



CHRIST

(DEEMED TO BE UNIVERSITY)

B E N G A L U R U • I N D I A

FACULTY OF ENGINEERING

Kengeri Campus, Kanminike, Kumbalgodu, Bangalore - 560074

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

MASTER OF TECHNOLOGY

COMPUTER SCIENCE AND ENGINEERING

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1.INTRODUCTION

CHRIST(Deemed to be University) blossomed out of the educational vision of the Carmelites of Mary Immaculate (CMI) congregation founded by St Kuriakose Elias Chavara. He was a visionary, an educationist and a social reformer of the nineteenth century who founded the Congregation in 1831 in South India.

CHRIST(Deemed to be University) was established in July 1969 as Christ College. It was the first institution in Karnataka to be accredited by the National Assessment and Accreditation Council (NAAC). University Grants Commission (UGC) conferred Autonomy to the institution in 2004. It became the first College in South India to be reaccredited with A+ by NAAC in 2005. UGC identified it as an Institution with Potential for Excellence in 2006. Under Section 3 of the UGC Act, 1956, Ministry of Human Resources Development of the Union Government of India, vide Notification No. F. 9-34/2007-U.3 (A), declared Christ College as a Deemed to be University, in the name and style of CHRIST(Deemed to be University) in July 2008. The CHRIST was accredited with 'A' Grade by NAAC in 2016.

CHRIST(Deemed to be University) offers 46 Bachelor, 47 Master, 16 MPhil and 17 PhD Programs in Humanities, Social Sciences, Sciences, Commerce and Management, Education, Law and Engineering. The Institution which celebrates diversity has students from all the states of India and 58 countries across the globe.

CHRIST(Deemed to be University) rooted in Gospel values, is committed to provide holistic education through the development of intellectual competence, personal skills, inter-personal skills and societal skills. CHRIST welcomes to its fold students from all over the country and the world in an environment of religious harmony and secularism.

VISION

"EXCELLENCE AND SERVICE"

- ❖ CHRIST(Deemed to be University), a premier educational institution, is an academic fraternity of individuals dedicated to the motto of excellence and service. We strive to reach out to the star of perfection through an earnest academic pursuit for excellence and our efforts blossom into 'service' through our creative and empathetic involvement in the society to transform it.
- ❖ Education prepares one to face the challenges of life by bringing out the best in him/her. If this is well accepted, education should be relevant to the needs of the time and address the problems of the day. Being inspired by Blessed Kuriakose Elias Chavara, the founder of Carmelites of Mary Immaculate and the pioneer in innovative education, CHRIST(Deemed to be University) was proactive to define and redefine its mission and strategies reading the signs of the time.

MISSION STATEMENT

"CHRIST(Deemed to be University) is a nurturing ground for an individual's holistic development to make effective contribution to the society in a dynamic environment."

CORE VALUES

The values which guide us at CHRIST(Deemed to be University) are:

Faith in God

Moral Uprightness

Love of Fellow Beings

Social Responsibility

Pursuit of Excellence

DEPARTMENT VISION

“To fortify Ethical Computational Excellence”

DEPARTMENT MISSION

1. Imparts core and contemporary knowledge in the areas of Computation and Information Technology
2. Promotes the culture of research and facilitates higher studies
3. Acquaints the students with the latest industrial practices, team building and entrepreneurship
4. Sensitizes the students to serve for environmental, social & ethical needs of society through lifelong learning.

GRADUATE ATTRIBUTE

- Ability to comprehend the problem in a specific domain and implementation of the solution in an ethical way.
- Ability to use skilled communication to enhance understanding and work in a team to contribute positively with an international perspective
- Ability to exhibit skills in research and enquiry based learning to identify and creatively tackle problems.
- Ability to execute a team project in the specific domain after going through the process of understanding, analyzing, designing, implementing and testing with real time data.
- Ability to execute a solution based for social cause.

2. PROGRAMMES OFFERED

- **Undergraduate Programmes**(B.Tech, 8 Semester Program)
 - Bachelor of Technology in Automobile Engineering (AE)
 - Bachelor of Technology in Civil Engineering(CIVIL)
 - **Bachelor of Technology in Computer Science and Engineering (CSE)**
 - Bachelor of Technology in Electronics and Communication Engineering (ECE)
 - Bachelor of Technology in Electrical and Electronics Engineering (EEE)
 - **Bachelor of Technology in Information Technology (IT)**
 - Bachelor of Technology in Mechanical Engineering (ME)
- **Postgraduate Programmes**(M. Tech, 4 Semester Program)
 - **Master of Technology in Computer Science and Engineering (CSE)**
 - Master of Technology in Communication Systems(ECE)
 - **Master of Technology in Information Technology(Data Analytics)**
 - Master of Technology in Machine Design(MD)
 - Master of Technology in Power Systems(PS)
 - Master of Technology in Structural Engineering(SE)
- **Doctoral Programmes (Ph.D.)**(Doctor of Philosophy)
 - **Doctor of Philosophy (Ph.D.) in Computer Science and Engineering**
 - Doctor of Philosophy (Ph.D.) in Electronics and Communication Engineering
 - Doctor of Philosophy (Ph.D.) in Civil Engineering
 - Doctor of Philosophy (Ph.D.) in Electrical and Electronics Engineering
 - Doctor of Philosophy (Ph.D.) in Mechanical Engineering
 - **Doctor of Philosophy (Ph.D.) in Information Technology**

03. ELIGIBILITY CRITERIA

For Undergraduate Programmes

A pass in PUC (10+2) or equivalent with 50% marks in aggregate with Mathematics, Physics and Chemistry is the minimum eligibility for admission.

Lateral Entry:

Candidates who have successfully completed 3 year diploma in Engineering are eligible to apply for lateral entry into:

- Automobile Engineering (AE)
- B.Tech Civil Engineering (CE)
- B.Tech Mechanical Engineering (ME)
- **B.Tech Computer Science and Engineering (CSE)**
- B.Tech Electronics & Communication Engineering (ECE)
- B.Tech Electrical and Electronics Engineering (EEE)
- **B.Tech Information Technology (IT)**

Candidates will be admitted to second year of the programme only after appearing the CHRIST(Deemed to be University)selection process for Engineering programmes.

❖ For Postgraduate Programmes:

- **For Master of Technology in Computer Science and Engineering**
 - A Pass in B.Tech/B.E or M.Sc with 55% aggregate.
- For Master of Technology in Communication Systems
 - A Pass in B.Tech/B.E or M.Sc in Electronics and VLSI Design with 55% aggregate.
- For Master of Technology in Civil Engineering
 - A Pass in BE/B.Tech or M.Sc in Civil and VLSI Design with 55% aggregate.
- For Master of Technology in Mechanical Engineering
 - A Pass in BE/B.Tech with 55% aggregate.
- **For Master of Technology in Information Technology(Data Analytics)**
 - A Pass in B.Tech/B.E or M.Sc with 55% aggregate.

❖ For Doctoral Programmes (Ph.D.):

- A pass with 55% marks in post graduation and equivalent in the relevant subject from any recognized university.
- A research proposal (Maximum 1500 words) has to be submitted along with the application.

4. SELECTION PROCESS

1) Candidates can process the admission based on the Undergraduate Entrance Test and Ranking by COMEDK.

OR

2) CHRIST(Deemed to be University) Selection Process as given below:

Process	Particulars	Date	Venue/Centre
Entrance Test	CHRIST(Deemed to be University)Entrance test for each candidate	As per the E- Admit Card	As per the E- Admit Card
Personal Interview	Personal interview for 15 minutes for each candidate by an expert panel	As per the E-Admit Card	As per the E- Admit Card

Academic Performance	Assessment of past performance in Class 10, Class 11/12 during the Personal Interview	As per the E-Admit Card	As per the E- Admit Card
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5. ADMISSION PROCESS

Candidates will be intimated about the Selection status (Selected/Wait Listed/Not Selected) through the University Notice Board/on the “Application Status” link on University website. The Selection results will be declared within 24 hours of Personal Interview session.

The selected candidates must process admission at **Office of Admissions, Central Block, CHRIST(Deemed to be University) within 3 working days of declaration of Selection Process results/as per the stipulated date and time mentioned by Office of Admissions.**

Selected candidates should collect the Fee Challan from the Office of Admissions and remit the Annual fee at the South Indian Bank, CHRIST(Deemed to be University) Branch. The Offer of Admission will stand cancelled, if failing to remit the fee within the stipulated date and time.

Admission will not be processed without the presence of the candidate and the mandatory original documents mentioned below;

1. The Offer of Admission Card (E-Admission Card/Mail)
2. Class 10 Marks Statement
3. Class 11 Marks Statement, if Candidate is pursuing class 12 and appearing for final examination during March-April Month
4. Class 12 Marks Statement, if candidate has appeared and passed the Class 12 examination

The Institution ID card is a smart card, which is both an ID card as well as a South Indian Bank ATM card with a chip containing the student personal details. All transactions within the University campus after commencement of classes, including fees payment will be processed only through this card. It is also an access card for Library and other restricted places. Candidates are advised to collect the South Indian Bank account opening form along with fees challan and process it at the Bank branch within the Institution premises.

Candidates who fall under International student category (ISC), If selected, should register with the Foreigner Regional Registration Officer (FRRO/FRO) of the Local Police in Bangalore, India within 14 working days from the date of admission or arriving in Bangalore.

All International student category (ISC) candidates if studied in India should obtain an NOC from the previous qualifying institution.

6. GENERAL RULES

- There is a grading scheme for each paper and for all the courses.
- All marks will indicate the marks, percentage obtained, grade and grade point average.
- The grade point average will be calculated as follows: for each subject, multiply the grade point with the number of credits; divide the sum of product by the total number of credits.
- The CGPA [Cumulative GPA] is calculated by adding the total number of earned points [GP x Cr] for all semesters and dividing by the total number of credit hours for all semesters.

$$\text{GPA} = \frac{\sum[\text{GPA} \times \text{Cr}]}{\sum \text{Cr}}$$

7. GRADING SCHEME FOR EACH PAPER: POSTGRADUATE COURSES

Percentage	Grade	Grade Point- 4 Point Scale	Grade Point-10 Point Scale	Interpretation	Class
80 and above	A+	4.0	10.00	Excellent	First Class with Distinction
75-79	A	3.75	9.38	Very Good	
70-74	A-	3.5	8.75	Good	First Class
65-69	B+	3.0	7.50	Good	
60-64	B	2.5	6.25	Above Average	
55-59	C+	2.0	5.00	Average	Second Class
50-54	C	1.5	3.75	Satisfactory	
40-49	C-	1.0	2.50	Exempted if aggregate is more than 50%	Pass Class
39 and below	F	0	0	Fails	Fail

1. Students has to score minimum 40% in ESE, 40 % in both CIA + ESE to pass in a course.
2. Students has to secure 50% aggregate to secure a pass in the semester

8. BRIEF HISTORY OF DEPARTMENT

Department of Computer Science and Engineering started of journey in the year 2009 to produce qualified Engineers for the society with variety of skills. The department offers the following degrees Bachelor of Technology, Master of Technology, and Doctor of

Philosophy in the areas of Computer Science and Engineering and Information Technology. Over the decade the department has inducted faculties to collectively pooled resources who can train the students in Artificial Intelligence, Machine learning, Computer Vision, Algorithms design, Cryptography, Computer Networking, Data mining, Data science, BIG DATA, Digital Image Processing, text mining, knowledge representation, soft computing, Cloud computing, etc.. The department from its inception has been keen on setting up labs for the students at present the labs infrastructure for the students are Tannenbaum lab, High Performance computing Lab, Bring your Own Device lab, Machine learning lab, CISCO Networking Lab, Red Hat Linux lab, specifically, for the students to be prepared for the lab curriculum and their research.

The department periodically conducts hands-on workshop on recent technology like Internet of Things, Cloud computing, Machine learning so that the students are connected with current and technologies. The department imparts teaching in Holistic method, where students who are trained under holistic education will be better citizens of Nation. The main educational goal is to prepare students for research and career in industry or in universities.

9. PROGRAMME OVERVIEW

The two year Post graduate program M. Tech in Computer Science and Engineering started in 2009. The course was started mainly to cater to the increasing demand for higher studies in the country. A growing intake with students from across the nation shows the popularity of the program.

The Department strives to give skills essential to practicing engineering professionals; it is also an objective to provide experience in leadership, management, planning, and organization. The department understands its role in developing and evaluating methods that encourage students to continue to learn after leaving the university. We believe that the student opportunities and experiences should lead to an appreciation of the holistic development of individual. We also try to pass to our students our passion for what we do, and to have the students comprehend that we also desire to continue to learn.

10. PROGRAMME OBJECTIVE

The Post graduate program aims to offer advanced knowledge in specific areas. Focus on research is a special feature of our program, in CHRIST (Deemed to be University) Faculty of Engineering where students are encouraged to undertake research level projects and have mandatory publications in national level conferences. Specific subjects for industry level skills are also offered for better employability.

11. TEACHING PEDAGOGY

- Team/Class room teaching.
- PowerPoint presentations and handouts.
- Simulated situations and role-plays.
- Video films on actual situations.
- Assignments.
- Case Studies.
- Exercises are solved hands on.

- Seminars
- Industry / Field visits.
- Information and Communication Technology.
- Project work.
- Learning Management System- Moodle

12. ASSESSMENT RULES AND DETAILS OF CIA (Continuous Internal Assessment):

Assessment is based on the performance of the student throughout the semester.

Assessment of each paper

- Continuous Internal Assessment (CIA) for Theory papers: 50% (50 marks out of 100 marks)
- End Semester Examination(ESE) : 50% (50 marks out of 100 marks)

Components of the CIA

CIA I : Mid Semester Examination (Theory)	: 25 marks
CIA II : Assignments	: 10 marks
CIA III: Quizzes/Seminar/Case Studies/Project Work	: 10 marks
Attendance	: 05 marks
Total	: 50 marks

For subjects having practical as part of the subject

End semester practical examination	: 25 marks
Records	: 05 marks
Mid semester examination	: 10 marks
Class work	: 10 marks
Total	: 50 marks

Mid semester practical examination will be conducted during regular practical hour with prior intimation to all candidates. End semester practical examination will have two examiners an internal and external examiner.

❖ Assessment of Project Work(Phase-II) and Dissertation

- Continuous Internal Assessment:100 Marks
 - ◆ Presentation assessed by Panel Members
 - ◆ Assessed by Guide
- End Semester Examination:100 Marks
 - ◆ Viva Voce
 - ◆ Demonstration
 - ◆ Project Report
- Dissertation (Exclusive assessment of Project Report): 100 Marks

❖ Assessment of Internship (M. Tech)

All students should complete internship before 3rd semester. This component carries 2 credits.

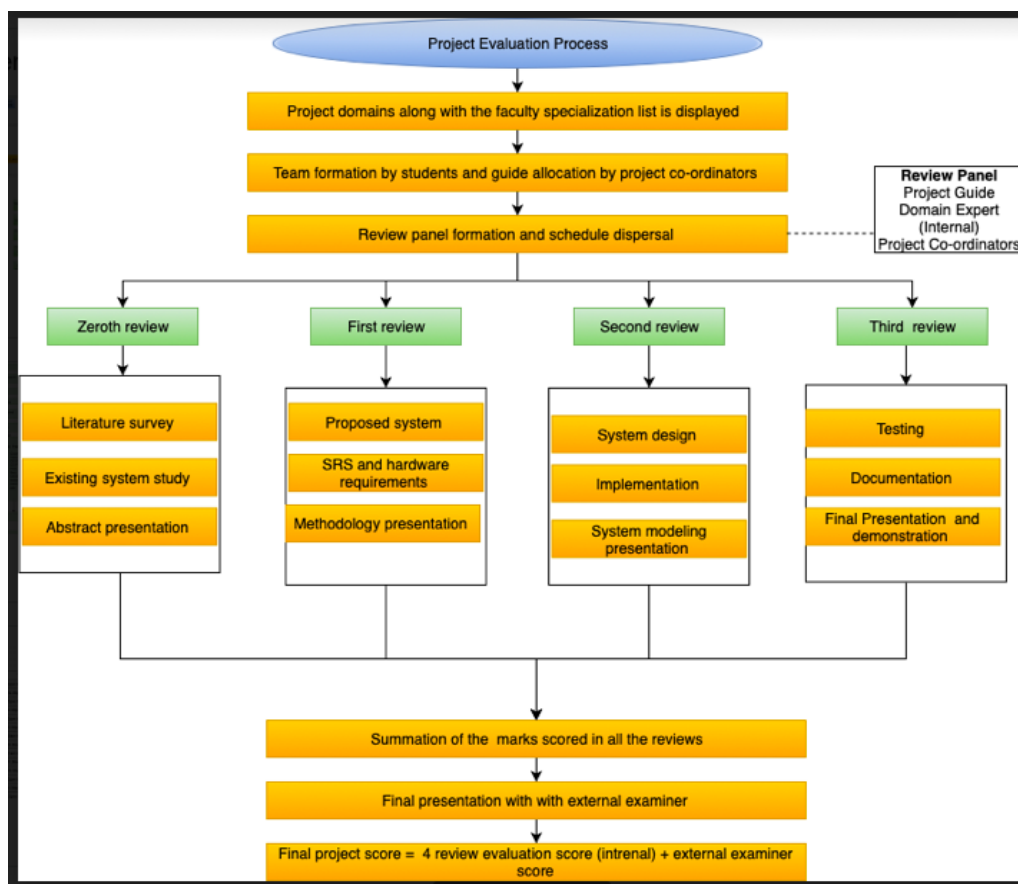
- Continuous Internal Assessment:2 credits
 - Presentation assessed by Panel Members

PROJECT EVALUATION

The project work carries a total marks of 200 out of which 100 marks is CIA and 100 marks is allotted for ESE. The following process is carried for continuous monitoring and evaluation of the student project work.

- Once the supervisors are allotted to the students, the students have to regularly meet the project supervisor.
- On project days, the project coordinator takes attendance at three slots and the students have to maintain a notebook to record the activities done during that day and get it signed by the supervisor.
- Within one month of the beginning of the eighth semester, a zeroth review will be conducted where students need to present their findings based on literature survey to the panel members which will consist of the supervisor, project coordinator and faculty experts. Only if the panel members accept the project to be considered as a final year project, it can be carried out otherwise the student group will be given two weeks to modify their idea and present again.
- One review in front of the panel consisting of supervisor, project coordinator and faculty experts will be conducted every month thus resulting in 3 reviews including the zeroth review. The students shall prepare a PowerPoint presentation and present it to the panel. Each review will be awarded marks and will be considered for final CIA evaluation. The guide lines for preparing the power point slides are issued to the students by the project coordinator.
- The third review will be considered as the final review and a model presentation for the external viva-voce presentation of the project so that students are ready.
- Following process is adopted for project report finalizing
 - The Deanery has adopted a latex template for preparing the Project thesis report. Special one day training on latex and how to use the template will be given to the students by the faculty members.
 - The project report approved by the guide will then be sent to the project coordinator by the respective guides.
 - The project reports received by the project coordinator will then be forwarded to two internal reviewers for reviewing the report.
 - The student has to incorporate the changes mentioned by the reviewers and the modified report will be sent by the respective guides to the project coordinator and only on the final approval from the project coordinator, the students can go ahead with the hard binding of the reports.
 - The hard bound reports will then be signed by all the students, guide, head of the department, Dean and the external examiner.
- An end semester project viva voce is conducted with the panel of internal and external examiners. The external examiner from other institution / university is appointed by the controller of examinations

The project evaluation process is shown below:



Process to assess individual and team performance

- Project group size varies from 2 to 4 members. The groups are formed by the students based on their area of interest.
- Thus students should be assessed both individually as well as in a team. For this, the department follows a process of reviews where the students will present for three times in front of the same panel members starting from the zeroth review.
- This will have continuity and the faculty members assess individual performance as well as team performance.
- A rubric is also formed for the project work which clearly mentions the criteria for assessing individual performance thus making the students aware of what they need to do in the beginning of the semester itself.

