pandas DataFrames: Read from CSV, JSON, cleaning empty cells, correcting data                           |







|    |                                                                                                                                                                     |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | format,                                                                                                                                                             |
| 5  | Pandas DataFrames: fixing wrong data, removing duplicates                                                                                                           |
| 6  | Python program to display multiple types of charts using Matplotlib/Seaborn package: plots, bar plots, boxplots, heat maps, scatter plots, histogram, bubble charts |
| 7  | Exploratory Data Analysis: univariate analysis                                                                                                                      |
| 8  | Exploratory Data Analysis: Bivariate analysis , simple linear regression                                                                                            |
| 9  | Exploratory Data Analysis: multivariate analysis, multiple regression, training and testing a model                                                                 |
| 10 | Logistic regression                                                                                                                                                 |
| 11 | Mini Project 1: ToDo List                                                                                                                                           |
| 12 | Mini Project 2: Student management system                                                                                                                           |

### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                           | Bloom's Taxonomy Level |
|--------|------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Apply Python libraries to interact with the operating system and file system for data-related tasks. | CL3                    |
| CO2    | Implement NumPy for numerical data manipulation and Pandas for data wrangling and transformation.    | CL3                    |
| CO3    | Analyze datasets and visualize insights using plotting libraries such as Matplotlib and Seaborn.     | CL3                    |
| CO4    | Evaluate data using EDA techniques and apply regression models for predictive analysis.              | CL3                    |

### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### ASSESSMENT STRATEGY:

- i. In Laboratory Courses where component (C) is not a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have 50% weightage (25 Marks). In such cases,
  - a) The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
  - b) One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.
  - c) The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) and component (B).



ii. The course instructor will design the rubrics for component (C).

**SEE QUESTION PAPER PATTERN:**

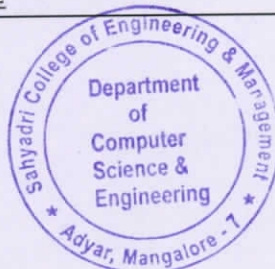
- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

**REFERENCE BOOKS:**

1. Mastering Python for Data Science, Samir Madhavan, Packt Pub Ltd, 2015

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):**

1. <https://www.w3schools.com/python/numpy/default.asp>
2. <https://www.w3schools.com/python/pandas/default.asp>
3. <https://www.kaggle.com/code/lonewolf95/eda-101-univariate-analysis-for-beginners>,  
<https://www.statology.org/univariate-analysis/>
4. <https://www.kaggle.com/code/lonewolf95/eda-102-bivariate-analysis-for-beginners>,  
<https://www.statology.org/bivariate-analysis/>
5. <https://www.kaggle.com/code/sanikamal/introduction-to-multivariate-analysis>
6. [https://github.com/amueller/introduction\\_to\\_ml\\_with\\_python/tree/main](https://github.com/amueller/introduction_to_ml_with_python/tree/main)
7. <https://nptel.ac.in/courses/106106182>







**WEB DEVELOPMENT**  
**(Effective from the Academic Year 2025-2026)**  
**SEMESTER - IV**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS408A4</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Basic knowledge of JavaScript and its syntax.
- Understanding of HTML and CSS for frontend structure and styling.
- Familiarity with basic web concepts, including how websites and HTTP work.

**COURSE OBJECTIVES:**

- Understand and apply the MERN stack (MongoDB, Express.js, React.js, Node.js) in full-stack web development.
- Develop responsive and dynamic user interfaces using React.js and Bootstrap.
- Implement server-side logic and REST APIs using Node.js and Express.js.
- Perform CRUD operations and data handling with MongoDB.
- Build and deploy real-world full-stack applications to address user needs.

**TEACHING - LEARNING STRATEGY:**

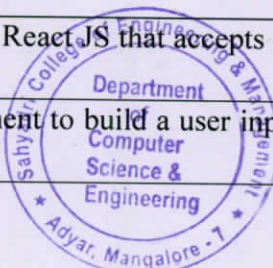
Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**LIST OF EXPERIMENTS**

**Design, develop, and implement the specified Web development application program using MERN stack**

| Exp. No.      | Description                                                                                                               |
|---------------|---------------------------------------------------------------------------------------------------------------------------|
| <b>Part A</b> |                                                                                                                           |
| 1             | Familiarization of HTML, CSS, Mongo DB, ExpressJS, NodeJS, ReactJS                                                        |
| 2             | Apply your knowledge of React JS to develop a simple calculator application that performs basic arithmetic operations.    |
| 3             | Use React JS to build a functional voting application that allows users to vote and view updated results in real-time.    |
| 4             | Implement a user login interface using React JS that accepts credentials and processes basic input validation.            |
| 5             | Use the React-Bootstrap Form component to build a user input form in React that includes fields for name, email, and age. |





|    |                                                                                                         |
|----|---------------------------------------------------------------------------------------------------------|
| 6  | Make a responsive image interaction using React JS and Bootstrap.                                       |
| 7  | Create a custom server using http module and explore the other modules of Node JS like OS, path, event. |
| 8  | Implement a simple program using Express JS to create a basic web server responding with a message.     |
| 9  | Implement basic database operation in Mongo DB.                                                         |
| 10 | Implement MERN stack to develop a full-stack web application with basic functionality.                  |

**Part B: Project**

|    |                                                                                                   |
|----|---------------------------------------------------------------------------------------------------|
| 10 | Develop a full-stack application using the MERN stack that addresses a common, everyday user need |
|----|---------------------------------------------------------------------------------------------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                             | Bloom's Taxonomy Level |
|--------|--------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Illustrate the core components and functionality of the MERN stack for full-stack web development.     | CL2                    |
| CO2    | Develop responsive and interactive user interfaces using React.js and Bootstrap.                       | CL3                    |
| CO3    | Implement RESTful APIs using Node.js and Express.js and integrate them with MongoDB for data handling. | CL3                    |
| CO4    | Design and deploy a basic full-stack application using MERN stack to address a real-world use case.    | CL3                    |

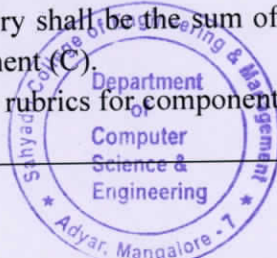
**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students' learning will be assessed using direct and indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Laboratory Work (A)                         | 50%           | 25         |
|         | Laboratory Test (B)                         | 30%           | 15         |
|         | Open-Ended Experiments/Mini Projects (C)    | 20%           | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |

**ASSESSMENT STRATEGY:**

- In laboratory courses where component (C) is a component of the assessment pattern, then component (A) will have 50% weightage (25 marks), and component (B) will have 30% weightage (15 marks) and component (C) will have 20% weightage (10 marks). In such cases,
  - The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
  - One or two laboratory tests [component (B)] similar to the SEE shall be conducted, and the marks shall be scaled down to 15 marks.
  - The CIA marks for the laboratory shall be the sum of marks obtained for component (A), component (B) and component (C).
- The course instructor will design the rubrics for component (C).







**SEE QUESTION PAPER PATTERN:**

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 marks, and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- A change of experiment is allowed only once, and 20% of the marks allotted to the procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

**REFERENCE BOOKS:**

1. Game Development with Unity Paperback – Import, 18 February 2011 by Michelle Menard

**REFERENCE WEB LINKS AND VIDEO LECTURES (E-RESOURCES) (IF ANY):**

1. <https://unity.com/games>





**BIOLOGY FOR ENGINEERS (CSE & ALLIED)**

**(Effective from the Academic Year 2025 - 2026)**

**IV SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BBS409TC</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 2:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>26L</b>      | Exam Hours | 03 |

**CREDITS – 2**

**COURSE PREREQUISITES:**

- Basic Concepts of Biology

**COURSE OBJECTIVES:**

- To familiarize the students with the basic biological concepts and their engineering applications.
- To enable the students with an understanding of biodesign principles to create novel devices and structures.
- To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
- To motivate the students to develop interdisciplinary vision of biological engineering.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**COURSE CONTENTS**

**MODULE - I**

**APPLICATION OF BIOMOLECULES**

**8 Hours**

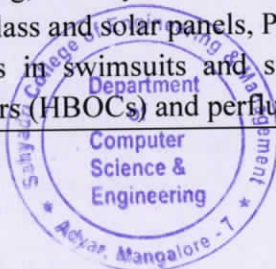
Carbohydrates in cellulose-based water filters production, PHA and PLA in bioplastics production, Nucleic acids in vaccines and diagnosis, Proteins in food production, lipids in biodiesel and detergents production, food processing, detergent formulation and textile processing

**MODULE - II**

**NATURE-BIOINSPIRED MATERIALS AND MECHANISMS:**

**6 Hours**

Echolocation: Ultrasonic sensors in robotics and autonomous vehicles, Photosynthesis: Bio-inspired CO<sub>2</sub> capture technologies, Bird flying, Aerodynamics design of aircraft and drones, Lotus leaf effect: Self-cleaning coatings for glass and solar panels, Plant burrs: Development of Velcro, Shark skin: Drag-reducing surfaces in swimsuits and submarines, Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).







**MODULE - III**

**ADAPTATION OF ANATOMICAL PRINCIPLES FOR BIOENGINEERING DESIGN**

**6 Hours**

Brain as a CPU system: Signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease, Eye as a Camera system: Retinal prosthetics and bionic eyes, Heart as a pump system: Artificial heart and ventricular assist devices (VADs), Lungs as purification system: Artificial respiration and ventilator design Kidney as a Filtration System: hemodialysis machines

**MODULE - IV**

**TRENDS IN BIOENGINEERING:**

**6 Hours**

Muscular and Skeletal Systems as scaffolds, scaffolds and tissue engineering, Bioprinting techniques and materials. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Bio concrete. Bioremediation. Biomining

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                              | Bloom's Taxonomy Level |
|--------|-----------------------------------------------------------------------------------------|------------------------|
| CO1    | Understand the role of biomolecules in engineering applications                         | CL2                    |
| CO2    | Identify bioinspired principles from nature to develop innovative engineering solutions | CL2                    |
| CO3    | Explain the analogy between human organ systems and engineered systems.                 | CL2                    |
| CO4    | Outline significant technological trends shaping modern bioengineering                  | CL2                    |

**ASSESSMENT STRATEGY**

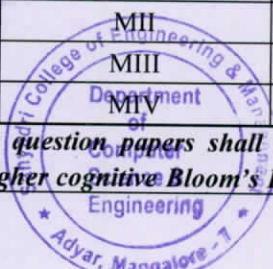
Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

**ASSESSMENT DETAILS**

| Continuous Internal Assessment (CIA) (50%) |      |     |                   | Assignment/<br>Activities<br>(40%) | Semester End Exam (SEE) (50%) |
|--------------------------------------------|------|-----|-------------------|------------------------------------|-------------------------------|
| Continuous Internal Evaluation (CIE) (60%) |      |     |                   |                                    |                               |
| I                                          | II   | III |                   |                                    |                               |
| Syllabus Coverage                          |      |     | Syllabus Coverage | Syllabus Coverage                  |                               |
| 40%                                        | 30%  | 30% | 100%              | 100%                               |                               |
| M1                                         |      |     | MI                | MI                                 |                               |
| MII                                        | MII  |     | MII               | MII                                |                               |
|                                            | MIII |     | MIII              | MIII                               |                               |
|                                            |      | MIV | MIV               | MIV                                |                               |

*Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the*





**assignments.**

**SEE QUESTION PAPER PATTERN:**

1. The question paper will have 7 full question from 4 modules which is divides into Part A & Part B
2. Question number 1 of part A will have any number of sub question covering all the 4 modules totalling to 20 marks.
3. Part A - Question number 2 & 3 will be from module 1 & 2 respectively with a maximum of 3 sub questions and without choice.Each question will carry a maximum of 20 marks.
4. Part B - Question number 4 & 5 will be from module 3 with the maximum of 3 sub questions, the students has to answer any one full question.Each question will carry a maximum of 20 marks.
5. Part B - Question number 6 & 7 will be from module 4 with a maximum of 3 sub questions,the students has to answer any one full question.Each question will carry a maximum of 20 marks.

**TEXT BOOKS:**

1. Biology for Engineers, Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023.
2. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
3. Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
4. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
5. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
6. Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N GeethaA C Udayashankar Lambert Academic Publishing, 2019.
6. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016

**REFERENCE BOOKS:**

1. Biomaterials Science and Tissue Engineering: Principles and Methods, by Bikramjit Basu, Cambridge IISc Series.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):**

1. <https://www.youtube.com/watch?v=96-u9s6D16k>
2. [https://www.youtube.com/watch?v=4\\_emccqgYMs](https://www.youtube.com/watch?v=4_emccqgYMs)
3. [https://onlinecourses.nptel.ac.in/noc22\\_cs56/preview](https://onlinecourses.nptel.ac.in/noc22_cs56/preview)
4. [https://onlinecourses.nptel.ac.in/noc22\\_cs29/preview](https://onlinecourses.nptel.ac.in/noc22_cs29/preview)







**UHV -2: UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT**

**(Effective from the Academic Year 2025 - 2026)**

**IV SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BHU407TK</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 1:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>15L</b>      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Have/Develop the critical analysis of the day today happenings.

**COURSE OBJECTIVES:**

This course will enable students to:

- To make the students to understand, the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- To highlight possible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

**TEACHING - LEARNING STRATEGY:**

These are some sample strategies, which course faculty members can incorporate in the Teaching Learning Process:

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies

**COURSE CONTENTS**

The course is mainly activity-based that will offer a set of activities for the student that enables them to connect with fellow human beings, nature, society, and the world at large. The course will engage student's interactive sessions, open mic, reading groups, storytelling sessions, and semester-long activities conducted by faculty mentors. In the following a set of activities planned for the course have been listed:

**MODULE - I**

**Introduction to Value Education:**

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education). Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to fulfill the Basic Human Aspirations.

**3 Hours**

**MODULE - II**

Computer Science & Engineering

Adyar, Mangalore - 1





|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                   |                                |                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-------------------|
| <b>Harmony in the Human Being:</b><br>Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                   | <b>3 Hours</b>                 |                   |
| <b>MODULE - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                   |                                |                   |
| <b>Harmony in the Family and Society:</b><br>Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.<br><b>Harmony in the Nature/Existence:</b><br>Understanding Harmony in the Nature, Inter-connectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence |                                                                                                                                                                                                                   | <b>5 Hours</b>                 |                   |
| <b>MODULE - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                   |                                |                   |
| <b>Implications of the Holistic Understanding – a Look at Professional Ethics:</b><br>Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.                                                                                                                                                                    |                                                                                                                                                                                                                   | <b>4 Hours</b>                 |                   |
| <b>COURSE OUTCOMES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                   |                                |                   |
| Upon completion of this course, the students will be able to:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                   |                                |                   |
| <b>CO No.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Course Outcome Description</b>                                                                                                                                                                                 | <b>Bloom's Taxonomy Level</b>  |                   |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Understand value education to develop basic human aspirations through a holistic approach.                                                                                                                        | CL3                            |                   |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Relate to the needs of self and body to establish co-existence leading to harmony in the human being.                                                                                                             | CL3                            |                   |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Recognize the importance of trust and respect to promote harmony in the family and society. And realize the existence as coexistence to establish harmony through mutual fulfillment among four orders of nature. | CL3                            |                   |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Recognize the needs for a holistic understanding of human values to develop ethical and professional conduct.                                                                                                     | CL3                            |                   |
| <b>ASSESSMENT STRATEGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                   |                                |                   |
| Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                   |                                |                   |
| <b>Sl. No.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Assessment Description</b>                                                                                                                                                                                     | <b>Weightage (%)</b>           | <b>Max. Marks</b> |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Continuous Internal Assessment (CIA)</b>                                                                                                                                                                       | <b>100 %</b>                   | <b>50</b>         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Continuous Internal Evaluation (CIE)                                                                                                                                                                              | 60 %                           | 30                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Assignments                                                                                                                                                                                                       | 40 %                           | 20                |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Semester End Examination (SEE)</b>                                                                                                                                                                             | <b>100%</b>                    | <b>50</b>         |
| <b>CO - ASSESSMENT MAPPING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                   |                                |                   |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Continuous Internal Assessment (CIA) (50%)</b>                                                                                                                                                                 | <b>Semester End Exam (SEE)</b> |                   |





|     | Continuous Internal Evaluation (CIE) (60%) |      |     | Assignment/ Activities (40%) | (50%)             |
|-----|--------------------------------------------|------|-----|------------------------------|-------------------|
|     | I                                          | II   | III |                              |                   |
|     | Syllabus Coverage                          |      |     | Syllabus Coverage            | Syllabus Coverage |
|     | 40%                                        | 30%  | 30% | 100%                         | 100%              |
| CO1 | MI                                         |      |     | MI                           | MI                |
| CO2 | MII                                        | MII  |     | MII                          | MII               |
| CO3 |                                            | MIII |     | MIII                         | MIII              |
| CO4 |                                            |      | MIV | MIV                          | MIV               |

**Note:** For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.

**SEE QUESTION PAPER PATTERN:**

Theory SEE will be conducted, with common question papers for the subject (**duration 01 hours**)

1. The question paper will have 50 questions. Each question is set for 01 marks.
2. The students have to answer all the questions, selecting one full question from each module

**TEXT BOOKS:**

1. The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1
2. The Teacher's Manual Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Gandhi - Romain Rolland (English)

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):**

1. <https://www.aicteindia.org/sites/default/files/Vol.%20II%20%20AICTE%20UG%20%20Curriculum.>
2. [https://www.youtube.com/channel/UCQxWr5QB\\_eZUnwxSwxXEkQw](https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw)
3. [https://fdp-si.aicte-india.org/8dayUHV\\_download.php](https://fdp-si.aicte-india.org/8dayUHV_download.php)
4. <https://www.youtube.com/watch?v=8ovkLRYXIjE>





**ADDITIONAL MATHEMATICS-II**  
(Effective from the Academic year 2025-2026)  
**IV - SEMESTER**

|                                        |                 |            |         |
|----------------------------------------|-----------------|------------|---------|
| Course Code                            | <b>BMA411NK</b> | CIA Marks  | 50      |
| Number of Contact Hours/Week (L:T:P:S) | 2:0:0:1         | SEE Marks  | 50      |
| Total Hours of Pedagogy                | <b>24L</b>      | Exam Hours | 3 Hours |

**CREDITS – 0**

**COURSE PREREQUISITES:**

- Basics of Differentiation and Integration, Additional Mathematics 1.

**Course Objectives:**

- Enable students to apply numerical techniques for solving engineering problems where analytical solutions are impractical.
- Equip students with the ability to solve systems of linear equations and compute eigenvalues and eigenvectors.
- Understand about differential equations of higher order and Laplace transforms.

**Teaching - Learning Strategy:**

These are some sample strategies, which course faculty members can incorporate in the Teaching Learning Process:

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses

**COURSE CONTENTS**

**MODULE I**

**Numerical Methods:** Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formula, Newton's divided difference and Lagrange's formula (All formulae without proof). Solution of polynomial and transcendental equations-Newton-Raphson and Regula-Falsi methods (only formulae)-illustrative examples.

**Numerical integration:** Simpson's  $(1/3)^{th}$  and  $(3/8)^{th}$  rules, Weddle's rule (without proof)

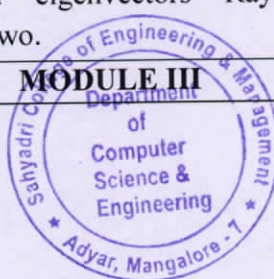
**6 Hours**

**MODULE II**

**Linear Algebra:** Rank of a matrix-echelon form. Solution of the system of linear equations consistency. Gauss-elimination method, Gauss- Jordan method and Approximate solution by Gauss-Seidel method. Eigenvalues and eigenvectors Rayleigh's power method. Diagonalization of a square matrix of order two.

**6 Hours**

**MODULE III**







|                                                                                                                                                                                                                                 |                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Differential Equations of higher-order:</b> - Second order linear ODEs with constant coefficients-Inverse differential operators<br><b>Integral Calculus:</b> Derivation of Reduction formula of $\cos^n x$ and $\sin^n x$ . | <b>6 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|

**MODULE IV**

|                                                                                                                                                                                                                                                                                                                    |                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Laplace Transform:</b> Definition and Laplace transforms of elementary functions (statements only). Laplace transforms of Periodic functions and unit-step function. Properties of Laplace transform.<br><b>Inverse Laplace Transform:</b> Various Techniques of Inverse Laplace Transform, Convolution Theorem | <b>6 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                              | Bloom's Taxonomy Level |
|--------|---------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | To solve numerical methods to obtain value of definite integrals.                                       | CL3                    |
| CO2    | Demonstrate matrix theory to solve system of linear equations and compute Eigenvalues and Eigenvectors. | CL3                    |
| CO3    | Solve higher-order linear differential equations with constant coefficients.                            | CL3                    |
| CO4    | Apply the concepts of Laplace and Inverse Laplace Transforms to solve differential equations.           | CL3                    |

**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

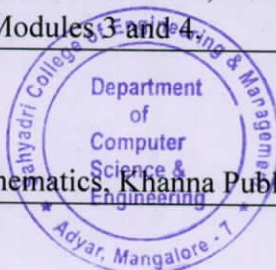
| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.





**SAHYADRI**

COLLEGE OF ENGINEERING & MANAGEMENT  
An Autonomous Institution  
MANGALURU

2. E.Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.
3. C Ray Wylie, Louis C Barrett: "Advanced Engineering Mathematics", 6th Edition,
4. B.V Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill,
5. H.K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics" S.Chand Publication (2014).

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):**

1. <https://www.youtube.com/watch?v=1HDRmEGdb9A>
2. <https://www.youtube.com/watch?v=AQHcZklcltI>
3. <https://www.youtube.com/watch?v=8Kg21jBCm-k>
4. <https://www.youtube.com/watch?v=Wa6kaCwyYRk>
5. [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
6. <http://academicearth.org/>

Chairperson  
Board of Studies (BoS)  
Computer Science & Engineering  
Sahyadri College of Engineering & Management

Dean-Academics

Sahyadri College of Engineering & Management  
An Autonomous Institution  
Mangaluru



Principal

Sahyadri College of Engineering & Management  
An Autonomous Institution  
Mangaluru





**ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**

(Effective from the Academic Year 2026 - 2027)

**V SEMESTER**

|                                           |                  |            |    |
|-------------------------------------------|------------------|------------|----|
| Course Code:                              | <b>BCS501G</b>   | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:2:0          | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L + 20P</b> | Exam Hours | 03 |

**CREDITS – 4**

**COURSE PREREQUISITES:**

- Basics of Mathematical concepts like linear algebra, discrete mathematics, probability and statistics.
- Fundamental knowledge of coding using Python.