A sample review evaluation sheet is shown below where students are assessed individually based on their performance in the review presentation

Below diagram shows the individual and team assessment through a rubric:

Dimension	Score 1	Score 2	Score 3	Score 4
1. Contribution to the team project/work	<ul style="list-style-type: none"> Does not collect any relevant information No useful suggestions to address team's needs 	<ul style="list-style-type: none"> Collects information when prodded Tries to offer some ideas, but not well developed and/or clearly expressed to meet team's needs 	<ul style="list-style-type: none"> Collects basic, useful information related to the project Occasionally offers useful ideas to meet the team's needs 	<ul style="list-style-type: none"> Collects and presents to the team a great deal of relevant information Offers well-developed and clearly expressed ideas directly related to the group's purpose
2. Taking responsibility	<ul style="list-style-type: none"> Does not perform assigned tasks Often misses meetings and, when present, does not have anything constructive to say Relies on others to do the work 	<ul style="list-style-type: none"> Performs assigned tasks but needs many reminders Attends meetings regularly but generally does not say anything constructive Sometimes expects others to do his/her work 	<ul style="list-style-type: none"> Performs all assigned tasks Attends meetings regularly and usually participates effectively Generally reliable 	<ul style="list-style-type: none"> Performs all tasks very effectively Attends all meetings and participates enthusiastically Very reliable.
3. Valuing other team members and quality of interactions	<ul style="list-style-type: none"> Often argues with team mates Doesn't let anyone else talk Occasional personal attacks and "put-downs" Wants to have things done his/her way and/or does not listen to alternate approaches 	<ul style="list-style-type: none"> Usually does much of the talking Does not pay much attention when others talk Often assumes others' ideas will not work No personal attacks and put-downs but sometimes patronizing 	<ul style="list-style-type: none"> Generally listens to others' points of view Always uses appropriate and respectful language Tries to make a definite effort to understand others' ideas 	<ul style="list-style-type: none"> Always listens to others and their ideas Helps them develop their ideas while giving them full credit Always helps the team reach a fair decision

13. QUESTION PAPER PATTERN:

End Semester Examination (ESE) :

Theory Papers:

The ESE is conducted for 100 marks of 3 hours duration.

The syllabus for the theory papers is divided into FIVE units and each unit carries equal weightage in terms of marks distribution.

Question paper pattern is as follows.

Two full questions with either or choice, will be drawn from each unit. Each question carries 20 marks. There could be a maximum of three sub divisions in a question. The emphasis on the questions is broadly based on the following criteria:

50 % - To test the objectiveness of the concept

30 % - To test the analytical skill of the concept

20 % - To test the application skill of the concept

Laboratory / Practical Papers:

The ESE is conducted for 50 marks of 3 hours duration. Writing, Execution and Viva - voce will carry weightage of 20, 20 and 10 respectively.

Mid Semester Examination (MSE) :

Theory Papers:

The MSE is conducted for 50 marks of 2 hours duration.

Question paper pattern; Five out of Six questions have to be answered. Each question carries 10 marks.

Laboratory / Practical Papers:

The MSE is conducted for 50 marks of 2 hours duration. Writing, Execution and Viva - voce will carry weightage of 20, 20 and 10 respectively.

Holistic Education:

End Semester Examination	25 Marks
Participation	25 Marks
Total	50 Marks

14. CURRICULUM DESIGN PROCESS

CHRIST (Deemed to be University), a premier educational institution, is an academic fraternity of individuals dedicated to the motto of "Excellence and Service".

- Department of Computer Science and Engineering is under the deanery of Faculty of Engineering of CHRIST (Deemed to be University).
- The department offers B. Tech in Computer Science and Engineering program whose curriculum should be approved by the Board of Studies (BoS) and University Academic Council (AC).

The University has laid down a regulation for Curriculum design, review and Approval which is as below:

Board of Studies is the primary academic body responsible for initiating all or any proposal concerning academic matters of the University including but not limited to

- Program structure
- Development and review of curriculum
- Syllabus
- Question paper pattern
- Question paper standards
- Examination systems
- Internal assessments
- Student development
- Teaching methodology
- Pedagogy
- Appointment of examiners
- Introduction of new programs/courses etc.

1. There shall be one Board of Studies (BoS) for each academic department of the University.
2. The Board of Studies of each department shall consist of:
 - a. Dean of Faculty/Head of the Department – Chairperson.
 - b. All Professors, Associate Professors, and Assistant Professors of the department.
 - c. Two members from teaching profession (outside the University) of the specialization not below the rank of Associate Professor, nominated with the approval of the Academic Council.
 - d. Up to two members from the Industry / Entrepreneurs, nominated with the approval of the Academic council.
 - e. Chairperson may nominate one of the faculty members of the department to be the Secretary of Board of Studies.
3. The term of the nominated members shall be two years and they are eligible for re-nomination.
4. Meeting of Board of Studies may be convened as and when needed but shall be held at least once in a year.
5. The quorum for the meeting of Board of Studies shall be two-third of the total membership of the Board of Studies of the Department.
6. The functions of Board of Studies are:
 - a. Preparation of syllabi for various program keeping in view the objectives of the program, interest of the stakeholders, and the level of knowledge expected of the subject. The syllabus must be as detailed as possible with

breakup of topics and sub topics to enable meaningful preparation of course plan, and propose up-to-date suggested reading and reference books/material with author and publisher information.

- b. Review of curriculum periodically for updating and revision according to changes in theory and practices from time to time.
- c. Suggest innovative teaching practices and evaluation methods.
- d. Suggest procedure for continuous internal assessment of students.
- e. Recommend panel of examiners for approval by the Academic Council.
- f. Propose introduction of new undergraduate, postgraduate and pre-doctoral, Doctoral, Diploma and Certificate program along with details of program structure, curriculum, and duration, for consideration by the Academic Council.
- g. Coordinate research, teaching, extension and other academic activities relating to the department.
- h. Suggest panel of experts to be nominated to the Board of Studies.
- i. Suggest co-curricular activities for student development including holistic education materials.
- j. Suggest value-added program for improving the quality standard of the students.
- k. Suggest methods of enhancing quality of teaching and teacher training program.
- l. Review and suggest ways to enhance the quality and quantity of research and publications by students and faculty.
- m. Review and suggest modes of increasing external research projects and consultancies.
- n. Review and suggest measures to improve the quality of Refresher Courses, Quality Improvement Program (QIP), Seminars, Conferences, and Workshops relating to the Department.
- o. The Academic Council may direct any other functions, as it may deem necessary

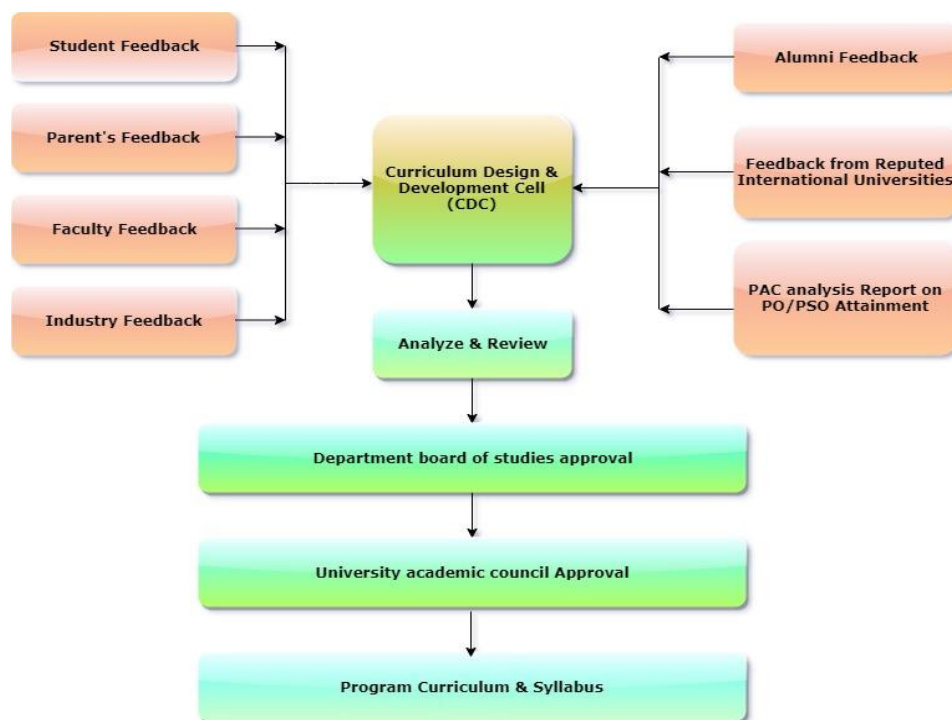


Figure 1 : Flow Chart for Curriculum Design Process

The Department of Computer Science and Engineering follows the following process for curriculum design:

1. The Head of the Department (HoD) in consultation with the Department Advisory Committee (DAC) nominates a BOS in-charge for the department.
2. In consultation with the BOS in-charge, the HoD formulates a Curriculum Design & Development Cell for the department (CDC). The CDC consists of professors, senior teachers with the HoD as the chairperson. The objective of the CDC is to review the curriculum and suggest recommendations every year to the BOS.
3. Meeting of the CDC Members may be convened as and when needed but should be held at least thrice in a year.
4. The CDC members will consolidate the feedback collected from all the stakeholders including students, faculty members, parents, alumni, employers, syllabus of reputed international universities and the entire course exit surveys collected in an academic year and analyze the feedbacks.
5. In consultation with Program Coordinator, HoD will formulate Program Assessment committee (PAC). PAC consists Program Coordinator, Domain Expert for each domain of Courses, two Associate professors and two assistant professor as its members and Program coordinator will be chair person.
6. The Program Assessment Committee (PAC) analyses the results which includes both direct and indirect assessment and submits a report which includes either an action plan in case of non PO/PSO attainment or a target increment in case of PO/PSO attainment to the CDC for their review. Analysis is done for attaining the PO/PSO's through the curriculum.
7. The CDC members then review the analysis of the PAC as well as review the feedbacks collected on the curriculum from the various stakeholders and provide their recommendations to the BOS on HOD's approval.
8. On the approval of the Board of Studies, the final approval of the curriculum is done by the academic council of the University.

State the process used to identify extent of compliance of the curriculum for attaining the Program Outcomes and Program Specific Outcomes

The following steps abstract the process of curriculum design and approval for the entire program:

- The curriculum is approved by the Board of Studies (BOS) which is held once every year in the month of either January/February.
- Before the BOS meeting, the department Curriculum Design & Development Cell (CDC) reviews all the feedbacks collected from the students, alumni, parents, recruiters and the faculty members and also analyze the PO and PSO attainment report submitted by PAC.
- The PO and PSO attainment with direct and indirect assessment is done by the PAC and the shortcomings, if any, are identified and recommended for consideration to the CDC.
- The CDC summarizes all the analysis and submit their recommendations for the approval of the BOS in the subsequent academic year.
- They are documented in the action plan of each PO/PSO and at the course level and reviewed every academic year for its attainment.

To satisfy the extent of compliance of curriculum for attaining the POs and PSOs, Course Outcomes for each subject in the programme is identified and each Course Outcome is mapped with POs and PSOs with the correlation level and attained the extent of compliance of the curriculum with the PO/PSO's.

- The curriculum is categorized based on the broader domains like basic sciences, engineering sciences, humanities and social sciences, program core, program electives, open elective, projects, seminars, internships etc.
- Each category is then mapped to the PO/PSO based on the courses from that category getting mapped to the PO/PSO's.
- This mapping gives us an idea where the PO/PSO are not getting mapped or getting mapped at a lower extent which allows the CDC to brainstorm on the categories on which curriculum needs to be improved.

Following is the process used to categorize the curriculum into broader domains and further mapped to PO/PSO's:

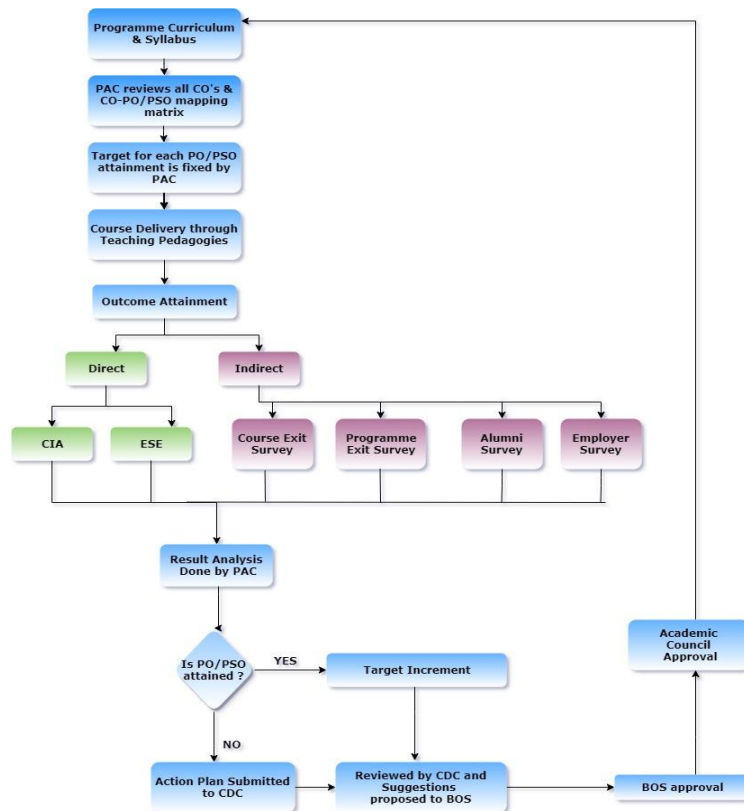
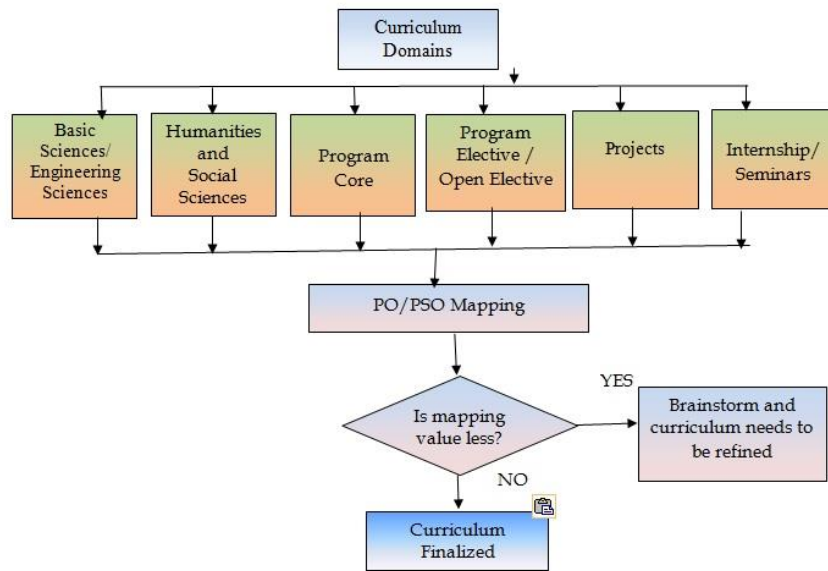


Figure 3: PO/PSO Attainment & Target Setting Process

Extent of compliance calculation is also analyzed through various feedback collected from various stakeholders. The following feedbacks are collected as part of indirect assessment of PO/PSO

Alumni Feedback

- The feedback regarding their adaptability to the industry or higher studies is taken and analyzed for further improvement of PO/PSO attainment.
- This feedback is also used as inputs in the curriculum development and design.

Student Feedback

- The feedback from students is collected for every course as well as at the end of the program. This feedback is analyzed for CO attainment of each course as well as in PO/PSO attainment.
- This feedback is also used as inputs in the curriculum development and design.

Employer Feedback

- This feedback is collected to enhance the program curriculum and allows us to understand where the PO attainment can be improved and thus helps in improved attainment.
- This feedback is also used as inputs in the curriculum development and design

Parent Feedback

- Parents are important stakeholders in any educational institution. This feedback is taken to survey the parent community as far as PO/PSO attainment is concerned.

15. LIST OF COURSES FOCUSSING ON EMPLOYABILITY/ ENTREPRENEURSHIP / SKILL DEVELOPMENT

Entrepreneurship	Employability	Skill Development
MTCS112 - Professional Practice - I: Teaching Skills, Laboratory Skills and other professional activities and Research Methodology Skills.	MTCS232: Data Science: Data analytics skill MTCS381: Internship: Industry based training 8 months MTCS382/483Dissertation Phase -I & II : Project implementation on advanced topics	MTCS131:Advanced Algorithms: problem solving skill MTCS132: Advanced Digital Image Processing: R & D MTCS231: Computer Communication Networks: Computer network skill
MTCS213 - Professional Practice - II: Entrepreneurship Skills and Presentation Skills.	MTCS141E01-Advanced Software Testing : Testing skill	MTCS142E03-Advanced Soft Computing: R & D
MTCS121-Research Methodology and IPR: Research Methodology Skills.	MTCS141E02-Object Oriented System Design: design skill	MTCS345E01-Agent Based Intelligent System: R & D
MTCS111/ MTCS212 Audit course 1/2: Audit courses	MTCS141E03-Software Project Management: software engineering skill MTCS141E04-Software Quality Assurance: quality estimation and checking skill	MTCS345E02-Advanced Artificial Intelligence: R & D MTCS345E03-Pattern Recognition: R & D MTCS345E04-Natural Language Processing: R & D
	MTCS142E01-Big Data Analytics: Real time Data analytical skill MTCS142E02-Machine Learning- Self learning algorithms design skill	MTCS345E05-Bio Informatics: R & D MTCS345E07-Advanced Computer Architecture : system architecture skill

<p>MTCS142E04-Visualization Techniques: Pre and post processing skill</p> <p>MTCS142E05-Information Retrieval- Storage management skill</p> <p>MTCS243E01-Cloud Computing: efficient computation techniques</p> <p>MTCS243E02-Advanced Mobile Computing: mobile software development skill</p> <p>MTCS243E03-Distributed Computing: efficient computation techniques</p> <p>MTCS243E04-Advanced Parallel Computing: efficient computation techniques</p> <p>MTCS244E01-Internet of Things: device and network skill</p> <p>MTCS244E02-Ad hoc Networks: dynamic network design skill</p> <p>MTCS244E03-Advanced Embedded Systems: Embedded Systems design skill</p> <p>MTCS244E04-Big Data Analytics for IoT: analytics skill</p> <p>MTCS244E05-Network Security: distributed environment security issues</p> <p>MTCS345E06-Multimedia Systems : software application development skill</p> <p>MTCS345E08-Software Process Management: software life cycle skill</p> <p>MTCS345E09-Very Large Database Management Systems: data base design for larger datasets</p> <p>MTCS345E10-Web Technology : web development skill</p> <p>MTCS345E11-XML And Web Services: unstructured data representation skill</p> <p>MTIT343E07-Modern Software Engineering Concepts : Software process skill</p> <p>MTIT343E08-Software</p>	<p>MTIT133-Mathematical Foundation for Information Science: mathematic fundamentals skill</p> <p>MTIT241E04-Computer Vision: R & D</p> <p>MTIT343E03-Deep and Reinforcement Techniques: R & D</p> <p>MTIT343E06-Theory of Computation</p> <p>MTIT343E09-Operations Research : R & D</p>
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	Reliability and Metrics : Software quality measurement skill	
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16. LIST OF COURSES FOCUSING ON REGIONAL NEEDS, NATIONAL NEEDS AND GLOBAL NEEDS

Identification of local needs	Identification of regional needs	Identification of national needs	Identification of global needs	Supporting Evidences/ Documents
<p>MTCS112 Professional Practice - I: Teaching Skills, Laboratory Skills and other professional activities and Research Methodology Skills. MTCS111/ MTCS212 Audit course 1/2: Audit courses, MTCS213 - Professional Practice - II: Entrepreneurship Skills and Presentation Skills, MTCS381: Internship: Industry based training 8 months</p>	<p>MTCS112 Professional Practice - I: Teaching Skills, Laboratory Skills and other professional activities and Research Methodology Skills. MTCS111/ MTCS212 Audit course 1/2: Audit courses, MTCS213 - Professional Practice - II: Entrepreneurship Skills and Presentation Skills, MTCS232: Data Science: Data analytics skill MTCS382/483Dissertation Phase -I& II : Project implementation on advanced topics MTCS141E01- Advanced Software Testing : Testing skill MTCS141E02- Object Oriented System Design: design skill MTCS141E03- Software Project Management: software engineering skill MTCS141E04- Software Quality Assurance: quality estimation and</p>	<p>MTCS112 Professional Practice - I: Teaching Skills, Laboratory Skills and other professional activities and Research Methodology Skills. MTCS111/ MTCS212 Audit course 1/2: Audit courses, MTCS213 - Professional Practice - II: Entrepreneurship Skills and Presentation Skills, MTCS345E04- Natural Language Processing: R & D MTCS345E05-Bio Informatics: R & D MTCS345E07- Advanced Computer Architecture system :architecture skill MTIT133- Mathematical Foundation for Information Science: mathematic fundamentals skill MTIT241E04- Computer Vision: R & D MTIT343E03-Deep and Reinforcement Techniques: R & D MTCS345E02-</p>	<p>MTCS112 - Professional Practice - I: Teaching Skills, Laboratory Skills and other professional activities and Research Methodology Skills. MTCS111/ MTCS212 Audit course 1/2: Audit courses, MTCS213 - Professional Practice - II: Entrepreneurship Skills and Presentation Skills, MTCS345E02- Advanced Artificial Intelligence: R & D MTCS345E03- Pattern Recognition: R & D MTCS345E04- Natural Language Processing: R & D MTCS345E05-Bio Informatics: R & D</p>	<p>Since Bangalore is considered as IT Capital of India,hence companies are looking for post graduate students with sound domain knowledge for roles in emerging areas such as AI, ML,IOT,Data Science, Robotics and Computer Vision. Most of the MNC's are having their Asia Pacific presence in India. Since the focus of technology sector shifted to emerging fields , hence demand for talents in such niche areas have also grown at a faster pace, unfurling expanding opportunities for PG students. According to the survey conducted on the employment by Network World by IDG the following facts are being presented: The overall average salary for bachelor's degree</p>

	<p>checking skill MTCS142E01-Big Data Analytics: Real time Data analytical skill MTCS142E02- Machine Learning-D Self learning algorithms design skill MTCS142E04- Visualization Techniques: Pre and post processing skill MTCS142E05- Information Retrieval- Storage management skill MTCS243E01- Cloud Computing: efficient computation techniques</p>	<p>Advanced Artificial Intelligence: R & D MTCS345E03- Pattern Recognition: R &</p>	<p>graduates earning computer science degrees is projected to be \$69,188 this year, according to the National Association of Colleges and Employers (NACE)(Source: <a href="https://www.nac
 eweb.org/job-
 market/compensa
 tion/stem-majors-
 projected-to-be-
 class-of-2019s-top-
 paid/">https://www.nac eweb.org/job- market/compensa tion/stem-majors- projected-to-be- class-of-2019s-top- paid/). That is the second-highest starting salary, behind only engineering graduates, who are projected to earn \$66,521. According to NACE survey top paid engineering graduate is Computer Science with annual package of \$67,539(Source: <i>Winter 2019 Salary Survey</i>, National Association of Colleges and Employers) . Additionally, NACE reports that among the 2019 crop of new graduates, those majoring in computer science enjoyed the highest full-time employment rate (76%) within six months of their graduation.Accord ing to MIT Graduate survey</p>
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			<p>report 2018, the percentage of students availing internship opportunities have consistently increased to 33% from 28% in the previous year. The percentage of students who have received an offer has also increased to 61% from 51% in the previous year. Top industries hiring MIT a graduate continues to be highest at 22% in the software sector compared to other domains. Top industries hiring MIT masters graduates in software sector stands at 12% making it the second highest recruitments. The percentage of PhD graduate seeking fulltime employment in industries has increased 59% from 51% in the previous year. Top industries hiring MIT PhD graduates in the software sector continues to be second highest at 10% (source: https://capd.mit.edu/sites/default/files/documents/MIT%20Employer%20Presentation-4-1-18SelectSlides.pdf)</p>
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			<p>Job industries are giving raising preference to Post graduate students and research scholars for cutting edge work in research and development. At IIT madras, the percentage of Post graduate placements continues to rise at 71%(2017-18) from 63% in the previous year. Similarly the percentage of research scholar placements has continues to rise at 36%(2017-18) from 23% in the previous year. All the four buckets under which companies were slotted for campus placements (analytics, finance, core, computer science) continues to prefer PG and PhD students. (Source: story:June 11, 2018">https://www.indiatoday.in>story:June 11, 2018). According to this survey Karnataka was the second highest state with maximum hiring activity after Maharashtra in the year 2018-19. Candidates from engineering domain were hired at 23% which is maximum across</p>
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			<p>all the domains. Among the engineering courses, CS/IT continues to secure highest employability percentage at 62%. Bangalore poses to be the number one city with highest employability. Karnataka stands at number one in the areas of learning agility and self determination in stateswide availability of skills. (source: India skills report 2019).As per the survey conducted by CDC team, the preference for opting CS/IT discipline as well as employability and opportunities continues to be highest in Software sector.</p>
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17. STAKE HOLDERS FEEDBACK

Category	Total Number of Requests	Total Number of Responses	Excellent	Good	Satisfactory	Average	Need to Improve
Alumni	20	20	11	9	0	0	0
Student	250	203	58	82	52	9	2
Industry	20	21	11	10	0	0	0
Parent	20	19	16	3	0	0	0
Teachers	45	42	40	2	0	0	0

18. COURSE STRUCTURE

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING M.TECH in CSE

COURSE STRUCTURE

M.TECH - (FOR 2020-2022BATCH)

I SEMESTER

Sl. No	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
			L	T	P		L	T	P	
THEORY										
1	MTCS131	Research Methodology and IPR	3	0	0	100	3	0	0	3
2	MTCS133	Advanced Algorithms	3	0	0	100	3	0	0	3
3	MTCS135	Advanced Digital Image Processing	3	0	0	100	3	0	0	3
4	MTCS141	Elective - I	3	0	0	100	3	0	0	3
5	MTCS142	Elective - II	3	0	0	100	3	0	0	3
6	HE171	Holistic Education-I	1	0	0	-	1	0	0	1
PRACTICAL										
7	MTCS151	Advanced Algorithms Lab	0	0	4	50	0	0	2	2
8	MTCS152	Advanced Digital Image Processing Lab	0	0	4	50	0	0	2	2
9	MTCS111	Audit Course -1	2	0	0	-	0	0	0	0
10	MTCS112	Professional Practice-I	0	0	2	50	0	0	1	1
		TOTAL	18	0	10	650	16	0	5	21

II SEMESTER

Sl. No	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
			L	T	P		L	T	P	
THEORY										
1	MTCS231	Computer Communication Networks	3	0	0	100	3	0	0	3
2	MTCS232	Data Science	3	0	0	100	3	0	0	3
3	MTCS243	Elective - III	3	0	0	100	3	0	0	3
4	MTCS244	Elective - IV	3	0	0	100	3	0	0	3
5	HE271	Holistic Education-II	1	0	0	-	1	0	0	1
PRACTICAL										
6	MTCS251	Networking Lab	0	0	4	50	0	0	2	2
7	MTCS252	Data Science Lab	0	0	4	50	0	0	2	2
8	MTCS212	Audit Course-2	2	0	0	-	0	0	0	0
9	MTCS213	Professional Practice-II	0	0	2	50	0	0	1	1
		TOTAL	15	0	10	550	13	0	5	18

III SEMESTER

Sl. No	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	MTCS345	Elective - V	3	0	0	100	3	0	0	3
2	MTCS361	Elective - VI(Global)	3	0	0	100	3	0	0	3
3	MTCS381	Internship	0	0	4	-	0	0	2	2
4	MTCS382	Dissertation Phase -I	0	0	20	200	0	0	10	10
Total			6	0	24	400	6	0	12	18

IV SEMESTER

Sl. No	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	MTCS483	Dissertation Phase - II	0	0	32	200	0	0	16	16
Total			0	0	32	200	0	0	16	16

LIST OF ELECTIVES (CS/IT -Basket)

Sl. No	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
			L	T	P		L	T	P	
MTCS141- ELECTIVE - I										
1	MTCS141E01	Advanced Software Testing	3	0	0	100	3	0	0	3
2	MTCS141E02	Object Oriented System Design	3	0	0	100	3	0	0	3
3	MTCS141E03	Software Project Management	3	0	0	100	3	0	0	3
4	MTCS141E04	Software Quality Assurance	3	0	0	100	3	0	0	3
MTCS142- ELECTIVE - II										
1	MTCS142E01	Big Data Analytics	3	0	0	100	3	0	0	3
2	MTCS142E02	Machine Learning	3	0	0	100	3	0	0	3
3	MTCS142E03	Advanced Soft Computing	3	0	0	100	3	0	0	3
4	MTCS142E04	Visualization Techniques	3	0	0	100	3	0	0	3
5	MTCS142E05	Information Retrieval	3	0	0	100	3	0	0	3
MTCS243- ELECTIVE - III										
1	MTCS243E01	Cloud Computing	3	0	0	100	3	0	0	3
2	MTCS243E02	Advanced Mobile Computing	3	0	0	100	3	0	0	3
3	MTCS243E03	Distributed Computing	3	0	0	100	3	0	0	3
4	MTCS243E04	Advanced Parallel Computing	3	0	0	100	3	0	0	3
MTCS244- ELECTIVE - IV										
1	MTCS244E01	Internet of Things	3	0	0	100	3	0	0	3
2	MTCS244E02	Ad hoc Networks	3	0	0	100	3	0	0	3
3	MTCS244E03	Advanced Embedded Systems	3	0	0	100	3	0	0	3
4	MTCS244E04	Big Data Analytics for IoT	3	0	0	100	3	0	0	3
5	MTCS244E05	Network Security	3	0	0	100	3	0	0	3
MTCS345- ELECTIVE - V										
1	MTCS345E01	Agent Based Intelligent System	3	0	0	100	3	0	0	3
2	MTCS345E02	Advanced Artificial Intelligence	3	0	0	100	3	0	0	3
3	MTCS345E03	Pattern Recognition	3	0	0	100	3	0	0	3
4	MTCS345E04	Natural Language Processing	3	0	0	100	3	0	0	3
5	MTCS345E05	Bio Informatics	3	0	0	100	3	0	0	3
6	MTCS345E06	Multimedia Systems	3	0	0	100	3	0	0	3
7	MTCS345E07	Advanced Computer Architecture	3	0	0	100	3	0	0	3
8	MTCS345E08	Software Process Management	3	0	0	100	3	0	0	3
9	MTCS345E09	Very Large Database Management Systems	3	0	0	100	3	0	0	3

10	MTCS345E10	Web Technology	3	0	0	100	3	0	0	3
11	MTCS345E11	Xml And Web Services	3	0	0	100	3	0	0	3
MTCS361-ELECTIVE - VI (Global)										
1	MTCS361E01	Internet Of Things	3	0	0	100	3	0	0	3
2	MTCS361E02	Machine Learning	3	0	0	100	3	0	0	3
3	MTCS361E03	Mobile application Development	3	0	0	100	3	0	0	3
4	MTCS361E04	Introduction to Data Science	3	0	0	100	3	0	0	3
5	MTCS361E05	Business Analytics	3	0	0	100	3	0	0	3
MTCS111- AUDIT COURSE -1										
1	MTCS111E01	English for Research Paper Writing	2	0	0	-	0	0	0	0
2	MTCS111E02	Disaster Management	2	0	0	-	0	0	0	0
3	MTCS111E03	Sanskrit for Technical Knowledge	2	0	0	-	0	0	0	0
4	MTCS111E04	Value Education	2	0	0	-	0	0	0	0
MTCS212- AUDIT COURSE -2										
1	MTCS212E01	Constitution of India	2	0	0	-	0	0	0	0
2	MTCS212E02	Pedagogy Studies	2	0	0	-	0	0	0	0
3	MTCS212E03	Stress Management by Yoga	2	0	0	-	0	0	0	0
4	MTCS212E04	Personality Development through Life Enlightenment Skills.	2	0	0	-	0	0	0	0

CREDIT DETAILS	
Semester	M.Tech- CS
I	21
II	18
III	18
IV	16
TOTAL CREDITS	73

19. DETAILED SYLLABUS

MTCS131	RESEARCH METHODOLOGY AND IPR						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
The aim of the course is to introduce the research methodology, the understanding on the research, methods, designs, data collection methods, report writing styles and various dos and don'ts in research.													
Prerequisite													
CS431 - PROBABILITY AND QUEUING THEORY MTCS133 - Advanced Algorithms													
Course Outcomes													
Explain the principles and concepts of research methodology.										L2			
Understand the different methods of data collection										L2			
Apply appropriate method of data collection and analyze using statistical/software tools.										L3			
Present research output in a structured report as per the technical and ethical standards.										L3			
Create research design for a given engineering and management problem /situation										L4			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1													
CO2													
CO3													
CO4													
CO5													
Syllabus													
Unit - I	INTRODUCTION TO RESEARCH METHODOLOGY									9	0	0	
Meaning, Objectives and Characteristics of research - Research methods Vs Methodology, Different Research Design: Types of research - Descriptive Vs. Analytical, Applied Vs. Fundamental, Quantitative Vs. Qualitative, Conceptual Vs. Empirical, Research process - Criteria of good research - Developing a research plan.													
Unit - 2	LITERATURE REVIEW AND RESEARCH PROBLEM IDENTIFICATION									9	0	0	
Defining the research problem - Selecting the problem - Necessity of defining the problem - Techniques involved in defining the problem - Importance of literature review in defining a problem - Survey of literature - Primary and secondary sources - Reviews, treatise, monographs, thesis reports, patents - web as a source - searching the web - Identifying gap areas from literature review - Development of working hypothesis.													
Unit - 3	DATA COLLECTION & ANALYSIS									9	0	0	
Selection of Appropriate Data Collection Method: Collection of Primary Data, Observation Method, Interview Method, Email, Collection of Data through Questionnaires, Collection of Data through Schedules, Collection of Secondary Data - internal & external. Sampling process: Direct & Indirect Methods, Non-probability sampling, Probability sampling: simple random sampling, systematic sampling, stratified sampling, cluster sampling, Determination of sample size; Analysis of data using different software tools.													

Unit - 4	RESEARCH PROBLEM SOLVING	9	0	0
Processing Operations, Types of Analysis, Statistics in Research, Measures of: Central Tendency, Dispersion, Asymmetry and Relationship, correlation and regression, Testing of Hypotheses for single sampling: Parametric (t, z and F), Chi Square, Logistic regression, ANOVA, non-parametric tests. Numerical problems				
Unit - 5	IPR AND RESEARCH WRITING	9	0	0
IPR: Invention and Creativity- Intellectual Property-Importance and Protection of Intellectual Property Rights (IPRs)- A brief summary of: Patents, Copyrights, Trademarks, Industrial Designs; Publication ethics, Plagiarism check				
Research Writing: Interpretation and report writing, Techniques of interpretation, Types of report - letters, articles, magazines, transactions, journals, conferences, technical reports, monographs and thesis; Structure and components of scientific writing: Paragraph writing, research proposal writing, reference writing, summarizing and paraphrasing, essay writing; Different steps in the preparation - Layout, structure and language of the report - Illustrations, figures, equations and tables.				
Text Books				
<ol style="list-style-type: none"> 1. Kothari C.R., "Research Methodology Methods and techniques", New Age International, New Delhi, 2004. 2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, "An introduction to Research Methodology", RBSA Publishers, 2002. 3. Day, R.A., "How to Write and Publish a Scientific Paper", Cambridge University Press, 1992. 				
Reference Books				
<ol style="list-style-type: none"> 1. Bjorn Gustavii, "How to Write and Illustrate Scientific Papers " Cambridge University Press, 2/e. 2. Sarah J Tracy, "Qualitative Research Methods" Wiley Balckwell- John wiley & sons, 1/e, 2013. 3. James Hartley, "Academic Writing and Publishing", Routledge Pub., 2008. 				
Course Designer(s)				
Dr Ajit Danti				
Course Reviewer				
Dr Balachandran K				

MTCS133	ADVANCED ALGORITHMS						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
To learn the systematic way of solving problems. To understand the different methods of organizing large amounts of data. To efficiently implement the different data structures. To efficiently implement solutions for specific problems													
Prerequisite													
Data structures and Algorithms													
Course Outcomes													
Summarize the properties of advanced data structures.										L3			
Experiment algorithms and employ appropriate advanced data structures for solving computing problems efficiently.										L4			
Compare the efficiency of algorithms.										L3			
Experiment and implement efficient algorithms for solving computing problems in a high-level object-oriented programming language.										L4			
Compare, contrast, and apply algorithmic trade-offs : time vs. space, deterministic vs. randomized, and exact vs. approximate										L4			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	1		1		1					1			
CO2	3	2	1	1								1	
CO3	3	2	1	1								1	
CO4	3	2	1	1								1	
CO5	3	2	1	1				1				1	
Syllabus													
Unit - I	INTRODUCTION									9	0	3	
Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence - tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods.													
Unit - 2	GRAPH ALGORITHMS AND POLYNOMIALS									9	0	3	
Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford -Fulkerson method; Maximum bipartite matching. Polynomials and the FFT: Representation of polynomials; The DFT and FFT; Efficient implementation of FFT.													
Unit - 3	NUMBER THEORETIC ALGORITHMS									9	0	3	
Number -Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA cryptosystem; Primality testing; Integer factorization													
Unit - 4	STRING MATCHING ALGORITHMS									9	0	3	
String-Matching Algorithms: Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer - Moore algorithms.													
Unit - 5	PROBABILISTIC ALGORITHMS									9	0	3	
Probabilistic and Randomized Algorithms: Probabilistic algorithms; Randomizing													

deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.

Case Study: Comparison of Algorithm Design Strategies based on CPU, Memory, Disk and Network usages.

Text Books

1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: "Introduction to Algorithms", 3rd Edition, The MIT Press, 2014.
2. Kenneth A. Berman, Jerome L. Paul: "Algorithms", Cengage Learning, 2013.

Reference Books

1. Horowitz, Sahni, Rajasekaran, "Computer Algorithms", University press 2008
2. Tanenbaum A.S., Langram Y, Augestien M.J., "Data Structures using Java", Prentice Hall of India, 2009
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in Java", 3rd edition, Pearson Education, 2012.
4. Aho, Hopcroft, Ullman, "Data Structures and Algorithms", Pearson Education, 2009.

Course Designer(s)

DrAjitDanti

Course Reviewer

DrRaju G

MTCS135	ADVANCED DIGITAL IMAGE PROCESSING				L	T	P	L	T	P	C	
					3	0	0	3	0	0	3	
Preamble												
The students will learn the fundamental concepts of Image Processing. The students will learn image enhancement techniques in spatial & frequency domain The students will learn the restoration & compression models. Help the students to segmentation and representation techniques for the region of interests. The students will learn the how to recognize objects using pattern recognition techniques.												
Prerequisite												
Computer Graphics with Open GL												
Course Outcomes												
Course Outcome 1: Ability to apply the image fundamentals and mathematical transformations necessary for image processing										L3		
Course Outcome 2: Ability to analyze image enhancement techniques in Spatial & frequency domain										L4		
Course Outcome 3: Ability to apply restoration models and compression models for image processing										L3		
Course Outcome 4: Ability to synthesis image using segmentation and representation techniques										L4		
Course Outcome 5: Ability to analyze and extract potential features of interest from the image										L4		
Course Outcome 6: Ability to design object recognition systems using pattern recognition techniques										L5		
Mapping with Program Outcomes (POs)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1										
CO2		2	2	2								
CO3		2	2	2								
CO4		2	3	2								
CO5		2	2	2								
CO6		3	2	2	3		2					1
Syllabus												
Unit - I	DIGITAL IMAGE FUNDAMENTALS									9	0	3
Image formation, Image transforms – Fourier transforms, Walsh, Hadamard, Discrete cosine, Hotelling transforms												
Unit - 2	IMAGE ENHANCEMENT & RESTORATION									9	0	3
Histogram modification techniques - Image smoothening - Image Sharpening - Image Restoration - Degradation Model - Noise models - Spatial filtering - Frequency domain filtering												
Unit - 3	IMAGE COMPRESSION & SEGMENTATION									9	0	3
Compression Models - Elements of information theory - Error free Compression -Image segmentation –Detection of discontinuities – Region based segmentation – Morphology												
Unit - 4	REPRESENTATION AND DESCRIPTION									9	0	3
Representation schemes- Boundary descriptors- Regional descriptors - Relational Descriptors												
Unit - 5	OBJECT RECOGNITION AND INTERPRETATION									9	0	3
Patterns and pattern classes - Decision-Theoretic methods - Structural methods-Case studies												
Text Books												
1. Gonzalez R.C. & Woods. R.E., "Digital Image Processing", 3rd Edition, Pearson Education, Indian edition published by Dorling Kindersely India Pvt. Ltd. Copyright © 2009, Third impression 2011.												