**COURSE OBJECTIVES:**

- Understand the historical foundations of AI and its principles in problem-solving, inference, and learning.
- Explore the use of AI techniques in intelligent agents, expert systems, and neural networks.
- Gain practical knowledge of ML based algorithms like supervised, unsupervised, and reinforcement learning algorithms.
- Encourage innovative thinking and problem-solving using AI techniques and promote interdisciplinary applications of machine learning.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

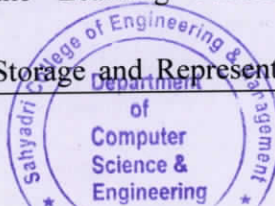
**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Artificial intelligence:</b> AI Problems, What is AI technique Problems, problem spaces and search: Defining the problem as a state space search, Production systems, Problem characteristics, Production system characteristics, Issues in design of search programs, additional problems.<br><b>Heuristic search techniques:</b> Generate and Test, Hill Climbing, Best First Search, Problem Reduction Knowledge representation issues: Representation and Mapping, Approaches to Knowledge Representation | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                                                                  |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to Machine Learning:</b> Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to Other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications.<br><b>Understanding Data:</b> Types of Data, Data Storage and Representation, Data Collection, | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                              |                        |                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------------------------|
| Data Preprocessing, Descriptive Statistics, Univariate Data Analysis and Visualization, Bivariate Data and Multivariate Data, Multivariate Statistics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                              |                        |                        |
| MODULE - III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                              |                        |                        |
| Similarity-based Learning: Introduction to Similarity or Instance-based Learning, Nearest-Neighbor Learning, Weighted K-Nearest-Neighbor Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR).<br>Regression Analysis: Introduction to Regression, Introduction to Linearity, Correlation, and Causation, Introduction to Linear Regression, Validation of Regression Methods, Multiple Linear Regression, Polynomial Regression, Logistic Regression.                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                              |                        | 10 Hours               |
| MODULE - IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                              |                        |                        |
| Decision Tree Learning: Introduction to Decision Tree Learning Model, Decision Tree Induction Algorithms, Validating and Pruning of Decision Trees.<br>Bayesian Learning: Introduction to Probability-based Learning, Fundamentals of Bayes Theorem, Classification Using Bayes Model.<br>Artificial Neural Networks: Introduction, Biological Neurons, Artificial Neurons, Perceptron and Learning Theory, Types of Artificial Neural Networks, Learning in a Multi-Layer Perceptron.<br>Support Vector Machines: Introduction to Support Vector Machines, Optimal Hyperplane, Functional and Geometric Margin, Hard Margin SVM as an Optimization Problem, Soft Margin Support Vector Machines, Introduction to Kernels and Non-Linear SVM, Kernel-based Non-Linear Classifier, Support Vector Regression. |                                                                                                                                                                                                                              |                        | 10 Hours               |
| COURSE OUTCOMES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                              |                        |                        |
| Upon completion of this course, the students will be able to:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                              |                        |                        |
| CO No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Course Outcome Description                                                                                                                                                                                                   | Bloom's Taxonomy Level |                        |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Apply the fundamental concepts of Artificial Intelligence to model and solve problems using state space search, production systems, and heuristic techniques.                                                                | CL3                    |                        |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Demonstrate machine learning workflows by preprocessing and organizing different types of data for effective model development and evaluation.                                                                               | CL3                    |                        |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Implement similarity-based and regression algorithms to develop predictive models and analyze data relationships.                                                                                                            | CL3                    |                        |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Execute decision tree models, neural networks, and Bayesian classifiers to perform classification and pattern recognition tasks.                                                                                             | CL3                    |                        |
| LABORATORY COMPONENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                              |                        |                        |
| Exp. No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Experiment Description                                                                                                                                                                                                       | CO No.                 | Bloom's Taxonomy Level |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | a. Demonstrate a simple Chatbot with minimum 10 conversations.<br>b. Write a program to implement the Tic-Tac-Toe game.                                                                                                      | CO1                    | CL3                    |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | a. Write a program to implement A* Algorithm .<br>b. Write a program to implement AO* Algorithm.                                                                                                                             | CO1                    | CL3                    |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Apply the K-Means clustering algorithm on the Iris dataset stored in a .CSV file by performing data preprocessing, determining the optimal number of clusters using the Elbow Method, and visualizing the clustered results. | CO2                    | CL3                    |





|     |                                                                                                                                                                                                                         |     |     |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
| 4   | Develop a program to demonstrate the working of the K-Nearest Neighbors (KNN) classification algorithm. Use an appropriate dataset to build the model and apply this knowledge to classify a new sample.                | CO3 | CL3 |
| 5   | Develop a program to demonstrate the working of the Linear Regression algorithm. Use an appropriate dataset to build the model and apply this knowledge to predict the output for a given input.                        | CO3 | CL3 |
| 6.  | Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.                      | CO4 | CL3 |
| 7.  | Write a program by using python library to implement Naïve Bayes Algorithm for solving classification problems.                                                                                                         | CO4 | CL3 |
| 8.  | Develop a program to demonstrate the working of the Gibbs Sampling algorithm. Use an appropriate dataset to build the probabilistic model and apply this knowledge to generate samples from the posterior distribution. | CO4 | CL3 |
| 9.  | Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.                                                                                         | CO4 | CL3 |
| 10. | Implement a program to illustrate the working of the Support Vector Machine (SVM) classification algorithm. Employ an appropriate dataset to construct the model and utilize this knowledge to classify a new instance. | CO4 | CL3 |

#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                                     | Weightage (%) | Max. Marks |
|---------|------------------------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b>                | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)                       | 30 %          | 15         |
|         | *Activity Based Assessment (As suggested by the BoS)       | 20 %          | 10         |
|         | Laboratory Continuous Assessment                           | 30 %          | 15         |
|         | Laboratory Test (After the completion of all experiments*) | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>                      | <b>100 %</b>  | <b>50</b>  |

**Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.**

#### SEE QUESTION PAPER PATTERN

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 mark totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from the first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules





**REFERENCE BOOKS:**

1. Elaine Rich, Kevin K and S B Nair, "Artificial Intelligence", 3<sup>rd</sup> Edition, McGraw Hill Education, 2017
2. S Sridhar and M Vijayalakshmi, "Machine Learning", 1<sup>st</sup> Edition, Oxford University Press, 2021.
3. M N Murty and Ananthanarayana V S, "Machine Learning: Theory and Practice", Universities Press (IndiaP), 2024
4. Tom M Mitchell, "Machine Learning", 1<sup>st</sup> Edition, McGraw Hill Education, 2017.
5. Miroslav Kubat, "An Introduction to Machine Learning", 2<sup>nd</sup> Edition, Springer, 2021.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (If Any):**

1. <https://www.youtube.com/watch?v=wnqkfpCpKlg>
2. <https://www.youtube.com/watch?v=t4K6lney7Zw>
3. <https://www.youtube.com/watch?v=VOaoabf3LPM>
4. Web links and Video Lectures (e-Resources):
5. [https://www.drssridhar.com/?page\\_id=1053](https://www.drssridhar.com/?page_id=1053)

**\*Activity Based Assessment (Suggested Activities in Class)/ Practical Based learning**

Course project by taking suitable machine learning-based real-world application problem [10 Marks]







**CLOUD COMPUTING AND SECURITY**  
**(Effective from the Academic Year (2026 - 2027))**  
**V SEMESTER**

|                                           |                  |            |    |
|-------------------------------------------|------------------|------------|----|
| Course Code                               | <b>BCS502G</b>   | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:2:0          | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L + 20P</b> | Exam Hours | 03 |

**CREDITS – 4**

**COURSE PREREQUISITES:**

- Basic understanding of computer architecture, operating systems, and networking concepts.
- Expertise in at least one programming language such as Python, Java, or C++.

**COURSE OBJECTIVES:**

- Provide students with the fundamentals and essentials of Cloud Computing.
- Develop skills to configure and manage cloud resources including virtual machines, storage, and networking.
- Learn and understand different types of Cloud security issues and cloud platforms for storage.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

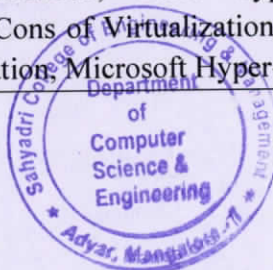
**COURSE CONTENTS**

**MODULE - I**

**Introduction to cloud:** Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments, Distributed Systems, Virtualization, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com,

**Introduction to virtualization:** Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples Xen: Paravirtualization, VMware: Full Virtualization, Microsoft Hyper-V

**10 Hours**







**MODULE – II**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>Cloud Computing Architecture:</b> Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds. Thread Programming, Introducing Parallelism for Single Machine Computation, Programming Applications with <b>Threads:</b> What is a Thread?, Thread APIs, Techniques for Parallel Computation with Threads, Domain Decomposition: Matrix Multiplication, Functional Decomposition: Sine, Cosine, and Tangent. | <b>10<br/>Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|

**MODULE – III**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>Map-Reduce Programming:</b> Data-Intensive Computing?, Characterization Data-Intensive Computations, Challenges Ahead, Historical Perspective, Technologies for Data-Intensive Computing, Storage Systems, Programming Platforms.<br><b>Cloud Security:</b> Security - Basic Components, Security Attacks, Classes of Threats, Policies and Mechanisms, Goals of Security, Trust and Assumptions, Types of Mechanisms, Operational Issues, Assurance, Human Issues, Passive and Active Attacks, Security Services, Role of Security, Types of Attack, Network Security, Security Stack, Privileged User Access, Regulatory Compliance & Audit, Data Location & Data Segregation . | <b>10<br/>Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|

**MODULE – IV**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>Cloud Platforms in Industry:</b> Amazon Web Services, Compute Services, Storage Services, Communication Services, Additional Services, Google AppEngine, Architecture and Core Concepts, Application Lifecycle, Cost Model, Observations, Microsoft Azure, Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance. Cloud Applications Scientific Applications, Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, <b>Biology:</b> Gene Expression Data Analysis for Cancer Diagnosis, Geoscience: Satellite Image Processing, Business and Consumer Applications, CRM and ERP, Productivity, Social Networking, Media Applications, Multiplayer Online Gaming. | <b>10<br/>Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|

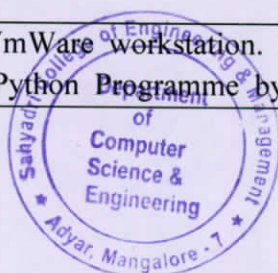
**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| <b>CO No.</b> | <b>Course Outcome Description</b>                                                                                           | <b>Bloom's Taxonomy Level</b> |
|---------------|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| CO1           | Interpret cloud computing, virtualization and classify services of cloud computing                                          | CL3                           |
| CO2           | Illustrate the architecture of cloud computing and apply cloud programming techniques for scalable application development. | CL3                           |
| CO3           | Demonstrate data-intensive computing models like MapReduce for processing large-scale distributed data.                     | CL3                           |
| CO4           | Identify cloud development platforms and apply real-world applications of cloud computing across different domains.         | CL3                           |

**LABORATORY COMPONENTS**

| <b>Exp. No.</b> | <b>Experiment Description</b>                                                                                                 | <b>CO No.</b> | <b>Bloom's Taxonomy Level</b> |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|
| 1.              | Install a Virtual Box, VmWare workstation. Install Guest OS and Execute simple C and Python Programme by using in the virtual | CO1           | CL3                           |







|    |                                                                                                         |     |     |
|----|---------------------------------------------------------------------------------------------------------|-----|-----|
|    | machine                                                                                                 |     |     |
| 2. | Creating EC2 Instances and connecting EC2 Instance leveraging AWS Compute Service                       | CO1 | CL3 |
| 3. | Deploy a Simple Web application on EC2 Instance                                                         | CO2 | CL3 |
| 4. | Create a simple Hello World programme using the apex programming language of salesforce.com             | CO2 | CL3 |
| 5. | Create a mailing service using apex programming language of salesforce.com                              | CO3 | CL3 |
| 6. | Create a bucket and load the objects in the bucket using AWS Storage service.                           | CO3 | CL3 |
| 7. | Set Up Cloud Monitoring with Azure Monitor and Monitor resource usage of a virtual machine.             | CO4 | CL3 |
| 8. | Simulate a Cloud Scenario using Cloud Sim and run a scheduling algorithm does not present in cloud sim. | CO4 | CL3 |
| 9. | Create a bucket and Upload and download a file                                                          | CO4 | CL3 |

#### ASSESSMENT STRATEGY

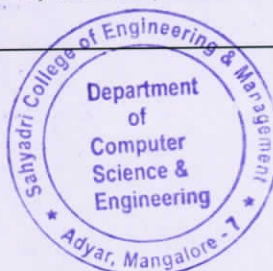
Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                                     | Weightage (%) | Max. Marks |
|---------|------------------------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b>                | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)                       | 30 %          | 15         |
|         | Activity Based Assessment (As suggested by the BoS)        | 20 %          | 10         |
|         | Laboratory Continuous Assessment                           | 30 %          | 15         |
|         | Laboratory Test (After the completion of all experiments*) | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>                      | <b>100 %</b>  | <b>50</b>  |

*Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.*

#### SEE QUESTION PAPER PATTERN

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 mark totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.





**SAHYADRI**

COLLEGE OF ENGINEERING & MANAGEMENT  
An Autonomous Institution  
MANGALURU

**REFERENCE BOOKS:**

1. Mastering Cloud Computing , Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi , 2<sup>nd</sup> Edition, McGraw Hill, 2024.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (If Any):**

1. <https://youtu.be/ZHCtVZ6cjdg?si=UPewlPkmH0susLzm>
2. [https://www.youtube.com/live/QVD\\_72LyCD0?si=4R3L1kKgNd3SQtl-](https://www.youtube.com/live/QVD_72LyCD0?si=4R3L1kKgNd3SQtl-)
3. <https://youtu.be/ZHCtVZ6cjdg?si=eMKLQMX5aYjK29MZ>







**THEORY OF COMPUTATION**  
(Effective from the Academic Year 2026 - 2027)

**V SEMESTER**

|                                           |         |            |    |
|-------------------------------------------|---------|------------|----|
| Course Code                               | BCS503T | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0 | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | 40L     | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Understanding of logic, sets, relations, functions, and proof techniques (like induction).
- Familiarity with formal languages, combinatorics, and number theory. Introduction to Programming (simulating automata).
- Basic knowledge of how algorithms work and how data is stored and accessed.

**COURSE OBJECTIVES:**

- To introduce the fundamental concepts of formal languages, grammars, and automata theory.
- To help students understand and construct finite automata and regular expressions for pattern recognition.
- To analyze the computational power and limitations of different models of computation.
- To apply mathematical reasoning and proof techniques in solving problems related to automata and language theory.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

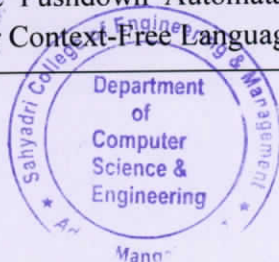
|                                                                                                                                                                                                                                                                        |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Introduction to Finite Automata, Structural Representations, Automata and Complexity. The Central Concepts of Automata Theory. Deterministic Finite Automata, Nondeterministic Finite Automata, An Application: Text Search, Finite Automata with Epsilon-Transitions. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                           |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Regular Expressions, Finite Automata and Regular Expressions, Proving Languages not to be Regular. Closure Properties of Regular Languages, Equivalence and Minimization of Automata, Applications of Regular Expressions | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                                                                                                                                                                    |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Context-Free Grammars, Parse Trees, Ambiguity in Grammars and Languages, Ambiguity in Grammars and Languages, Definition of the Pushdown Automaton, The Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata. Normal Forms for Context-Free Grammars, The Pumping Lemma for Context-Free Languages. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|





**MODULE - IV**

Introduction to Turing Machines: Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines, Extensions to the Basic Turing Machine, Undecidability: A Language That Is Not Recursively Enumerable.

**10  
Hours**

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| <b>CO No.</b> | <b>Course Outcome Description</b>                                                                                                                                                                                                                                 | <b>Bloom's Taxonomy Level</b> |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| CO1           | To equip students with a foundational understanding of formal languages, finite state machines (FSMs), and regular languages, including their design, properties, and practical applications.                                                                     | CL3                           |
| CO2           | To develop the ability to analyze, design, and simplify regular and context-free grammars, understand their relationship with languages, and address concepts like derivations, parse trees, and ambiguity in grammars.                                           | CL3                           |
| CO3           | To understand pushdown automata and their equivalence to context free grammars, explore the limitations of context-free languages through noncontext-free language properties, and analyze decidable and undecidable questions related to context-free languages. | CL3                           |
| CO4           | To understand the fundamentals of Turing machines, their role in modeling computation, the limits of computability, the Church-Turing thesis, complexity classes, and key undecidable problems like the Halting Problem.                                          | CL3                           |

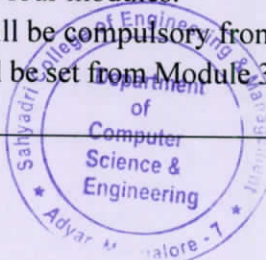
**ASSESSMENT  
STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| <b>Sl. No.</b> | <b>Assessment Description</b>               | <b>Weightage (%)</b> | <b>Max. Marks</b> |
|----------------|---------------------------------------------|----------------------|-------------------|
| 1              | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>         | <b>50</b>         |
|                | Continuous Internal Evaluation (CIE)        | 60 %                 | 30                |
|                | Assignments                                 | 40 %                 | 20                |
| 2              | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>         | <b>50</b>         |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 m totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with ch in respective modules.







- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages and Computation," 3<sup>rd</sup> Edition, Pearson, 2013.
2. Elain Rich, "Automata, Computability and complexity," 1<sup>st</sup> Edition, Pearson Education, 2012.
3. K.L.P Mishra, N Chandrashekar, 3<sup>rd</sup> Edition, "Theory of Computer Science", PHI, 2023.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):**

1. <https://www.coursera.org/learn/engineering-mechanics-statics>
2. <https://www.youtube.com/playlist?list=PLwdnzlV3ogoV7wYUVlSIFnfjCX0L8DAJX>





**DATABASE MANAGEMENT SYSTEM**  
**(Effective from the Academic Year 2026- 2027)**  
**V SEMESTER**

|                                           |                |            |    |
|-------------------------------------------|----------------|------------|----|
| Course Code                               | <b>BCS504T</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0        | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>     | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Understanding of fundamental computer concepts such as algorithms, data structures, and programming basics.
- Familiarity with mathematical concepts like sets, relations, logic, and functions, which are foundational to database theory.
- Proficiency in at least one programming language (e.g., C, C++, Java, or Python) to understand database programming and queries.

**COURSE OBJECTIVES:**

- Introduce fundamental concepts of database systems including data models, database architecture, and database languages.
- Develop skills to design efficient and normalized database schemas using Entity-Relationship (ER) modeling and other design methodologies.
- Learn Structured Query Language (SQL) to create, manipulate, and query databases effectively.
- Get exposure to advanced topics like distributed databases, NoSQL databases, and database security.

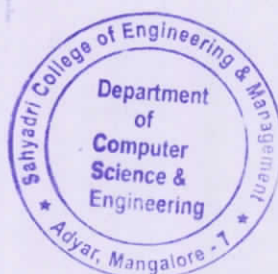
**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**







|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                           |                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------|
| <b>Introduction to Databases:</b> Overview, Characteristics and, Advantages of using the DBMS approach. <b>Database System Concepts and Architecture:</b> Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, Database System environment. <b>Data Modeling Using the Entity-Relationship (ER) Model:</b> Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, Relationship Types of Degree Higher than Two, Examples.<br><b>Relational Database Design by ER-to-Relational Mapping:</b> Relational Database Design using ER-to-Relational mapping. <b>The Relational Data Model and Relational Database Constraints:</b> Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. |                                                                           | <b>10 Hours</b>               |
| <b>MODULE - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                           |                               |
| <b>Basic SQL:</b> SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL. <b>SQL: Advances Queries:</b> More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.<br><b>The Relational Algebra:</b> Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Additional relational operations (aggregate, grouping, etc.), Examples of Queries in relational algebra.                                                                                                                                                                                                                                                                                    |                                                                           | <b>10 Hours</b>               |
| <b>MODULE - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                           |                               |
| <b>Basics of Functional Dependencies and Normalization for Relational Databases:</b> Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form.<br><b>Relational Database Design Algorithms and Further Dependencies:</b> Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design.                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                           | <b>10 Hours</b>               |
| <b>MODULE - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                           |                               |
| <b>Introduction to Transaction Processing Concepts and Theory:</b> Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, characterizing schedules based on recoverability, characterizing schedules based on Serializability, Transaction support in SQL.<br><b>Concurrency Control Techniques:</b> Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering.<br><b>Introduction to NOSQL Databases:</b> Emergence of NOSQL Systems, Characteristics of NOSQL Systems, Categories of NOSQL Systems.                                                                                                                                                                                                                                                                                                              |                                                                           | <b>10 Hours</b>               |
| <b>COURSE OUTCOMES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                           |                               |
| Upon completion of this course, the students will be able to:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                           |                               |
| <b>CO No.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Course Outcome Description</b>                                         | <b>Bloom's Taxonomy Level</b> |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Interpret the fundamental concepts of database technology and demonstrate | CL3                           |







|     |                                                                                                                                                                                                |     |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
|     | conceptual database design using the Entity-Relationship (ER) model and explain the basic principles of the relational model.                                                                  |     |
| CO2 | Illustrate the fundamental concepts of Structured Query Language (SQL) and advanced Structured Query Language in database application development. Examine the concepts of relational algebra. | CL3 |
| CO3 | Apply the functional dependency to measure the appropriateness of attribute groupings into relation schemas and discuss the process of normalization with its algorithms                       | CL3 |
| CO4 | Execute the basic concepts and theory needed for transaction processing, concurrency control in database applications. Discuss the fundamentals of NoSQL data store.                           | CL3 |

**ASSESSMENT  
STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

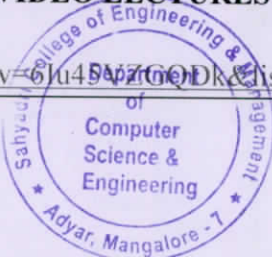
- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 7<sup>th</sup> Edition, Pearson, 2015.
2. Ramakrishnan, and Gehrke, Database management systems, 3<sup>rd</sup> Edition, McGraw Hill, 2003.
3. Silberschatz Korth and Sudharshan, Database System Concepts, 6<sup>th</sup> Edition, Mc-GrawHill, 2010.
4. Coronel, Morris, and Rob, Database Principles Fundamentals of Design, Implementation and Management, 11<sup>th</sup> Edition, Cengage Learning, 2014.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):**

1. [https://www.youtube.com/watch?v=6Ju49A7ZG0k&list=PLBlnK6fEyyqRi\\_CUQ-](https://www.youtube.com/watch?v=6Ju49A7ZG0k&list=PLBlnK6fEyyqRi_CUQ-)







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2. <https://www.youtube.com/watch?v=IoL9Ve2SRwQ&list=PLIwC9bZ0rmjSkm1VRJROX4vP2YMif4Ebh>
3. <https://www.youtube.com/watch?v=OMwgGL3IHil&list=PLBlnK6fEyqRieryTrbKHX1Sh9luYI0dhX>
4. [https://onlinecourses.nptel.ac.in/noc23\\_cs41/preview](https://onlinecourses.nptel.ac.in/noc23_cs41/preview)
5. <http://vlabs.iitkgp.ernet.in/se/4/>





**DATABASE MANAGEMENT SYSTEM LABORATORY**  
**(Effective from the Academic Year 2026 - 2027)**  
**V SEMESTER**

|                                           |                |            |    |
|-------------------------------------------|----------------|------------|----|
| Course Code                               | <b>BCS505L</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0        | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>     | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Understanding of fundamental data structures such as arrays, linked lists, and trees.
- Familiarity with basic programming concepts using languages like C, C++, or Java.

**COURSE OBJECTIVES:**

- To introduce students to SQL and procedural extensions for managing data in relational databases.
- To provide hands-on experience in creating, modifying, and querying databases using DDL, DML, and DCL commands.
- To expose students to database connectivity using front-end tools or programming languages.

**TEACHING - LEARNING STRATEGY:**

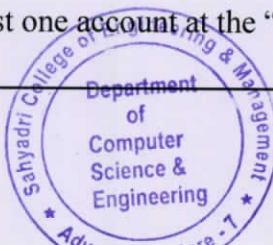
Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**LIST OF EXPERIMENTS**

**Pre-requisite: Introduction to SQL. Demonstrate the Basic Database operations.**

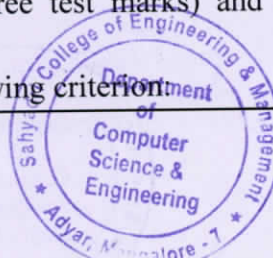
| Exp. No. | Description                                                                                                                                                                                                                                                                                                                                                                                                                                              | CO No. | Bloom's Taxonomy Level |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------|
| 1        | Consider the following schema for Bank Database:<br>BRANCH (bid: varchar, bname:string, branch-name:string, assets:integer)<br>ACCOUNT (accno:int, bid: varchar, acctype: varchar, accbalance:integer, Cid:varchar)<br>CUSTOMER (Cid:varchar, customer-name:string, customer-age:integer, customer-address:string, customer-phone:string)<br>Write SQL queries to,<br>1. Find all the customers who have at least one account at the "Mangaluru" branch. | CO1    | CL3                    |





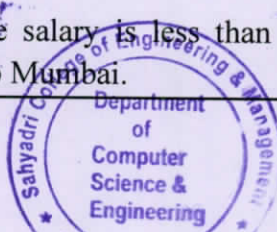


|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     |     |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
|   | <p>2. Find names of the depositors who have deposited highest amount among all the customers.</p> <p>3. Retrieve the Customer name and loan amount of a customer who borrowed a loan more than 5,00,000.</p> <p>4. Retrieve the details of bank branch with maximum and minimum assets among the various branches.</p> <p>Demonstrate how you delete all account tuples at every branch located in a specific city.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |
| 2 | <p>Consider the following schema for a Library Database:</p> <p>BOOK (Book_id:vchar, Title:string, Publisher_Name:string, Pub_Year:integer)</p> <p>BOOK_AUTHORS (Book_id:vchar, Author_Name:string)</p> <p>PUBLISHER (Name:string, Address:string, Phone:integer)</p> <p>BOOK_COPIES (Book_id:vchar, Programme_id:vchar, No-of_Copies:integer)</p> <p>BOOK_LENDING (Book_id:vchar, Programme_id:vchar, Card_No:vchar, Date_Out:date, Due_Date:date)</p> <p>LIBRARY_PROGRAMME (Programme_id:vchar, Programme_Name:string, Address:string)</p> <p>Write SQL queries to</p> <ol style="list-style-type: none"><li>1. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each Programme, etc.</li><li>2. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2025 to Jun 2025.</li><li>3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation.</li><li>4. Partition the BOOK table based on year of publication. Demonstrate its working with a simple query.</li></ol> <p>Create a view of all books and its number of copies that are currently available in the Library</p> | CO1 | CL3 |
| 3 | <p>Consider the schema for College Database:</p> <p>STUDENT (USN, SName, Address, Phone, Gender)</p> <p>SEMSEC (SSID, Sem, Sec)</p> <p>CLASS (USN, SSID)</p> <p>COURSE (Subcode, Title, Sem, Credits)</p> <p>IAMARKS (USN, Subcode, SSID, Test1, Test2, Test3, FinalIA)</p> <p>Write SQL queries to</p> <ol style="list-style-type: none"><li>1. List all the student details studying in fourth semester „C“ section.</li><li>2. Compute the total number of male and female students in each semester and in each section.</li><li>3. Create a view of Test1 marks of student USN “4SF20CD001” in all Courses.</li><li>4. Calculate the FinalIA (average of three test marks) and update the corresponding table for all students.</li><li>5. Categorize students based on the following criterion:</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                           | CO2 | CL3 |





|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
|   | <p>If FinalIA = 45 to 50 then CAT = "Outstanding"<br/>If FinalIA = 40 to 45 then CAT = "Good"<br/>If FinalIA = 30 to 40 then CAT = "Average"<br/>If FinalIA &lt; 30 then CAT = "Weak"</p> <p>Give these details only for 8th semester A, B, and C section students.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |     |     |
| 4 | <p>Consider the schema for Company Database:</p> <p>EMPLOYEE (Eid:vchar, Name:string, Address: string, Gender:string, Salary: integer, SuperEid: varchar, Dno: varchar)</p> <p>DEPARTMENT (Dnum: varchar, Dname: string, DMgr_id:varchar, Mgr_start_date: date)</p> <p>DLOCATION (Dno: varchar, Dlocation:string)</p> <p>PROJECT (Pnum:varchar, Pname: string, Plocation:string, Dno:varchar )</p> <p>WORKS_ON (Eid: varchar, Pno: varchar, Hours: integer)</p> <p>DEPENDENT (Empid: varchar, Dep_name:string, Gender:string, Bdate:date, Relationship:String)</p> <p>Write SQL queries to</p> <ol style="list-style-type: none"><li>1. Make a list of all project numbers for projects that involve an employee whose name is "Rahul", either as a worker or as a manager of the department that controls the project.</li><li>2. Show the resulting salaries if every employee working on the "IoT" project is given a 10 percent raise.</li><li>3. Find the sum of the salaries of all employees of the "Accounts" department, as well as the maximum salary, the minimum salary, and the average salary in this department.</li><li>4. Retrieve the name of each employee who works on all the projects controlled by department number 5 (use NOT EXISTS operator).</li></ol> <p>Create a view Dept_info that gives details of department name, Number of employees and total salary of each department.</p> | CO2 | CL3 |
| 5 | <p>Consider the schema for Airline Database:</p> <p>Flights (fno: varchar, from: string, to: string, distance: integer, departs: time, arrives: time, price: integer)</p> <p>Aircraft (aid: varchar, aname: string, cruisingrange: integer)</p> <p>Certified (eid: varchar, aid: varchar)</p> <p>Employees (eid: varchar, ename: string, salary: integer)</p> <p>Note: The Employees relation describes pilots and other kinds of employees as well; Every pilot is certified for some aircraft, and only pilots are certified to fly.</p> <p>Write SQL queries to</p> <ol style="list-style-type: none"><li>1. Find the names of aircraft such that all pilots certified to operate them have salaries more than Rs. 80,000.</li><li>2. For each pilot who is certified for more than three aircrafts, find the eid and the maximum cruisingrange of the aircraft for which she or he is certified.</li><li>3. Find the names of pilots whose salary is less than the price of the cheapest route from Bengaluru to Mumbai.</li></ol>                                                                                                                                                                                                                                                                                                                                                                            | CO3 | CL3 |







|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
| 4. Find the aids of all aircraft that can be used on routes from Bengaluru to New Delhi.<br>Find the employee name and salary earning second highest salary.                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |     |
| For any societal problem statement selected. <ul style="list-style-type: none"> <li>Make sure that the application should have five or more tables, one trigger and one Stored Procedure.</li> <li>Mobile Applications are strictly prohibited.</li> <li>The mini project team may consist of maximum two members.</li> <li>The areas for problem statement may include, but not limited to the following: <ul style="list-style-type: none"> <li>Educational sector</li> <li>Environmental issues</li> <li>Healthcare</li> <li>Women empowerment</li> <li>Childcare</li> </ul> </li> </ul> Banking sector | CO4 | CL4 |

#### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

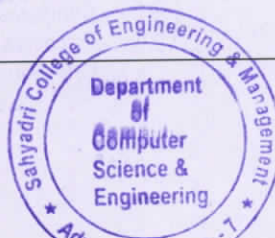
| CO No. | Course Outcome Description                                                                                                                        | Bloom's Taxonomy Level |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Use SQL programming and different concepts of DBMS to create, update and query on the Bank and Library databases                                  | CL3                    |
| CO2    | Demonstrate SQL programming and different concepts of DBMS to create, update and query on the College and Company database.                       | CL3                    |
| CO3    | Illustrate the concepts of SQL programming and DBMS to create, update and query on the Airline database.                                          | CL3                    |
| CO4    | Design, implement and demonstrate a mini project using front end tools and database and compile the working with well document using modern tool. | CL4                    |

#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

**ASSESSMENT STRATEGY:**





- i. In Laboratory Courses where component (C) is a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have 30% weightage (15 Marks) and component (C) will have 20% weightage (10 Marks). In such cases,
  - a) The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
  - b) One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.
  - c) The CIA marks for the laboratory shall be the sum of marks obtained for the component (A), component (B) and component (C).
- ii. The course instructor will design the rubrics for component (C).