2. Gonzalez.R.C& Woods. R.E., "Digital Image Processing using MATLAB", 2nd Edition, McGraw Hill Education (India) Pvt Ltd 2011 (Asia)
3. Madan, " An Introduction to MATLAB for Behavioural Researchers", Sage Publications, 2014

Reference Books

1. Author Name(s), "Book title", Edition, Publisher Name, Year (if it is old edition, reprint details should be given)

Course Designer(s)

DrAjitDanti

Course Reviewer

DrRaju G

MTCS141E01	ADVANCED SOFTWARE TESTING						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
To give an overview of the software testing techniques. To design and understand test cases, various levels of testing related concepts and advanced skills in test estimation, test planning, test monitoring, and test control.													
Prerequisite													
1. Software Engineering 2. Software Testing													
Course Outcomes													
Describes the concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.										L1			
Discuss various software testing issues and solutions in software unit test; integration, regression, and system testing.										L2			
Discuss how to planning a test project, design test cases and data, conduct testing operations, manage software problems and defects, and generate a testing report.										L2			
Investigate the software test automation problems and provide solutions using modern software testing tools to support software testing projects.										L4			
Determine to gain software testing experience by applying software testing knowledge and methods to practice-oriented software testing projects.										L3			
Describes to learn how to write software testing documents, and communicate with engineers in various forms.										L1			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	2		3					3	1			
CO2	3	2		1	1				2	2			
CO3	3	1	1						2	1			
CO4	2	2	1	2	2				2	2			
CO5	2	2		1			2		1				
CO6	2	2							1				
Syllabus													
Unit - I	Introduction									9	3	0	
Introduction to Testing Design Strategies - The Smarter Tester - Test Case Design Strategies - Using Black Box Approach to Test Case Design Random Testing - Requirements based testing - positive and negative testing - Boundary Value Analysis - decision tables - Equivalence Class Partitioning state-based testing - cause effect graphing - error guessing - compatibility testing - user documentation testing - domain testing Using White-Box Approach to Test design - Test Adequacy Criteria - static testing vs. structural testing - code functional testing - Coverage and Control Flow Graphs - Covering Code Logic - Paths - Their Role in White-box Based Test Design - code complexity testing - Evaluating Test Adequacy Criteria.													
Unit - 2	Testing Process									9	3	0	

Introduction, Test Planning, Monitoring, and Control, Test Analysis, Test Design, Test Implementation, Test Execution, Evaluating Exit Criteria and Reporting Test Closure Activities				
Unit - 3	Test Management	9	3	0
Test Management in Context, Risk-Based Testing and Other Approaches for Test Prioritization and Effort Allocation, Test Documentation and Other Work Products, Test Estimation, Defining and Using Test Metrics, Business Value of Testing, Distributed, Outsourced, and Insourced Testing, Managing the Application of Industry Standards				
Unit - 4	Reviews and Defect Management	9	3	0
Management Reviews and Audits, Managing Reviews, Metrics for Reviews, Managing Formal Reviews, The Defect Lifecycle and the Software Development Lifecycle, Defect Report Information, Assessing Process Capability with Defect Report Information				
Unit - 5	Improving the Testing Process , Test Tools and Automation	9	3	0
Test Improvement Process, Improving the Testing Process, Improving the Testing Process with TMMi, Improving the Testing Process with TPI Next, Improving the Testing Process with CTP, Improving the Testing Process with STEP, Tool Selection, Tool Lifecycle, Tool Metrics				
Text Books				
Alex Black, Advanced Software Testing - Vol. 2, 2nd Edition, 2nd Edition, 2014 2. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing - Principles and Practices", Pearson education, 2008.				
Reference Books				
Steve Dustin, "Effective Software Testing", Pearson Education, First Edition, 2008. Gary Ward, "Software Testing in the Real World", Pearson Education, 2008. Srujan P. Mathur, "Foundations of Software Testing", Pearson Education, 2011.				
Course Designer(s)				
Praveen Naik				
Course Reviewer				
Dr Natarajan K				

MTCS141E02	OBJECT ORIENTED SYSTEM DESIGN					Hours			Credits			
						L	T	P	L	T	P	C
						3	0	0	3	0	0	3
Preamble												
The basic components of object oriented system development with five methodologies are explained. The Unified Modeling Language oriented with unified approach has been demonstrated. The second part of the content gives detailed knowledge in Object Oriented analysis and design phases followed by maintenance and monitoring activities of delivered software products.												
Prerequisite												
CS632- Object Oriented Analysis and Design CS532 - Software Engineering												
Course Outcomes												
Explain the basic concepts and the lifecycle of Object -Oriented System Development.										L2		
Describe the Grady Booch, Jacobson,Rumbaugh, Shaler and Coad Object Oriented Methodologies.										L2		
Illustrate the Unified approach and the UML diagrams in real time systems.										L3		
Examine Object oriented analysis approaches and documentation										L4		
Demonstrate the concept of design axioms and object interoperability in Modeling Language.										L3		
Investigate the maintenance and testing methods with case studies.										L4		
Mapping with Program Outcomes (POs)												
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO12
CO1	2						1				3	
CO2	2							3			3	
CO3	2	3	1		2							
CO4		3		3				3	1		3	
CO5		3						3			3	
CO6				3	2			3			3	1
Syllabus												
Unit - I	OBJECT ORIENTED DESIGN FUNDAMENTALS									9	0	0
The Object Model - Classes and Objects - Complexity of Software - Classification - Notation - Process - Pragmatics - Binary And Entity Relationship - Object Types - Object State - OOSD Life Cycle.												
Unit - 2	OBJECT ORIENTED METHODOLOGIES AND UML									9	0	0
Object Oriented Methodology: Rumbaugh, Booch, Jacobson, Shaler/Mellor, Coad/Yardon - Patterns - Frame Works - The Unified Approach - UML												
Unit - 3	OBJECT ORIENTED ANALYSIS									9	0	0
Identify Use Cases - Use Case Model - Documentation - Classification - Identifying Classes - Noun Phrases Approach - Common Class Pattern Approach - Use Case Driven Approach - Identifying Object Relationship, Attributes And Models.												
Unit - 4	OBJECT ORIENTED DESIGN									9	0	0
Design Process - Design Axioms - Designing Classes - Access Layer Design - View Layer Design.												
Unit - 5	MANAGING OBJECT ORIENTED									9	0	0

DEVELOPMENT			
Managing Analysis And Design - Evaluation Testing - Coding - Maintenance - Metrics - Case Study: Foundation Class Library - Client/Server Computing.			
Text Books			
<ol style="list-style-type: none"> 1. Ali Bahrami, "Object Oriented System Development", McGraw Hill International Edition, 2008. 2. Larman, "Applying UML & Patterns: An Introduction to Object Oriented Analysis and Design", Pearson Education, 3rd Edition, 2005. 			
Reference Books			
<ol style="list-style-type: none"> 1. Bernd Bruegge, Allen H. Dutoit, "Object Oriented Software Engineering using UML, Patterns and Java", Pearson Education 3rd Edition 2004. 			
Course Designer(s)			
P.Kanmani			
Course Reviewer			
Praveen Naik			

MTCS141E03	SOFTWARE PROJECT MANAGEMENT	Hours			Credits							
		L	T	P	L	T	P	C				
		3	0	0	3	0	0	3				
Preamble												
<p>The main goal of software development projects is to create a software system with a predetermined functionality and quality in a given time frame and with given costs. For achieving this goal, models are required for determining target values and for continuously controlling these values. This course focuses on principles, techniques, methods & tools for model-based management of software projects. Assurance of product quality and process adherence (quality assurance), as well as experience-based creation & improvement of models (process management). The goals of the course can be characterized as follows.</p> <ul style="list-style-type: none"> • Understanding the specific roles within a software organization as related to project and process management • Understanding the basic infrastructure competences (e.g., process modeling and measurement) • Understanding the basic steps of project planning, project management. Quality assurance, and process management and their relationships. 												
Prerequisite												
Software Engineering												
Understanding the specific roles within a Conventional Software Management organization as related to project.										L2		
Describe and determine the purpose and importance of project management from the perspectives of planning, cost, tracking and completion of project.										L5		
Evaluate a project to develop the scope of work, provide accurate cost estimates and to plan the various activities.										L5		
Implement a project to manage project schedule, expenses and resources with the application of suitable project management tools.										L4		
Identify the resources required for a project and to produce a work plan and resource Schedule.										L4		
Compare and differentiate organization structures and project structures.										L2		
Mapping with Program Outcomes (POs)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2									
CO2	1	2	2									
CO3		1	2									
CO4		1	2									

CO5	1		2			1						
CO6	2	1	2									
Syllabus												
Unit - I	UNIT-1						L-9	T-1	P-0			
Conventional Software Management: The waterfall model, conventional software Management performance. Evolution of Software Economics: Software Economics. Pragmatic software cost estimation.												
Unit - 2	UNIT-2						L-9	T-1	P-0			
Improving Software Economics: Reducing Software product size, Improving software processes, improving team effectiveness. Improving automation, Achieving required quality, peer inspections. The old way and the new- The principles of conventional software engineering. Principles of modern software management, transitioning to an iterative process.												
Unit - 3	UNIT-3						L-9	T-1	P-0			
Life cycle phases: Engineering and production stages, inception. Elaboration, construction, transition phases. Artifacts of the process: The artifact sets. Management artifacts, Engineering artifacts, programmatic artifacts. Model based software architectures: A Management perspective and technical perspective.												
Unit - 4	UNIT-4						L-9	T-1	P-0			
Work Flows of the process: Software process workflow, Inter trans workflows. Checkpoints of the Process: Major Mile Stones, Minor Milestones, Periodic status assessments. Iterative Process Planning Work breakdown structures, planning guidelines, cost and scheduled estimating, Interaction, planning process, Pragmatic planning.												
Unit - 5	UNIT-5						L-9	T-1	P-0			
Project Control and Process instrumentation: The server care Metrics, Management indicators, and quality indicators. Life cycle expectations pragmatic Software Metrics, Metrics automation. Tailoring the Process: Process discriminates, Example. Future Software Project Management: Modern Project Profiles Next generation Software economics modern Process transitions. Case Study: The Command Center Processing and Display System. Replacement (CCPDS. R).												
Text Books												
<ol style="list-style-type: none"> 1. Software Project Management. Walker Royce, Pearson Education 2010. 2. Software Project Management, Bob Hughes & Mike Cotterell, fourth edition, Tate McGraw HD 2012. 												
Reference Books												

1. Applied Software Project Management, Andrew Stellman & Jennifer Greene, O'Reilly. 2006
2. Head First PMP, Jennifer Greene & Andrew Stellman, O'Reilly. 2007
3. Software Engineering Project Management. Richard H. Thayer & Edward Yourdon, second edition, Wiley India, 2004.
4. A Guide to Project Management, Jim Highsmith. Pearson Education, 2004
5. The art of Project management. Scott Berkun. O'Reilly, 2005.
6. Software Project Management in Practice. Pankaj Jalote. Pearson Education, 2002.
7. SEI.CMMI-Tutorial,
www.sei.cmu.edu/cmmi/publications/stc.presentations/tutorial.html

Course Designer(s)

Praveen Naik

Course Reviewer

DrNatarajan K

MTCS141E04	SOFTWARE QUALITY ASSURANCE						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
<p>To present the concepts, techniques and metrics for quality assurance in software development.</p> <p>To develop a good understanding of issues, techniques and tools for software testing.</p> <p>To enable students to gain a working knowledge of techniques for management of testing projects.</p>													
Prerequisite													
<p>1. Software Engineering</p> <p>2. Software Quality Management</p> <p>3. Software Testing</p>													
Course Outcomes													
Describes the quality, cost of quality and quality model;										L1			
Implement white-box testing, black-box testing, and inspection techniques;										L3			
Verify how test tools can be used in the testing life cycle;										L5			
Discuss the quality metrics and its methodology										L2			
use testing metrics for product and process;										L3			
Examine how to do performance testing and usability testing.										L4			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	2		3					2	1			
CO2	3	2		1					2	1			
CO3	3	1	1		2				2	1			
CO4	2	2	1	2					2	2			
CO5	2	2		1			2		1				
CO6	2	2							1				
Syllabus													
Unit - I		SOFTWARE QUALITY ASSURANCE FRAMEWORK AND STANDARDS								9	3	0	
<p>SQA Framework: What is Quality? Software Quality Assurance, Components of Software Quality Assurance - Software Quality Assurance Plan: Steps to develop and implement a Software Quality Assurance Plan - Quality Standards: ISO 9000 and Companion ISO Standards, CMM, CMMI, PCMM, MalcomBalridge, 3 Sigma, 6 Sigma</p>													
Unit - 2		SOFTWARE QUALITY ASSURANCE METRICS AND MEASUREMENT								9	3	0	
<p>Software Quality Metrics: Product Quality metrics, In-Process Quality Metrics, Metrics for Software Maintenance, Examples of Metric Programs - Software Quality metrics methodology: Establish quality requirements, Identify Software quality metrics, Implement the software quality metrics, analyze software metrics results, validate the software quality metrics - Software quality indicators - Fundamentals in Measurement theory</p>													
Unit - 3		SOFTWARE TESTING STRATEGY AND ENVIRONMENT								9	3	0	
<p>Establishing testing policy, structured approach to testing, test factors, Economics of System Development Life Cycle (SDLC) Testing.</p> <p>Software Testing Methodology: Defects hard to find, verification and validation, functional</p>													

and structural testing, workbench concept, eight considerations in developing testing methodologies, testing tactics checklist				
Unit - 4	SOFTWARE TESTING TECHNIQUES	9	3	0
Black-Box, Boundary value, Bottom-up, Branch coverage, Cause-Effect graphing, CRUD, Database, Exception, Gray-Box, Histograms, Inspections, JADs, Pareto Analysis, Prototyping, Random Testing, Risk-based Testing, Regression Testing, Structured Walkthroughs, Thread Testing, Performance Testing, White-Box Testing. Software Testing Tools: Taxonomy of Testing tools, Methodology to evaluate automated testing tools, Load Runner, Win runner and Rational Testing Tools, Java Testing Tools, JMetra, JUNIT and Cactus.				
Unit - 5	PROCESS	9	3	0
Eleven Step Testing Process: Assess Project Management Development Estimate and Status, Develop Test Plan, Requirements Phase Testing, Design Phase Testing, Program Phase Testing, Execute Test and Record Results, Acceptance Test, Report test results, testing software installation, Test software changes, Evaluate Test Effectiveness. Testing Specialized Systems and Applications Testing Client/Server - Web applications, Testing off the Shelf Components, Testing Security, Testing a Data Warehouse-case study				
Text Books				
1. Effective Methods for Software Testing, 2nd Edition by <i>William E. Perry</i> , Second Edition, published by Wiley 4 th edition Reprint edition 2010 2. Software Quality: Producing Practical, Consistent Software 2014 by MordechaiBenMenachem and Garry S. Marliss				
Reference Books				
1. Testing and Quality Assurance for Component-based Software, by Gao, Tsao and Wu, Artech House Publishers 2010 2. Software Testing Techniques, by BoriesBeizer, Second Edition, Dreamtech Press 2005 3. Managing the Testing Process, by Rex Black, Wiley 2009 4. Handbook of Software Quality Assurance, by G. Gordon Schulmeyer, James I.McManus, Second Edition, International Thomson Computer Press 2007 5. Software Testing and continuous Quality Improvement, by William E.Lewis, GunasekaranVeerapillai, Second Edition, Auerbach Publications 2004 6. Metrics and Models for Software Quality Engineering, by Stephen H. Kan, by Pearson Education Publication2005				
Course Designer(s)				
Praveen Naik				
Course Reviewer				
RudraPrathap				

MTCS142E01	BIG DATA ANALYTICS						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
To Understand big data for business intelligence To Learn business case studies for big data analytics To Understand Nosql big data management To manage Big data without SQL To understanding map-reduce analytics using Hadoop and related tools													
Prerequisite													
NIL													
Course Outcomes													
Describe big data and use cases from selected business domains										Remembering			
Discuss open source technologies										Understanding			
Explain NoSQL big data management										Understanding			
Discuss basics of Hadoop and HDFS										Understanding			
Discuss map-reduce analytics using Hadoop										Understanding			
Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data Analytics										Applying			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	3											
CO2	3	3											
CO3			2		3								
CO4			2		3								
CO5	3	3			3								
CO6	3	3			3								
Syllabus													
Unit - I		UNDERSTANDING BIG DATA								9	0	0	
What is big data - why big data -.Data!, Data Storage and Analysis, Comparison with Other Systems, Rational Database Management System , Grid Computing, Volunteer Computing, convergence of key trends - unstructured data - industry examples of big data - web analytics - big data and marketing - fraud and big data - risk and big data - credit risk management - big data and algorithmic trading - big data and healthcare - big data in medicine - advertising and big data- big data technologies - introduction to Hadoop - open source technologies - cloud and big data - mobile business intelligence - Crowd sourcing analytics - inter and trans firewall analytics.													
Unit - 2		NOSQL DATA MANAGEMENT								9	0	0	
Introduction to NoSQL - aggregate data models - aggregates - key-value and document data models - relationships -graph databases - schema less databases - materialized views - distribution models - sharding -- version - Map reduce -partitioning and combining - composing map-reduce calculations													
Unit - 3		BASICS OF HADOOP								9	0	0	
Data format - analyzing data with Hadoop - scaling out - Hadoop streaming - Hadoop pipes - design of Hadoop distributed file system (HDFS) - HDFS concepts - Java interface - data flow - Hadoop I/O - data integrity - compression - serialization - Avro - file-based data structures													
Unit - 4		MAPREDUCE APPLICATIONS								9	0	0	
MapReduce workflows - unit tests with MRUnit - test data and local tests - anatomy of MapReduce job run - classic Map-reduce - YARN - failures in classic Map-reduce and YARN - job scheduling - shuffle and sort - task execution -MapReduce types - input formats - output formats													

Unit - 5	HADOOP RELATED TOOLS	9	0	0
Hbase - data model and implementations - Hbase clients - Hbase examples -praxis. Cassandra - Cassandra data model -cassandra examples - cassandra clients -Hadoop integration. Pig - Grunt - pig data model - Pig Latin - developing and testing Pig Latin scripts. Hive - data types and file formats - HiveQL data definition - HiveQL data manipulation -HiveQL queries-case study.				
Text Books				
1. Tom White, "Hadoop: The Definitive Guide", 4 th Edition, O'Reilley, 2012. 2. Eric Sammer, "Hadoop Operations",1 st Edition, O'Reilley, 2012.				
Reference Books				
1. VigneshPrajapati, Big data analytics with R and Hadoop, SPD 2013. 2. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012. 3. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011. 4. Alan Gates, "Programming Pig", O'Reilley, 2011.				
Course Designer(s)				
Dr. Raghavendra S.				
Course Reviewer				
DrManohar M				

MTCS142E02	ADVANCED ARTIFICIAL INTELLIGENCE						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
This course provides a strong foundation of fundamental concepts in Artificial Intelligence. To provide an empirical evidence and the scientific approach applying Artificial Intelligence techniques for problem solving using probabilistic, fuzzy, statistical and Deep Learning Models.													
Prerequisite													
Basic Python / R Programming / Probability													
Course Outcomes													
Demonstrate the concepts and features of agents, environments and uniformed search strategies.										L3			
Illustrate inference using Bayesian Networks, Hidden Markov Models as an approach to Probabilistic Reasoning										L2			
Apply Fuzzy Logic Systems to Neural Network Architectures										L3			
Compare and contrast performance of different Statistical learning methods used in machine learning										L2			
Discuss the Deep Learning models to image and text processing application										L3			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	3	2										
CO2	3	3	2						1	1			
CO3	3	3	2	3	2				1	1			
CO4	3	3	3	3	2				1	1			
CO5	3	3	2	2									
Syllabus													
Unit - I		INTRODUCTION								L-9	T-0	P-0	
Intelligent Agents - Agents and environments - Good behaviour - The nature of environments - structure of agents - Problem Solving agents - Acting under uncertainty - Inference using full joint distributions; -Independence; Bayes' rule and its use; -The Wumpus world revisited.													
Unit - 2		PROBABILISTIC REASONING								9	0	0	
Representing knowledge in an uncertain domain; - The semantics of Bayesian networks; Efficient representation of conditional distributions; - Inference in Bayesian networks; Approximate inference in Bayesian Networks; - Extending probability to first-order representations; Other approaches to Uncertain Reasoning. - Time and uncertainty; Inference in temporal models; - Hidden Markov models; - Kalman filters; Dynamic Bayesian Networks.													
Unit - 3		CONNECTIONIST MODELS and FUZZY LOGIC SYSTEM								9	0	0	
Hopfield Networks; Learning in Neural Network - Application - Recurrent Network; - Distributed Representation - Fuzzy logic system Introduction. Crisp Sets- Fuzzy Sets and Terminologies - Fuzzy Logic Control - Sugeno Style of Fuzzy Inference - Fuzzy Hedges. Alpha cut Threshold - Neuro Fuzzy Systems.													
Unit - 4		STATISTICAL AND REINFORCEMENT LEARNING								9	0	0	
Learning from observations - forms of learning - Inductive learning - Learning decision trees - Ensemble learning - Knowledge in learning - Logical formulation of learning - Explanation based learning - Learning using relevant information - Inductive logic programming Statistical learning methods - Learning with complete data - Learning with hidden variable -													