#### **SEE QUESTION PAPER PATTERN:**

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

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1. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 7<sup>th</sup> Edition, Pearson, 2015.
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1. [https://www.youtube.com/watch?v=6lu45VZGQDk&list=PLBlnK6fEyqRi\\_CUQ-FXxgzKQ1dwr\\_ZJWZ](https://www.youtube.com/watch?v=6lu45VZGQDk&list=PLBlnK6fEyqRi_CUQ-FXxgzKQ1dwr_ZJWZ)
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3. <https://www.youtube.com/watch?v=OMwgGL3IHII&list=PLBlnK6fEyqRiRyryTrbKHX1Sh9luYI0dhX>
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5. <http://vlabs.iitkgp.ernet.in/se/4/>







**CYBER SECURITY AND SECURE CODING**  
**(Effective from the Academic Year 2026 - 2027)**  
**V SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS506E1</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Basic understanding of networking concepts, protocols (TCP/IP, HTTP), and network security.
- Knowledge of OS concepts like memory management, process control, and file systems.
- Proficiency in writing and debugging code, especially with input/output handling and memory.

**COURSE OBJECTIVES:**

- To introduce fundamental concepts of cybersecurity, including threats, vulnerabilities, and attack vectors.
- To teach secure coding practices that help prevent common software vulnerabilities such as buffer overflows, injection attacks, and race conditions.
- To familiarize students with cryptographic principles and their application in securing communication and data.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

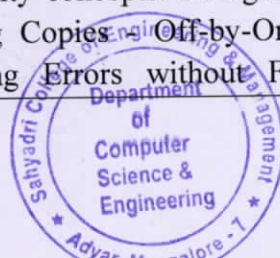
|                                                                                                                                                                                                                                                                            |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to Cybercrime:</b> Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes, An Indian Perspective, Hacking and Indian Laws., Global Perspectives, Types of Cybercrimes | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Tools and Methods used in Cybercrime:</b> Proxy Servers, Anonymizers, Password Cracking, Key Loggers and Spyways, Virus and Worms, Trozen Horses and Backdoors, Steganography, DoS and DDOS Attacks, Attacks on Wireless networks.<br><b>Phishing and Identity Theft:</b> Methods of phishing, techniques, spear phishing, types of phishing scams, phishing toolkits and spy phishing, counter measures, Identity Theft | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                                                                                                |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Running with Scissors:</b> Gauging the threat, Security concepts. Strings: Common String Manipulation errors - Improperly Bounded String Copies - Off-by-One Errors - Null Termination Errors - String Truncation - String Errors without Functions, String | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







vulnerabilities - Buffer Overflow - Process memory organization – Stack management – Stack smashing, Mitigation techniques String handling functions. Concurrency: Multithreading, Parallelism, Performance Goals, Common Errors, Mitigation Strategies, Mitigation pitfalls. File I/O: TOCTOU, Mitigation strategies.

#### MODULE - IV

**Dynamic Memory Management:** C Memory management functions, Common C Memory Management Errors – Initialization Errors - Failing to Check Return Values – Dereferencing Null or Invalid Pointers Referencing Freed Memory - Freeing Memory Multiple Times - Memory Leaks - Zero-Length Allocations, Memory Managers, Doug Lea's Memory Allocator.

**10 Hours**

**Formatted Output:** Variadic Functions, Formatted Output Functions, Stack Randomization, Mitigation Strategies.

#### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                     | Bloom's Taxonomy Level |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Understand the fundamental concepts related to cyber security and laws related to cybercrime.                                                  | CL2                    |
| CO2    | Describe Cyber offenses & Illustrate Tools and Methods used on Cybercrime                                                                      | CL2                    |
| CO3    | Understand the common security threats in software applications and identify/mitigate vulnerabilities stemming from string manipulation errors | CL2                    |
| CO4    | Apply strategies to identify and address vulnerabilities associated with coding.                                                               | CL3                    |

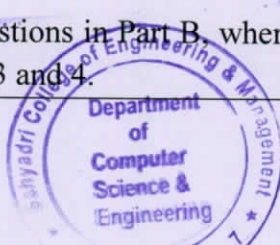
#### ASSESSMENT STRATEGY

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| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |

#### SEE QUESTION PAPER PATTERN:

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 m totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with ch in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.





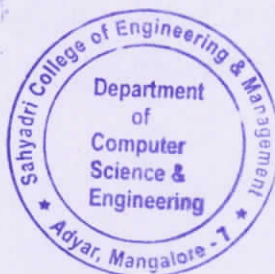


### REFERENCE BOOKS:

1. Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81- 265-21791, 2011, 1<sup>st</sup> Edition (Reprinted 2018)
2. Robert C. Seacord "Secure Coding in C and C++", Addison-Wesley Professional, 2<sup>nd</sup> Edition, 2013.
3. Brian Chess and Jacob West , "Secure Programming with Static Analysis," Addison-Wesley Professional, 1<sup>st</sup> Edition, 2007.
4. Dafydd Stuttard & Marcus Pinto, The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Wiley, 2<sup>nd</sup> Edition, 2011.

### REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):

1. Introduction to Cyber Security available at <http://uou.ac.in/foundation-cou>
2. Fundamentals of Information Security <http://uou.ac.in/progdetail?pid=CEGCS-17>
3. Cyber Security Techniques <http://uou.ac.in/progdetail?pid=CEGCS-17>
4. Cyber Attacks and Counter Measures: User Perspective <http://uou.ac.in/progdetail?pid=CEGCS-17>
5. Information System <http://uou.ac.in/progdetail?pid=CEGCS-17>
6. Secure coding: [nptel.ac.in/securecoding](http://nptel.ac.in/securecoding)





**INTERNET OF THINGS**

(Effective from the Academic Year 2026 - 2027)

**V SEMESTER**

|                                           |          |            |    |
|-------------------------------------------|----------|------------|----|
| Course Code                               | BCS506E2 | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0  | SEE Marks  | 50 |
| Total Hours of Pedagogy:                  | 40L      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Ability to write basic programs and interface with hardware using C/C++ or Python.
- Familiarity with logic gates, circuits, sensors, actuators and embedded systems.
- Basic knowledge of IP addressing, OSI model, and data transmission protocols.

**COURSE OBJECTIVES:**

- To introduce the fundamentals of IoT architecture, components, and communication protocols.
- To develop the ability to interface sensors, actuators, and microcontrollers for real-world applications.
- To understand IoT networking, data transmission, and wireless communication technologies.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

**FUNDAMENTALS OF IoT-** Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

**10  
Hours**

**MODULE - II**

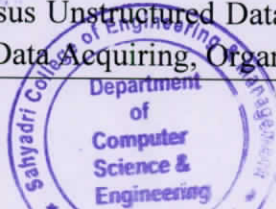
**UNIT II: IoT PROTOCOLS-** IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.11ah and Lora WAN, **Network Layer:** IP versions, Constrained Nodes and Constrained Networks, 6LoWPAN, **Application Transport Methods:** SCADA, Application Layer Protocols: CoAP and MQTT.

**10  
Hours**

**MODULE - III**

**UNIT III: DESIGN AND DEVELOPMENT-** Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board details, **Data Analytics:** Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M

**10  
Hours**







**MODULE - IV**

**IoT Applications:** Healthcare IoT: Introduction & Components of healthcare, Case Studies, IoT, Agriculture IoT: Components of an agricultural IoT, Advantages of IoT in agriculture, Case Studies, **Vehicular IoT:** Architecture of vehicular IoT, Components of vehicular IoT, Advantages of vehicular IoT, Crime assistance in a smart IoT transportation system

**10  
Hours**

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                                      | Bloom's Taxonomy Level |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Describe IoT evolution, enabling technologies, sensors, and actuators.                                                                                                                          | CL2                    |
| CO2    | Demonstrate conceptual understanding of IoT access technologies, network protocols, and application layer protocols including IEEE 802.15.4, 802.11ah, LoRaWAN, 6LoWPAN, SCADA, CoAP, and MQTT. | CL2                    |
| CO3    | Explain the design methodology of IoT systems, embedded components, supported hardware platforms, and basic concepts of IoT data analytics.                                                     | CL2                    |
| CO4    | Interpret the applications of IoT in healthcare, agriculture, and vehicular systems.                                                                                                            | CL2                    |

**ASSESSMENT  
STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

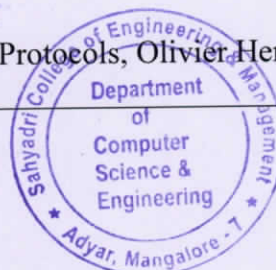
| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks total to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi, Wiley, 2<sup>nd</sup> Edition, 2021.





2. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, Elsevier, 1<sup>st</sup> Edition, 2014.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 1<sup>st</sup> Edition, 2011.
4. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", VPT, 2<sup>nd</sup> Edition, 2016.
5. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 2<sup>nd</sup> Edition, Apress Publications, 2021.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):**

1. [https://onlinecourses.nptel.ac.in/noc22\\_cs53/preview](https://onlinecourses.nptel.ac.in/noc22_cs53/preview)
2. [https://onlinecourses.nptel.ac.in/noc20\\_cs69/preview](https://onlinecourses.nptel.ac.in/noc20_cs69/preview)







**INFORMATION STORAGE  
MANAGEMENT**

**(Effective from the Academic Year 2026 - 2027)**

**V SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS506E3</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Understanding of memory hierarchy, I/O systems, and basic hardware organization.
- Knowledge of file systems, storage devices, and process management.
- Understanding virtualization, on-demand resources, and service models (IaaS/PaaS/SaaS).

**COURSE OBJECTIVES:**

- Develop a solid understanding of the fundamentals of storage systems, including traditional and modern architectures.
- Be able to analyze different data protection methods, including RAID configurations, intelligent storage systems, and their impact on data security and availability.
- Gain hands-on knowledge of networked storage technologies, including NAS, SAN, and IP-SAN, and understand their role in enabling efficient, scalable data storage across enterprises.
- Acquire the necessary skills to design and manage data protection strategies, including backup, replication, and disaster recovery, to ensure the availability and security of critical data.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

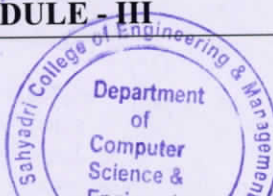
**MODULE - I**

|                                                                                                                                                                                                                                                                                                                      |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to Information Storage and Management:</b> Information Storage, Evolution of Storage Technology and Architecture ,Data Center Infrastructure , Components of a Storage System Environment, Disk drive components, Disk Drive Performance, Logical Components.Key Challenges in Managing Information. | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                 |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Data protection:</b> Concept of RAID and its Components, Different RAID levels and their suitability for different application environments, Comparison of Levels. Intelligent Storage Systems: Components, Intelligent Storage Array, High-level architecture and working of an intelligent storage system. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**







|                                                                                                                                                                                                                                                                                                                                                                                            |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to Networked Storage:</b> Evolution of networked storage, Architecture, Overview of FC-SAN, NAS, and IP-SAN. Network-Attached Storage (NAS): Benefits of NAS, Components, Implementations, File Sharing, I/O operations, Performance and Availability. Content Addressed Storage (CAS): features and Benefits of a CAS, CAS Architecture, Storage and Retrieval, Examples. | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - IV**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Information Availability &amp; Monitoring &amp; Managing Datacenter:</b> Information Availability, Business continuity, Failure Analysis, Business impact Analysis, Disaster Recovery: Backup Purpose, Backup Methods, Local replication Technologies, Remote Replication Technologies, Information Security Framework, Storage security domains, Security Implementations, Monitoring the Storage Infrastructure, Storage Management Activities, Challenges and solutions. | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| <b>CO No.</b> | <b>Course Outcome Description</b>                                                                | <b>Bloom's Taxonomy Level</b> |
|---------------|--------------------------------------------------------------------------------------------------|-------------------------------|
| CO1           | Explain the fundamentals of storage systems, data management, and IT infrastructure components.  | CL2                           |
| CO2           | Describe RAID techniques and virtualization strategies for efficient storage management.         | CL2                           |
| CO3           | Illustrate various storage technologies such as DAS, NAS, SAN, and object-based storage systems. | CL3                           |
| CO4           | Demonstrate the idea of Information Availability, Security, and Disaster Recovery                | CL3                           |

**ASSESSMENT**

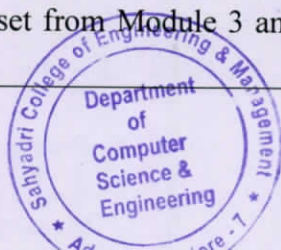
**STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| <b>Sl. No.</b> | <b>Assessment Description</b>               | <b>Weightage (%)</b> | <b>Max. Marks</b> |
|----------------|---------------------------------------------|----------------------|-------------------|
| <b>1</b>       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>          | <b>50</b>         |
|                | Continuous Internal Evaluation (CIE)        | 60 %                 | 30                |
|                | Assignments                                 | 40 %                 | 20                |
| <b>2</b>       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>          | <b>50</b>         |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 m totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, choice in respective modules.





**SAHYADRI**

COLLEGE OF ENGINEERING & MANAGEMENT  
An Autonomous Institution  
MANGALURU

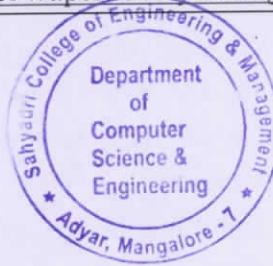
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Somasundaram Gnanasundaram, Alok Shrivastava, Information Storage and Management, 2<sup>nd</sup> Edition, Wiley, 2017.
2. G. Somasundaram & Alok Shrivastava, Information Storage and Management: Storing, Managing, and Protecting Digital Information, 2<sup>nd</sup> Edition, Wiley India, 2009.
3. EMC Education Services, Information Storage and Management: Storing, Managing and Protecting Digital Information in Classic, Virtualized, and Cloud Environments, 2<sup>nd</sup> Edition, Wiley, 2012.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):**

1. <https://download.e-bookshelf.de/download/0000/6294/34/L-G-0000629434-0007576353.pdf>
2. <https://www.youtube.com/playlist?list=PLc9wupcNUcNyrOkHgi-20dHUr3FrcAT2s>





**SOCIAL AND WEB ANALYTICS**

**(Effective from the Academic Year 2026 - 2027)**

**V SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS506E4</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Understanding basic statistical concepts like mean, variance, correlation, and regression.
- Ability to write and run code in Python for data manipulation and analysis.
- Familiarity with collecting, cleaning, and interpreting data.
- Awareness of how social platforms function and are used in society

**COURSE OBJECTIVES:**

- Determine how social and web analytics contribute to understanding user behaviour, online communities, and digital interactions across platforms.
- Analyse the architecture and functionality of social media platforms, including data structures, APIs, and semantic web technologies.
- Illustrate digital interactions and relationships by modelling users, content, and connections as nodes and edges in network graphs.
- Apply network analysis techniques to identify influencers, clusters, and patterns within social and web datasets.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                                               |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Web Intelligence:</b> Thinking and Intelligent Web Applications, The Information Age ,The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web. | <b>10 Hours</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                    |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Semantic Web Applications, Services and Technology:</b> Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents, and Semantic Methods. | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







**MODULE - III**

|                                                                                                                                                                                                                                                                                                                              |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Social Network Analysis and semantic web:</b> What is social Networks analysis, Development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - IV**

|                                                                                                                                                                                                                                                                                                                                              |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Evaluation of web-based social network extraction:</b> Differences between survey methods and electronic data extraction, Context of the empirical study, Data collection, Preparing the data, Optimizing goodness of it, Comparison across methods and networks, Predicting the goodness of it, Evaluation through analysis, Discussion. | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| <b>CO No.</b> | <b>Course Outcome Description</b>                                                                                                                                                         | <b>Bloom's Taxonomy Level</b> |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| CO1           | Understand the principles and evolution of intelligent web applications by exploring semantic web technologies, artificial intelligence, and the architecture of the next-generation web. | CL1                           |
| CO2           | Develop the ability to design and apply semantic web technologies and services, including OWL-S ontologies, semantic search, and intelligent web agents across various domains.           | CL3                           |
| CO3           | Gain the ability to analyze social networks using electronic sources and develop semantic web applications integrated with social networking features.                                    | CL2                           |
| CO4           | Demonstrate the ability to evaluate web-based social network extraction methods by comparing survey and electronic data, optimizing data quality, and analyzing network structures.       | CL3                           |

**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| <b>Sl. No.</b> | <b>Assessment Description</b>               | <b>Weightage (%)</b> | <b>Max. Marks</b> |
|----------------|---------------------------------------------|----------------------|-------------------|
| <b>1</b>       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>          | <b>50</b>         |
|                | Continuous Internal Evaluation (CIE)        | 60 %                 | 30                |
|                | Assignments                                 | 40 %                 | 20                |
| <b>2</b>       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>          | <b>50</b>         |





**SEE QUESTION PAPER PATTERN:**

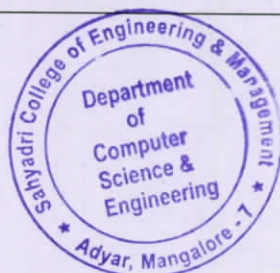
- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from the first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, we will have choices in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Thinking on the Web - Berners Lee, Godel and Turing, Wiley inter science, 1<sup>st</sup> Edition, 2008.
2. Social Networks and the Semantic Web, Peter Mika, Springer, 1<sup>st</sup> Edition, 2007
3. John Scott, "Social Network Analysis", 4<sup>th</sup> Edition, 2014.
4. David Easley and John Kleinberg, "Networks, crowds and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.

**Reference web links and video lectures**

1. <https://www.youtube.com/watch?v=GBf-Lh4qvJU>
2. <https://www.youtube.com/watch?v=vcDdv-EyTwg>
3. <https://www.youtube.com/watch?v=PbmqH6sPboo>







## RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS

(Effective from the Academic Year 2024- 2025)

### SEMESTER – V

|                                           |          |            |    |
|-------------------------------------------|----------|------------|----|
| Course Code                               | BBS508TK | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 1:0:0:0  | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | 16L      | Exam Hours | 03 |

### CREDIT– 1

#### COURSE PREREQUISITES:

- A foundational understanding of research and knowledge of research problem formulation, familiarity with academic ethics, a basic understanding of statistics and data analysis, ability to search and evaluate academic sources, basic writing and communication skills, critical thinking skills, time management skills and awareness of ethical considerations in research.

#### COURSE OBJECTIVES:

- Understand the basic concepts, principles, and types of research methodologies
- Collect, analyze, and interpret data using relevant techniques.
- Ethically conduct research and adhere to academic integrity.
- Communicate research findings effectively through written and oral presentations.
- Understand the intellectual property rights and the types of IPR.

#### TEACHING - LEARNING STRATEGY:

Following are some sample strategies that can be incorporated into the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem-Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

### COURSE CONTENTS

#### MODULE - I

##### Introduction to Research Methodology and Literature Review

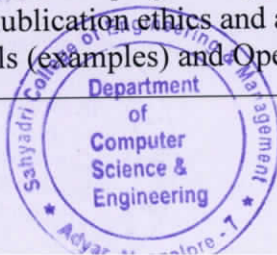
**Introduction to Research Methodology:** Meaning of research, Objectives of research, Types of research, Importance of scientific research in decision making, Defining the research problem, techniques involved in defining a problem. Research Design: Meaning of research design, need for research design, Features of good design.

**Literature Review:** Significance of literature review, Sources for literature: Books, Journals, Proceedings, Thesis and Dissertations. Online databases: Web of Science, Google and Google Scholar. Quality research papers. Research metrics: Citation, Citation Index, Impact Factor, H-index, i10-index, Google index and their significance.

##### Ethics in Research

Ethics with respect to research, ethical principles, the importance of adhering to ethical norms in research, research misconducts, plagiarism, penalties for plagiarism, publication ethics, conflict of interest, publication misconduct, violation of publication ethics and authorships, identification of publication misconduct, complaints and appeals (examples) and Open Access Publishing.

4 Hours







**MODULE – II**

**Data Collection, Analysis and Report Writing**

**Data Collection:** Introduction, collection of primary data: observation method, questionnaires and case study method, collection of secondary data, Selection of an appropriate method for data collection.

**Data Analysis:** Introduction, Data analysis process, Types of data analysis, Methods of data analysis: Qualitative analysis, Quantitative analysis. Tools for data analysis.

**Report Writing:** Effective technical writing, Steps for writing a report, structure of the research report, method of writing a research article (manuscript)/ research report, crafting effective project proposals, Paper writing for National and international journals, submitting papers to journals (Scopus Indexed Journals, Science Citation Indexed journals), preparation of effective slides, pictures, and graphs for presentation.

**4 Hours**

**MODULE - III**

**Intellectual Property Rights, Patents and Industrial Designs:**

**Intellectual Property Rights:** Introduction to intellectual property and intellectual property rights, objectives of IPR, History of IPR in India, Role of WIPO and WTO in IPR establishments, Types of Intellectual property rights.

**Patents:** Introduction to patent, need and importance of a patent, requirements of patent, types of patents, few famous examples of patent, patentable and non-patentable items, Duration, limitations of a patent, the Indian Patent Act-1970, Rights associated with patents, Enforcement of patent rights, Patent infringements. Case Studies on Patents: Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, Case study of Basmati patent

**Industrial Designs:** Design introduction, Features of Design, Design law 2000, Registration of Design, Need for registration of Design, Procedure for registration of Design, Infringement of Design. Famous Case Law: Apple Inc. vs. Samsung Electronics Co.

**4 Hours**

**MODULE - IV**

**Copyrights, Trademarks and Geographical Indications:**

**Copyrights:** Introduction to copyright, characteristics of copyright, copyright-National Vs international, Indian copyright Act-1957, Indian perspective on copyright, Term/duration of copyright, registration of copyright, copyright symbol, procedure of copyright certification, benefits of copyright registration, copyright infringement, limitations of copyright.

**Trademarks:** Introduction to Trademark, signs which may serve as Trademarks, functions of Trademark, Essential features of Trademark, Types of Trademark, the validity of the trademark, Unfair competition, Trademark Act 1999, Infringement of Trademark, Famous case law: Coca-Cola Company vs. Bisleri International Pvt. Ltd.

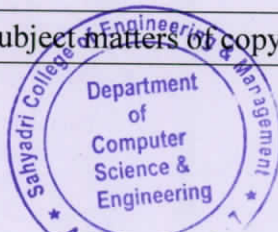
**Geographical Indications:** Introduction to G.I, History of G.I, G.I Act 1999, Registration of G.I, Registration process of G.I, Duration of G.I Tag, Infringement of G.I, Some important G.I Tags.