EM algorithm - Instance based learning - Reinforcement learning - Passive reinforcement learning - Active reinforcement learning - Generalization in reinforcement learning.				
Unit - 5	DEEP LEARNING	9	0	0
Convolutional Neural Networks, Motivation, Convolution operations, Pooling, Image classification, Modern CNN architectures, Recurrent Neural Network, Motivation, Vanishing/Exploding gradient problem, Applications to sequences, Modern RNN architectures, Tuning/Debugging Neural Networks, Parameter search, Overfitting, Visualizations, Pretrained Models.				
Text Books				
<ol style="list-style-type: none"> 1. Stuart Russell and Peter Norvig, "Artificial Intelligence - A Modern Approach", 3rd Edition, Pearson Education, 2014. 2. Elaine Rich and Kevin Knight, "Artificial Intelligence", 3rd Edition, Tata McGraw-Hill, 2012. 3. Francois Chollet "Deep Learning with Python", 1st Edition Manning Publication, 2018 				
Reference Books				
<ol style="list-style-type: none"> 1. Nils J. Nilsson, "Artificial Intelligence: A New Synthesis", 1st Edition, Harcourt Asia Pvt. Ltd., 2012. 2. George F. Luger, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving", 6th Edition, Pearson Education / PHI, 2009. 				
Course Designer(s)				
Vinai George Biju				
Course Reviewer				
Dr. SamikshaShukla				

MTCS142E03	ADVANCED SOFT COMPUTING					Hours			Credits				
						L	T	P	L	T	P	C	
						3	0	0	3	0	0	3	
Preamble													
The course help in understanding the concepts in Soft Computing techniques VIZ Fuzzy systems, Genetic algorithms, Simulated annealing, Ant Colony Optimization and Artificial Neural Networks, to apply these tools in solving problems, to analyze the strengths and weakness of these methods and to choose appropriate Soft Computing technique(s) for a given problem.													
Prerequisite													
DISCRETE MATHEMATICS													
Course Outcomes													
Explain concepts in Fuzzy sets, Fuzzy Logic, Genetic Algorithm, Simulated Annealing and Ant Colony Optimization.										L2			
Illustrate how Fuzzy Logic, Simulated annealing, Genetic Algorithm and Ant Colony optimization are used to solve problems.										L3			
Explain concepts in Artificial Neural Networks (MLP, RBFN, KSOM, ART, BAM, ELM, Deep NN, CNN, RNN).										L2			
Illustrate the use of ANN in solving problems.										L3			
Select appropriate Soft Computing technique to solve a problem.										L5			
Solve Engineering problems using Soft Computing techniques.										L3			
Mapping with Program Outcomes (POs)													
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO12	
CO1	3	1											
CO2	3	3	2										
CO3	3	1											
CO4	3	3	2										
CO5	3	3	2										
CO6	3	3	3		1								
Syllabus													
Unit - I		FUZZY SET THEORY									9	0	0
Introduction to Soft Computing. Fuzzy sets and relations- operations - composition. Membership functions - features - Fuzzification - membership value assignments. Defuzzification - Lambda cuts (sets and relations) - Defuzzification to scalars. Fuzzy Logic - approximate reasoning - different forms of implication. Natural language and Linguistic hedges. Fuzzy Rule-based systems - graphical techniques for inference. Extension principle and Fuzzy arithmetic. Case Studies (minimum two) - application of Fuzzy Logic.													
Unit - 2		OPTIMIZATION									9	0	0
Genetic algorithm - Biological background - Search space - Basic terminologies in GA - a simple GA - General GA - Operators in GA (Encoding, Selection, Crossover - mutation) - stopping conditions - Constraints - Problem solving - The schema theorem - advantages - applications. Case study - Application of GA. Simulated Annealing: Annealing Schedule, Parameter Selection, Applications. Case study - Application of SA. Ant Colony Optimization: Ant Foraging Behavior, artificial ants and minimum cost paths, ACO Metaheuristic, ACO algorithm for TSP problem, Theoretical considerations, convergence proof, ACO and Model based search. ACO optimization for subset problem,													

Unit - 3	NEURAL NETWORKS -I	9	0	0
Supervised Learning Neural Networks - Perceptrons - Adaline - BackpropagationMutilayerPerceptrons - Radial Basis Function Networks - Unsupervised Learning Neural Networks - Competitive Learning Networks - Kohonen Self-Organizing Networks. Case study - Application of ANN.				
Unit - 4	NEURAL NETWORKS -II	9	0	0
Adaptive Resonance Theory - Introduction - ART 1 - ART2 - Applications. Basic concepts in Associative memory - BAM. Extreme Learning Machines - introduction - theory - applications- case study. Hybrid soft computing systems - ANFIS - concepts and architecture - case study.				
Unit - 5	DEEP NETWORKS	9	0	0
Introduction to Deep learning - Deep neural networks - concepts. Recurrent neural network - concepts - applications. Convolutional neural network - concepts - case study based on image classification.				
Text Books				
<ol style="list-style-type: none"> 1. Sivanandam&Deepa, "Principles of Soft Computing", 2nd Edition, Wiley India, 2011 2. T. J. Ross, "Fuzzy Logic with Engineering Applications", 3rd Edition, Wilev, 2014 3. Dorigo Marco, Stützle Thomas, "ANT COLONY OPTIMIZATION", PHI, 2005 				
Reference Books				
<ol style="list-style-type: none"> 1. Rajasekaran and G A V Pai, " Neural Networks, Fuzzy Logic and Genetic Algorithm", 1stEdn, PHI, 2011 2. D. E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", 1stEdn, Pearson, 2016 3. J S R Jang, C T Sun and E Mizutani, " Neuro-Fuzzy and Soft Computing", 1stEdn, Pearson, 2015 4. Charu C. Agrawal, "Neural Networks and Deep Learning", Springer, 2018 5. Frank Millstein, "Convolutional Neural Networks in Python", CreateSpace Independent Publishing Platform, 2018 				
Course Designer(s)				
RAJU G				
Course Reviewer				
Dr. SamikshaShukla				

MTCS142E04	VISUALIZATION TECHNIQUE SYSTEMS						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
<ul style="list-style-type: none"> The students will understand the basic model of the information visualization process, information processing, visual representation, interaction in visual systems and its impacts. The students will learn the conceptual framework for visualization design. The students will learn how information can be transformed and visualized. Helps the students to develop the skills necessary to solve visualization problems and critique and evaluate Information visualization systems. 													
Prerequisite													
Computer Graphics													
Course Outcomes													
Ability to explain and interpret the basic model of the information visualization and interactive systems.											L2		
Ability to investigate and experiment analysis the different Visualization techniques and mapping the data to visual representations											L4		
Ability to understand and implement Fisheye visualizations in the information space.											L3		
Ability to measure different types of information that can be transformed into visualization.											L5		
Ability to solve and organize the visualization problems and to demonstrate visualization based user interface.											L4		
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3												
CO2		3	3	3	3								
CO3	3		3		3	2							
CO4	3	3	3	3	3							2	
CO5		3		3		2						2	
Syllabus													
Unit - I	VISUALIZATION									9	0	0	
Introduction - Issues - Data Representation - Data Presentation - Interaction.													
Unit - 2	FOUNDATIONS FOR DATA VISUALIZATION									9	0	0	
Visualization stages - Experimental Semiotics based on Perception Gibson's Affordance theory - A Model of Perceptual Processing - Types of Data													
Unit - 3	COMPUTER VISUALIZATION									9	0	0	
Non-Computer Visualization - Computer Visualization: Exploring Complex Information Spaces - Fisheye Views - Applications - Comprehensible Fisheye views - Fisheye views for 3D data - Non Linear Magnification - Comparing Visualization of Information Spaces - Abstraction in computer Graphics - Abstraction in user interfaces.													
Unit - 4	MULTIDIMENSIONAL VISUALIZATION									9	0	0	
One Dimension - Two Dimensions - Three Dimensions - Multiple Dimensions - Trees - Web Works - Data Mapping: Document Visualization - Workspaces													
Unit - 5	CASE STUDY									9	0	0	
Case study - Small interactive calendars - Selecting one from many - Web browsing through a key hole - Communication analysis - Archival analysis													
Text Books													

1. Colin Ware, "Information Visualization Perception for Design", 3rd edition Morgan Kaufmann Publishers, 2012, (Unit II)
2. Robert Spence "Information visualization - An Introduction", 3rd Edition, Pearson Education, 2014. (Unit I &V)
3. Stuart.K.Card, Jock.D.Mackinlay and Ben Shneiderman, "Readings in Information Visualization Using Vision to think", Morgan Kaufmann Publishers
4. Thomas Strothotte, Computer Visualization Graphics Abstraction and Interactivity, Springer Verlag Berlin Heiderberg,

Course Designer(s)

Dr. O.S GNANA PRAKASI

Course Reviewer

AJIT DANTI

MTCS142E05	INFORMATION RETRIEVAL				Hours			Credits				
					L	T	P	L	T	P	C	
					3	-	-	3	-	-	-	
Preamble												
The course provides good understanding of the foundation concepts of information retrieval techniques and be able to apply these concepts into practice.												
Prerequisite												
DAA, Internet Programming.												
Course Outcomes												
Elaborate various retrieval techniques and index construction.											L2	
Compute score in search system and estimate the informational retrieval using feedback and query expansion.											L3	
Acquire knowledge on various retrieval and classification techniques											L3	
Explore various clustering and indexing techniques.											L3	
Illustrate web search, web crawling and indexing for real time web based system											L4	
Mapping with Program Outcomes (POs)												
COs	PO1	P O 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO12
CO1	3	3	3	2								
CO2	3	3	3	2								
CO3	3	3	3	2								
CO4	3	2	2	2								
CO5	3	3	3	2								
Syllabus												
Unit - I	INTRODUCTION									L 9	T -	P -
Boolean retrieval. The term vocabulary and postings lists. Dictionaries and tolerant retrieval. Index construction. Index compression.												
Unit - 2	SCORING									L 9	T -	P -
Scoring, term weighting and the vector space model. Computing scores in a complete search system. Evaluation in information retrieval. Relevance feedback and query expansion.												
Unit - 3	XML									L 9	T -	P -
XML retrieval. Probabilistic information retrieval. Language models for information retrieval. Text classification. Vector space classification.												
Unit - 4	CONCURRENCY CONTROL AND RECOVERY									L 9	T -	P -
Support vector machines and machine learning on documents, Flat clustering, Hierarchical clustering, Matrix decompositions and latent semantic indexing.												
Unit - 5	DATABASE SECURITY									L 9	T -	P -
Web search basics. Web crawling and indexes, Link analysis. Case study of Google Information Retrieval System or any web based system.												
Text Books												

1. Introduction to Information Retrieval, Christopher D. Manning, PrabhakarRaghavan and HinrichSchütze, Cambridge University Press. 2008

Reference Books

1. Information Storage and Retrieval Systems: Theory and Implementation, Kowalski, Gerald, Mark T Maybury, Springer 2009.
2. Modern Information Retrieval, Ricardo Baeza-Yates, Pearson Education, 2007.
3. Information Retrieval: Algorithms and Heuristics, David A Grossman and OphirFrieder, 2nd Edition, Springer, 2008.

Course Designer(s)

Daniel D

Course Reviewer

Manohar M

MTCS151	ADVANCED ALGORITHMS LAB	Hours			Credits			
		L	T	P	L	T	P	C
		0	0	2	0	0	2	2
Preamble								
List of Experiments								
Project Based Lab								
Course Designer(s)								
Mithun B N								
Course Reviewer								
DrBalamurugan								

MTCS152	ADVANCED DIGITAL IMAGE PROCESSING LAB						Hours			Credits			
							L	T	P	L	T	P	C
							0	0	2	0	0	2	2
Preamble													
Students are expected to implement the image processing algorithms and techniques to solve the real life problems.													
Prerequisite													
Name of Course(s) which is (are) required as prerequisite for this course													
Course Outcomes													
Examine the principles and techniques of digital image processing in applications related to digital imaging system design and analysis										L3			
Experiment and implement image processing algorithms										L4			
Understand software tools for processing digital images										L2			
Experiment image processing problems and techniques										L4			
Examine image processing algorithms on computers										L4			
Demonstrate algorithms to solve image processing problems										L3			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	2	2											
CO2			2	2									
CO3					2								
CO4			2										
CO5				3									
CO6				2									
List of Experiments													
<ol style="list-style-type: none"> 1. Display of Grayscale Images, 2. Implementation of various transforms and their use. 3. Implementation of Histogram Equalization, Non-linear Filtering. 4. Implementation of Edge detection using Operators, 2-D DFT and DCT. 5. Implementation of Filtering in frequency domain. 6. Implementation of Segmentation using various transform. 7. Implementation of various Morphological algorithms. Implementation of IEEE/ACM paper in Digital image processing area.													
Course Designer(s)													
AJIT DANTI													
Course Reviewer													
DrRaju G													

MTCS111E01	ENGLISH FOR RESEARCH PAPER WRITING	Hours			Credits			
		L	T	P	L	T	P	C
		2	0	0	2	0	0	2
Preamble								
Prerequisite								
Nil								
Unit - I				4	0	0		
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness								
Unit - 2				4	0	0		
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction								
Unit - 3				4	0	0		
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.								
Unit - 4				4	0	0		
key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature								
Unit - 5				4	0	0		
skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions, useful phrases, how to ensure paper is as good as it could possibly be the first- time submission								
Text Books								
Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)								
Reference Books								
Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011								
Course Designer(s)								
Syllabus is taken from AICTE Model curriculum								
Course Reviewer								

MTCS111E02	DISASTER MANAGEMENT	Hours			Credits			
		L	T	P	L	T	P	C
		2	0	0	2	0	0	2
Preamble								
<p>1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.</p> <p>2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.</p> <p>3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.</p> <p>4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in</p>								
Prerequisite								
Nil								
Unit - I	INTRODUCTION			4	0	0		
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.								
Unit - 2	REPERCUSSIONS OF DISASTERS AND HAZARDS			4	0	0		
Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.								
Unit - 3	DISASTER PRONE AREAS IN INDIA STUDY OF SEISMIC ZONES			4	0	0		
Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics								
Unit - 4	DISASTER PREPAREDNESS AND MANAGEMENT PREPAREDNESS			4	0	0		
Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.								
Unit - 5	RISK ASSESSMENT DISASTER RISK			4	0	0		
Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival. Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.								
Text Books								
1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies ""New Royal book Company.								
Reference Books								
<p>1. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.</p> <p>2. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep&Deep Publication Pvt. Ltd., New Delhi.</p>								
Course Designer(s)								
Syllabus is taken from AICTE Model curriculum								

MTCS111E03	SANSKRIT FOR TECHNICAL KNOWLEDGE	Hours			Credits			
		L	T	P	L	T	P	C
		2	0	0	2	0	0	2
Preamble								
1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world 2. Learning of Sanskrit to improve brain functioning 3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects 4. enhancing the memory power 5. The engineering scholars equipped with Sanskrit will be able to explore the 6. huge knowledge from ancient literature								
Prerequisite								
Nil								
Unit - I				8	0	0		
Alphabets in Sanskrit, · Past/Present/Future Tense, · Simple Sentences								
Unit - 2				8	0	0		
Order · Introduction of roots · Technical information about Sanskrit Literature								
Unit - 3				8	0	0		
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics								
Text Books								
“Abhyaspustakam” - Dr.Vishwas, Samskrita-Bharti Publication, New Delhi								
Reference Books								
“Teach Yourself Sanskrit” PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.								
Course Designer(s)								
Syllabus is taken from AICTE Model curriculum								
Course Reviewer								

MTCS111E04	VALUE EDUCATION	Hours			Credits			
		L	T	P	L	T	P	C
		2	0	0	2	0	0	2
Preamble								
Understand value of education and self- development Imbibe good values in students Let the should know about the importance of character								
Prerequisite								
Nil								
Unit - I				5	0	0		
Values and self-development -Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. · Value judgements								
Unit - 2				5	0	0		
Importance of cultivation of values. · Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. · Honesty, Humanity. Power of faith, National Unity. ·Patriotism.Love for nature,Discipline								
Unit - 3				5	0	0		
Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. · Punctuality, Love and Kindness. · Avoid fault Thinking. · Free from anger, Dignity of labour. · Universal brotherhood and religious tolerance. · True friendship. · Happiness Vs suffering, love for truth. · Aware of self-destructive habits. · Association and Cooperation. · Doing best for saving nature								
Unit - 4				5	0	0		
Character and Competence -Holy books vs Blind faith. · Self-management and Good health. · Science of reincarnation. · Equality, Nonviolence,Humility, Role of Women. · All religions and same message. · Mind your Mind, Self-control. · Honesty, Studying effectively								
Text Books								
Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi								
Reference Books								
Course Designer(s)								
Syllabus is taken from AICTE Model curriculum								
Course Reviewer								

MTCS112	PROFESSIONAL PRACTICE- I	Hours			Credits			
		L	T	P	L	T	P	C
		0	0	2	0	0	2	1
Preamble								
<p>SUBJECT DESCRIPTION:</p> <p>During the seminar session each student is expected to prepare and present a topic on engineering / technology, it is designed to:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Review and increase their understanding of the specific topics tested. <input type="checkbox"/> Improve their ability to communicate that understanding to the grader. <input type="checkbox"/> Increase the effectiveness with which they use the limited examination time. <p>SUBJECT OBJECTIVE:</p> <p>Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models. This will enable them to gain confidence in facing the placement interviews and intended to increase the score they earn on the upcoming exam above what they would otherwise earn.</p> <p>This course is specially designed for the students of higher degree. It aims to train and equip the students towards acquiring competence in teaching, laboratory skills, research methodologies and other professional activities including ethics in the respective academic disciplines.</p> <p>The course will broadly cover the following aspects:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Teaching skills <input type="checkbox"/> Laboratory skills and other professional activities <input type="checkbox"/> Research methodology <p>For teaching suitable courses where strengthening in the training of the students is required will be identified and the student will be asked to prepare lectures on selected topics pertaining to the courses and present these lectures before a panel of faculty members. The student will also be required to prepare question papers which will test the concepts, analytical abilities and grasp in the subject. Wherever the laboratories are involved, students will also be asked to carry out laboratory experiments and learn about the use and applications of the instruments. The general guiding principle is that the students should be able to teach and participate in the undergraduate degree courses in his/her discipline in an effective manner. The students will also assist the faculty in teaching and research activities. The course will also contain the component of research methodology, in which a broad topic will be assigned to each student and he/ she is supposed to carry out intensive literature survey, data analysis and prepare a research proposal.</p> <p>Each group will carry out many professional activities beside teaching and research. Such as, purchase of equipments, hardware, software and planning for new experiments and also laboratories etc. Along with these the students will also be assigned some well defined activities. The student is expected to acquire knowledge of professional ethics in the discipline.</p>								
Prerequisite								
Nil								

OPERATIONAL DETAILS

Head of the Department will assign a suitable instructor/faculty member to each student. Students and faculty members covering a broad area will be grouped in a panel consisting of 4-5 students and 4-5 faculty members.

Within one week after registration, the student should plan the details of the topics of lectures, laboratory experiments, developmental activities and broad topic of research etc in consultation with the assigned instructor/faculty. The student has to submit two copies of the written outline of the total work to the instructor within one week.