**4 Hours**

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                    | Bloom's Taxonomy Level |
|--------|-------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Comprehend the process of research methodology to define a research problem.                                                  | CL2                    |
| CO2    | Understand the analytical tools for the analysis and interpretation of data.                                                  | CL2                    |
| CO3    | Illustrate the significance of Intellectual property rights and of research projects for economic growth and social benefits. | CL2                    |
| CO4    | Demonstrate the copyright laws, subject matters of copyrights and Trademarks.                                                 | CL2                    |







### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignment                                  | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### CO - ASSESSMENT MAPPING

| Continuous Internal Assessment (CIA) (50%) |      |     |                   | Semester End Exam (SEE)<br>(50%) |
|--------------------------------------------|------|-----|-------------------|----------------------------------|
| Continuous Internal Evaluation (CIE) (60%) |      |     | Assignment (40%)  |                                  |
| I                                          | II   | III |                   |                                  |
| Syllabus Coverage                          |      |     | Syllabus Coverage |                                  |
| 40%                                        | 30%  | 30% | 100%              | 100%                             |
| 40%                                        | 30%  | 30% | 100%              | 100%                             |
| M1                                         |      |     | MI                | MI                               |
| MII                                        | MII  |     | MII               | MII                              |
|                                            | MIII |     | MIII              | MIII                             |
|                                            |      | MIV | MIV               | MIV                              |

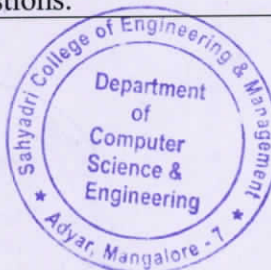
#### NOTE

- Assessment will be both CIA and SEE.
- The assignment of the IPCC shall be for CIE only.
- The Theory component of the IPCC shall be for both CIA and SEE respectively.

*Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.*

#### SEE QUESTION PAPER PATTERN:

1. The question paper will include Multiple Choice Questions (MCQs) from all four modules.
2. There will be a total of 50 questions, each carrying 2 marks.
3. Students are required to attempt all the questions.





**TEXT BOOKS:**

1. Kothari C R and Gaurav Garg, Research Methodology Methods and Techniques, Fourth Edition by, New Age International, 2019.
2. Ranjit Kumar, Research Methodology- A step by step guide for beginners, Pearson Education, Australia, 2005.
3. Pratim Ray, Partha "A Guide to Research and Publication Ethics" First edition, New Delhi Publishers c2022.
4. Deborah E Bouchoux, Intellectual Property Rights by CENGAGE Learning.
5. Rupinder Tewari and Mamta Bhardwa, Intellectual Property A Primer for Academia.

**REFERENCE BOOKS:**

1. David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488-4.
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. Acharya N K, Intellectual Property Rights, Asia Law House 6th Edition. ISBN: 978-93-81849-30-9

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):**

1. <https://nptel.ac.in/courses/106/105/106105077/>
2. <https://youtu.be/oPXyj3mAEKg>
3. <https://youtu.be/E2gGF1rburw>
4. [https://www.youtube.com/watch?v=VzIgPAd0Fs&list=RDCMUCLVol4Vq\\_9CKVYNv4tDZhXw&start\\_radio=1&rv=VzIgPAd0Fs&t=0](https://www.youtube.com/watch?v=VzIgPAd0Fs&list=RDCMUCLVol4Vq_9CKVYNv4tDZhXw&start_radio=1&rv=VzIgPAd0Fs&t=0)

**Assignments:**

1. **Case Study:** Conduct a literature survey on a suitable research topic and prepare a report with a minimum of 10 references that adheres to standard journal specifications.
2. **Case Study:** Download 5 quality research papers published within the last five years from reputed journals on the topic of your choice and provide your analysis and perspective on the chosen topic
3. **Case Study:** Conduct a prior art search using free online databases and prepare a report.







**ENVIRONMENTAL STUDIES**

(Effective from the Academic Year 2024 - 2025)

**V SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BBS509TK</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 1:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>16L</b>      | Exam Hours | 01 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Fundamental knowledge of Ecosystems, Environment Pollution and its effects.

**COURSE OBJECTIVES:**

- To create environmental and sustainability awareness among the students.
- To educate the students to understand the various environmental pollutants, waste management techniques, and the legal framework governing environmental protection.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**COURSE CONTENTS**

**MODULE - I**

**Ecosystem and Sustainability:**

Structure and function of ecosystems in Forest, Desert, Wetlands, River, Oceanic and Lakes. Sustainability: 17 SDGs- History, targets, implementation, Capacity Development. Marine ecosystem and its conservation.

Success stories - best practices related to urban ecosystem conservation, plastic pollution control and sustainable innovations.

**4 Hours**

**MODULE - II**

**Advances in Energy Systems and Sustainable Practices:**

Hydrogen, Solar, OTEC, Tidal, and Wind energy systems: (Merits and Demerits. Global status and applications of renewable energy sources.) Concepts and case studies in disaster management with a focus on technology and data-driven solutions.

**Bioenergy** - Use of biomass, biogas, and biofuels in the context of renewable energy - their environmental impacts, sustainability, and applications.

Case studies on Sustainable mining practices and their environmental impact. Carbon trading, its role in reducing carbon emissions & Green certification.

**4 Hours**

**MODULE - III**

**Environmental Pollution, Global Issues and Waste Management**

**Environmental Pollution and global issues:** Sources, impacts, and control of surface and ground water pollutants. Soil pollutants and their effects on ecosystems. Air pollutants and their consequences on air quality, ozone depletion. Radon and fluoride concentration in drinking water and potential health risks. Environmental toxicology - causes and control measures.

**Waste Management:** Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes;

**4 Hours**





Industrial and Municipal Sludge. Solid waste management: sources, characteristics, health hazards, and disposal methods of E-Waste and Plastic waste.  
Different approaches of recycling and metal recovery from E-Waste. Role of stake holders in environmental management of e-waste (producers, consumers, recyclers, and statutory bodies).  
Strategies for plastic pollution control.

#### MODULE - IV

#### **Environmental Legislation and Sustainable Green Technologies**

**4 Hours**

**Environmental Legislation:** Water Act 1974, Air Act 1981, Environmental Protection Act 1984, Solid Waste Management Rules-2016, E- Waste management Rule - 2022, Biomedical Waste management- 2016 and The Biological Diversity Act, 2002.

#### **Sustainable Green Technologies**

Sustainable agriculture practices and green technologies. Waste-to-Energy Technologies.  
Introduction to circular economy principles and green data centre technologies.

#### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                             | Bloom's Taxonomy Level |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Summarize the role of Engineers in maintaining the ecosystem functionalities and sustainable development in the field of environmental science.                        | CL2                    |
| CO2    | Understand the advances in energy systems and approaches relevant to natural resource management.                                                                      | CL2                    |
| CO3    | Illustrate the sources, impacts & control of environmental pollution and understand the process involved in solid waste management.                                    | CL2                    |
| CO4    | Summarize global environmental challenges and sustainable solutions in relation to environmental legislation, waste management, and biological diversity preservation. | CL2                    |

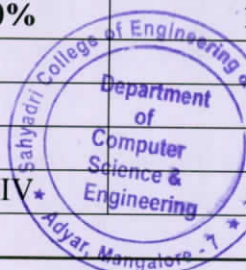
#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Practical Session (Laboratory Component)    | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

#### CO - ASSESSMENT MAPPING

| Continuous Internal Assessment (CIA) (50%) |      |     |                             | Semester End Exam (SEE)<br>(50%) |
|--------------------------------------------|------|-----|-----------------------------|----------------------------------|
| Continuous Internal Evaluation (CIE) (60%) |      |     | Practical Sessions<br>(40%) |                                  |
| I                                          | II   | III |                             |                                  |
| Syllabus Coverage                          |      |     | Syllabus Coverage           |                                  |
| 40%                                        | 30%  | 30% | 100%                        | 100%                             |
| M1                                         |      |     | MI                          | MI                               |
| MII                                        | MII  |     | MII                         | MII                              |
|                                            | MIII |     | MIII                        | MIII                             |
|                                            |      | MIV | MIV                         | MIV                              |







## NOTE

- Assessment will be both CIA and SEE.
- The practical sessions of the IPCC shall be for CIE only.
- The Theory component of the IPCC shall be for both CIA and SEE respectively.
- The questions from the practical sessions shall be included in Theory SEE.

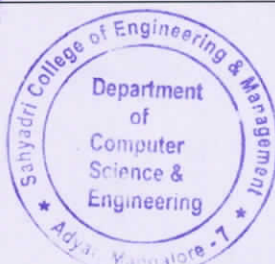
*Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.*

## SEE QUESTION PAPER PATTERN:

- The Question paper will have **FIFTY** multiple choice questions covering the entire four module syllabus.
- Each question may have a maximum of four sub-questions and each question will be for 01 mark.
- Examination will be **ONLINE** and students will have to answer all the questions.
- The Duration of the Exam will be 01 hour.

## Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

**Field work:** Visit to Zero Waste Management Plant / Solid waste management plant/Biogas production plant.



*[Signature]*  
Chairperson

Board of Studies (BoS)  
Computer Science & Engineering  
Sahyadri College of Engineering & Management

*[Signature]*  
Dean-Academics  
Sahyadri College of Engineering & Management  
An Autonomous Institution  
Mangaluru

*[Signature]*  
Principal  
Sahyadri College of Engineering & Management  
An Autonomous Institution  
Mangaluru



**FINANCIAL MANAGEMENT AND TAXATION**

(Effective from the Academic Year 2026 - 2027)

**VI SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BBA601TC</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Understanding the time value of money (e.g., present and future value)
- Ability to interpret data, analyze problems logically, and apply quantitative techniques to decision-making.
- Basic understanding of India Taxation System.
- Basic understanding of Direct Tax and GST
- Familiarity with Excel or any spreadsheet software

**COURSE OBJECTIVES:**

- Understand the basics of financial management and its importance in business.
- Learn to analyze financial statements and evaluate a company's performance.
- Develop skills to calculate and apply the time value of money.
- Tax is an unavoidable part of our life and also plays an important role in functioning of any economy. It typically involves a number of key skills, including legal interpretation and analysis, calculations under different heads of income and providing advice.
- One will gain the expertise to run a business with a proper structure and varied techniques to ensure it is profitable.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

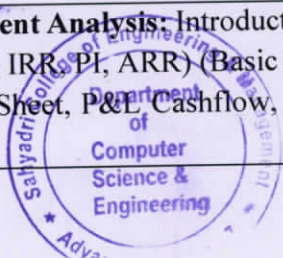
**COURSE CONTENTS**

**MODULE – I**

|                                                                                                                                                                                                                                                                                                                            |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Financial Management Overview and Time Value of Money:</b> Finance Function, Finance Related disciplines, Scope of Financial Management, Emerging Role of Financial management Introduction to Time value of Money, Compounding Technique, Present value and Future Value and its Practical Implication (Basic Problem) | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – II**

|                                                                                                                                                                                                                                                                                              |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Capital Budgeting &amp; Financial Statement Analysis:</b> Introduction, Nature of capital Budgeting, Techniques of Capital budgeting ( NPV, IRR, PI, ARR) (Basic Problems)<br>Financial Statement Analysis: Balance Sheet, P&L, Cashflow, Comparative and Common Size Statement Analysis. | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







**MODULE – III**

|                                                                                                                                                                                        |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to Direct Tax &amp; Deduction under 80:</b> , Deductions under 80C, 80CCD, 80D, 80TTA from Total Income of an Individual and Tax Liability (Old Regime and New Regime) | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – IV**

|                                                                                                                                                                                                                                                                                                                                                      |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Goods &amp; Services Tax &amp; Computation Transaction Value/Value of Taxable Supply:</b><br>Introduction to Good and Services Tax (GST), GST Model, Good and Services Tax Network (GSTN), Exemptions from GST, Meaning and condition for transaction value, inclusive transaction value, and exclusive discount excluded from transaction Value. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                | Bloom's Taxonomy Level |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Understand the core functions and evolving scope of financial management and apply the concepts of the time value of money to basic financial problems.   | CL2                    |
| CO2    | Evaluate long-term investment decisions using capital budgeting techniques and analyze financial statements to assess an organization's financial health. | CL4                    |
| CO3    | Understand the gross and taxable income from salary, incorporating allowances, deductions, and tax regulations under different regimes.                   | CL2                    |
| CO4    | Understand the foundational knowledge of GST, including computation of transaction values and exemptions, for compliance and practical applications.      | CL2                    |

**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

**ASSESSMENT DETAILS**

| Continuous Internal Assessment (CIA) (50%) |      |      | Semester End Exam (SEE) (50%)   |                   |
|--------------------------------------------|------|------|---------------------------------|-------------------|
| Continuous Internal Evaluation (CIE) (60%) |      |      | Assignment/<br>Activities (40%) |                   |
| I                                          | II   | III  |                                 |                   |
| Syllabus Coverage                          |      |      | Syllabus Coverage               | Syllabus Coverage |
| 40%                                        | 30%  | 30%  | 100%                            | 100%              |
| MI                                         |      |      | MI                              | MI                |
| MII                                        | MII  |      | MII                             | MII               |
|                                            | MIII | MIII | MIII                            | MIII              |
|                                            |      | MIV  | MIV                             | MIV               |





**SEE QUESTION PAPER PATTERN:**

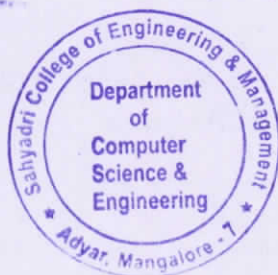
- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Financial Management, Khan M. Y. & Jain P. K., TMH, 8/e
2. Students Handbook on Taxation T N Manoharan- Snow White Publications Pvt. Ltd

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if any):**

1. [https://www.youtube.com/watch?v=gY0MwGLq9W8&list=PLyqSpQzTE6M9DKhN7z2fOpKTJWu-639\\_P](https://www.youtube.com/watch?v=gY0MwGLq9W8&list=PLyqSpQzTE6M9DKhN7z2fOpKTJWu-639_P)
2. <https://www.youtube.com/watch?v=5Y8Lfsreeck&list=PL7DC83C6B3312DF1E>
3. [https://onlinecourses.nptel.ac.in/noc22\\_mg66/preview](https://onlinecourses.nptel.ac.in/noc22_mg66/preview)
4. [https://onlinecourses.swayam2.ac.in/cec21\\_cm02/preview](https://onlinecourses.swayam2.ac.in/cec21_cm02/preview)







**COMPILER DESIGN**

(Effective from the Academic Year 2026 - 2027)

**VI SEMESTER**

|                                           |                  |            |    |
|-------------------------------------------|------------------|------------|----|
| Course Code                               | <b>BCS602G</b>   | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:2:0          | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L + 20P</b> | Exam Hours | 03 |

**CREDITS – 4**

**COURSE PREREQUISITES:**

- Foundation in Formal Languages & Automata Theory provides the theoretical foundation for lexical analysis and parsing. Theory of Computation
- Basics of Computer Organization aids in understanding code generation and low-level optimizations.
- Knowledge of Programming Languages helps understand syntax, semantics, and runtime behavior of programming constructs.

**COURSE OBJECTIVES:**

- Understand the phases of a compiler and their role in translating high-level code to machine code.
- Design lexical analyzers and parsers using formal grammars and finite automata.
- Understand the principles of code generation and target machine architecture.
- Implement syntax-directed translation and semantic analysis techniques.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Activity/Problem Based Learning
- MOOC/NPTEL Courses

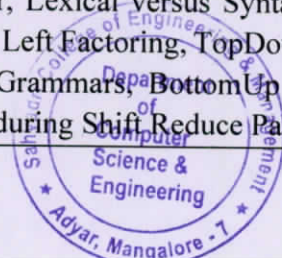
**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                          |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction:</b> Language Processors, The structure of a compiler, The evaluation of programming languages, The science of building a compiler, Applications of compiler technology. | <b>10 Hours</b> |
| <b>Lexical Analysis:</b> The role of lexical analyser, Input buffering, Specifications of token, recognition of tokens.                                                                  |                 |
| <b>Lex and Yacc:</b> Parser-Lexer Communication, Regular Expression, The LEXER, A YACC Parser, YACC – Grammars, Recursive Rules, Shift/Reduce Parsing, What YACC Cannot Parse.           |                 |

**MODULE – II**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Syntax Analysis:</b> Role of parser, Representative Grammars, Syntax Error Handling, Error Recovery Strategies, Context Free Grammars, Derivations, Parse tree and Derivations, Ambiguity, Verifying the Language Generated by a Grammar, Context Free Grammars versus Regular Expressions. Writing a grammar, Lexical versus Syntactic Analysis, Elimination of ambiguity, Elimination of Left Recursion, Left Factoring, TopDown Parsing, Recursive Descent Parsing, FIRST and FOLLOW, LL(1) Grammars, BottomUp Parsing, Reductions, Handle Pruning, Shift Reduce Parsing, Conflicts during Shift Reduce Parsing. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







**MODULE – III**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <p><b>Semantic Analysis:</b> Syntax Directed Definition, Inherited and Synthesized Attributes, Evaluating an SDD at the Nodes of a Parse Tree, Evaluation Order for SDD's, Dependency Graphs, Ordering the Evaluation of Attributes, S-Attributed Definitions, L-Attributed Definitions, Applications of Syntax Directed Translation, Construction of a syntax trees, The Structure of a Type.</p> <p><b>Intermediate Code Generation:</b> Variants of Syntax trees, Directed Acyclic Graphs for Expressions, The Value Number Method for Constructing DAG's, Three Address Code, Translation of Expressions.</p> | <b>10 Hours</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – IV**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <p><b>Code Generation:</b> Issues in the Design of Code, Code Generator, Input to the Code Generator, The Target Program, Instruction Selection, Register Allocation, Evaluation Order, The Target Language, A simple Target Machine Model, Program and Instruction Costs.</p> <p><b>Parallelization:</b> Automatic Parallelization, Optimization for Cache Locality and Vectorization, Domain Specific Languages, Instruction Scheduling and Software Pipelining, Impact of Language Design and Architecture Evaluation on Compilers, Static Single Assignment.</p> | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                   | Bloom's Taxonomy Level |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Analyze the different phases in design of a compiler and demonstrate the Lexical Analysis and Syntax Analysis phases using LEX & YACC tools. | CL3                    |
| CO2    | Apply the parsing techniques for the given programming construct described in context free grammar.                                          | CL3                    |
| CO3    | Show the syntax directed tree, syntax directed definitions and intermediate code representations for the given grammar.                      | CL3                    |
| CO4    | Apply the principles of code generation and parallelization to support high performance compiler design.                                     | CL3                    |

**LABORATORY COMPONENTS**

| Exp. No. | Experiment Description                                                                                                                                                                                                              | CO No. | Bloom's Taxonomy Level |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------|
| 1.       | Develop a LEX program to recognize valid arithmetic expressions. Identifiers in the expression could be only integers and operators could be + and *. Count the identifiers & operators present and print them separately.          | CO1    | CL3                    |
| 2.       | Develop a LEX program to eliminate comment lines in a C program and copy the resulting program into a separate file.                                                                                                                | CO1    | CL3                    |
| 3.       | i) Develop, a YACC program recognize all strings ending with b preceded by n a's using the grammar a n b (note: input n value)<br>ii) Develop a YACC program to evaluate arithmetic expression involving operators: +, -, *, and /. | CO1    | CL3                    |
| 4.       | Develop a YACC program to recognize valid identifiers, operators and keywords in the given text (C program) file.                                                                                                                   | CO1    | CL3                    |
| 5.       | Design, develop and implement YACC/C program to construct Predictive / LL(1) Parsing Table for the grammar rules: $S \rightarrow a(L), L \rightarrow$                                                                               | CO2    | CL3                    |





|     |                                                                                                                                                                                                                                                |     |     |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
|     | $>S L' , L' \rightarrow , S L' \mid \epsilon$ . Use this table to parse the sentence: (a, a)\$                                                                                                                                                 |     |     |
| 6.  | Design, develop and implement YACC/C program to construct Predictive / LL(1) Parsing Table for the grammar rules: $A \rightarrow aBa$ , $B \rightarrow bB \mid \epsilon$ . Use this table to parse the sentence: abba\$                        | CO2 | CL3 |
| 7.  | Design, develop and implement YACC/C program to demonstrate Shift Reduce Parsing technique for the grammar rules: $S \rightarrow (S+S) \mid (S*S) \mid (S-S) \mid (S/S) \mid id$ and parse the sentence: (id - id) * id                        | CO3 | CL3 |
| 8.  | Design, develop and implement YACC/C program to demonstrate Shift Reduce Parsing technique for the grammar rules: $E \rightarrow E+T \mid T$ , $T \rightarrow T * F \mid F$ , $F \rightarrow (E) \mid id$ and parse the sentence: id + id * id | CO3 | CL3 |
| 9.  | Design, develop and implement a C/Java program to generate the machine code using Triples for the statement $A = -B * (C + D)$ whose intermediate code in three-address form: $T1 = -B$ $T2 = C + D$ $T3 = T1 + T2$ $A = T3$                   | CO4 | CL3 |
| 10. | Design, develop and implement a C/Java program to generate the machine code using Triples for the statement $A = B * (-C) + B * (-C)$ .                                                                                                        | CO4 | CL3 |

#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                                     | Weightage (%) | Max. Marks |
|---------|------------------------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b>                | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)                       | 30 %          | 15         |
|         | Activity Based Assessment (As suggested by the BoS)        | 20 %          | 10         |
|         | Laboratory Continuous Assessment                           | 30 %          | 15         |
|         | Laboratory Test (After the completion of all experiments*) | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>                      | <b>100 %</b>  | <b>50</b>  |

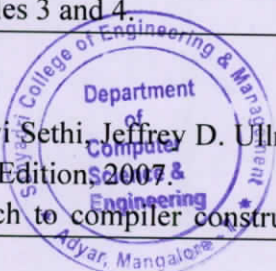
**Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.**

#### SEE QUESTION PAPER PATTERN:

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

#### REFERENCE BOOKS:

1. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers-Principles, Techniques and Tools," Pearson Education, 2<sup>nd</sup> Edition, 2007.
2. Des Watson, "A practical approach to compiler construction", Germany Springer International





Publishing, 2017.

3. Doug Brown, John Levine, Tony Mason, lex & yacc, O'Reilly Media, 2<sup>nd</sup> Edition, October 2012.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (If Any):**

1. <https://archive.nptel.ac.in/courses/106/106/106106237/>
2. <https://www.youtube.com/watch?v=1KZZHxhD4s8>
3. <https://hits.digimat.in/nptel/courses/video/106106237/L20.html>







**DEEP LEARNING**

(Effective from the Academic Year 2026 - 2027)

**VI SEMESTER**

|                                           |         |            |    |
|-------------------------------------------|---------|------------|----|
| Course Code                               | BCS603T | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0 | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | 40L     | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- It is recommended that students have a strong mathematical background (linear algebra, calculus especially taking partial derivatives, and probabilities & statistics)
- An introductory course in Machine Learning, Strong programming skills (specifically Python) are necessary to complete the assignments.

**COURSE OBJECTIVES:**

- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- Elaborate the internal structure of LSTM and GRU and the differences between them
- Describe the Auto Encoders for Image Processing

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

**FOUNDATIONS OF NEURAL NETWORKS AND DEEP LEARNING**

Neural Networks, Training Neural Networks, Activation Functions, Loss Functions, Hyperparameters, Defining Deep Learning: What Is Deep Learning?, Common Architectural Principles of Deep Networks: Parameters, Layers, Activation Functions, Loss Functions, Optimization Algorithms, Hyperparameters, Building Blocks of Deep Networks: RBMs, Autoencoders, Variational Autoencoders

**10 Hours**

**MODULE - II**

**ARCHITECTURES OF DEEP NETWORKS, BUILDING DEEP NETWORKS - 1**

Unsupervised Pretrained Networks, Convolutional Neural Networks (CNNs), Recurrent Neural Networks, Recursive Neural Networks. Matching Deep Networks to the Right Problem, The DL4J Suite of Tools, Basic Concepts of the DL4J API, Modeling CSV Data with Multilayer Perceptron Networks.

**10 Hours**





**MODULE - III**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>BUILDING DEEP NETWORKS – 2, TUNING DEEP NETWORKS – 1</b><br>Modeling Handwritten Images Using CNNs, Modeling Sequence Data by Using Recurrent Neural Networks, Using Autoencoders for Anomaly Detection, Using Variational Autoencoders to Reconstruct MNIST Digits. Basic Concepts in Tuning Deep Networks, Matching Input Data and Network Architectures, Relating Model Goal and Output Layers, Working with Layer Count, Parameter Count, and Memory, Weight Initialization Strategies, Using Activation Functions | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - IV**

|                                                                                                                                                                                                                                                                                                                                                         |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>TUNING DEEP NETWORKS – 2, TUNING DEEP NETWORK ARCHITECTURES</b><br>Applying Loss Functions, Understanding Learning Rates, How Sparsity Affects Learning, Applying Methods of Optimization, Using Parallelization and GPUs for Faster Training. Convolutional Neural Networks (CNNs), Recurrent Neural Networks, Restricted Boltzmann Machines, DBNs. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| <b>CO No.</b> | <b>Course Outcome Description</b>                                                                                                                 | <b>Bloom's Taxonomy Level</b> |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| CO1           | Understand the fundamentals of Neural Networks and Deep Learning                                                                                  | CL2                           |
| CO2           | Implement the Unsupervised algorithms like Convolutional Neural Networks (CNNs), Recurrent Neural Networks, Recursive Neural Networks (RNN).      | CL3                           |
| CO3           | Apply Deep Networks to the Right Problem using the DL4J Suite of Tools by Using Recurrent Neural Networks                                         | CL3                           |
| CO4           | Interpret Tuning of Deep Networks using Activation Functions by applying optimization methods and Implement tuning of Deep Network Architectures. | CL3                           |

**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| <b>Sl. No.</b> | <b>Assessment Description</b>               | <b>Weightage (%)</b> | <b>Max. Marks</b> |
|----------------|---------------------------------------------|----------------------|-------------------|
| <b>1</b>       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>         | <b>50</b>         |
|                | Continuous Internal Evaluation (CIE)        | 60 %                 | 30                |
|                | Assignments                                 | 40 %                 | 20                |
| <b>2</b>       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>         | <b>50</b>         |







**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, 1<sup>st</sup> Edition, 2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress, 1<sup>st</sup> Edition, 2018.
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 1<sup>st</sup> Edition, 2020.
4. Deep Learning with Python, François Chollet, Manning Shelter Island, 2<sup>nd</sup> Edition, 2021.
5. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress, 1<sup>st</sup> Edition, 2017.
6. Neural Networks and Learning Machines, Simon Haykin, Pearson, 3<sup>rd</sup> Edition, 2009

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):**

1. <https://www.youtube.com/watch?v=FbxTVRfQFuI>
2. <https://www.youtube.com/watch?v=uQ764z6twBo>
3. <https://www.youtube.com/watch?v=aircAruvnKk>
4. <https://www.youtube.com/watch?v=KBftoy0DPxI>





**NATURAL LANGUAGE PROCESSING**  
(Effective from the Academic Year 2026 - 2027)  
**VI SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS604E1</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Fundamentals of Automata Theory and Basic knowledge of English Grammar.