In a particular discipline, Instructors belonging to the broad areas will form the panel and will nominate one of them as the panel coordinator. The coordinator together with the instructors will draw a complete plan of lectures to be delivered by all students in a semester. Each student will present 3- 4 lectures, which will be attended by all other students and Instructors. These lectures will be evenly distributed over the entire semester. The coordinator will announce the schedule for the entire semester and fix suitable meeting time in the week.

Each student will also prepare one presentation about his findings on the broad topic of research. The final report has to be submitted in the form of a complete research proposal. The References and the bibliography should be cited in a standard format. The research proposal should contain a) Topic of research b) Background and current status of the research work in the area as evident from the literature review c) Scope of the proposed work d) Methodology e) References and bibliography.

A report covering laboratory experiments, developmental activities and code of professional conduct and ethics in discipline has to be submitted by individual student.

The panel will jointly evaluate all the components of the course throughout the semester and the mid semester grade will be announced by the respective instructor to his student.

A comprehensive viva/test will be conducted at the end of the semester jointly, wherever feasible by all the panels in a particular academic discipline/department, in which integration of knowledge attained through various courses will be tested and evaluated.

Wherever necessary and feasible, the panel coordinator in consultation with the concerned group may also seek participation of the faculty members from other groups in lectures and comprehensive viva.

Mid semester report and final evaluation report should be submitted in the 9th week and 15th week of the semester respectively. These should contain the following sections:

Section (A): Lecture notes along with two question papers each of 180 min duration, one quiz paper (CIA-I) of 120 min duration on the topics of lectures. The question paper should test concepts, analytical abilities and grasp of the subject. Solutions of questions also should be provided. All these will constitute lecture material.

Section (B): Laboratory experiments reports and professional work report.

Section (C): Research proposal with detailed references and bibliography in a standard format.

Wherever necessary, respective Head of the Departments could be approached by

Instructors/panel coordinators for smooth operation of the course. Special lectures dealing with professional ethics in the discipline may also be arranged by the group from time to time.

MTCS231	Computer Communication Networks					Hours			Credits				
						L	T	P	L	T	P	C	
						3	0	0	3	0	0	3	
Preamble													
This course is designed to give a clear understanding of internetworking, functions of different layers And To introduce IEEE standards employed in computer networking. To make the students get familiarized with different protocols and network components.													
Prerequisite													
Computer networks-I. Computer networks-II													
Course Outcomes													
Recognize the basic requirements of building of network and layering of protocols.										L2			
Distinguish the concept of internetworking and routing through internet protocol addressing.										L2			
Discuss the role of different protocols in internetworking.										L2			
Examine the security issues and congestion control in the networks										L4			
Determine the features and operations of various application layer protocols.										L2			
Mapping with Program Outcomes (POs)													
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO12	
CO1	3	3						2		2		2	
CO2	3	3	2					2		2		2	
CO3	3		2										
CO4	3	3	2										
CO5	3												
Syllabus													
Unit - I	INTRODUCTION										L	T	P
											9	0	0
Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait , Sliding Window, Concurrent Logical Channels.													
Unit - 2	INTERNETWORKING- I										L	T	P
											9	0	0
Switching and Bridging, Datagram's, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), Service Model, Global Addresses, Datagram Forwarding in IP, subnetting and classless addressing, Address Translation(ARP), Host Configuration(DHCP), Error Reporting(ICMP), Virtual Networks and Tunnels.													
Unit - 3	INTERNETWORKING- II										L	T	P
											9	0	0
Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems (BGP), IP Version 6(IPv6), Mobility and Mobile IP.													

Unit - 4	NETWORK SECURITY	L 9	T 0	P 0
Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), End-to-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery.				
Unit - 5	APPLICATIONS	L 9	T 0	P 0
Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System(DNS),Electronic Mail(SMTP,POP,IMAP,MIME),World Wide Web(HTTP),Network Management(SNMP).				
Text Books				
<ol style="list-style-type: none"> 1. Larry Peterson and Bruce S Davis "Computer Networks: A System Approach" 5th Edition, Elsevier -2014 2. Douglas E Comer, "Internetworking with TCP/IP, Principles, Protocols and Architecture" 6th Edition, PHI - 2014 				
Reference Books				
<ol style="list-style-type: none"> 1. Uyles Black "Computer Networks, Protocols, Standards and Interfaces" 2nd Edition - PHI 2. Behrouz A Forouzan "TCP /IP Protocol Suite" 4th Edition - Tata McGraw-Hill 2010 3. Andrew S. Tanenbaum, "Computer Networks", Pearson Education 4th edition, 2012. 4. Larry L.Peterson and Brule S.Davie, "Computer Networks - A System Approach" MarGankangmann - Harcourt Asia, Fifth Edition, 2011. 5. William Stallings, "SNMP, SNMP V2, SNMPV3, RMON 1 and 2", Pearson 2006 6. J.F Kurose and K.W. Ross, "Computer Networking -A top -down approach featuring the internet", Pearson, 2012. 7. William Stallings, "Data & Computer Communication", 6th Edition, Pearson Education, 2009. 8. Mani Subramanian, "Network Management: Principles and Practice", Addison Wesley, 2010. 9. http://www.springer.com/engineering/signals/book/978-1-4614-6153-1 10. http://www.proceedings.com/23900.html 				
Course Designer(s)				
Praveen Kulkarni				
Course Reviewer				
Dr. Ganesh Kumar				

MTCS232	DATA SCIENCE						Hours			Credits			
							L	T	P	L	T	P	C
							3	-	-	3	-	-	3
Preamble													
Able to apply fundamental algorithmic ideas to process data. Learn to apply hypotheses and data into actionable predictions. Document and transfer the results and effectively communicate the findings using visualization techniques.													
Prerequisite													
Advanced Data Base Management Systems Advanced Algorithms													
Course Outcomes													
Understand the foundations of data processing										Understand			
Apply the clustering methods for modelling the data										Apply			
Analysis of Statistical models and data distributions using R Programming										Analyze			
Analysis of distributed file system and Map reducing technique using Hadoop										Analyze			
Evaluating the results of data science experiment using R Programming.										Evaluate			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	2											
CO2	3	3	3										
CO3	2	2	2		3								
CO4	2	2	2		3								
CO5	2	2	2		3								
Syllabus													
Unit - I	INTRODUCTION TO DATA SCIENCE									9	-	-	
Data science process - roles, stages in data science project - working with data from files - relational and Non-Relational databases - exploring data - managing data - cleaning and sampling for modeling and validation - Data preprocessing-Statistics for Data Science-Data Distributions													
Unit - 2	MODELING METHODS									9	-	-	
Choosing and evaluating models - mapping problems to machine learning, evaluating clustering models, validating models - cluster analysis - K-means algorithm, Naïve Bayes - Memorization Methods - Linear and logistic regression - unsupervised methods.													
Unit - 3	ANALYTICS WITH PYTHON									9	-	-	
Data Analysis with Numpy and Pandas - Visualization with Seaborn Matplotlib, Plotly and Cufflinks - Scikit-learn -Regression, KNN, PCA and SVM in Python- Recommender systems - NLP with NLTK - Neural Nets and Deep Learning with Tensor Flow.													
Unit - 4	SPARK SYSTEMS									9	-	-	
Introduction -Hadoop vs Spark - Spark Data Frame - Group by and Aggregate - RDD - Spark SQL - Spark Running on Cluster - Machine Learning with Mlib - Collaborative Filtering - NLP Applications - Spark Streaming.													
Unit - 5	DELIVERING RESULTS with POWER BI									9	-	-	
Power BI Desktop - Connecting and Shaping Data - Creating Table Relationship - Database Normalization - Snowflake Schema - Filter Flow - DAX Calculations - Implicit and Explicit													

DAX Measures – DAX Function Categories – Visualization with Power BI Reports – Case studies.

Text Books

1. William McKinney- Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython, O'Reilly; Second edition, 2017
2. Sandy Ryza, Uri Laserson. Advanced Analytics with Spark: Patterns for Learning from Data at Scale – O'Reilly 2017
3. Brett Powell Mastering Microsoft Power Bi, Packt Publishing, 2018

Reference Books

1. Jake VanderPlas. Python Data Science Handbook: Essential Tools for Working with Data O'Reilly 2016.
2. Holden Karau, Andy Konwinski, Learning Spark: Lightning-Fast Big Data Analysis, O'Reilly 2015
3. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", Packt Publishing Ltd., 2014.
4. Aurélien GÈron Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems O'Reilly 2017.
5. Devin Knight, Brian Knight. Microsoft Power BI Quick Start Guide: Build dashboards and visualizations to make your data come to life, Packt Publishing, 2018.

Course Designer(s)

Vinai George

Course Reviewer

Dr. Manohar M

MTCS243E01	CLOUD COMPUTING						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	0
Preamble													
Cloud computing is a model for enabling ubiquitous, convenient, on-demand access to a shared pool of configurable computing resources. Cloud computing paradigm possesses tremendous momentum but its unique aspects exacerbate security and privacy challenges. Cloud computing enables increasing number of IT services to be delivered over the Internet. The cloud platform enables business to run successfully without dedicated hardware, software and services.													
Prerequisite													
Cloud Computing is a broad area, to learn Cloud Computing skills related to basic concepts of Operating Systems (how they work and operate at a high level and Networking are required.													
Course Outcomes													
Understand the fundamentals of Cloud Storage, Cloud Architecture and Cloud Computing											L2		
Explain Cloud Computing technologies with respect to platforms, services, network, security and applications											L2		
Analyze Virtualization techniques, Virtual machines provisioning and Migrating services.											L4		
Examine Work flow and Map-reduce programming models											L4		
Assess various Cloud applications, Security and Performance issues											L5		
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3												
CO2	3												
CO3	2	2	2		1								
CO4	2	2	2	1									
CO5	3	3	2	2	2								
CO6													
Syllabus													
Unit - I	UNIT 1: UNDERSTANDING CLOUD COMPUTING									L : 9	T : 0	P : 0	
Cloud Computing - History of Cloud Computing - Cloud Architecture - Cloud Storage - Why Cloud Computing Matters - Advantages/Disadvantages of Cloud Computing - Types of Cloud - Architecture of Cloud- Cloud Services- Web-Based Application - Pros and Cons of Cloud Service Development.													
Unit - 2	UNIT II: CLOUD COMPUTING ARCHITECTURE									L : 9	T : 0	P : 0	
Types of Cloud Service Development - Infrastructure / Hardware as a Service-Software as a Service - Platform as a Service - Web Services - On-Demand Computing - Migrating into a Cloud -Types of Clouds-Amazon Ec2 - Google App Engine - Microsoft Azure - IBM Clouds.													
Unit - 3	UNIT III: VIRTUALIZATION TECHNIQUES; VIRTUAL MACHINES PROVISIONING AND MIGRATION SERVICES									L : 9	T : 0	P : 0	
Characteristics of Virtualized Environment - Taxonomy of Virtualization Techniques- Virtualization and Cloud Computing - Pros and Cons of Virtualization - Technology Examples: Xen, VMware, Hyper-V- Virtual Machines Provisioning and Manageability-													

Virtual Machine Migration Services – Provisioning in the Cloud Context.				
Unit – 4	UNIT IV: WORKFLOW AND MAP-REDUCE PROGRAMMING MODELS	L : 9	T : 0	P : 0
Workflow Management Systems and Clouds- Architecture of Workflow Management Systems – Utilizing Clouds for Workflow Execution – Data-Intensive Computing- Technologies for Data-Intensive Computing – Storage Systems – Programming Platforms- Aneka MapReduce Programming – Major MapReduce Implementations for the Cloud.				
Unit – 5	UNIT V: CLOUD APPLICATIONS: SECURITY AND PERFORMANCE ISSUES	L : 9	T : 0	P : 0
Case Study: Business and Consumer Applications: CRM and ERP, Social Networking, Multiplayer Online Gaming – Technologies for Data Security in Cloud Computing – Cloud Computing and Data Security Risk- The Cloud, Digital Identity, and Data Security-Content Level Security-Data Privacy and Security Issues – HPC in the Cloud: Performance related Issues.				
Text Books				
<ol style="list-style-type: none"> 1. <u>RajkumarBuyya, Vecchiola, Selvi</u>, “Mastering Cloud Computing”, McGraw Hill. 2013. 2. Anthony Velte, Toby Velte, and Robert Elsenpeter. “Cloud Computing – A Practical Approach”, McGraw Hill. 2010. 3. <u>RajkumarBuyya, James Broberg, Andrzej M. Goscinski</u>, “Cloud Computing: Principles and Paradigms”, Wiley 2013. 				
Reference Books				
<ol style="list-style-type: none"> 1. Massimo Cafaro and Giovanni Aloisio. “Grids, Clouds and Virtualization”. Springer 2012. 2. Michael Miller, “Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online”, Que Publishing, August 2008. 				
Course Designer(s)				
Dr Ganesh Kumar R.				
Course Reviewer				
Dr AVN Krishna				

MTCS243E02	ADVANCED MOBILE COMPUTING					Hours			Credits			
						L	T	P	L	T	P	C
						3	0	0	3	0	0	3
Preamble												
At the end of the course, the student should understand <ul style="list-style-type: none"> • The basics of wireless voice and data communications technologies. • To build working knowledge on various telephone and satellite networks. • To study the working principles of wireless LAN and its standards. • To build knowledge on various mobile computing algorithms. • To build skills in working with wireless application protocols to develop mobile content applications. 												
Prerequisite												
Nil												
Course Outcomes												
Describe and compare different mobile application models/architectures and patterns.											L2	
To be able to Create, test and debug third party application by setting up development 3rd party frameworks like Phonegap, Native Script etc..											L4	
Develop an windows based universal applications which uses visual studio environment, universal windows platform as framework and user specific development languages like java, HTML, JSP etc..											L4	
Develop android applications which uses android studio, development language java and demonstrates knowledge UI framework, persistent storage, Google maps, GPS etc..											L4	
Develop android applications which uses Animations and other graphical features.											L4	
Mapping with Program Outcomes (POs)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2									
CO2	2	2	2	2	2				2			
CO3	2	2	2	2	2				2			
CO4	2	2	2	2	2				2			
CO5	2	2	2	2	2				2			
Unit - I												
Unit - I		Introduction to Mobile Communications and Computing								9	0	0
Introduction to Mobile Communications and Computing : Mobile Computing (MC) : Introduction to MC, novel applications, limitations, and architecture. Wireless Transmission Fundamentals: Introduction to wireless transmission, signal propagation, Multiplexing, Modulation, Spread Spectrum												
Unit - 2		GSM								9	0	0
GSM : Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services. (Wireless) Medium Access Control :Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals),												

SDMA, FDMA, TDMA, CDMA.				
Unit - 3	Mobile Network Layer	9	0	0
Mobile Network Layer : Mobile IP (Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP). Mobile Transport Layer : Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/ fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.				
Unit - 4	Wireless LAN Technology	9	0	0
Wireless LAN Technology-IEEE 802.11 (System Architecture, protocol architecture, physical layer, medium access control layer, mac management, 802.11b, 802.11a) Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms, security in MANETs.				
Unit - 5	Bluetooth	9	0	0
Bluetooth: User scenarios, Architecture, Radio layer, Baseband layer, Link manager protocol, L2CAP, Security , SDP , profiles , IEEE 802.15 . Wireless Application Protocol : Architecture, Wireless datagram protocol, Wireless transport layer security, Wireless truncation protocol, Wireless session protocol, Wireless application environment, Wireless markup language, WML Script, Wireless telephony application, Push architecture, Push/pull services, Examples stacks with WAP 1.X.				
Text Books				
<ol style="list-style-type: none"> 1. J.Schiller, "Mobile Communication", 2nd Edition, Pearson Education, 2012. 2. Cory Beard, William Stallings, "Wireless Communication and Networks", 5/e, Pearson Education, 2015. 3. Raj Pandya, " Mobile and Personal Communication Systems and Services", Prentice Hall of India. 2010 4. UweHansmann, LotharMerk, Martin Nicklous, Thomas Stober, " Principles of Mobile Computing" , Springer International Edition. 2011 				
Reference Books				
<ol style="list-style-type: none"> 1. Singhal, "WAP-Wireless Application Protocol", Pearson Education 2002. 2. LotharMerk, Martin. S. Nicklaus and Thomas Stober, "Principles of Mobile Computing", Second Edition, Dreamtech press 2006. 3. William C.Y.Lee, "Mobile Communication Design Fundamentals", John Wiley. 2011. 4. Reza Behravanfar, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML", ISBN: 0521817331, Cambridge University Press, 2004. 5. Adelstein, Frank, Gupta, Sandeep KS, Richard III, Golden ,Schwiebert, Loren, "Fundamentals of Mobile and Pervasive Computing", ISBN: 0071412379, McGraw-Hill Professional, 2005. 6. MartynMallick, "Mobile and Wireless Design Essentials", Wiley DreamTech. 2003. 				
Course Designer(s)				
Sujatha A K				
Course Reviewer				
Dr Ganesh Kumar R				

MTCS243E03	DISTRIBUTED COMPUTING	Hours			Credits							
		L	T	P	L	T	P	C				
		3	0	0	3	0	0	3				
Preamble												
<ul style="list-style-type: none"> To get a comprehensive knowledge of the architecture of distributed systems. To understand the deadlock and shared memory issues and their solutions in distributed environments. To know the security issues and protection mechanisms for distributed environments. To get a knowledge of distributed transaction processing. 												
Prerequisite												
Nil												
Course Outcomes												
Experiment the concepts and principles of distributed computing.							L3					
Examine the methods of communication that is happening in a distributed environment.							L4					
Outline the architecture and the support of operating systems in a distributed environment and also implement any architecture for the current issues prevailing.							L4					
Examine the concepts and issues of transaction that happens in a distributed Environment.							L3					
Mapping with Program Outcomes (POs)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CO1	2				2							
CO2	2				2							
CO3	2				2							
CO4	2				2							
Unit - I										9	0	0
INTRODUCTION Characterization of Distributed Systems - Examples - Trends-Resource Sharing- System Models - Physical, Architectural and Fundamental Models - Networking and Internetworking - Types of Networks - Network Principles - Internet Protocols - Case Studies.												
Unit - 2										9	0	0
PROCESSES AND DISTRIBUTED OBJECTS Interprocess Communication - The API for the Internet Protocols - External Data Representation and Marshalling - Client-Server Communication - Group Communication - Case Study Distributed Objects and Remote Invocation - -Request Reply protocols-Remote Procedure Call - Remote method Invocation - Java RMI Case Study.												
Unit - 3										9	0	0
OPERATING SYSTEM ISSUES - I The OS Layer - Protection - Processes and Threads - Communication and Invocation - OS Architecture - Security - Overview - Cryptographic Algorithms - Digital Signatures - Cryptography Pragmatics - Case Studies - Distributed File Systems - File Service Architecture Sun Network File System - CASE STUDY The Andrew File System												

Unit - 4	OPERATING SYSTEM ISSUES - II	9	0	0
Directory Service - Clocks, Events and Process States - Synchronizing Physical Clocks - Logical Time And Logical Clocks - Global States - Distributed Debugging - Distributed Mutual Exclusion - Elections -Coordination and Agreement in group Communication- Consensus and Related Problems.				
Unit - 5	DISTRIBUTED TRANSACTION PROCESSING	9	0	0
Transactions - Nested Transactions - Locks - Optimistic Concurrency Control - Timestamp Ordering - Comparison - Flat and Nested Distributed Transactions - Atomic Commit Protocols- Concurrency Control in Distributed Transactions - Distributed Deadlocks - Transaction Recovery.				
Text Books				
1.Coulouris G, Dollimore J. &Kindberg T, G Blair , Distributed Systems Concepts And Design, 5th Edition, Addison-Wesley 2012.				
Reference Books				
1. Andrew S Tanenbaum , Maartenvan Steen, "Distributed Systems -Principles and paradigms"Second edition , Pearson Education, 2015 (Reprint)				
2. MugeshSinghal,Niranjan G Shivaratri, "Advanced Concepts in Operating Systems", Tata McGraw Hill Edition, 2011				
3. M.L.Liu, "Distributed Computing Principles and Applications", Pearson Education, 2004.				
4. SapeMullender, "Distributed Systems", Addison Wesley, 2nd Edition, 1993.				
Course Designer(s)				
Sujatha A K				
Course Reviewer				
Dr Ganesh Kumar R				