**COURSE OBJECTIVES:**

This course will enable students to:

- Define the natural language and analyze the importance of natural language.
- Analyze spelling error detection and correction methods and parsing techniques in NLP.
- Understand the Applications of natural language processing.
- Illustrate the information retrieval models in natural language processing.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporated for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies

**COURSE CONTENTS**

**MODULE – I**

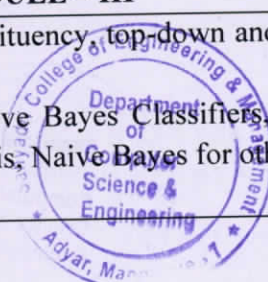
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Overview and language modeling:</b> Introduction to NLP - Various stages of NLP –The Ambiguity of Language: Why NLP Is Difficult-Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure, Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications.<br><b>Text Preprocessing and Morphology:</b> Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis. | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – II**

|                                                                                                                                                                                                                                                                                                                                                                                 |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Language Modeling:</b> Various Grammar- based Language Models, Statistical Language Model- N-gram model- (unigram, bigram), Paninon Framework, Karaka theory, Smoothing Technique.<br><b>Word Level Analysis:</b> Regular Expressions, Finite State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word Classes-Part-of Speech Tagging. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – III**

|                                                                                                                                                                                                                                                                                                                                                   |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Syntactic Analysis:</b> Context-free Grammar, Constituency top-down and bottom-up Parsing, CYK parsing.<br><b>Naive Bayes and Sentiment Classification:</b> Naive Bayes Classifiers, Training the Naive Bayes Classifier, Optimizing for Sentiment Analysis, Naive Bayes for other text classification tasks, Naive Bayes as a Language Model. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







**MODULE – IV**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Information Retrieval and Lexical Resources:</b> Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval- Custer model, Fuzzy model, LSTM model, Major Issues in Information Retrieval. HMM (hidden markov model)<br><b>Lexical Resources:</b> World Net, Frame Net, Stemmers, POS Tagger- Research Corpora.<br><b>Recent Trends:</b> Recent trends in NLP | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                                       | Bloom's Taxonomy Level |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Outline natural language processing and demonstrate the statistical-based language models and smoothing techniques                                                                               | CL2                    |
| CO2    | Apply regular expressions, finite state automata, morphological parsing, spelling error detection and correction, and part-of-speech tagging to tackle various natural language processing tasks | CL3                    |
| CO3    | Demonstrate the use of context-free grammar, and different parsing approaches, Apply the Naïve Bayes classifier and sentiment analysis for Natural language problems and text classifications    | CL3                    |
| CO4    | Illustrate the use of Information Retrieval in the context of NLP                                                                                                                                | CL3                    |

**ASSESSMENT STRATEGY**

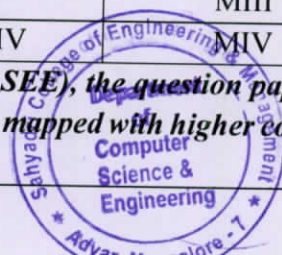
Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

**ASSESSMENT DETAILS**

| Continuous Internal Assessment (CIA) (50%) |      |     | Semester End Exam (SEE) (50%)   |                   |
|--------------------------------------------|------|-----|---------------------------------|-------------------|
| Continuous Internal Evaluation (CIE) (60%) |      |     | Assignment/<br>Activities (40%) |                   |
| I                                          | II   | III |                                 |                   |
| Syllabus Coverage                          |      |     | Syllabus Coverage               | Syllabus Coverage |
| 40%                                        | 30%  | 30% | 100%                            | 100%              |
| MI                                         |      |     | MI                              | MI                |
| MII                                        | MII  |     | MII                             | MII               |
|                                            | MIII |     | MIII                            | MIII              |
|                                            |      | MIV | MIV                             | MIV               |

**Note:** For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.





**SEE QUESTION PAPER PATTERN:**

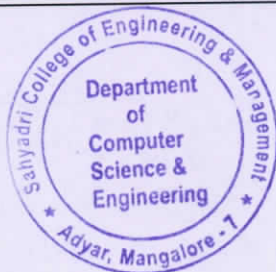
- The question paper will have **TEN** full questions from **FIVE** Modules
- There will be 2 full questions from each module. Every question will carry a maximum of 20 marks.
- Each full question may have a maximum of four sub-questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

**REFERENCE BOOKS:**

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval," Oxford University Press, 1<sup>st</sup> Edition, 2008.
2. D. Jurafsky, J. H. Martin, "Speech and Language Processing, An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition (3e)", Pearson Education, 3<sup>rd</sup> Edition, 2023.
3. Akshay Kulkarni, Adarsha Shivananda, "Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python," Apress, 1<sup>st</sup> Edition, 2019
4. James Allen, "Natural Language Understanding", 2nd edition, Benjamin/Cummings publishing company, 2<sup>nd</sup> Edition, 1995.
5. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer Academic Publishers, 1<sup>st</sup> Edition, 2000

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) :**

1. <https://www.deeplearning.ai/resources/natural-language-processing/>
2. <https://www.coursera.org/in/articles/natural-language-processing>







**FOUNDATIONS OF BLOCKCHAIN TECHNOLOGY**

(Effective from the Academic Year 2026 - 2027)

**VI SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS604E2</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Basics of computer networks, database, cryptography and network security & data structures

**COURSE OBJECTIVES:**

- Understand the Core Concepts of Blockchain Technology
- Develop Knowledge of Blockchain Architecture and Functionality
- Analyze Blockchain Applications and Industry Use Cases
- Gain Practical Insights into Smart Contracts and Decentralized Applications (DApps)

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                                                   |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Introduction to Blockchain Technology: Fundamental concepts, Distributed Ledger Technology (DLT), cryptographic hashes, and consensus mechanisms.<br>Types of blockchains: Public, Private, and Consortium. Smart contracts and Decentralized Applications (DApps). Blockchain Use Cases: Finance, Supply Chain, Healthcare, etc. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                       |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Public-key cryptography and digital signatures. Hashing algorithms Cryptographic principles behind Bitcoin and Ethereum. Security vulnerabilities in blockchain . Wallets: Hot vs Cold, private keys. | <b>10 Hours</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

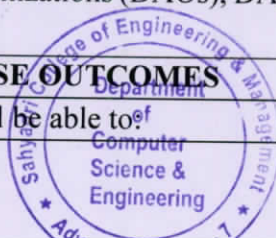
|                                                                                                                                                                                                                                                                        |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Blockchain structure: Blocks, transactions, and chains. Consensus algorithms: Proof of Work (PoW), Proof of Stake (PoS), Delegated PoS, and alternatives. Scalability and performance: Layer 1 vs Layer 2 solutions. Case studies: Bitcoin vs Ethereum vs Hyperledger. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - IV**

|                                                                                                                                                                                                     |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Smart contracts, Examples from Ethereum, Solidity programming basics: Syntax, data types, and deployment. Decentralized Autonomous Organizations (DAOs), DApp case studies: DeFi, NFTs, and beyond. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:





| CO No. | Course Outcome Description                                                                  | Bloom's Taxonomy Level |
|--------|---------------------------------------------------------------------------------------------|------------------------|
| CO1    | Understand the basics and evolution of blockchain and its core components.                  | CL3                    |
| CO2    | Gain insight into the cryptographic backbone and security challenges of blockchain systems. | CL3                    |
| CO3    | Understand blockchain's architecture and evaluate different consensus mechanisms.           | CL3                    |
| CO4    | Develop and deploy smart contracts and DApps on blockchain platforms.                       | CL3                    |

#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

#### SEE QUESTION PAPER PATTERN:

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

#### REFERENCE BOOKS:

1. "Mastering Blockchain", Imran Bashir, Packt Publishing, 4<sup>th</sup> Edition, 2023.
2. Blockchain Technology: Concepts and Applications", Koshik Raj, McGraw Hill Education, 1<sup>st</sup> Edition, 2019.
3. Solidity Programming Essentials", Ritesh Modi, Packt Publishing, 2<sup>nd</sup> Edition, 2022.

#### REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if any):

1. NOC:Blockchain and its Applications
2. Blockchain Tutorial Videos | Edureka







**CRYPTOGRAPHY AND NETWORK SECURITY**

(Effective from the Academic Year 2026 - 2027)

**VI SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS604E3</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Knowledge of mathematical principles, such as linear algebra, number theory, and combinatorics.

**COURSE OBJECTIVES:**

- Illustrate cryptographic techniques essential for ensuring secure communication.
- Demonstrate the principles and applications of Public and Private key cryptography.
- Classify strategies for key management, distribution, and certification in cryptographic systems.
- Outline proficiency in effectively implementing IPsec for secure communication protocols.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Classical Encryption Techniques</b> Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute Force Attack, Substitution Techniques, Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Cipher, One Time Pad. Block Ciphers and the data encryption standard: Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the feistel Cipher structure, the feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example, results, the avalanche effect. Advanced Encryption Standard: AES Structure | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Public-Key Cryptography and RSA:</b> Principles of public-key cryptosystems. Public-key cryptosystems. Applications for public-key cryptosystems, requirements for public-key cryptosystems. public-key cryptanalysis. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA. Other Public-Key Cryptosystems: Diffie-Hellman, Key exchange, The algorithm, key exchange protocols, man in the middle attack, Elgamal Cryptographic systems | <b>10 Hours</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Elliptic curve cryptography,</b> Analog of Diffie-hellman key exchange, Elliptic curve encryption/ decryption, security of Elliptic curve cryptography, Pseudorandom number generation based on an asymmetric cipher, PRNG based on RSA.<br><b>Key Management and Distribution:</b> Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|





|                                                                                                                                                                                                                                                                                                                                                                                                            |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory, public key authority, public keys certificates. |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

**MODULE - IV**

|                                                                                                                                                                                                                                                                                                                                                                                                 |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>X-509 certificates.</b> Certificates, X-509 version 3, public key infrastructure. Kerberos, Motivation, Kerberos version 4, Kerberos version 5, Remote user Authentication using Asymmetric encryption, Mutual Authentication, one way Authentication<br><b>Network EndPoint Security:</b> Firewalls, Intrusion Detection Systems, Malicious Software, Distributed Denial of Service Attacks | <b>10 Hours</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                                                                           | Bloom's Taxonomy Level |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Apply classical and modern encryption techniques, including DES and AES, to design secure cryptographic solutions                                                                                                                    | CL3                    |
| CO2    | Apply public-key cryptographic principles and algorithms, including RSA, Diffie-Hellman, and Elgamal, to secure communication and analyze their computational aspects and vulnerabilities                                            | CL3                    |
| CO3    | Illustrate elliptic curve cryptography, pseudorandom number generators, and advanced key management techniques to implement secure encryption, key exchange, and authentication protocols                                            | CL3                    |
| CO4    | Examine secure authentication protocols, including X.509 certificates, Kerberos, and endpoint security measures like firewalls and intrusion detection systems, to protect against network threats and ensure reliable communication | CL3                    |

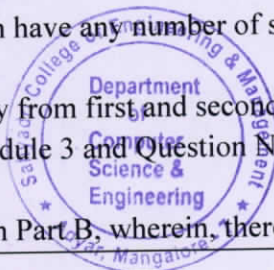
**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
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| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1







and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Cryptography and Network Security, William Stallings, Pearson 8<sup>th</sup> Global edition, 2023.
2. Cryptography and Information Security, V K Pachghare, PHI, 2<sup>nd</sup> Edition, 2019.
3. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory," Pearson, 2<sup>nd</sup> Edition, 2006
4. Modern Cryptography – Theory and Practice, W. Mao, Pearson Education, 1<sup>st</sup> Edition, 2003.
5. Security in computing, Charles P. Pfleeger, Shari Lawrence Pfleeger, – Prentice Hall of India, 5<sup>th</sup> Edition, 2015.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if any):**

1. <https://www.coursera.org/learn/engineering-mechanics-statics>
2. <https://www.youtube.com/playlist?list=PLwdnzlV3ogoV7wYUUVIS1FnjCX0L8DAJX>





**FUNDAMENTALS OF FOG AND EDGE  
COMPUTING**  
(Effective from the Academic Year 2026 - 2027)  
**VI SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS604E4</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |
| <b>CREDITS – 3</b>                        |                 |            |    |

**COURSE PREREQUISITES:**

- Networking basics: Understanding of concepts like IP addresses, DNS, HTTP/HTTPS, and basic protocols.
- Cloud computing fundamentals: Familiarity with cloud infrastructure, virtualization, and cloud service models (IaaS, PaaS, SaaS).

**COURSE OBJECTIVES:**

- Introduce IoT technologies and opportunities.
- Review technologies, challenges, performance metrics and fog computing frameworks.
- Teach sensor data logging and analytics.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE – I**

**Edge Computing and Challenges in Resource Federation**

|                                                                                                                                                                                                                                                                                                                                              |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Introduction - Relevant Technologies- Fog and Edge Computing Completing the Cloud-Hierarchy of Fog and Edge Computing- Business Models –Opportunities and Challenges-Integrated C2F2T Literature by Modeling Technique - Integrated C2F2T Literature by Use - Case Scenarios - Integrated C2F2T Literature by Metrics – Threads – Standards. | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – II**

**Orchestration of Network Slices in Fog, Edge, and Clouds**

|                                                                                                                                                                                                                                                                                                                                                                                                                       |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Cloud Computing, Mobile Edge Computing (MEC), Infrastructure Layer, Network Function and Virtualization Layer, Service and Application Layer, Slicing Management and Orchestration (MANO), Network Slicing in Software-Defined Clouds, Network-Aware Virtual Machines Management, Network-Aware Virtual Machine Migration Planning, Virtual Network Functions Management, Network Slicing Management in Edge and Fog. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – III**

**Middleware for Fog and Edge Computing**

|                                                                                                                                                                                                                                                                 |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Need for Fog and Edge Computing Middleware, Design Goals, State-of-the-Art Middleware Infrastructures, System Model, Proposed Architecture, Middleware, Future Research Directions, Clusters for Lightweight Edge Clouds, Architecture Management – Storage and | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|





Orchestration. Security Management for Edge Cloud Architectures.

**MODULE – IV**  
**Applications and Issues**

**Exploiting Fog Computing in Health Monitoring** -An Architecture of a Health Monitoring IoT-Based System with Fog Computing, System Implementation.  
**Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking**- Human Object Detection, Object Tracking, Lightweight Human Detection.  
**Legal Aspects of Operating IoT Applications in the Fog**- Restrictions of the GDPR Affecting Cloud, Fog, and IoT Applications

**10 Hours**

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                                                                           | Bloom's Taxonomy Level |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Understand fog and edge computing, its hierarchy, business models, challenges, and opportunities. Analyze C2F2T literature through modeling, use cases, metrics, threads, and standards.                                             | CL2                    |
| CO2    | Understand cloud and mobile edge computing, virtualization, network slicing, and VM management in edge and fog environments.                                                                                                         | CL2                    |
| CO3    | Develop knowledge of fog and edge computing middleware, architectures, system models, lightweight edge clouds, and security and storage management for edge environments.                                                            | CL3                    |
| CO4    | Apply fog computing in health monitoring and smart surveillance, focusing on system implementation, real-time object tracking, and lightweight detection while addressing legal aspects like GDPR restrictions for IoT applications. | CL3                    |

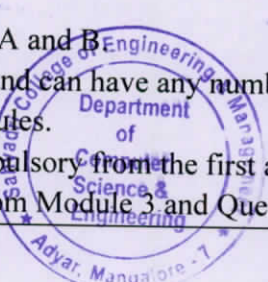
**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                                       | Weightage (%) | Max. Marks |
|---------|--------------------------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b>                  | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)                         | 60 %          | 30         |
|         | Assignments                                                  | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>                        | <b>100 %</b>  | <b>50</b>  |
| 9       | Industry Visit + Report                                      | 50 %          | 10         |
| 10      | NPTEL/MOOC Courses – Registration and Assignment Submissions | 50 %          | 10         |
|         | NPTEL Certification                                          | 75 %          | 15         |
| 11      | Any other Innovative Assignments (CL4 and above)             | 50 %          | 10         |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from the first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with





choice in respective modules.

- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, they will have a choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Buyya, Rajkumar, and Satish Narayana Srirama, Fog and Edge computing: Principles and Paradigms, John Wiley & Sons, USA, 1<sup>st</sup> edition, 2019.
2. Bahga, Arshdeep, and Vijay Madiseti, Cloud computing: A hands-on approach, CreateSpace Independent Publishing Platform, USA, 2<sup>nd</sup> edition, 2014.
3. OvidiuVermesan, Peter Friess, "Internet of Things –From Research and Innovation to Market Deployment," River Publishers, India, 1<sup>st</sup> edition, 2014.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if any):**

1. [https://onlinecourses.nptel.ac.in/noc24\\_cs66/preview](https://onlinecourses.nptel.ac.in/noc24_cs66/preview)
2. [https://onlinecourses.nptel.ac.in/noc23\\_cs65/preview](https://onlinecourses.nptel.ac.in/noc23_cs65/preview)







**INTRODUCTION TO CYBER SECURITY**  
**(Effective from the Academic Year 2026 - 2027)**  
**VI SEMESTER**

|                                           |          |            |    |
|-------------------------------------------|----------|------------|----|
| Course Code                               | BCS605Q1 | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0  | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | 40L      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Basic knowledge of IP addressing, DNS, firewalls, ports, TCP/IP, OSI model.
- Familiarity with at least one programming/scripting language (e.g., Python, Java, or C/C++).
- General understanding of software applications, databases, and how systems interact.

**COURSE OBJECTIVES:**

- To understand fundamental concepts of cyber security, including threats, vulnerabilities, and risks.
- To identify and analyze various types of cyber attacks and malicious activities in digital systems.
- To create awareness of ethical, legal, and societal aspects of cybersecurity.
- To cultivate safe computing practices for individuals and organizations.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                                                     |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to Cybercrime:</b> Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes, An Indian Perspective, Hacking and Indian Laws., Global Perspectives.Types of cyber attacks: passive attacks and active attacks, Laws related to cyber attacks. | <b>10 Hours</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                               |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Tools and Methods used in Cybercrime:</b> Introduction, Proxy Servers, Anonymizers, Phishing, Password Cracking, Key Loggers and Spyways, Virus and Worms, Trozen Horses and backdoors. National and international laws about cyber crime. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                                                                                                                                                        |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Phishing and identity theft:</b> Introduction, Proxy Servers, Anonymizers, Phishing, Password methods of phishing, phishing, phising techniques, spear phishing, types of phishing scams, phishing toolkits and spy phishing, counter measures, Identity Theft:Medical,Criminal,Financial and child identity theft. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - IV**

|                                                                                                                                                                                                                                                                                                   |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Computer Forensics:</b> Introdcution, Historical Background of Cyberforensics, Digital Foresics Science, Need for Computer Foresics, Cyber Forensics and Digital Evidence, Digital Forensic Life cycle, Chain of Custody Concepts, network forensics, Forensic data analysis, Malware analysis | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|





### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                | Bloom's Taxonomy Level |
|--------|---------------------------------------------------------------------------|------------------------|
| CO1    | Explain the cybercrime terminologies                                      | CL2                    |
| CO2    | Describe Cyber offenses & Illustrate Tools and Methods used on Cybercrime | CL2                    |
| CO3    | Interpreting the phishing techniques and counter measures                 | CL3                    |
| CO4    | Implementing and presenting the cyber forensics and network forensics.    | CL3                    |

### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### SEE QUESTION PAPER PATTERN:

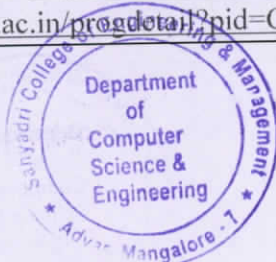
- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

### REFERENCE BOOKS:

- Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, Revised Edition, 2025.

### REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):

1. Introduction to Cyber Security available at <http://uou.ac.in/foundation-course>
2. Fundamentals of Information Security <http://uou.ac.in/progdetail?pid=CEGCS-17>
3. Cyber Security Techniques <http://uou.ac.in/progdetail?pid=CEGCS-17>
4. Cyber Attacks: User Perspective <http://uou.ac.in/progdetail?pid=CEGCS-17>
5. Information System <http://uou.ac.in/progdetail?pid=CEGCS-17>







**INTRODUCTION TO DATA STRUCTURE**  
(Effective from the Academic Year 2026 - 2027)

**VI SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS605Q2</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Familiarity with discrete mathematics, especially logic, sets, and functions.
- Understanding of basic programming constructs: variables, data types, loops, conditionals, functions.

**COURSE OBJECTIVES:**

This course will enable students to:

- Explain the fundamentals of various types of data structures and their applications essential for implementing solutions to problems.
- Illustrate representations and implementations of various linear and nonlinear data structures such as Stack, Queues, linked list, Trees, Graphs and Hashing.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- Any other innovative initiatives with respect to the Course contents

**COURSE CONTENTS**

**MODULE – I**

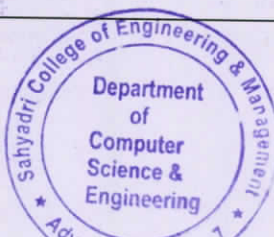
|                                                                                                                                                                                                                              |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Introduction: Classifications, Data structure Operations, Demonstration of Sparse Matrices with arrays, Strings: Operations and Pattern Matching Algorithms. Stack: Concepts and Operations, Array Representation of Stacks. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – II**

|                                                                                                                                                                                                                                                  |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Introduction to Queues and Linked Representation of Queues. Operations on linear queues, Types of Queue: Circular queues, Dequeues, Priority Queues. Linked Lists: Representation of linked lists in Memory, Dynamic Memory allocation functions | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – III**

|                                                                                                                                                                                                                    |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Singly Linked list Operations: Traversing, Searching, Insertion and Deletion, Doubly Linked lists. Trees: Terminologies, Binary Trees, Properties of Binary trees, Array and linked representation of Binary Trees | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|





**MODULE – IV**

|                                                                                                                                                                                                                                                                                             |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Binary Tree Traversals, Binary Search Trees: Definition, Insertion, Deletion. Graphs: Terminologies, Graph representations, Traversal methods: Breadth First Search and Depth First Search. Hashing: Introduction, Hash Table organizations, Hashing Functions, Static and Dynamic Hashing. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                | Bloom's Taxonomy Level |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Demonstrate the fundamental knowledge of various types of data structures.                                                                | CL3                    |
| CO2    | Illustrate the operations such as insertion, deletion and searching on singly linked lists, circular linked lists and doubly linked list. | CL3                    |
| CO3    | Illustrate the concept of linked list and tree data structure                                                                             | CL3                    |
| CO4    | Demonstrate the concepts of tree traversals, graphs and hashing techniques.                                                               | CL3                    |

**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

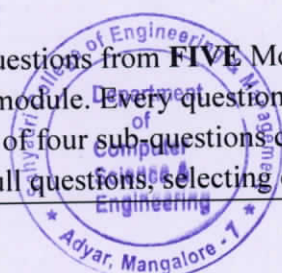
**ASSESSMENT DETAILS**

| Continuous Internal Assessment (CIA) (50%) |      |     | Semester End Exam (SEE) (50%) |                   |
|--------------------------------------------|------|-----|-------------------------------|-------------------|
| Continuous Internal Evaluation (CIE) (60%) |      |     | Assignment/ Activities (40%)  |                   |
| I                                          | II   | III |                               |                   |
| Syllabus Coverage                          |      |     | Syllabus Coverage             | Syllabus Coverage |
| 40%                                        | 30%  | 30% | 100%                          | 100%              |
| MI                                         |      |     | MI                            | MI                |
| MII                                        | MII  |     | MII                           | MII               |
|                                            | MIII |     | MIII                          | MIII              |
|                                            |      | MIV | MIV                           | MIV               |

*Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.*

**SEE QUESTION PAPER PATTERN:**

- The question paper will have **TEN** full questions from **FIVE** Modules
- There will be 2 full questions from each module. Every question will carry a maximum of 20 marks.
- Each full question may have a maximum of four sub-questions covering all the topics under a module.
- The students will have to answer **FIVE** full questions, selecting one full question from each module.







**REFERENCE BOOKS:**

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2<sup>nd</sup> Ed, Universities Press, 2008.
2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised Edition, McGraw Hill, 2017.
3. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2<sup>nd</sup> Ed, Cengage Learning, 2019.
4. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2<sup>nd</sup> Ed, McGraw Hill, 2013
5. A M Tenenbaum, Data Structures using C, PHI, 1989.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):**

1. <https://www.udemy.com/topic/data-structures/>
2. <https://www.youtube.com/watch?v=O9v10jQkm5c>
3. <https://www.youtube.com/watch?v=-D5u5HJbISc&list=PLqleLpAMfxGAf5rrWdm92WMK3-gsrXgz>





**INTRODUCTION TO JAVA  
PROGRAMMING  
(Effective from the Academic Year 2026 - 2027)  
VI SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS605Q3</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Fundamental of programming concepts
- Object-Oriented Programming (OOP) Fundamentals.
- Mathematics for Computing

**COURSE OBJECTIVES:**

- Learn fundamental features of object oriented language and JAVA.
- Set up Java JDK environment to create, debug and run simple Java programs.
- Learn object oriented concepts using programming examples.
- Study the concepts of importing of packages and exception handling mechanism.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses

**COURSE CONTENTS**

**MODULE - I**

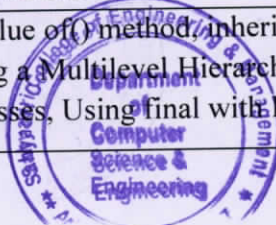
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>An Overview of Java:</b> Object-Oriented Programming, A Simple Program, Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries, Data Types, Variables, and Arrays, Literals, Type Conversion and Casting, Automatic Type Promotion in Expressions, Operators: Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Selection Statements, Iteration Statements, Jump Statements. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                      |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introducing Classes:</b> Class Fundamentals, Declaring Objects, Introducing Methods, Constructors, The this Keyword, Garbage Collection, The finalize( ) Method, A Stack Class, Overloading Methods, Using Objects as Parameters, Recursion, Introducing Access Control, Understanding static, Introducing final. | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                                                                                                                |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Enumerations :</b> Fundamentals, values() and value of() method, inherit enum, example.<br><b>Inheritance:</b> Inheritance, Using super, Creating a Multilevel Hierarchy, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance. | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







**MODULE - IV**

**Packages and Interfaces:** Packages, Access Protection, Importing Packages, Interfaces, Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Using Exceptions.

**10 Hours**

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                            | Bloom's Taxonomy Level |
|--------|---------------------------------------------------------------------------------------|------------------------|
| CO1    | Describe the fundamental features of java as an object oriented programming language. | CL2                    |
| CO2    | Apply and execute simple java programs using basic operators and control statements.  | CL3                    |
| CO3    | Develop re-usable programs for real-world applications involving inheritance          | CL3                    |
| CO4    | Use packages, interfaces and write exception free application programs.               | CL3                    |

**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

*Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.*

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Herbert Schildt, Java The Complete Reference, 12<sup>th</sup> Edition, Tata McGraw Hill, 2024.
2. Cay S Horstmann, "Core Java - Vol. 1 Fundamentals", Pearson Education, 12<sup>th</sup> Edition, 2023.
3. Raoul-Gabriel Urma, Mario Fusco, Alan Mycroft, "Java 8 in Action", Dreamtech Press/Manning

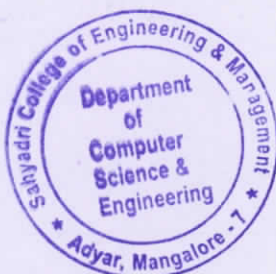


**SAHYADRI**  
COLLEGE OF ENGINEERING & MANAGEMENT  
An Autonomous Institution  
MANGALURU

Press, 1<sup>st</sup> Edition, 2014.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):**

1. <https://nptel.ac.in/courses/106105191>
2. [https://onlinecourses.nptel.ac.in/noc22\\_cs47/preview](https://onlinecourses.nptel.ac.in/noc22_cs47/preview)







**FUNDAMENTALS OF WEB TECHNOLOGY**  
**(Effective from the Academic Year 2026 - 2027)**  
**VI SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS605Q4</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Programming Fundamentals
- Basic Understanding of Networking
- Problem-Solving Skills

**COURSE OBJECTIVES:**

- Learn the fundamentals of web pages using HTML syntax and semantics.
- Practice visually format forms using HTML and CSS.
- Study Client-Side Scripts using JavaScript to generate and display the contents dynamically.
- Comprehend fully functional dynamic web applications using the concepts of PHP, MySQL.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                                  |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to HTML:</b> Introduction to HTML, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                                                     |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Cascade Style Sheet:</b> Introduction to CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.<br><b>Advanced CSS:</b> Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                                      |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>JavaScript:</b> Client-Side Scripting, JavaScript Design Principles, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms, JavaScript programs on Event Handling | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - IV**

|                                                                                                                                                                                                                                              |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Working with Databases:</b> Databases and Web Development, SQL, Database APIs, Managing a MYSQL Database, Accessing MySQL in PHP, Building a application to connect front end to back end: Hospital Management System using PHP and MySQL | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|



### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                   | Bloom's Taxonomy Level |
|--------|----------------------------------------------------------------------------------------------|------------------------|
| CO1    | Develop web pages using HTML syntax and semantics.                                           | CL3                    |
| CO2    | Construct and visually format forms using HTML and CSS.                                      | CL3                    |
| CO3    | Build Client-Side Scripts using JavaScript to generate and display the contents dynamically. | CL3                    |
| CO4    | Apply fully functional dynamic web applications using the concepts of MySQL.                 | CL3                    |

### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Practical Session (Laboratory Component)    | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

#### NOTE:

- Assessment will be both CIA and SEE.
- The questions from the practical sessions shall be included in Theory SEE.

*Note: For Examinations (both CIE and SEE), the question papers shall contain the questions mapped to the appropriate Bloom's Level. Any COs mapped with higher cognitive Bloom's Level may also be assessed through the assignments.*

#### SEE QUESTION PAPER PATTERN:

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

#### REFERENCE BOOKS:

- Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", Pearson Education India, 3<sup>rd</sup> Edition, 2022.
- Robin Nixon, "Learning PHP, MySQL & JavaScript with jQuery, CSS and HTML5", O'Reilly Publications, 7<sup>th</sup> Edition, 2025.
- Luke Welling, Laura Thomson, "PHP and MySQL Web Development", Pearson Education, 5<sup>th</sup> Edition, 2016
- Nicholas C Zakas, "Professional JavaScript for Web Developers", Wrox/Wiley India, 3<sup>rd</sup> Edition, 2012.







5. David Sawyer Mcfarland, "JavaScript & jQuery: The Missing Manual," O'Reilly/Shroff Publishers & Distributors Pvt Ltd, 3<sup>rd</sup> Edition, 2014.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES):**

1. [https://onlinecourses.nptel.ac.in/noc22\\_cs93/unit?unit=17&lesson=18](https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=17&lesson=18)
2. [https://onlinecourses.nptel.ac.in/noc22\\_cs93/unit?unit=26&lesson=27](https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=26&lesson=27)
3. [https://onlinecourses.nptel.ac.in/noc22\\_cs93/unit?unit=43&lesson=44](https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=43&lesson=44)
4. [https://onlinecourses.nptel.ac.in/noc22\\_cs93/unit?unit=52&lesson=53](https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=52&lesson=53)
5. [https://onlinecourses.nptel.ac.in/noc22\\_cs93/unit?unit=75&lesson=76](https://onlinecourses.nptel.ac.in/noc22_cs93/unit?unit=75&lesson=76)





**DEEP LEARNING LABORATORY**  
**(Effective from the Academic Year 2026 - 2027)**  
**VI SEMESTER**

|                                           |                |            |    |
|-------------------------------------------|----------------|------------|----|
| Course Code                               | <b>BCS607L</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0        | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>     | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Basic Knowledge of programming language like Python.

**COURSE OBJECTIVES:**

- Design, analyze, and implement various algorithms in Python.
- Make use of different algorithmic design techniques to solve problems.
- Analyze and contrast the effectiveness of various algorithms.

**TEACHING - LEARNING STRATEGY:**

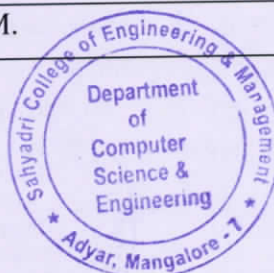
Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**LIST OF EXPERIMENTS**

**Design, develop, and implement the specified algorithms using Python Programming under LINUX/Windows environment.**

| Exp. No. | Description                                                                                     |
|----------|-------------------------------------------------------------------------------------------------|
| 1        | Solving XOR problem using Multilayer perceptron                                                 |
| 2        | Implement character and Digit Recognition using ANN.                                            |
| 3        | Implement the analysis of X-ray image using autoencoders                                        |
| 4        | Implement Speech Recognition using NLP .                                                        |
| 5        | Develop a code to design object detection and classification for traffic analysis using CNN     |
| 6        | Implement online fraud detection of share market data using any one of the data analytics tools |
| 7        | Implement image augmentation using deep RBM.                                                    |
| 8        | Implement Sentiment Analysis using LSTM.                                                        |







### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                           | Bloom's Taxonomy Level |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | To comprehend and apply various neural network architectures such as multilayer perceptrons, ANNs, CNNs, and LSTMs to solve complex problems.                        | CL3                    |
| CO2    | To analyze and interpret complex data using advanced techniques such as autoencoders for X-ray image analysis and NLP for speech recognition.                        | CL4                    |
| CO3    | To design and develop sophisticated machine learning models using data analytics tools, including object detection, classification systems for traffic analysis etc. | CL3                    |
| CO4    | To implement data augmentation techniques to enhance their ability to improve the quality and diversity of training datasets.                                        | CL3                    |

### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### ASSESSMENT STRATEGY:

- I. In Laboratory Courses where (B) and (C) are not the components of the assessment pattern, then (A) will have 100% weightage (50 Marks).

**Assessment Mode:** Weekly Assessment of Laboratory Work (50 Marks) - the marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment, each of 25 marks) of the students in each laboratory session. The average of all the marks obtained across the sessions will be the Final CIA marks.

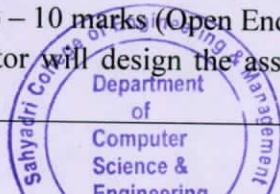
- II. In Laboratory Courses where (C) is not a component of the assessment pattern, then (A) will have 50% weightage (25 Marks), and (B) will have 50% weightage (25 Marks).

**Assessment Mode:** The marks will be awarded based on the Continuous Internal Assessment (Weekly Assessment) (A) and One Laboratory Test (B).

- In Weekly Assessment, the student will be evaluated in each laboratory session for 25 marks. The average marks obtained across all the experiments will be the marks obtained for (A).
  - A Laboratory Test, similar to the SEE exam, is conducted towards the end of the Semester/Course, whichever is earlier. The obtained marks are scaled down to 25 Marks (B)
- The Sum of marks obtained across (A) and (B) will be the Final CIA marks.

- III. In Laboratory Courses where (C) is a component of the assessment pattern, then assessment will be done by considering the weightages given above, i.e. (A) – 25 Marks (Weekly Assessment), (B) – 15 Marks (Laboratory Examination), (C) – 10 marks (Open Ended Experiments/Mini Projects)

- The respective course instructor will design the assessment criteria for the said assessment components.





- The assessment components will be made known to the students by the respective Course Coordinators prior to the commencement of the Laboratory Work.

In all the cases, the assessments will be done based on the criteria designed by the Course Coordinator.

**SEE QUESTION PAPER PATTERN:**

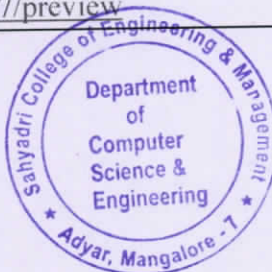
- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

**REFERENCE BOOKS:**

1. Wani, M.A., Raj, B., Luo, F., Dou, D. (Eds.), "Deep Learning Applications", Volume 3, Springer Publications, 1<sup>st</sup> Edition, 2022.
2. Stone, James. (2019), " Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning", Sebtel Press, United States, 1<sup>st</sup> Edition, 2019

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):**

1. <https://nptel.ac.in/courses/106105191>
2. [https://onlinecourses.nptel.ac.in/noc22\\_cs47/preview](https://onlinecourses.nptel.ac.in/noc22_cs47/preview)







**MONGODB**

**(Effective from the Academic Year 2026 - 2027)**

**VI SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS608A1</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Fundamentals of Database management systems concepts.
- Knowledge of Structure Query Language or equivalent.

**COURSE OBJECTIVES:**

- Demonstrate a solid understanding of MongoDB fundamentals, including its NoSQL architecture, key features
- Understand basic MongoDB functions, operators and types of operations in MongoDB.
- Demonstrate the use of Indexing, Advanced Indexing in MongoDB.
- Apply the aggregation and Map Reduction in MongoDB.

**TEACHING - LEARNING STRATEGY:**

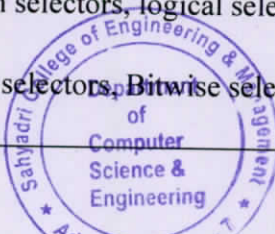
Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**LIST OF EXPERIMENTS**

**Design, develop, and implement the specified algorithms using Python Programming under LINUX/Windows environment.**

| Exp. No. | Description                                                                                                                                                                                                                                       |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | a. Demonstrate how to create database in MongoDB. Execute the document manipulation operations in MongoDB: Insert, Update, Delete and Projection, and drop database in MongoDB.<br>b. Illustrate the where clause, AND, OR operations in MongoDB. |
| 2        | a. Develop a MongoDB query to select certain fields and ignore some fields of the documents from any collection.<br>b. Develop a MongoDB query to display the first 5 documents from the results obtained in 2a. [use of limit and find]          |
| 3        | a. Execute query selectors (comparison selectors, logical selectors) and list out the results on any collection<br>b. Execute query selectors (Geospatial selectors, Bitwise selectors) and list out the results on any collection                |







|    |                                                                                                                                                                                                                                                                                                                   |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4  | Create and demonstrate how projection operators (\$, \$elemmatch and \$slice) would be used in the MongoDB.                                                                                                                                                                                                       |
| 5  | Execute Aggregation operations (\$avg, \$min, \$max, \$push, \$addToSet etc.). students encourage to execute several queries to demonstrate various aggregation operators)                                                                                                                                        |
| 6  | Execute Aggregation Pipeline and its operations (pipeline must contain \$match, \$group, \$sort, \$project, \$skip etc. students encourage to execute several queries to demonstrate various aggregation operators)                                                                                               |
| 7  | a. Find all listings with listing_url, name, address, host_picture_url in the listings and Reviews collection that have a host with a picture url<br>b. Using E-commerce collection write a query to display reviews summary.                                                                                     |
| 8  | a. Develop a query using full-text search to find documents that contain the exact phrase "smart watch" but exclude documents that mention "refurbished".<br>b. Create a compound MongoDB query to search for documents that match a full-text search and also satisfy an additional filter (e.g., price < 1000). |
| 9  | a. Develop a query to implement Text search using catalog data collection for a given word.<br>b. Develop queries to illustrate excluding documents with certain words and phrases.                                                                                                                               |
| 10 | a. Demonstrate creation of different types of indexes on collection (unique, sparse, compound and multi-key indexes)<br>b. Demonstrate optimization of queries using indexes.                                                                                                                                     |

#### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                            | Bloom's Taxonomy Level |
|--------|-----------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Demonstrate MongoDB fundamentals, data manipulation operations, creating and dropping databases and collections.      | CL3                    |
| CO2    | Illustrate the use of collections with specific options, and perform data projection and filtering based on criteria. | CL3                    |
| CO3    | Develop aggregate pipelines to demonstrate the ability to enhance data retrieval.                                     | CL3                    |
| CO4    | Demonstrate optimization of queries by creating indexes.                                                              | CL3                    |

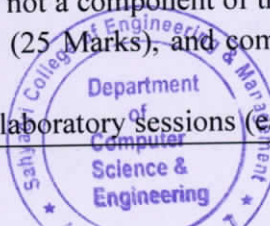
#### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

#### ASSESSMENT STRATEGY:

- In Laboratory Courses where component (C) is not a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have 50% weightage (25 Marks). In such cases,
  - The average marks obtained across all the laboratory sessions (each laboratory session







shall be evaluated for 25 marks) shall be the marks for component (A).

- b) One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.
- c) The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) and component (B).

ii. The course instructor will design the rubrics for component (C).

**SEE QUESTION PAPER PATTERN:**

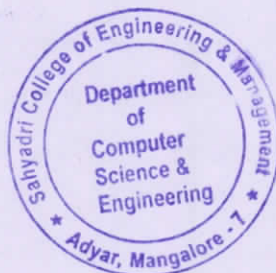
- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

**REFERENCE BOOKS:**

1. "MongoDB: The Definitive Guide", Kristina chodorow, O'REILLY, 2<sup>nd</sup> Edition, 2013.
2. "MongoDB in Action" by KYLE BANKER et. al., Manning publication, 2<sup>nd</sup> Edition, 2016
3. "MongoDB Complete Guide" by Manu Sharma, bpb publication, 1<sup>st</sup> Edition, 2023.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):**

1. Installation of MongoDB Video: <https://www.youtube.com/watch?v=dEm2AS5amyA>
2. Video on Aggregation: <https://www.youtube.com/watch?v=vx1C8EyTa7Y>
3. MongoDB in action book Code download URL: <https://www.manning.com/downloads/529>
4. MongoDB Exercise URL: <https://www.w3resource.com/mongodb-exercises/>





**VULNERABILITY ANALYSIS AND PENETRATION TESTING**

**(Effective from the Academic Year 2026 - 2027)**

**VI SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS608A2</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Knowledge and understanding of networking concepts
- Foundation basics of TCP/IP, DNS, and HTTP/HTTPS protocols.

**COURSE OBJECTIVES:**

- Understand the principles, methodologies, and phases of penetration testing, including reconnaissance, exploitation, and post-exploitation.
- To perform practical testing on real-world systems, including web servers, network infrastructures, and wireless networks, to evaluate their security posture.

**TEACHING - LEARNING STRATEGY:**

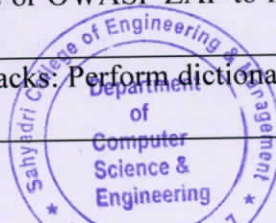
Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**LIST OF EXPERIMENTS**

**Design, develop, and implement the specified algorithms using Python Programming under LINUX/Windows environment.**

| Exp. No. | Description                                                                                                                                                               |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | Introduction to Penetration Testing and Vulnerability Analysis<br>Set up a virtual penetration testing lab using tools like VirtualBox and Kali Linux.                    |
| 2        | Reconnaissance and Information Gathering Tools for reconnaissance: Nmap, whois, and Shodan.<br>Perform a network scan and gather information about open ports and service |
| 3        | Vulnerability Scanning: Tools: Nessus, OpenVAS.<br>Conduct vulnerability scans on a test environment and interpret the results.                                           |
| 4        | Exploitation Basics<br>Use Metasploit to exploit a known vulnerability (e.g., SMB vulnerability).                                                                         |
| 5        | Web Application Security se Burp Suite or OWASP ZAP to find and exploit vulnerabilities in a web application.                                                             |
| 6        | Password Cracking and Brute Force Attacks: Perform dictionary and brute-force attacks on a test system.                                                                   |







|   |                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------|
| 7 | Wireless Network Penetration Testing: Test the security of a wireless network and attempt to crack WEP/WPA passwords. |
| 8 | Post-Exploitation Techniques: Use tools like Netcat or Meterpreter for post-exploitation.                             |
| 9 | Reporting and Mitigation: Create a report for a simulated penetration test.                                           |

### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                    | Bloom's Taxonomy Level |
|--------|-----------------------------------------------------------------------------------------------|------------------------|
| CO1    | Demonstrating the ability to successfully exploit a vulnerability to gain unauthorized access | CL3                    |
| CO2    | Prioritize list of risks that helps the organization focus on the most critical issues        | CL3                    |
| CO3    | Advice best practices on how to fix the identified vulnerabilities                            | CL3                    |
| CO4    | Improving password policies or implementing network segmentation.                             | CL3                    |

### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

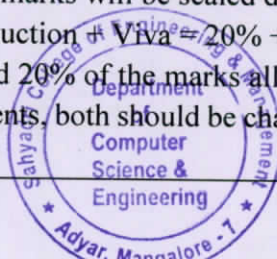
| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### ASSESSMENT STRATEGY:

- In Laboratory Courses where component (C) is not a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have 50% weightage (25 Marks). In such cases,
  - The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
  - One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.
  - The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) and component (B).
- The course instructor will design the rubrics for component (C).

### SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.



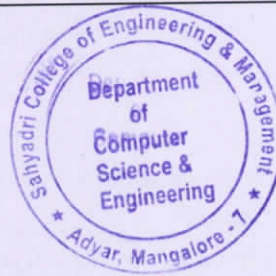


**REFERENCE BOOKS:**

- The Web Application Hacker's Handbook" by Dafydd Stuttard and Marcus Pinto, Wiley 2<sup>nd</sup> Edition, 2011
- "Penetration Testing: A Hands-On Introduction to Hacking", Georgia Weidman, No Starch Press, 1<sup>st</sup> Edition, 2014

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):**

1. TryHackMe (platform for hands-on penetration testing).
2. OWASP and NIST guidelines.







**DEVOPS**

**(Effective from the Academic Year 2026 - 2027)**

**VI SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS608A3</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Basic knowledge of operating systems and file systems.
- Familiarity with programming concepts and basic coding skills.

**COURSE OBJECTIVES:**

- To equip students with the foundational knowledge of Linux, command-line tools, and file systems essential for DevOps practices.
- To provide practical experience in implementing source code management, continuous integration, and deployment workflows using tools like Git, GitHub, Jenkins, and Docker.
- To enable students to develop, containerize, and automate the deployment of applications as part of a complete CI/CD pipeline.

**TEACHING - LEARNING STRATEGY:**

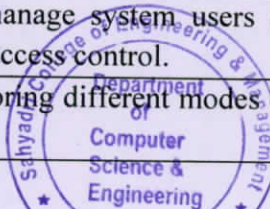
Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**LIST OF EXPERIMENTS**

**Design, develop, and implement the specified algorithms using Python Programming under LINUX/Windows environment.**

| Exp. No. | Description                                                                                                                                                                          |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | Explore the Linux operating system, command-line environment, and file systems by executing basic commands such as pwd, ls, cd, and whoami to navigate and interact with the system. |
| 2        | Practice file and directory operations in Linux using essential commands such as mkdir, cp, mv, rm, touch, cat, and echo to create, move, and delete files or directories.           |
| 3        | Understand file types using the file command and apply filters like grep, awk, sort, uniq, and wc to manipulate and analyze textual data.                                            |
| 4        | Learn input/output redirection (>, >>, <,  , tee) and manage system users and groups using commands like useradd, groupadd, and passwd for basic access control.                     |
| 5        | Practice creating and editing files using Vim editor, exploring different modes (command, insert, and visual) and performing file editing operations.                                |







|    |                                                                                                                                                              |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6  | Explore Git and GitHub commands to manage source code repositories by creating, cloning, branching, committing changes, and performing push/pull operations. |
| 7  | Install and set up Jenkins, explore its environment, and demonstrate continuous integration workflows by automating build and test processes.                |
| 8  | Explore continuous development and deployment pipelines in Jenkins by configuring jobs for automating tasks, integrating tools, and monitoring builds.       |
| 9  | Learn the fundamentals of Docker, practice core commands like docker pull, docker run, docker ps, and docker stop, and manage containers efficiently.        |
| 10 | Build a simple containerized application using Docker by creating a Dockerfile, packaging the application, and running it as a container.                    |
| 11 | Explore advanced Docker features such as container networking, data volume management, and linking containers to enable efficient communication and storage. |
| 12 | Integrate Jenkins with Docker to implement a complete CI/CD pipeline that automates building, testing, and deploying containerized applications.             |

### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                   | Bloom's Taxonomy Level |
|--------|--------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Demonstrate proficiency in Linux operating systems, command-line operations, and file management.            | CL3                    |
| CO2    | Utilize Git and GitHub for effective source code management and collaboration.                               | CL3                    |
| CO3    | Implement and manage Continuous Integration and Continuous Deployment workflows using Jenkins.               | CL3                    |
| CO4    | Develop, deploy, and manage containerized applications using Docker and integrate them with CI/CD pipelines. | CL3                    |

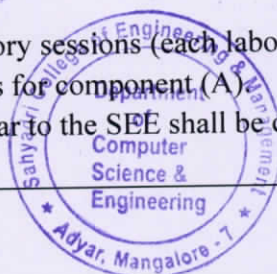
### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### ASSESSMENT STRATEGY:

- In Laboratory Courses where component (C) is not a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have 50% weightage (25 Marks). In such cases,
  - The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
  - One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.







- c) The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) and component (B).
- ii. The course instructor will design the rubrics for component (C).

**SEE QUESTION PAPER PATTERN:**

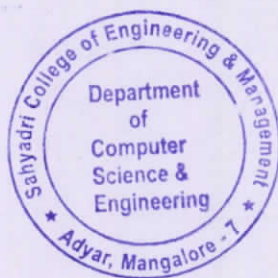
- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

**REFERENCE BOOKS:**

1. DevOps: A Software Architect's Perspective, Len Bass, Ingo Weber, Liming Zhu Publ, Addison-Wesley, 1<sup>st</sup> Edition, 2015
2. The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations, Gene Kim, Jez Humble, Patrick Debois, John Willis, IT Revolution Press, 2<sup>nd</sup> Edition, 2021
3. DevOps for Developers, Michael Hüttermann, Apress, Apress, 1<sup>st</sup> Edition, 2012

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):**

1. <https://www.udemy.com/course/decodingdevops/?couponCode=ST21MT121624>
2. <https://www.udemy.com/course/learn-devops-ci-cd-with-jenkins-using-pipelines-and-docker/?couponCode=ST21MT121624>





**GENERATIVE AI AND PROMPT ENGINEERING**  
**(Effective from the Academic Year 2026 - 2027)**  
**VI SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS608A4</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>      | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Basic understanding and hands on experience with Python programming.
- Familiarity with mathematical concepts like linear algebra, calculus, and probability.

**COURSE OBJECTIVES:**

- Apply foundational principles of Artificial Intelligence to solve real-world problems.
- Experiment with generative AI tools to create innovative applications in text and image generation.
- Analyze the impact of prompt engineering on the performance of AI models.
- Utilize advanced generative AI platforms like ChatGPT, Gemini, and Copilot to automate tasks and enhance productivity.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- MOOC/NPTEL Courses
- Any other innovative initiatives with respect to the Course contents

**PART-A**

**Theory:** An Introduction to Artificial Intelligence, Introduction to Generative AI, Commonly Used Generative AI Platforms, Introduction to Chatgpt, Gemini, Copilot, Prompt Engineering with examples.