MTCS243E04	ADVANCED PARALLEL COMPUTING						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
To study the scalability, clustering issues, parallel programming models, shared memory programming and enabling technologies for parallel computing.													
Prerequisite													
Digital Systems and Microprocessors Computer Organization and Architecture													
Course Outcomes													
Justify the need for parallel computing from a performance point of view.										L5			
Explain massive parallelism in modern parallel computers with shared memory and distributed memory from an architectural perspective.										L2			
Categorize parallel computing models based on shared address space platforms, distributed memory systems and heterogeneous platforms.										L4			
Compare the runtime performance of parallel programs with their serial implementations to propose improvements.										L2			
Design and Propose parallel algorithms using programming models - OpenMP, MPI and CUDA with improved performance.										L6			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	3											
CO2	3	3											
CO3	3	3		2									
CO4	3	3	2	2	2								
CO5	3	3	3	2	2								
Syllabus													
Unit - I	SCALABILITY AND CLUSTERING									9	0	0	
Evolution of Computer Architecture - Dimensions of Scalability - Parallel Computer Models - Basic Concepts Of Clustering - Scalable Design Principles - Parallel Programming Overview - Processes, Tasks and Threads - Parallelism Issues - Interaction / Communication Issues - Semantic Issues In Parallel Programs.													
Unit - 2	ENABLING TECHNOLOGIES									9	0	0	
System Development Trends - Principles of Processor Design - Microprocessor Architecture Families - Hierarchical Memory Technology - Cache Coherence Protocols - Shared Memory Consistency - Distributed Cache Memory Architecture - Latency Tolerance Techniques - Multithreaded Latency Hiding.													
Unit - 3	SYSTEM INTERCONNECTS PARALLEL PROGRAMMING									9	0	0	
Basics of Interconnection Networks - Network Topologies and Properties - Buses, Crossbar and Multistage Switches Software Multithreading - Synchronization Mechanisms. Paradigms And Programmability - Parallel Programming Models - Shared Memory Programming using OpenMP													
Unit - 4	PARALLEL PROGRAMMING MESSAGE PASSING PROGRAMMING									9	0	0	
Paradigms And Programmability - Parallel Programming Models - Shared Memory Programming. Message Passing Paradigm - Message Passing Interface - MPI programming.													
Unit - 5	MESSAGE PASSING PROGRAMMING GPU AND									9	0	0	

CUDA PROGRAMMING			
Message Passing Paradigm - Message Passing Interface. Parallel Virtual Machine. Case Study.			
GPU Architecture - Basics of CUDA - CUDA Threads - CUDA Memories - Synchronization Handling - Performance Issues - Application Development			
Text Books			
1. Kai Hwang and Zhi.WeiXu, "Scalable Parallel Computing", Tata McGraw-Hill, 2003			
Reference Books			
1. Michael J. Quinn, "Parallel Programming in C with MPI & OpenMP", Tata McGraw-Hill, New Delhi, 2003.			
2. Kai Hwang, "Advanced Computer Architecture" Tata McGraw-Hill, New Delhi, 2003			
3. David E. Culler & Jaswinder Pal Singh, "Parallel Computing Architecture: A Hardware/Software Approach", Morgan Kaufman Publishers, 1999			
4. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, 2011.			
5. John L. Hennessey and David A. Patterson, "Computer Architecture - A quantitative Approach", Morgan Kaufmann / Elsevier Publishers, 5th. Edition, 2012.			
6. Shane Cook, "CUDA Programming: -A Developer's Guide to Parallel Computing with GPUs(Applications of GPU Computing)", First Edition, Morgan Kaufmann, 2012.			
7. David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors - A Hands-on Approach", Second Edition, Morgan Kaufmann, 2012			
Course Designer(s)			
Raju G.			
Course Reviewer			
Dr. SamikshaShukla			

MTCS244E01	INTERNET OF THINGS						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
This course introduces the basic concepts of IoT, the functionalities of different types of sensors, actuators and micro controllers. It covers the protocols used in different layers and gives insight on programming IoT for different domains.													
Computer Networks Basics of Programming													
Course Outcomes													
Explain the fundamental building blocks of an IoT environment from a logical and physical perspective.										Understand			
Experiment with Arduino and Raspberry Pi to choose the appropriate hardware for different IoT projects.										Build			
Summarize various IoT protocols in Application and Network layers by outlining their advantages and disadvantages.										Analyze			
Develop IoT solutions using Arduino and Raspberry Pi to solve real life problems.										Analyze, Apply			
Survey successful IoT products and solutions to analyze their architecture and technologies.										Analyze			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	2												
CO2	2	1	1										
CO3	3	2	2	1									
CO4	2	2			1								
CO5	3	3	3	3	2				1				
Syllabus													
Unit - I	INTRODUCTION AND BACKGROUND									9	0	0	
Definition and Characteristics of IoT, Physical Design of IoT: Things in IoT, Logical Design of IoT: IoT functional Blocks, IoT Communication Blocks, IoT communication APIs, IoT Enabling Technologies: WSN, Cloud Computing, Big Data Analysis, Communication Protocols, Embedded Systems.													
Unit - 2	IOT HARDWARE, DEVICES AND PLATFORMS									9	0	0	
Basics of Arduino: The Arduino Hardware, The Arduino IDE, Basic Arduino Programming, Basics of Raspberry pi: Introduction to Raspberry Pi, Programming with Raspberry Pi, CDAC IoT devices: Ubimote, Wi-Fi mote, BLE mote, WINGZ gateway, Introduction to IoT Platforms, IoT Sensors and actuators.													
Unit - 3	IOT PROTOCOLS									9	0	0	
IoT Data Link Protocols, Network Layer Routing Protocols, Network Layer Encapsulation Protocols, Session Layer Protocols, IoT Security Protocols, Service Discovery Protocols, Infrastructure Protocols.													
Unit - 4	IOT PROGRAMMING									9	0	0	
Arduino Programming: Serial Communications, Getting input from sensors, Visual, Physical and Audio Outputs, Remotely Controlling External Devices, Wireless Communication. Programming with Raspberry Pi: Basics of Python Programming, Python packages of IoT,													

IoT Programming with CDAC IoT devices.				
Unit - 5	IOT DESIGN AND CLOUD INCORPORATION	9	0	0
Case Studies- IoT Design and Cloud incorporation: Introduction to IOT Design, Home Automation, Smart Lighting , Home Intrusion Detection, Cities , Smart Parking , Environment , Weather Monitoring System , Weather Reporting Bot , Air Pollution Monitoring , Forest Fire Detection, Agriculture, Smart Irrigation, Productivity Applications , IoT Printer..				
Text Books				
<ol style="list-style-type: none"> 1. Vijay Madiseti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. 2. Margolis, Michael. "Arduino Cookbook: Recipes to Begin, Expand, and Enhance Your Projects." O'Reilly Media, Inc.", 2011. 3. Monk, Simon. Raspberry Pi cookbook: Software and hardware problems and solutions. " O'Reilly Media, Inc.", 2016. 				
Reference Books				
<ol style="list-style-type: none"> 1. The Internet of Things: Applications to the Smart Grid and Building Automation by - Olivier Hersent, Omar Elloumi and David Boswarthick - Wiley Publications -2012. 2. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012. 3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010. 4. Al-Fuqaha, Ala, et al. "Internet of things: A survey on enabling technologies, protocols, and applications." IEEE Communications Surveys & Tutorials 17.4 (2015): 2347-2376. 5. Tsitsigkos, Alkiviadis, et al. "A case study of internet of things using wireless sensor networks and smartphones." Proceedings of the Wireless World Research Forum (WWRF) Meeting: Technologies and Visions for a Sustainable Wireless Internet, Athens, Greece. Vol. 2325. 2012. 6. Ye, Mengmei, et al. "Security Analysis of Internet-of-Things: A Case Study of August Smart Lock." 				
Course Designer(s)				
Naveen J				
Course Reviewer				
Bijeesh T. V				

MTCS244E02	ADHOC NETWORKS							Hours			Credits			
								L	T	P	L	T	P	C
								45	15	0	3	0	0	0
Preamble														
To understand the Software quality models, to understand the fundamentals of ad hoc technology, to know about various ad hoc routing protocols, to understand various security issues in ad hoc networks, to know about the QoS and energy management approaches.														
Prerequisite														
Computer Networks CS435														
Course Outcomes														
Course Outcome 1 - To understand the fundamentals of ad hoc wireless communication technology										L2				
Course Outcome 2 - To understand various ad hoc routing protocols and apply for different problems										L3				
Course Outcome 3 - To understand the different multicast routing protocols and compare them with respect to different parameters										L3				
Course Outcome 4 - To know about the transport layer protocols and secure routing approaches in ad hoc wireless networks										L2				
Course Outcome 5 - To know about the quality of services and energy management approaches in ad hoc wireless networks										L2				
Mapping with Program Outcomes (POs)														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		
CO1	2	2	1											
CO2	2	2	1	2										
CO3	2	2	1	1										
CO4	2	2	1											
CO5	2	2	1											
CO6														
Syllabus														
Unit - I		Introduction								9	3	P		
Introduction-Fundamentals of Wireless Communication Technology - The Electromagnetic Spectrum - Radio Propagation Mechanisms - Characteristics of the Wireless Channel - IEEE 802.11a,b Standard - Origin Of Ad hoc: Packet Radio Networks - Technical Challenges - Architecture of PRNETs - Components of Packet Radios - Ad hoc Wireless Networks -What Is an Ad Hoc Network? Heterogeneity in Mobile Devices - Wireless Sensor Networks - Traffic Profiles - Types of Ad hoc Mobile Communications - Types of Mobile Host Movements - Challenges Facing Ad Hoc Mobile Networks-Ad hoc wireless Internet														
Unit - 2		Ad Hoc Routing Protocols								9	3	P		
Introduction - Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks - Classifications of Routing Protocols -Table-Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV) - Wireless Routing Protocol (WRP) - Cluster Switch Gateway Routing (CSGR) - Source-Initiated On-Demand Approaches - Ad Hoc On-Demand Distance Vector Routing (AODV) - Dynamic Source Routing (DSR) -Temporally Ordered Routing Algorithm (TORA) - Signal Stability Routing (SSR) -Location-Aided Routing (LAR) - Power-Aware Routing (PAR) - Zone Routing Protocol (ZRP) .														
Unit - 3		Multicast Routing in Ad Hoc Networks								9	3	P		
Introduction - Issues in Designing a Multicast Routing Protocol - Operation of Multicast Routing Protocols - An Architecture Reference Model for Multicast Routing Protocols - Classifications of Multicast Routing Protocols - Tree-Based Multicast Routing Protocols-Mesh-Based Multicast Routing Protocols - Summary of Tree-and Mesh-Based Protocols -														

Energy-Efficient Multicasting - Multicasting with Quality of Service Guarantees - Application-Dependent Multicast Routing - Comparisons of Multicast Routing Protocols				
Unit - 4	Transport Layer, Security Protocols	9	3	P
Introduction - Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks - Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks -Classification of Transport Layer Solutions - TCP Over Ad Hoc Wireless Networks -Other Transport Layer Protocols for Ad Hoc Wireless Networks - Security in Ad Hoc Wireless Networks - Network Security Requirements - Issues and Challenges in Security Provisioning - Network Security Attacks - Key Management - Secure Routing in Ad Hoc Wireless Networks				
Unit - 5	QOS and Energy Management	9	3	P
Introduction - Issues and Challenges in Providing QoS in Ad Hoc Wireless Networks - Classifications of QoS Solutions - MAC Layer Solutions - Network Layer Solutions - QoS Frameworks for Ad Hoc Wireless Networks Energy Management in Ad Hoc Wireless Networks -Introduction - Need for Energy Management in Ad Hoc Wireless Networks - Classification of Energy Management Schemes - Battery Management Schemes - Transmission Power Management Schemes - System Power Management Schemes				
Text Books				
4. C. Siva Ram Murthy and B.S. Manoj "Ad Hoc Wireless Networks: Architectures and Protocols", Prentice Hall PTR 2011.				
5. C.K. Toh, "Ad Hoc Mobile Wireless Networks: Protocols and Systems", Pearson Education 2009				
Reference Books				
4. C. Siva Ram Murthy and B.S. Manoj "Ad Hoc Wireless Networks: Architectures and Protocols", Pearson, 2006.				
5. C.K. Toh, "Ad Hoc Mobile Wireless Networks: Protocols and Systems", Pearson, 2007.				
6. Charles E. Perkins, "Ad Hoc Networking", Pearson, 2008				
Course Designer(s)				
Diana Jeba Jingle				
Course Reviewer				
Dr Ganesh Kumar				

MTCS244E03	ADVANCED EMBEDDED SYSTEM						Hours			Credits			
							L	T	P	L	T	P	C
							45	0	0	3	0	0	3
Preamble													
To introduce students to the embedded systems, its hardware, software, embedded networking with programming concepts, real time operating systems, inter-task communication and an exemplary case of MUCOS - IRTOS.													
Prerequisite													
Digital System, Operating System, OOPS													
Course Outcomes													
Understand concepts of embedded hardware and software										L2			
Determine the types of buses and devices used for various types of embedded system										L2			
Apply basic programming concepts to develop an application for embedded systems										L3			
Use basic concepts of RTOS in embedded systems										L3			
Compare various functions of Real Time Operating system										L2			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1		1		3			1	1	1	1	1		
CO2		2		3	2		1					3	
CO3	3	1	3	3	3		3		1			1	
CO4	2	2	1	2			1						
CO5		3			3	2			1	2	1	1	
Syllabus													
Unit - I	Introduction to Embedded Systems									9	0	0	
Definition and Classification - Overview of Processors and hardware units in an embedded system - Software embedded into the system - Exemplary Embedded Systems - Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits													
Unit - 2	Devices and Buses for Devices Network									9	0	0	
I/O Devices - Device I/O Types and Examples - Synchronous - Iso-synchronous and Asynchronous Communications from Serial Devices - Examples of Internal Serial-Communication Devices - UART and HDLC - Parallel Port Devices - Sophisticated interfacing features in Devices/Ports- Timer and Counting Devices - '12C', 'USB', 'CAN' and advanced I/O Serial high speed buses- ISA, PCI, PCI-X, cPCI and advanced buses.													
Unit - 3	Programming Concepts and Embedded Programming in C and C++									9	0	0	
Programming in assembly language (ALP) vs. High Level Language - C Program Elements, Macros and functions -Use of Pointers - NULL Pointers - Use of Function Calls - Multiple function calls in a Cyclic Order in the Main Function Pointers - Function Queues and Interrupt Service Routines Queues Pointers - Concepts of EMBEDDED PROGRAMMING in C++ - Objected Oriented Programming - Embedded Programming in C++, 'C' Program compilers - Cross compiler - Optimization of memory codes.													
Unit - 4	Real-Time Operating Systems - Part 1									9	0	0	
Definitions of process, tasks and threads - Clear cut distinction between functions - ISRs and tasks by their characteristics - Operating System Services- Goals - Structures- Kernel - Process Management - Memory Management - Device Management - File System Organization and Implementation - I/O Subsystems - Interrupt Routines Handling in RTOS, REAL TIME OPERATING SYSTEMS : RTOS Task scheduling models - Handling of task scheduling and latency and deadlines as performance metrics - Co-operative Round Robin Scheduling - Cyclic													

Scheduling with Time Slicing (Rate Monotonic Co-operative Scheduling) – Preemptive Scheduling Model strategy by a Scheduler – Critical Section Service by a Preemptive Scheduler – Fixed (Static) Real time scheduling of tasks				
Unit - 5	Real-Time Operating Systems - Part 2	9	0	0
Study of Micro C/OS-II or Vx Works or Any other popular RTOS – RTOS System Level Functions – Task Service Functions – Time Delay Functions – Memory Allocation Related Functions – Semaphore Related Functions – Mailbox Related Functions – Queue Related Functions – Case Studies of Programming with RTOS				
Text Books				
6. Rajkamal, “Embedded Systems Architecture, Programming and Design”, TATA McGraw-Hill, Second Edition 2008.				
Reference Books				
7. Steve Heath, “Embedded Systems Design”, Second Edition-2003, Newnes,				
8. David E.Simon, “An Embedded Software Primer”, Pearson Education Asia, First Indian Reprint 2002.				
Course Designer(s)				
Surendra H				
Course Reviewer				
Bijeesh T V				

MTCS244E04	BIG DATA ANALYTICS FOR IOT						Hours			Credits			
							L	T	P	L	T	P	C
							45	0	0	3	0	0	3
Preamble													
To learn the concepts of big data analytics To learn the concepts about Internet of things To understand and implement smart systems													
Prerequisite													
Computer Network													
Course Outcomes													
Understand the application of Big data in IoT										L1			
Explain the RFID false authentications										L2			
Describe the concept of fog computation										L2			
Illustrate the web enhanced building										L2			
Examine the sustainability of data										L4			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	2		1		2								
CO2	2		1		2								
CO3	2		1		2								
CO4	2		1		2								
CO5	2		1		2								
Syllabus													
Unit - I	BIG DATA PLATFORMS FOR THE INTERNET OF THINGS									9	0	0	
Big Data Platforms for the Internet of Things: network protocol- data dissemination-current state of art- Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context- Big Data Management Systems for the Exploitation of Pervasive Environments - Big Data challenges and requirements coming from different SmartCity applications													
Unit - 2	RFID FALSE AUTHENTICATIONS									9	0	0	
On RFID False Authentications: YA TRAP - Necessary and sufficient condition for false authentication prevention - Adaptive Pipelined Neural Network Structure in Self-aware Internet of Things: self-healing systems-Role of adaptive neural network- Spatial Dimensions of Big Data: Application of Geographical Concepts and Spatial Technology to the Internet of Things- Applying spatial relationships, functions, and models													
Unit - 3	FOG COMPUTING									9	0	0	
Fog Computing: A Platform for Internet of Things and Analytics: a massively distributed number of sources - Big Data Metadata Management in Smart Grids: semantic inconsistencies - role of metadata													
Unit - 4	WEB ENHANCED BUILDING									9	0	0	
Toward Web Enhanced Building Automation Systems: heterogeneity between existing installations and native IP devices - loosely-coupled Web protocol stack -energy saving in smart building- Intelligent Transportation Systems and Wireless Access in Vehicular Environment Technology for Developing Smart Cities: advantages and achievements- Emerging Technologies in Health Information Systems: Genomics Driven Wellness Tracking and Management System (GO-WELL) - predictive care - personalized medicine													
Unit - 5	SUSTAINABILITY DATA AND ANALYTICS									9	0	0	
Sustainability Data and Analytics in Cloud-Based M2M Systems - potential stakeholders and													

their complex relationships to data and analytics applications - Social Networking Analysis - Building a useful understanding of a social network - Leveraging Social Media and IoT to Bootstrap Smart Environments : lightweight Cyber Physical Social Systems - citizen actuation

Text Books

1. Stackowiak, R., Licht, A., Mantha, V., Nagode, L.," Big Data and The Internet of Things Enterprise Information Architecture for A New Age", Apress, 2015.