**LIST OF EXPERIMENTS**

**Design, develop, and implement the specified algorithms using Python Programming under LINUX/Windows environment.**

| Exp. No. | Description                                                                                                         |
|----------|---------------------------------------------------------------------------------------------------------------------|
| 1        | Develop a program to demonstrate a simple supervised learning task using linear regression.                         |
| 2        | Develop a program to implement a rule-based chatbot.                                                                |
| 3        | Develop a program to demonstrate generating images from text using the Stability AI Stable Diffusion model.         |
| 4        | Develop a program to demonstrate how to use the OpenAI GPT API for generating conversational responses.             |
| 5        | Develop a program to demonstrate how to use GitHub Copilot directly within Python IDEs or editors, such as VS Code. |
| 6        | Develop a program to show how to use simple, straightforward prompts to generate responses from                     |





|   |                                                                                                   |
|---|---------------------------------------------------------------------------------------------------|
|   | ChatGPT.                                                                                          |
| 7 | Develop a mini project using any standard generative AI tool with emphasis on prompt engineering. |

### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                 | Bloom's Taxonomy Level |
|--------|------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Demonstrate an understanding of the foundational concepts of Artificial Intelligence and its applications. | CL3                    |
| CO2    | Develop AI-driven solutions using generative models like GPT and Stable Diffusion.                         | CL3                    |
| CO3    | Implement effective prompts to optimize generative AI outputs for diverse use cases.                       | CL3                    |
| CO4    | Explore the functionalities of modern generative AI platforms to integrate them into various workflows.    | CL3                    |

### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

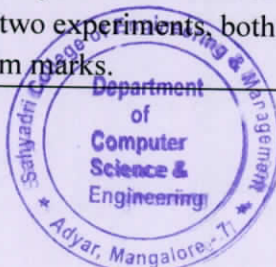
| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### ASSESSMENT STRATEGY:

- In Laboratory Courses with component (C), component (A) will have 50% weightage (25 Marks), and component (B) will have 30% weightage (15 Marks) and component C will have remaining 20% (10 Marks).
- The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
- One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 15 marks.
- The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) component (B) and component (C).
- The course instructor will design the rubrics for component (C).

### SEE QUESTION PAPER PATTERN:

- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.



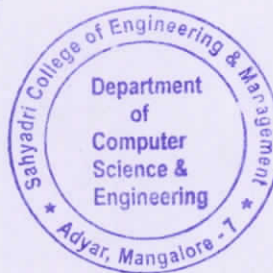


**REFERENCE BOOKS:**

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Pearson Publishers, 4<sup>th</sup> Edition, 2020.
2. Principles of Generative AI: A Technical Introduction, Karan Singh, Wiley India, 1<sup>st</sup> Edition, 2024.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):**

1. [https://onlinecourses.swayam2.ac.in/nou25\\_ma05/preview](https://onlinecourses.swayam2.ac.in/nou25_ma05/preview)
2. [https://onlinecourses.nptel.ac.in/noc25\\_cs137/preview](https://onlinecourses.nptel.ac.in/noc25_cs137/preview)



  
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**An Autonomous Institution**  
**Mangaluru**





**HIGH PERFORMANCE COMPUTING**  
(Effective from the Academic Year 2027 - 2028)

**VII SEMESTER**

|                                           |                  |            |    |
|-------------------------------------------|------------------|------------|----|
| Course Code                               | <b>BCS701G</b>   | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:2:0          | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L + 20P</b> | Exam Hours | 03 |

**CREDITS – 4**

**COURSE PREREQUISITES:**

- Proficiency in C, C++ or Python for system-level and performance-critical coding.
- Understanding of computer architecture like CPUs, memory hierarchy, and parallel hardware.
- Knowledge in basic mathematical foundations like linear algebra and numerical methods.

**COURSE OBJECTIVES:**

- To provide students with a solid understanding of parallel computing fundamentals
- To develop proficiency in modern processor architectures and high-performance programming
- To equip students with knowledge and practical skills in shared-memory parallel programming using OpenMP and hybrid parallelization models (MPI and OpenMP)

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE – I**

|                                                                                                                                                                                                                                                                                                                                                                                         |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to Parallel Computing:</b> Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platform, Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Communication Costs in Parallel Machines, Impact of Process-Processor Mapping and Mapping Techniques. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                       |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Modern processors:</b> Stored-program computer architecture, General-purpose cache-based microprocessor architecture, Memory hierarchies, Multicore processors, Multithreaded processors, Vector processors, Locality and data reuse, programming strategies for high performance. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Shared-memory parallel programming with OpenMP:</b> Introduction to OpenMP, Case study: OpenMP-parallel Jacobi algorithm, Advanced OpenMP: Wavefront parallelization.<br><b>Efficient OpenMP programming:</b> Profiling OpenMP programs, Case study: Parallel sparse matrix-vector multiply.<br><b>Hybrid parallelization with MPI and OpenMP:</b> Basic MPI/OpenMP programming models, MPI taxonomy of thread interoperability, Hybrid decomposition and mapping. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







**MODULE - IV**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>The CUDA Execution Model:</b> GPU Architecture Overview, Warp Scheduling and TLP, ILP: Higher Performance at Lower Occupancy, CUDA Tools to Identify Limiting Factors.<br><b>CUDA Memory:</b> The CUDA Memory Hierarchy, GPU Memory, L2 Cache, L1 Cache, CUDA Memory Types, Global Memory.<br><b>Techniques to Increase Parallelism:</b> CUDA Contexts Extend Parallelism, Out-of-Order Execution with Multiple Streams, Tying Data to Computation. | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

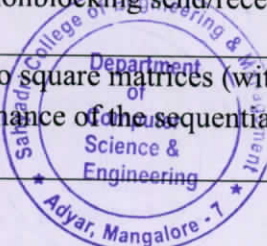
**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| <b>CO No.</b> | <b>Course Outcome Description</b>                                  | <b>Bloom's Taxonomy Level</b> |
|---------------|--------------------------------------------------------------------|-------------------------------|
| CO1           | Develop Parallel Algorithms Using OpenMP                           | CL3                           |
| CO2           | Apply MPI for Parallel and Distributed Computing                   | CL3                           |
| CO3           | Apply Synchronization Techniques in Multi-Threaded Programs        | CL3                           |
| CO4           | Apply Optimization Techniques to Enhance Parallel Code Performance | CL3                           |

**LABORATORY COMPONENTS**

| <b>Exp. No.</b> | <b>Experiment Description</b>                                                                                                                                                                                                           | <b>CO No.</b> | <b>Bloom's Taxonomy Level</b> |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------|
| 1               | Develop a program to perform matrix-vector multiplication using the OpenMP PARALLEL directive for parallel execution.                                                                                                                   | CO1           | CL3                           |
| 2               | Write a program to compute the sum of elements of a one-dimensional real array A using the OpenMP PARALLEL DO directive for parallel execution.                                                                                         | CO1           | CL3                           |
| 3               | Implement a program to compute the value of the PI function using numerical integration with the <b>OpenMP PARALLEL SECTION</b> directive.                                                                                              | CO1           | CL3                           |
| 4               | Using OpenMP, Design, develop and run a multi-threaded program to generate and print Fibonacci Series. One thread must generate the numbers up to the specified limit and another thread must print them. Ensure proper synchronization | CO2           | CL3                           |
| 5               | Develop a program to find the largest element in a list of numbers using the OpenMP CRITICAL SECTION directive to ensure thread safety during the comparison process.                                                                   | CO2           | CL3                           |
| 6               | Develop an OpenMP program to compute and print the sum of the elements in an array using the Reduction clause.                                                                                                                          | CO2           | CL3                           |
| 7               | Implement a program to calculate the sum of a given set of numbers in parallel using MPI (Message Passing Interface).                                                                                                                   | CO3           | CL3                           |
| 8               | Design a program that implements MPI Collective Communications.                                                                                                                                                                         | CO3           | CL3                           |
| 9               | a) Design a MPI program that uses blocking send/receive routines.<br>b) Design a MPI program that uses nonblocking send/receive routines.                                                                                               | CO4           | CL3                           |
| 10              | Implement a program to multiply two square matrices (with dimensions 1000, 2000, or 3000). Compare the performance of the sequential and parallel algorithms using OpenMP                                                               | CO4           | CL3                           |







### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                                     | Weightage (%) | Max. Marks |
|---------|------------------------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b>                | <b>100 %</b>  | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)                       | 30 %          | 15         |
|         | Activity Based Assessment (As suggested by the BoS)        | 20 %          | 10         |
|         | Laboratory Continuous Assessment                           | 30 %          | 15         |
|         | Laboratory Test (After the completion of all experiments*) | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>                      | <b>100 %</b>  | <b>50</b>  |

### SEE QUESTION PAPER PATTERN:

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totaling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and however, will have choice in Modules 3 and 4.

### REFERENCE BOOKS:

1. Introduction to Parallel Computing, AnanthGrama, Anshul Gupta, George Karypis, and Vipin Kumar, Addison-Welsey, 2<sup>nd</sup> Edition, 2003.
2. Introduction to High Performance Computing for Scientists and Engineers, Chapman & Hall/CRC Computational Science Series, 2<sup>nd</sup> Edition, 2021.
3. Victor Eijkhout, Edmond Chow, Robert van de Geijn, Introduction to High Performance Scientific Computing, 2<sup>nd</sup> Edition, 2016.
4. Rob Farber, CUDA Application Design and Development, Morgan Kaufmann Publishers, 1<sup>st</sup> Edition, 2011.
5. Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series, 1<sup>st</sup> Edition, 2007.

### REFERENCE WEB LINKS & VIDEO LECTURES:

1. [https://www.cdac.in/index.aspx?id=tap&tapcat=High\\_Performance\\_Computing](https://www.cdac.in/index.aspx?id=tap&tapcat=High_Performance_Computing)
2. [https://www.youtube.com/watch?v=zJ\\_D6AiGIV8](https://www.youtube.com/watch?v=zJ_D6AiGIV8)





**DIGITAL IMAGE PROCESSING AND  
COMPUTER VISION**  
(Effective from the Academic Year 2027 - 2028)  
**VII SEMESTER**

|                                           |                |            |    |
|-------------------------------------------|----------------|------------|----|
| Course Code                               | <b>BCS702T</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0        | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>     | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Basic understanding of mathematical concepts like Linear Algebra, Discrete Mathematics.
- Programming languages: Python, Libraries and Frameworks: OpenCV, scikit-image, Pillow, TensorFlow or PyTorch.
- Knowledge of machine learning concepts.

**COURSE OBJECTIVES:**

This course will enable students to:

- Understand Fundamental Concepts of high performance computing.
- Explore Image Enhancement and Restoration techniques.
- Develop Skills in Image Segmentation and Feature Extraction.
- Apply Machine Learning in Vision Tasks and Solve Real-World Problems

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE – I**

**Fundamentals Of Digital Image Processing**

|                                                                                                                                                                                                                                                                                                                                                  |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Origins of Digital Image Processing, Fundamental steps in digital image processing, Components of an Image processing system, Elements of Visual Perception, A Simple Image Formation Model, Basic Concepts in Sampling and Quantization, Representing Digital Images, Zooming and Shrinking Digital Images, Basic Relationships Between Pixels. | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – II**

**Image Transformation And Enhancement**

|                                                                                                                                                                                                                                                                            |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Geometric Primitives and transformations (2D & 3D transformations, 3D Rotations. 3D to 2D Projections), Point operators (Pixel Transform, Colour Transforms, Histogram Equalization), Linear Filtering, Nonlinear filtering, Bilateral filtering, Binary image processing. | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE – III**

**Image Segmentation**

|                                                                                                                                                                       |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Segmentation by clustering: Human vision, Applications, Image segmentation by clustering pixels, segmentation, clustering and graphs, Image Segmentation in practice. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|





**MODULE – IV**

**Image Classification And Detection**

|                                                                                                                                                                                                                                                                                                                                          |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Classifying images: Building good image features (Applications, Encoding layout, summarizing images with visual words, spatial pyramid kernel, dimensionality reduction with principal components & canonical variates), Detecting objects in images: The sliding window method (Face Detection, Detecting Humans, Detecting Boundaries) | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| <b>CO No.</b> | <b>Course Outcome Description</b>                        | <b>Bloom's Taxonomy Level</b> |
|---------------|----------------------------------------------------------|-------------------------------|
| CO1           | Apply Basic Digital Image Processing Techniques          | CL3                           |
| CO2           | Apply Image Enhancement and Transformation Techniques    | CL3                           |
| CO3           | Implement Image Segmentation Techniques Using Clustering | CL3                           |
| CO4           | Apply Image Classification and Object Detection Methods  | CL3                           |

**ASSESSMENT**

**STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| <b>Sl. No.</b> | <b>Assessment Description</b>               | <b>Weightage (%)</b> | <b>Max. Marks</b> |
|----------------|---------------------------------------------|----------------------|-------------------|
| <b>1</b>       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>          | <b>50</b>         |
|                | Continuous Internal Evaluation (CIE)        | 60 %                 | 30                |
|                | Assignments                                 | 40 %                 | 20                |
| <b>2</b>       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>          | <b>50</b>         |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks tot to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with c in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 a however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing," Pearson Education, 4<sup>th</sup> Edition, 2018.
2. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2<sup>nd</sup> Edition, 2022.
3. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 1<sup>st</sup> Edition, 2003.
4. Anil K. Jain "Fundamentals of Digital Image Processing, PHI, 2015.
5. Milan Sonka, Vaciav Hlavac, Roger Boyle, "Image Processing Analysis and Vision", Fourth Edition, Cengage India, 4<sup>th</sup> Edition, 2017.
6. S. Sridhar, "Digital Image Processing,," Oxford University, 2<sup>nd</sup> Edition, 2016.



**SAHYADRI**  
COLLEGE OF ENGINEERING & MANAGEMENT  
An Autonomous Institution  
MANGALURU

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):**

1. <https://arsanatl.medium.com/introduction-to-digital-image-processing-computer-vision-and-opencv-92ce7383b24b>
2. [https://onlinecourses.nptel.ac.in/noc23\\_ee39/preview](https://onlinecourses.nptel.ac.in/noc23_ee39/preview)
3. <https://www.mccormick.northwestern.edu/electrical-computer/academics/graduate/masters/specializations/computer-vision-and-image-processing.html>







**BIG DATA ANALYTICS**

(Effective from the Academic Year 2027 - 2028)

**VII SEMESTER**

|                                           |          |            |    |
|-------------------------------------------|----------|------------|----|
| Course Code                               | BCS703E1 | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0  | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | 40L      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Knowledge of SQL and relational databases for structured data handling.
- Ability to write data-driven code using Python or Java is essential.

**COURSE OBJECTIVES:**

- Understand the fundamentals and applications of Big Data analytics.
- Explore the Hadoop framework and Hadoop Distributed File system and essential Hadoop Ecosystem Tools.
- Employ Map Reduce programming model to process the big data.
- Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to Big Data:</b> Classification of data, Big Data Characteristics, Types, Big Data Classification and Big Data Handling Techniques, Data Architecture Design, Managing Data for analysis, Data Sources, Quality, Pre-Processing and Storing<br><b>Data Storage and Analysis:</b> Traditional Systems Storage and Management, Big Data Storage, Big Data Platform, Big Data Analytics, Big data Applications and Case Studies. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                                                                                                                                         |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to Hadoop:</b> Introducing hadoop, Why hadoop, Why not RDBMS, RDBMS Vs Hadoop, History of Hadoop, Hadoop overview, HDFS (Hadoop Distributed File System), Processing data with Hadoop, Managing resources and applications with Hadoop YARN (Yet Another Resource Negotiator).<br><b>Introduction to Map Reduce Programming:</b> Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>NoSQL Big Data Management:</b> Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns: Key-Value Store, Document Store, Tabular Data, Object Data Store, Graph Database, Variations of NoSQL Architectural Patterns, NoSQL to Manage Big Data<br><b>MongoDB:</b> Features, Dynamic Schema, Replication, Autos-sharding, Data Types, Rich Queries and other DB functionalities, MongoDB Query Language and Database Commands. | <b>10 Hours</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|





Cassandra Databases.

**MODULE - IV**

**Introduction to Hive:** What is Hive, Hive Architecture, Hive data types, Hive file formats, Hive Query Language (HQL), RC File implementation, User Defined Function (UDF).

**Introduction to Pig:** What is Pig, Anatomy of Pig, Pig on Hadoop, Pig Philosophy, Use case for Pig, Pig Latin Overview, Data types in Pig, Running Pig, Execution Modes of Pig, HDFS Commands, Relational Operators, Eval Function, Complex Data Types, Piggy Bank, User Defined Function, Pig Vs Hive.

**Spark and Big Data Analytics:** Spark, Introduction to Data Analysis with Spark.

**10 Hours**

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                 | Bloom's Taxonomy Level |
|--------|----------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Illustrate the fundamentals of big data analytics and discuss some case studies.                                           | CL2                    |
| CO2    | Interpret the Hadoop framework and understand the concepts of Hadoop Distributed File system, MapReduce Programming Model. | CL2                    |
| CO3    | Demonstrate the concepts of NoSQL through the use of MongoDB and Cassandra in Big Data                                     | CL3                    |
| CO4    | Apply MapReduce, Hive, HiveQL, Pig programming model to understand processing of big data.                                 | CL3                    |

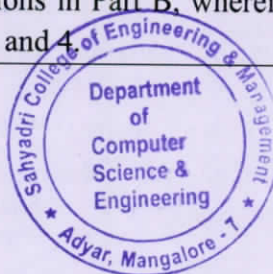
**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks total to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have a choice in Modules 3 and 4.







**REFERENCE BOOKS:**

1. Seema Acharya and Subhashini Chellappan "Big data and Analytics" Wiley India Publishers, 2<sup>nd</sup> Edition, 2019.
2. Raj Kamal and Preeti Saxena, "Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning", McGraw Hill Education, 1<sup>st</sup> Edition, 2018
3. Douglas Edline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1<sup>st</sup> Edition, Pearson Education, 2016.
4. Tom White, "Hadoop: The Definitive Guide", O'Reilly Media, 4<sup>th</sup> Edition, 2015.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E – RESOURCES ) ( if any):**

1. [https://www.youtube.com/watch?v=n\\_Krer6YWWY4](https://www.youtube.com/watch?v=n_Krer6YWWY4)
2. [https://onlinecourses.nptel.ac.in/noc20\\_cs92/preview](https://onlinecourses.nptel.ac.in/noc20_cs92/preview)
3. <https://www.digimat.in/nptel/courses/video/106104189/L01.html>





**ETHICAL HACKING**

**(Effective from the Academic Year 2027 - 2028)**

**VII SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS703E2</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Fundamental knowledge of networking, operating systems (Windows/Linux), cybersecurity.

**COURSE OBJECTIVES:**

- Develop Expertise in Ethical Hacking
- Master Reconnaissance and Network Scanning
- Understand Vulnerability Analysis and Enumeration
- Explore Wireless Security and Attack Mitigation

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                                                                                                                 |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to Ethical Hacking:</b> Ethical Hacking Overview, Role of Security and Penetration Testers, Penetration, Testing Methodologies, Laws of the Land, Overview of TCP/IP, The Application Layer, The Transport Layer, The Internet Layer, IP Addressing, Network and Computer Attacks, Malware, Protecting Against Malware Attacks, Intruder Attacks, Addressing Physical Security. | <b>10 Hours</b> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                                                                                 |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Foot Printing, Reconnaissance and scanning Networks:</b> Foot printing Concepts, Foot printing through Search Engines, Web Services, Social Networking Sites, Website, Email, Competitive Intelligence, Foot printing through Social Engineering, Foot printing Tools, Network Scanning Concepts, Port-Scanning Tools, Scanning Techniques, Scanning Beyond IDS and Firewall | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                                                                                                                                                                                         |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Enumeration and Vulnerability Analysis:</b> Enumeration Concepts, NetBIOS Enumeration, SNMP, LDAP, NTP, SMTP and DNS Enumeration, Vulnerability Assessment Concepts, Desktop and Server OS Vulnerabilities, Windows OS Vulnerabilities, Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities, Vulnerabilities of Embedded Oss. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







**MODULE - IV**

**Wireless Hacking:** Wireless Foot printing, Wireless Scanning and Enumeration, Gaining Access, Tools that exploiting WEP Weakness, Denial of Services Attacks, Firewalls: Firewalls landscape, Firewall Identification-Scanning Through firewalls, packet Filtering, Application Proxy Vulnerabilities, Denial of Service Attacks, Motivation of Dos Attackers, Types of DoS attacks, Generic Dos Attacks, UNIX and Windows DoS.  
Case study practical: with real time example footprinting, dos attack.

**10 Hours**

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                                 | Bloom's Taxonomy Level |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Understand the fundamentals of ethical hacking, penetration testing methodologies, and legal frameworks, along with key networking concepts like TCP/IP and malware protection.            | CL2                    |
| CO2    | Gain practical knowledge in footprinting, reconnaissance, and scanning networks using various tools, including methods to bypass IDS and firewalls.                                        | CL3                    |
| CO3    | Learn enumeration techniques for various services (NetBIOS, SNMP, LDAP, etc.), vulnerability assessment for different OS platforms, and methods for identifying system vulnerabilities.    | CL3                    |
| CO4    | Master wireless hacking techniques, including footprinting, scanning, gaining access, exploiting WEP weaknesses, and understanding denial of service attacks and firewall vulnerabilities. | CL3                    |

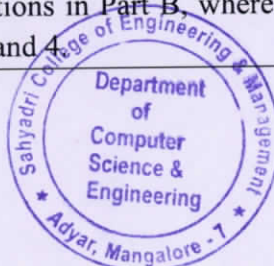
**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks total to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.



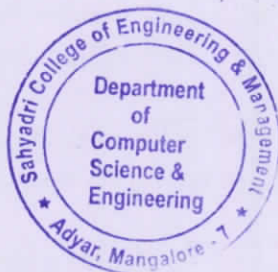


**REFERENCE BOOKS:**

1. Stuart McClure, Joel Scambray and Goerge Kurtz, Hacking Exposed 7: Network Security Secrets & Solutions, Tata Mc Graw Hill Publishers, 7<sup>th</sup> Edition, 2012.
2. Ben Smith, and Brian Komer, Microsoft Windows Security Resource Kit, Prentice Hall of India, 1<sup>st</sup> Edition, 2005.
3. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 3<sup>rd</sup> Edition, 2016.
4. The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS/Elsevier, 2<sup>nd</sup> Edition, 2016.
5. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2<sup>nd</sup> Edition, 2011.
6. Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2<sup>nd</sup> Edition, 2021.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):**

1. [https://infyspringboard.onwingspan.com/web/en/page/lex\\_auth\\_0139599183212380165](https://infyspringboard.onwingspan.com/web/en/page/lex_auth_0139599183212380165)
2. <https://archive.nptel.ac.in/courses/106/105/106105217/>
3. [https://onlinecourses.nptel.ac.in/noc19\\_cs68/preview](https://onlinecourses.nptel.ac.in/noc19_cs68/preview)







**ROBOTIC PROCESS AUTOMATION**  
(Effective from the Academic Year 2027 - 2028)

**VII SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code:                              | <b>BCS703E3</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy:40                | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Fundamental knowledge of automation and programming languages

**COURSE OBJECTIVES:**

- Understand Basic Concepts and Applications of RPA
- Describe different types of variables and control flow concepts.
- Automate Image, Text, and Data Tables and Handle Exceptions

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- PowerPoint Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

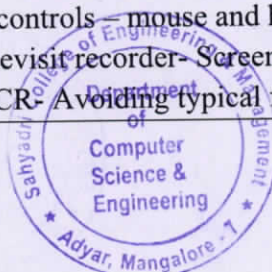
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>RPA Foundations-</b> The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA – Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-OnPremise Vs. the Cloud- Web Technology- Programming Languages and Low Code- OCR-DatabasesAPIs- AI-Cognitive Automation-Agile, Scrum, Kanban and Waterfall DevOps- Flow Charts.<br><b>Components of RPA-</b> RPA Platforms-About Ui Path- About UiPath - The future of automation - Record and Play | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Sequence, Flowchart, and Control Flow-</b> Sequencing the workflow Activities-Control flow, various types of loops, and decision making Step-by-step example using Sequence and Flow Chart-Step-by step example using Sequence and Control flow-Data Manipulation-Variables and Scope CollectionsArguments – Purpose and use-Data table usage with examples Clipboard management-File operation with step-by-step example-CSV/Excel to data table and vice versa (with a step-by-step example). | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                                                                                                                                                                                     |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Taking Control of the Controls-</b> Finding and attaching windows- Finding the control- Techniques for waiting for a control- Act on controls – mouse and keyboard activities- Working with UiExplorerHandling events- Revisit recorder- Screen Scraping- When to use OCR- Types of OCR availableHow to use OCR- Avoiding typical failure points | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







**MODULE - IV**

**Exception Handling, Debugging, and Logging-** Exception handling- Common exceptions and ways to handle them- Logging and taking screenshots Debugging techniques- Collecting crash dumps Error reporting- Future of RPA

**10 Hours**

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                        | Bloom's Taxonomy Level |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Understand the fundamentals of RPA, its benefits, limitations, technologies, and future prospects, using tools like UiPath for automation solutions                               | CL2                    |
| CO2    | Apply sequencing, flowcharts, control flows, and data manipulation techniques to design and implement automated workflows using variables, arguments, and file operations in RPA. | CL3                    |
| CO3    | Illustrate techniques for interacting with UI controls, handling events, and utilizing OCR for screen scraping while addressing potential failure points in RPA workflows         | CL3                    |
| CO4    | Apply exception handling, debugging, and logging techniques to identify, manage, and report errors in RPA workflows, ensuring reliability and efficiency.                         | CL3                    |

**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks total to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from the first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2 however, they will have a choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems, Apress, 1<sup>st</sup> Edition, 2020,
2. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing, 1<sup>st</sup> Edition, 2018.







3. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer," Institute of Robotic Process Automation, 1<sup>st</sup> Edition, 2016.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):**

1. <https://www.youtube.com/watch?v=n6nxTBB16ag>
2. [https://www.youtube.com/watch?v=McqDT1DMLh8&list=PLXDsvE7qtfNdt9oYEHJ\\_LMXDUGu6bH-L6](https://www.youtube.com/watch?v=McqDT1DMLh8&list=PLXDsvE7qtfNdt9oYEHJ_LMXDUGu6bH-L6)





**QUANTUM COMPUTING & APPLICATIONS**

(Effective from the Academic Year 2027 - 2028)

**VII SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS703E4</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Basic understanding of linear algebra and probability theory.
- Basics of computational complexity, algorithm design, probability and statistics.

**COURSE OBJECTIVES:**

- Understand the basic concepts of quantum mechanics that underpin quantum computing, including superposition, entanglement, and quantum interference.
- Analyze the role of quantum gates in quantum circuits and understand how quantum operations are performed on quantum bits (qubits).
- Apply the principles of quantum computing to solve problems using quantum algorithms like Grover's and Shor's algorithms.
- Evaluate the current state of quantum computing hardware and software and explore potential applications in cryptography, optimization and machine learning.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                          |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to Quantum Computing:</b> Overview to Quantum Mechanics, Qubits and Quantum States, Superposition and Entanglement, Quantum Interference | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

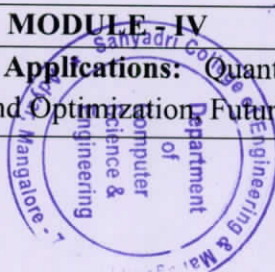
|                                                                                                                                                                                                   |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Quantum Gates and Circuits:</b> Introduction to Quantum Gates, Quantum Circuits, Quantum Algorithms Using Gates, Quantum Error Correction. Case Study: Google's Willow Quantum Computing Chip. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                             |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Quantum Algorithms:</b> Introduction to Quantum Algorithms, Grover's Search Algorithm, Shor's Factoring Algorithm, Overview of other quantum algorithms: HHL for solving linear systems. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - IV**

|                                                                                                                                                                       |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Quantum Computing and Real-World Applications:</b> Quantum Hardware, Quantum Cryptography, Quantum Machine Learning and Optimization, Future of Quantum Computing. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                             | Bloom's Taxonomy Level |
|--------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Explain the fundamental principles of quantum mechanics related to quantum computing.                                                  | CL2                    |
| CO2    | Design quantum circuits using basic quantum gates and understand their functioning in quantum algorithms.                              | CL3                    |
| CO3    | Demonstrate the application of quantum algorithms and analyze their advantages over classical algorithms in solving specific problems. | CL3                    |
| CO4    | Assess real-world applications of quantum computing and demonstrate its potential impact on various industries.                        | CL3                    |

### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |

### SEE QUESTION PAPER PATTERN:

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks tot to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with c in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 a however, will have choice in Modules 3 and 4.

### REFERENCE BOOKS:

1. Quantum Computation and Quantum Information" by Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press, 10<sup>th</sup> Edition, 2010.
2. Quantum Computing: An Applied Approach" by Jack D. Hidary, Springer, 2<sup>nd</sup> Edition, 2021.
3. Quantum Computing for Computer Scientists" by Noson S. Yanofsky and Mirco A. Mannucci, Cambridge University Press, 1<sup>st</sup> Edition, 2008.

### REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):

1. <https://www.youtube.com/watch?v=JhHMJCUMq28>
2. <https://nptel.ac.in/courses/106106232>
3. <https://archive.nptel.ac.in/courses/115101115101092/>





**INTRODUCTION TO ALGORITHMS**  
(Effective from the Academic Year 2027 - 2028)

**VII SEMESTER**

|                                           |          |            |    |
|-------------------------------------------|----------|------------|----|
| Course Code                               | BCS704Q1 | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0  | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | 40L      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Fundamental knowledge of mathematical concepts and data structures.

**COURSE OBJECTIVES:**

This course will enable students to:

- Describe the techniques for analyzing algorithms and how to evaluate their performance. Indicate the effectiveness of the method using asymptotic notations.
- Utilize algorithm design techniques including the brute force approach, greedy approach, divide-and-conquer strategy, decrease-and-conquer strategy, transform-and-conquer strategy, dynamic programming, backtracking, and branch-and-bound to solve issues.
- Decide on the best data structure and algorithm design technique for the given application.
- Recognize the fundamental ideas behind NP-complete and NP-hard class issues.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to Algorithms-</b> Properties, Specification, Fundamentals of Algorithmic Problem solving, Analysis Framework.<br><b>Performance Analysis:</b> Estimating Space complexity and Time complexity of algorithms. Asymptotic Notations with examples, Basic efficiency classes, Mathematical analysis of Non-Recursive and Recursive Algorithms with Examples.<br><b>Brute force design techniques:</b> Selection sort, sequential search and String-matching algorithm with complexity Analysis. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                                                                           |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Divide and Conquer:</b> General method, Recurrence equation for divides and conquers, solving it using Master's theorem, Divide and Conquer algorithms and complexity Analysis of Finding the maximum & minimum, Binary search, Merge sort, Quick sort.<br><b>Greedy Method:</b> General method, Coin Change Problem, Knapsack Problem, Job sequencing with deadlines, | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|







**MODULE - III**

|                                                                                                                                                                                                                                                                                                            |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Greedy Method:</b> Minimum cost spanning tree algorithms: Prim's Algorithm, Kruskal's Algorithm.<br><b>Single source shortest paths:</b> Dijkstra's Algorithm.<br><b>Optimal Tree problems:</b> Huffman Trees and Codes<br><b>Dynamic Programming:</b> General method with Examples, Multistage Graphs. | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - IV**

|                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Transitive Closure:</b> Warshall's Algorithm. All Pairs Shortest Paths: Floyd's Algorithm, Knapsack problem, Optimal Binary Search Trees, Travelling Sales Person problem.<br><b>Backtracking:</b> General method, N-Queens problem, Sum of subsets problem, Hamiltonian cycles Problems.<br><b>Branch and Bound:</b> Basic concepts, Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                    | Bloom's Taxonomy Level |
|--------|---------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Solve the time complexity of recursive, non-recursive and brute force algorithm using asymptotic notations.   | CL3                    |
| CO2    | Solve the recurrence relation to obtain the performance of divide-and-conquer, decrease-and conquer approach. | CL3                    |
| CO3    | Apply greedy technique, transform and conquer strategy to solve the problem for optimal solution.             | CL3                    |
| CO4    | Apply Dynamic-Programming, backtracking and branch-and-bound approach on combinatorial problems.              | CL3                    |

**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks tot to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with cho respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 a however, will have choice in Modules 3 and 4.





**REFERENCE BOOKS:**

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin: Pearson, 3<sup>rd</sup> Edition, 2011.
2. Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, Universities Press, 2<sup>nd</sup> Edition, 2008.
3. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, PHI, 4<sup>th</sup> Edition, 2022.
4. Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education), 2<sup>nd</sup> Edition, 2020.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if any):**

1. <https://www.youtube.com/playlist?list=PLU14u3cNGP63EdVPNLG3ToM6LaEUuStEY>
2. <https://nptel.ac.in/courses/106/102/106102064/>
3. [https://www.youtube.com/playlist?list=PL2\\_aWCzGMAwLLTJfQPnZ0co2jqwVxCtwj](https://www.youtube.com/playlist?list=PL2_aWCzGMAwLLTJfQPnZ0co2jqwVxCtwj)







**SOFTWARE ENGINEERING**  
**(Effective from the Academic Year 2027 - 2028)**  
**VII SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS704Q2</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Proficiency in at least one language (e.g., Java, C++, Python) for coding and debugging.
- Knowledge in basic computer science principles like compilation, abstraction, and system-level architecture.

**COURSE OBJECTIVES:**

- To gain knowledge of various software development methodologies and processes such as agile, waterfall, iterative development, to effectively manage and execute software projects.
- To develop proficiency in designing scalable and maintainable software systems using design principles, architecture patterns, and system integration techniques.
- To acquire essential project management skills including planning, scheduling, budgeting, resource allocation, risk management, and team coordination to successfully deliver software projects on time and within budget.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction:</b> Need for Software Engineering. Professional Software Development, Software Engineering Ethics. Case Studies.<br><b>Software Processes Models:</b> Waterfall Model, Incremental Model and Spiral Model Process activities.<br><b>Requirements Engineering:</b> Requirements Engineering Processes. Requirements Elicitation and Analysis. Functional and non-functional requirements. The software Requirements Document Requirements Specification Requirements Validation, Requirements Management. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                           |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>System Models:</b> Context models, Interaction models, Structural Models, Behavioral Models Model-driven engineering.<br><b>Design and Implementation:</b> Introduction to RUP, Design Principles. Object-oriented design using the UML Design patterns Implementation issues Open-source development. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|





**MODULE - III**

**Software Testing:** Development testing, Test-driven development, Release testing, User testing Test Automation.

**10 Hours**

**Software Evolution:** Evolution processes, Program evolution dynamics, Software maintenance Legacy system management.

**MODULE - IV**

**Project Planning:** Software pricing, Plan-driven development, Project scheduling, Estimation techniques.

**10 Hours**

**Quality management:** Software quality Reviews and inspections. Software measurement and metrics Software standards.

**Agile Software Development:** Coping with Change, The Agile Manifesto: Values and Principles. Agile methods: SCRUM and Extreme Programming Plan-driven and agile development. Agile project management, Scaling agile methods.

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

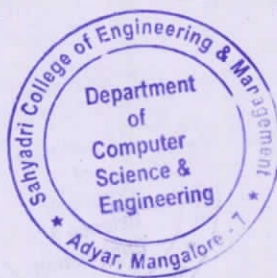
| CO No. | Course Outcome Description                                                                                                                                                                                               | Bloom's Taxonomy Level |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Interpret various software process models to effectively manage software development project, ensuring alignment with project requirements and constraints.                                                              | CL2                    |
| CO2    | Determine various software testing strategies, including test-driven development and test automation and apply techniques for managing software evolution and maintenance                                                | CL3                    |
| CO3    | Illustrate project plans, incorporating software pricing, scheduling and resource estimation using plan –driven development techniques, while demonstrating effective quality management practices.                      | CL3                    |
| CO4    | Examine and apply agile principles, including copying with change as per the Agile Manifesto to effectively implement SCRUM and Extreme Programming methodologies, compare plan-driven and agile development approaches. | CL3                    |

**ASSESSMENT**

**STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |







**SEE QUESTION PAPER PATTERN:**

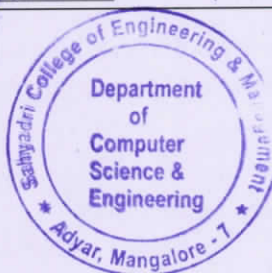
- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Ian Sommerville: Software Engineering, Pearson Education, 10<sup>th</sup> Edition, 2015.
2. The SCRUM Primer A lightweight Guide to the theory and practice of scrum by Pete Deemer, Gabrielle Benefield, Craig Larman, Bas Vodde, Ver 2.0., 2009.
3. Roger S. Pressman: Software Engineering-A Practitioners approach, Tata McGraw Hill, 9<sup>th</sup> Edition, 2019.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):**

1. [https://onlinecourses.nptel.ac.in/noc24\\_mg01/preview](https://onlinecourses.nptel.ac.in/noc24_mg01/preview)
2. [https://onlinecourses.nptel.ac.in/noc20\\_cs68/preview](https://onlinecourses.nptel.ac.in/noc20_cs68/preview)
3. <https://archive.nptel.ac.in/courses/106/105/106105182/>





**FUNDAMENTALS OF OPERATING  
SYSTEMS**  
(Effective from the Academic Year 2027 - 2028)  
**VII SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS704Q3</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Familiarity with arrays, stacks, queues, trees, and linked lists.
- Understanding of CPU, memory, I/O devices, and instruction cycles.
- Logic, sets, functions, and combinatorics for process and resource modeling.

**COURSE OBJECTIVES:**

- Explain the mechanisms by which OS handles processes, threads, and their communication.
- Describe the mechanisms involved in memory management in contemporary operating systems.
- Analyze distributed operating system concepts, including architecture, mutual exclusion algorithms, deadlock detection algorithms, and agreement protocols.
- Identify the components and management aspects of concurrency management.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introductory Concepts:</b> Operating system functions and characteristics, historical evolution of operating systems, Real time systems, Distributed systems, Methodologies for implementation of O/S service system calls, system programs, Interrupt mechanisms.<br><b>File Systems:</b> Functions of the system, File access and allocation methods, Director Systems: Structured Organization, directory and file protection mechanisms, implementation issues; hierarchy of file and device management. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                                                                                               |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>CPU Scheduling:</b> Levels of Scheduling, Comparative study of scheduling algorithms, multiple processor scheduling.<br><b>Storage Management:</b> Storage allocation methods: Single contiguous allocation, Multiple contiguous allocation, Paging, Segmentation combination of Paging and Segmentation, Virtual memory concepts, Demand Paging, Page, replacement Algorithms, Thrashing. | <b>10 Hours</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                                                            |                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Device Management:</b> Hardware Organization, Device scheduling policies.<br><b>Deadlocks:</b> Deadlock characterization, Deadlock prevention and avoidance, Deadlock detection and recovery, practical considerations. | <b>10 Hours</b> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|





**MODULE - IV**

**Concurrent Processes:** Critical section problem, Semaphores, Classical process coordination problems and their solutions, Interprocess Communications.

**10 Hours**

**Protection:** Mechanisms and Policies, Implementation.

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                                                                                  | Bloom's Taxonomy Level |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Understand operating system functions, evaluate real-time and distributed systems, apply system call methodologies, and develop efficient file systems and directory management structures. | CL3                    |
| CO2    | Apply CPU scheduling algorithms, storage allocation methods, and virtual memory concepts, including paging, segmentation, and thrashing.                                                    | CL3                    |
| CO3    | Compare various storage and device management techniques and determine their suitability for different applications.                                                                        | CL3                    |
| CO4    | Design deadlock-free and synchronized concurrent algorithms to ensure system reliability and assess their correctness.                                                                      | CL3                    |

**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Peterson, J.L. & Silberschatz, A.: Operating System Concepts, Addison, Wiley, 10th Edition, 2018.
2. Brinch, Hansen: Operating System Principles, Prentice Hall of India, 1<sup>st</sup> Edition, 1973.
3. Haberman, A.N.: Introduction to Operating System Design Galgotia Publication, Original Edition, 1976.
4. Tanenbaum, A.S.: Operating System, Pearson, 4<sup>th</sup> Edition, 2014.

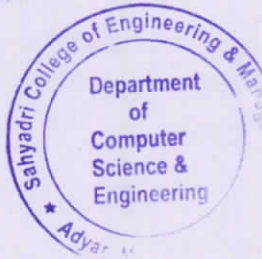
**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if any):**

1. Operating System by Prof. Niket Agarwal (IIT Roorkee) <https://nptel.ac.in/courses/106107073>



**SAHYADRI**  
COLLEGE OF ENGINEERING & MANAGEMENT  
An Autonomous Institution  
MANGALURU

2. Operating System Fundamentals by Prof. P.K. Biswas (IIT Kharagpur)  
<https://nptel.ac.in/courses/106105214>
3. Operating Systems by Prof. Nitin V. Deshpande (IIT Madras)  
<https://onlinecourses.nptel.ac.in/noc23-cs89>







**INTRODUCTION TO DATABASE  
MANAGEMENT SYSTEM**  
(Effective from the Academic Year 2027 - 2028)  
**VII SEMESTER**

|                                           |                 |            |    |
|-------------------------------------------|-----------------|------------|----|
| Course Code                               | <b>BCS704Q4</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 3:0:0:0         | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>40L</b>      | Exam Hours | 03 |

**CREDITS – 3**

**COURSE PREREQUISITES:**

- Understanding of sets, relations, functions, and basic logic.
- Familiarity with arrays, linked lists, stacks, queues, and trees.

**COURSE OBJECTIVES:**

- To Provide students with a solid understanding of fundamental database concepts
- To equip students with the skills necessary to work with databases using SQL
- To enable students to design efficient and well-structured database schemas and apply normalization techniques.

**TEACHING - LEARNING STRATEGY:**

Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Case Studies

**COURSE CONTENTS**

**MODULE - I**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Introduction to DBMS:</b> Characteristics of database approach, Advantages of using the DBMS approach.<br><b>Overview of Database Languages and Architectures:</b> Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, Data Modeling Using the Entity-Relationship (ER) Model: Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, Relationship Types of Degree Higher than Two, Examples.<br><b>Relational Database Design by ER-to-Relational Mapping:</b> Relational Database Design using ER-to-Relational mapping. | <b>10 Hours</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - II**

|                                                                                                                                                                                                                                                                                                                                                                                                         |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>The Relational Data Model and Relational Database Constraints:</b> Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.<br><b>Basic SQL:</b> SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL. | <b>10 Hours</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|

**MODULE - III**

|                                                                                                                                                                                                                                                                                          |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>The Relational Algebra :</b> Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Additional relational operations (aggregate, grouping, etc.), Examples of Queries in relational algebra | <b>10 Hours</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|





**MODULE - IV**

**Basics of Functional Dependencies and Normalization for Relational Databases:**  
Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form.

**10 Hours**

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                                         | Bloom's Taxonomy Level |
|--------|------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Discuss the fundamental concepts of database technology and Entity Relationship (ER) model.                                        | CL2                    |
| CO2    | Apply conceptual database design, relational model principles, and SQL fundamentals to manipulate and manage databases effectively | CL3                    |
| CO3    | Examine the concepts of relational algebra and apply on relational databases.                                                      | CL3                    |
| CO4    | Design standard databases for various Real-world problems                                                                          | CL4                    |

**ASSESSMENT STRATEGY**

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100%</b>   | <b>50</b>  |
|         | Continuous Internal Evaluation (CIE)        | 60 %          | 30         |
|         | Assignments                                 | 40 %          | 20         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100%</b>   | <b>50</b>  |

**SEE QUESTION PAPER PATTERN:**

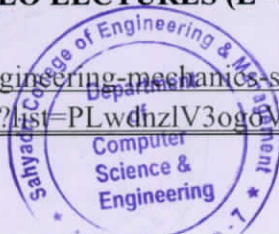
- The question paper will have two parts, A and B.
- The Question 1 in Part A is mandatory and can have any number of sub questions each of 1-3 marks totalling to 20 covering all the four modules.
- In Part B, Question 2 and 3 will be compulsory from first and second module.
- The Question No. 4 and 5 will be set from Module 3 and Question No. 6 or 7 from Module 4, with choice in respective modules.
- The students have to answer 4 full questions in Part B, wherein, there is no choice in Modules 1 and 2, however, will have choice in Modules 3 and 4.

**REFERENCE BOOKS:**

1. Database System Concepts by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw Hill, 7<sup>th</sup> Edition, 2020.
2. Fundamentals of Database Systems by Ramez Elmasri, Shamkant B. Navathe, Pearson, 7<sup>th</sup> Edition, 2016

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES)(if any):**

1. <https://www.coursera.org/learn/engineering-mechanics-statics>
2. <https://www.youtube.com/playlist?list=PLwdhzIV3ogcV7wYUV1S1FnfjCX0L8DAJX>







**DIGITAL IMAGE PROCESSING AND COMPUTER VISION LABORATORY**

**(Effective from the Academic Year 2027 - 2028)**

**VII SEMESTER**

|                                           |                |            |    |
|-------------------------------------------|----------------|------------|----|
| Course Code                               | <b>BCS705L</b> | CIA Marks  | 50 |
| Number of Contact Hours/Week (L: T: P: S) | 0:0:2:0        | SEE Marks  | 50 |
| Total Hours of Pedagogy                   | <b>24P</b>     | Exam Hours | 03 |

**CREDITS – 1**

**COURSE PREREQUISITES:**

- Basics of Python Programming
- Proficiency in usage of IDEs like Jupyter Notebook/ PyCharm.

**COURSE OBJECTIVES:**

- Design, analyze, and implement various algorithms in Python.
- Make use of different algorithmic design techniques to solve problems.
- Analyze and contrast the effectiveness of various algorithms.

**TEACHING - LEARNING STRATEGY:**

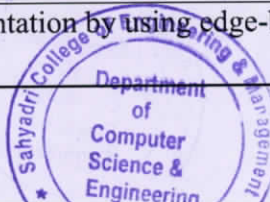
Following are some sample strategies that can be incorporate for the Course Delivery

- Chalk and Talk Method/Blended Mode Method
- Power Point Presentation
- Demonstration
- Expert Talk/Webinar/Seminar
- Video Streaming/Self-Study/Simulations
- Peer-to-Peer Activities
- Activity/Problem Based Learning
- Case Studies
- Any other innovative initiatives with respect to the Course contents

**LIST OF EXPERIMENTS**

**Design, develop, and implement the specified algorithms using Python Programming under LINUX/Windows environment.**

| Exp. No. | Description                                                                                                                                                                                                       | CO No. | Bloom's Taxonomy Level |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------|
| 1        | a) Develop a Program to read a digital image. Split and display image into 4 quadrants, up, down, right and left.<br>b) Perform conversion of images and complement of an image.                                  | CO1    | CL3                    |
| 2        | a) Read an image and extract and display low-level features such as edges, textures using filtering techniques.<br>b) Implement contrast adjustment of an image. Implement Histogram processing and equalization. | CO1    | CL3                    |
| 3        | Implement and compare the various linear filtering, nonlinear and bilateral filtering mechanisms for noise removal                                                                                                | CO2    | CL3                    |
| 4        | Implement image analysis using SIFT and HOG features                                                                                                                                                              | CO2    | CL3                    |
| 5        | Design a program for image segmentation by using edge-based segmentation                                                                                                                                          | CO3    | CL3                    |





|   |                                                                                                                                                                                                                                                                           |     |     |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
| 6 | Implement Object detection and Recognition on available online image datasets                                                                                                                                                                                             | CO3 | CL3 |
| 7 | Design a program that can perform classification on three different types of image data: digits, characters (letters) and faces.                                                                                                                                          | CO3 | CL3 |
| 8 | a) Develop a program to: Detect the contours of objects in the image and draw them on the original image. Use edge detection and contour finding methods.<br>b) For each detected contour, compute and draw a bounding box around it to highlight the object in the image | CO3 | CL3 |
| 9 | Given a dataset with multiple features, apply Principal Component Analysis (PCA) to reduce the dimensionality of the dataset to two principal components and visualize the transformed data in a 2D plot.                                                                 | CO4 | CL3 |

### COURSE OUTCOMES

Upon completion of this course, the students will be able to:

| CO No. | Course Outcome Description                                                                                    | Bloom's Taxonomy Level |
|--------|---------------------------------------------------------------------------------------------------------------|------------------------|
| CO1    | Demonstrate proficiency in using image processing libraries and frameworks for real-world tasks.              | CL3                    |
| CO2    | Design Image Enhancement and Filtering Techniques                                                             | CL3                    |
| CO3    | Develop and evaluate computer vision algorithms for feature extraction, segmentation, and object recognition. | CL3                    |
| CO4    | Apply the concepts of PCA for transformed data in 2D plot                                                     | CL3                    |

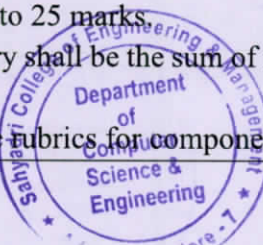
### ASSESSMENT STRATEGY

Assessment will be both CIA and SEE. Students learning will be assessed using Direct and Indirect methods:

| Sl. No. | Assessment Description                      | Weightage (%) | Max. Marks |
|---------|---------------------------------------------|---------------|------------|
| 1       | <b>Continuous Internal Assessment (CIA)</b> | <b>100 %</b>  | <b>50</b>  |
|         | Laboratory Work (A)                         | 50 %          | 25         |
|         | Laboratory Test (B)                         | 30 %          | 15         |
|         | Open Ended Experiments /Mini Projects (C)   | 20 %          | 10         |
| 2       | <b>Semester End Examination (SEE)</b>       | <b>100 %</b>  | <b>50</b>  |

### ASSESSMENT STRATEGY:

- In Laboratory Courses where component (C) is not a component of the assessment pattern, then component (A) will have 50% weightage (25 Marks), and component (B) will have 50% weightage (25 Marks). In such cases,
  - The average marks obtained across all the laboratory sessions (each laboratory session shall be evaluated for 25 marks) shall be the marks for component (A).
  - One or two laboratory tests [component (B)] similar to the SEE shall be conducted and the marks shall be scaled down to 25 marks.
  - The CIA marks for the laboratory shall be the sum of marks obtained for the component (A) and component (B).
- The course instructor will design the rubrics for component (C).







**SEE QUESTION PAPER PATTERN:**

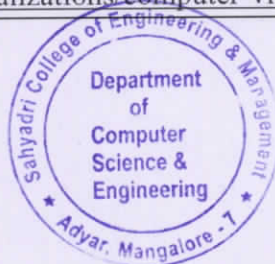
- All laboratory experiments should be included for practical examination, from which students are allowed to pick one experiment from the lot.
- SEE shall be conducted for 100 Marks and the marks will be scaled down to 50.
- General Marks Distribution: Procedure + Conduction + Viva = 20% + 50% + 30%.
- Change of experiment is allowed only once and 20% of the marks allotted to the Procedure will be made ZERO (if a question carries two experiments, both should be changed). The evaluation will be done for 80% of the total maximum marks.

**TEXT BOOKS:**

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing," Pearson Education, 4<sup>th</sup> Edition, 2018.
2. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2<sup>nd</sup> Edition, 2022.
3. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 1<sup>st</sup> Edition, 2003.
4. Anil K. Jain "Fundamentals of Digital Image Processing," PHI, 2015.

**REFERENCE WEB LINKS AND VIDEO LECTURES (E - RESOURCES) (if Any):**

1. <https://arsanatl.medium.com/introduction-to-digital-image-processing-computer-vision-and-opencv-92ce7383b24b>
2. [https://onlinecourses.nptel.ac.in/noc23\\_ee39/preview](https://onlinecourses.nptel.ac.in/noc23_ee39/preview)
3. <https://www.mccormick.northwestern.edu/electrical-computer/academics/graduate/masters/specializations/computer-vision-and-image-processing.html>



  
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