Reference Books

Dr. John Bates , "Thingalytics - Smart Big Data Analytics for the Internet of Things", john Bates, 2015

Course Designer(s)

Naveen J

Course Reviewer

Bijeesh T V

MTCS244E05	NETWORK SECURITY						Hours			Credits			
							L	T	P	L	T	P	C
							45	0	0	3	0	0	3
Preamble													
This course covers the major aspects of computer and network security. It starts with a general introduction to information security, and then proceeds to cover types of threats and attacks, hacking techniques, network vulnerabilities, security policies and standards, firewalls, cryptography, Authentication & digital signatures, the SSL protocol, Wireless security, intrusion detection and prevention.													
Prerequisite													
Computer Network													
Course Outcomes													
Evaluate the factors driving the need for network security.										L4			
Demonstrate the implications of implementing encryption at different levels of the OSI reference model.										L2			
Identify types of firewall implementation suitable for differing security requirements.										L2			
Experiment and explain simple filtering rules based on IP and TCP header information.										L4			
Distinguish between firewalls based on packet-filtering routers, application level gateways and circuit level gateways.										L4			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	2				2								
CO2	2				2								
CO3	2				2								
CO4	2				2								
CO5	2				2								
Syllabus													
Unit - I										9	0	0	
Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs Conventional Encryption Principles, Conventional encryption algorithms (DES, Triple DES, AES), cipher block modes of operation (CBC, CFB), location of encryption devices, key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC.													
Unit - 2										9	0	0	
Public key cryptography principles, public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management, Kerberos, X.509 Directory Authentication Service.													
Unit - 3										9	0	0	
Email privacy: Pretty Good Privacy (PGP) and S/MIME. IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.													
Unit - 4										9	0	0	
Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET). Intruders,													
Unit - 5										9	0	0	
Viruses and related threats. Firewall Design principles, Trusted Systems. Intrusion Detection													

Systems.
Text Books
Network Security Essentials (Applications and Standards) by William Stallings Pearson Education, 5 th Edition 2013.
Reference Books
1. Cryptography and network Security, Third edition, Stallings, PHI/ Pearson 2011 2. Principles of Information Security, Whitman, Thomson. 2010 3. Network Security:The complete reference,Robert Bragg,Mark Rhodes, TMH 2010 4. Introduction to Cryptography, Buchmann, Springer. 2012
Course Designer(s)
Diana Jeba Jingle
Course Reviewer
Dr Ganesh Kumar

MTCS251	NETWORKING LAB					Hours			Credits			
						L	T	P	L	T	P	C
						0	0	2	0	0	2	2
Preamble												
Developing a project to implement some of the areas in networking using different protocols and various techniques over wireless Ad-hoc networks with varying traffic loads.												
Prerequisite												
Computer networks I ,computer Network II, basics of simulation tools, Java Programming												
Course Outcomes												
Examine the performances of Routing protocol										L4		
Experiment with different application layer protocols										L4		
Experiment with different security techniques over peer to peer medium.										L4		
Mapping with Program Outcomes (POs)												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3			2							
CO2	3	3			2							1
CO3	3	3			2							
List of Experiments												
<ul style="list-style-type: none"> • Design, develop the project to implement following areas in networks: • TCP/IP suite like ICMP Protocol, TFTP, NNTP, Proxy Server, Application Firewall, Web browsers, ARP, DHCP, ICMP, DNS and SNMP. • Performance Evaluation of TCP and UDP over Wireless Ad-hoc Networks with varying traffic loads. • Prevention of ARP spoofing: A probe packet based technique. • Security techniques over media streaming over peer-to-peer networks. • Various techniques in optimization of bandwidth consumption, request for unauthorized access, signal-to-noise ratio, download channel capacity, packet delivery ratio and inter-packet delay. 												
Course Designer(s)												
Praveen Kulkarni												
Course Reviewer												
Dr Ganesh Kumar												

MTCS252	DATA SCIENCE LAB	Hours			Credits			
		L	T	P	L	T	P	C
		0	0	2	0	0	2	2
Preamble								
.								
Prerequisite								
Database systems								
List of Experiments								
<ul style="list-style-type: none"> • Introduction to the Weka machine learning toolkit • To learn to perform exploratory data analysis using the R language • Introduction to linear regression using R • Classification using the Weka toolkit - Part 1 								
Course Designer(s)								
DrSundaraPandiyan								
Course Reviewer								
DrManohar M								

MTCS212E01	CONSTITUTION OF INDIA	Hours			Credits			
		L	T	P	L	T	P	C
		2	0	0	2	0	0	2
Preamble								
Students will be able to: 1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective. 2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism. 3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.								
Prerequisite								
Nil								
Unit - I								
				4	0	0		
History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working)								
Unit - 2								
				4	0	0		
·Philosophy of the Indian Constitution: Preamble Salient Features, ·Contours of Constitutional Rights & Duties: · Fundamental Rights · Right to Equality · Right to Freedom · Right against Exploitation · Right to Freedom of Religion · Cultural and Educational Rights · Right to Constitutional Remedies · Directive Principles of State Policy · Fundamental Duties.								
Unit - 3								
				4	0	0		
Organs of Governance: · Parliament · Composition · Qualifications and Disqualifications · Powers and Functions · Executive · President · Governor · Council of Ministers · Judiciary, Appointment and Transfer of Judges, Qualifications · Powers and Functions								
Unit - 4								
				4	0	0		
Local Administration: · District's Administration head: Role and Importance, · Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. ·Pachayati raj: Introduction, PRI: ZilaPachayat. · Elected officials and their roles, CEO ZilaPachayat: Position and role. · Block level: Organizational Hierarchy (Different departments), · Village level: Role of Elected and Appointed officials, · Importance of grass root democracy								
Unit - 5								
				4	0	0		
·Election Commission: · Election Commission: Role and Functioning. · Chief Election Commissioner and Election Commissioners. · State Election Commission: Role and Functioning. · Institute and Bodies for the welfare of SC/ST/OBC and women.								
Text Books								
1. The Constitution of India, 1950 (Bare Act), Government Publication. 2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015. 3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.								
Reference Books								
D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.								
Course Designer(s)								
Syllabus is taken from AICTE Model curriculum								
Course Reviewer								

MTCS212E02	PEDAGOGY STUDIES	Hours			Credits			
		L	T	P	L	T	P	C
		2	0	0	2	0	0	2
Preamble								
Students will be able to: <ul style="list-style-type: none"> Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers. Identify critical evidence gaps to guide the development. 								
Prerequisite								
Nil								
Unit - I								
				4	0	0		
· Introduction and Methodology: · Aims and rationale, Policy background, Conceptual framework and terminology · Theories of learning, Curriculum, Teacher education. · Conceptual framework, Research questions. · Overview of methodology and Searching.								
Unit - 2								
				4	0	0		
· Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. · Curriculum, Teacher education.								
Unit - 3								
				4	0	0		
· Evidence on the effectiveness of pedagogical practices · Methodology for the in depth stage: quality assessment of included studies. · How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? · Theory of change. · Strength and nature of the body of evidence for effective pedagogical practices. · Pedagogic theory and pedagogical approaches. · Teachers' attitudes and beliefs and Pedagogic strategies.								
Unit - 4								
				4	0	0		
· Professional development: alignment with classroom practices and follow-up support · Peer support ·Support from the head teacher and the community. · Curriculum and assessment · Barriers to learning: limited resources and large class sizes								
Unit - 5								
				4	0	0		
Research gaps and future directions · Research design · Contexts · Pedagogy · Teacher education · Curriculum and assessment · Dissemination and research impact.								
Text Books								
Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.								
Reference Books								
<ol style="list-style-type: none"> Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign. www.pratham.org/images/resource%20working%20paper%202.pdf. 								
Course Designer(s)								
Syllabus is taken from AICTE Model curriculum								
Course Reviewer								

MTCS212E03	STRESS MANAGEMENT BY YOGA	Hours			Credits			
		L	T	P	L	T	P	C
		2	0	0	2	0	0	2
Preamble								
<ul style="list-style-type: none"> To achieve overall health of body and mind To overcome stress 								
Prerequisite								
Nil								
Unit - I								
Definitions of Eight parts of yog. (Ashtanga)				8	0	0		
Unit - 2								
· Yam and Niyam. Do`s and Don`t`s in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan				8	0	0		
Unit - 3								
·Asan and Pranayam i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects-Types of pranayam				8	0	0		
Text Books								
‘Yogic Asanas for Group Tarining-Part-I’ :Janardan Swami YogabhyasiMandal, Nagpur								
Reference Books								
“Rajayoga or conquering the Internal Nature” by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata								
Course Designer(s)								
Syllabus is taken from AICTE Model curriculum								
Course Reviewer								

MTCS212E04	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	Hours			Credits			
		L	T	P	L	T	P	C
		2	0	0	2	0	0	2
Preamble								
<ul style="list-style-type: none"> To learn to achieve the highest goal happily To become a person with stable mind, pleasing personality and determination To awaken wisdom in students 								
Prerequisite								
Nil								
Unit - I								
				8	0	0		
Neetisatakam-Holistic development of personality · Verses- 19,20,21,22 (wisdom) · Verses- 29,31,32 (pride & heroism) · Verses- 26,28,63,65 (virtue) · Verses- 52,53,59 (don't's) · Verses- 71,73,75,78 (do's)								
Unit - 2								
				8	0	0		
Approach to day to day work and duties. ·ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48, · Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, · Chapter 18-Verses 45, 46, 48.								
Unit - 3								
				8	0	0		
Statements of basic knowledge. ·ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68 · Chapter 12 -Verses 13, 14, 15, 16,17, 18 · Personality of Role model. ShrimadBhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, · Chapter 4-Verses 18, 38,39 · Chapter18 - Verses 37,38,63								
Text Books								
“Srimad Bhagavad Gita” by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata								
Reference Books								
Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by P.Gopinath, 4. Rashtriya Sanskrit Sansthanam, New Delhi.								
Course Designer(s)								
Syllabus is taken from AICTE Model curriculum								
Course Reviewer								

MTCS213	PROFESSIONAL PRACTICE- II	Hours			Credits			
		L	T	P	L	T	P	C
		0	0	2	0	0	2	1

Preamble

SUBJECT DESCRIPTION:

During the seminar session each student is expected to prepare and present a topic on engineering / technology, it is designed to:

- Review and increase their understanding of the specific topics tested.
- Improve their ability to communicate that understanding to the grader.
- Increase the effectiveness with which they use the limited examination time.

SUBJECT OBJECTIVES:

Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models. This will enable them to gain confidence in facing the placement interviews and intended to increase the score they earn on the upcoming exam above what they would otherwise earn.

This course is specially designed for the students of higher degree. It aims to train and equip the students towards acquiring competence in teaching, laboratory skills, research methodologies and other professional activities including ethics in the respective academic disciplines.

The course will broadly cover the following aspects:

- Teaching skills
- Laboratory skills and other professional activities
- Research methodology

For teaching suitable courses where strengthening in the training of the students is required will be identified and the student will be asked to prepare lectures on selected topics pertaining to the courses and present these lectures before a panel of faculty members. The student will also be required to prepare question papers which will test the concepts, analytical abilities and grasp in the subject. Wherever the laboratories are involved, students

will also be asked to carry out laboratory experiments and learn about the use and applications of the instruments. The general guiding principle is that the students should be able to teach and participate in the undergraduate degree courses in his/her discipline in an effective manner. The students will also assist the faculty in teaching and research activities.

The course will also contain the component of research methodology, in which a broad topic will be assigned to each student and he/ she is supposed to carry out intensive literature survey, data analysis and prepare a research proposal.

Each group will carry out many professional activities beside teaching and research. Such as, purchase of equipments, hardware, software and planning for new experiments and also laboratories etc. Along with these the students will also be assigned some well defined activities. The student is expected to acquire knowledge of professional ethics in the discipline.

Prerequisite

Nil

OPERATIONAL DETAILS

Head of the Department will assign a suitable instructor/faculty member to each student. Students and faculty members covering a broad area will be grouped in a panel consisting of 4-5 students and 4-5 faculty members.

Within one week after registration, the student should plan the details of the topics of lectures, laboratory experiments, developmental activities and broad topic of research etc in consultation with the assigned instructor/faculty. The student has to submit two copies of the written outline of the total work to the instructor within one week.

In a particular discipline, Instructors belonging to the broad areas will form the panel and will nominate one of them as the panel coordinator. The coordinator together with the instructors will draw a complete plan of lectures to be delivered by all students in a semester. Each student will present 3- 4 lectures, which will be attended by all other students and Instructors. These lectures will be evenly distributed over the entire semester. The coordinator will announce the schedule for the entire semester and fix suitable meeting time in the week. Each student will also prepare one presentation about his findings on the broad topic of research. The final report has to be submitted in the form of a complete research proposal. The References and the bibliography should be cited in a standard format. The research proposal should contain a) Topic of research b) Background and current status of the research work in the area as evident from the literature review c) Scope of the proposed work d) Methodology e) References and bibliography.

A report covering laboratory experiments, developmental activities and code of professional conduct and ethics in discipline has to be submitted by individual student.

The panel will jointly evaluate all the components of the course throughout the semester and the mid semester grade will be announced by the respective instructor to his student.

A comprehensive viva/test will be conducted at the end of the semester jointly, wherever feasible by all the panels in a particular academic discipline/department, in which integration of knowledge attained through various courses will be tested and evaluated.

Wherever necessary and feasible, the panel coordinator in consultation with the concerned group may also seek participation of the faculty members from other groups in lectures and comprehensive viva.

Mid semester report and final evaluation report should be submitted in the 9th week and 15th week of the semester respectively. These should contain the following sections:

- Section (A): Lecture notes along with two question papers each of 180 min duration, one quiz paper (CIA-I) of 120 min duration on the topics of lectures. The question paper should test concepts, analytical abilities and grasp of the subject. Solutions of questions also should be provided. All these will constitute lecture material.
- Section (B): Laboratory experiments reports and professional work report.
- Section (C): Research proposal with detailed references and bibliography in a standard format.

Wherever necessary, respective Head of the Departments could be approached by Instructors/panel coordinators for smooth operation of the course. Special lectures dealing

with professional ethics in the discipline may also be arranged by the group from time to time.

EVALUATION SCHEME

Component	Instructors	Weightage
Teaching	Lecture materials	7.5
	Lecture presentation	10
Laboratory and Professional activities	Reports	10
	Viva/presentation	7.5
Research	Proposal	2.5
	Viva/presentation	2.5
Comprehensive	Test/ viva	10
	Total	50

COURSE NOTICES:

Notices pertaining to this course will be displayed on the respective departmental notice boards by the panel coordinator/ instructor. Students may also check the exam notice board for notices issued by the exam division.

MAKE UP POLICY:

All students are required to attend all the lectures and presentations in the panel. Participation and cooperation will also be taken into account in the final evaluation. Requests for makeup should normally be avoided. However, in genuine cases, panel will decide action on a case by case basis.

NOTE: Seminar shall be presented in the department in presence of a committee (Batch of Teachers) constituted by HOD. The seminar marks are to be awarded by the committee. Students shall submit the seminar report in the prescribed Standard format.

MTCS345E01	AGENT BASED INTELLIGENT SYSTEM						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
This course provides a strong foundation of fundamental concepts in Agent Based Intelligent System. To provide an empirical evidence and the scientific approach applying the concept of advanced artificial intelligence techniques for problem solving using probabilistic, fuzzy, statistical and Deep Learning Models.													
Prerequisite													
Basic Artificial Intelligence/ Python / Prolog/ R Programming / Probability													
Course Outcomes													
To demonstrate the concepts and features of agents, environments and uniformed search strategies.										L3			
To understand knowledge representation and reasoning.										L2			
To understand different planning strategies.										L3			
To understand inference using Bayesian Networks, Hidden Markov Models as an approach to Probabilistic Reasoning.										L2			
To Compare and contrast performance of different Statistical learning methods used in machine learning										L3			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	3	2										
CO2	3	3	2										
CO3	3	3	2	3	2								
CO4	3	3	3	3	2								
CO5	3	3	2	2									
Syllabus													
Unit - I	INTRODUCTION									L-9	T-0	P-0	
Definitions - Foundations - History - Intelligent Agents-Problem Solving-Searching - Heuristics -Constraint Satisfaction Problems - Game playing.													
Unit - 2	KNOWLEDGE REPRESENTATION AND REASONING									9	0	0	
Logical Agents-First order logic-First Order Inference-Unification-Chaining- Resolution Strategies-Knowledge Representation-Objects-Actions-Events													
Unit - 3	PLANNING AGENTS									9	0	0	
Planning Problem-State Space Search-Partial Order Planning-Graphs-Nondeterministic Domains-Conditional Planning-Continuous Planning-MultiAgent Planning.													
Unit - 4	AGENTS AND UNCERTAINTY									9	0	0	
Acting under uncertainty - Probability Notation-Bayes Rule and use - Bayesian Networks- Other Approaches-Time and Uncertainty-Temporal Models- Utility Theory - Decision Network -Complex Decisions.													
Unit - 5	HIGHER LEVEL AGENTS									9	0	0	
Knowledge in Learning-Relevance Information-Statistical Learning Methods-Reinforcement Learning-Communication-Formal Grammar-Augmented Grammars- Future of AI.													
Text Books													
4. Stuart Russell and Peter Norvig, "Artificial Intelligence - A Modern Approach", 3rd Edition, Pearson Education, 2014.													
5. Michael Wooldridge, "An Introduction to Multi Agent System", Second Edition, John Wiley, 2009.													

6. Patrick Henry Winston, "Artificial Intelligence", Third Edition, Addison-Wesley, 2002.
7. Nils J. Nilsson, "Artificial Intelligence: A New Synthesis", First Edition, Harcourt Asia Pvt. Ltd., 2012.

Reference Books

3. George F. Luger, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving", Sixth Edition, Pearson Education / PHI, 2009.
4. Francois Chollet "Deep Learning with Python", First Edition Manning Publication, 2018

Course Designer(s)

DrSamikshaShukla

Course Reviewer

Dr Ganesh Kumar

MTCS345E02	ADVANCED ARTIFICIAL INTELLIGENCE						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
This course provides a strong foundation of fundamental concepts in Artificial Intelligence. To provide an empirical evidence and the scientific approach applying Artificial Intelligence techniques for problem solving using probabilistic, fuzzy, statistical and Deep Learning Models.													
Prerequisite													
Basic Python / R Programming / Probability													
Course Outcomes													
To demonstrate the concepts and features of agents, environments and uniformed search strategies.										L3			
To understand inference using Bayesian Networks, Hidden Markov Models as an approach to Probabilistic Reasoning										L2			
To Apply Fuzzy Logic Systems to Neural Network Architectures										L3			
To Compare and contrast performance of different Statistical learning methods used in machine learning										L2			
To explore Deep Learning models to image and text processing application										L3			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	3	2										
CO2	3	3	2						1	1			
CO3	3	3	2	3	2				1	1			
CO4	3	3	3	3	2				1	1			
CO5	3	3	2	2									
Syllabus													
Unit - I		INTRODUCTION								L-9	T-0	P-0	
Intelligent Agents - Agents and environments - Good behaviour - The nature of environments - structure of agents - Problem Solving agents - Acting under uncertainty - Inference using full joint distributions; -Independence; Bayes' rule and its use; -The Wumpus world revisited.													
Unit - 2		SEARCHING TECHNIQUES								9	0	0	
Problem-Solving Agents, Well-defined problems and solutions, Formulating problems, Real-world problems. Uninformed Search Strategies, Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search, Informed (Heuristic) Search Strategies, Greedy best-first search, A* search: Minimizing the total estimated solution cost, Heuristic Functions. The effect of heuristic accuracy on performance. Beyond Classical Search, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.													
Unit - 3		GAME PLAYING								9	0	0	
Games, Optimal Decisions in Games, The minimax algorithm, Optimal decisions in multiplayer games, Alpha Beta Pruning, Move ordering, Imperfect Real-Time Decisions, Cutting off search, Forward pruning. Stochastic Games, Evaluation functions for games of chance. Partially Observable Games. Krieg spiel: Partially observable chess. Card games.													
Math of CS (2020-2022) Programs, Alternative Approaches													

Unit - 4	STATISTICAL AND REINFORCEMENT LEARNING	9	0	0
Learning from observations - forms of learning - Inductive learning - Learning decision trees - Ensemble learning - Knowledge in learning - Logical formulation of learning - Explanation based learning - Learning using relevant information - Inductive logic programming - Statistical learning methods - Learning with complete data - Learning with hidden variable - EM algorithm - Instance based learning - Reinforcement learning - Passive reinforcement learning - Active reinforcement learning - Generalization in reinforcement learning.				
Unit - 5	DEEP LEARNING	9	0	0
Convolutional Neural Networks, Motivation, Convolution operations, Pooling, Image classification, Modern CNN architectures, Recurrent Neural Network, Motivation, Vanishing/Exploding gradient problem, Applications to sequences, Modern RNN architectures, Tuning/Debugging Neural Networks, Parameter search, Overfitting, Visualizations, Pretrained Models.				
Text Books				
<ol style="list-style-type: none"> 1. Stuart Russell and Peter Norvig, "Artificial Intelligence - A Modern Approach", 3rd Edition, Pearson Education, 2014. 2. Elaine Rich and Kevin Knight, "Artificial Intelligence", 3rd Edition, Tata McGraw-Hill, 2012. 3. Francois Chollet "Deep Learning with Python", 1st Edition Manning Publication, 2018 				
Reference Books				
<ol style="list-style-type: none"> 5. Nils J. Nilsson, "Artificial Intelligence: A New Synthesis", 1st Edition, Harcourt Asia Pvt. Ltd., 2012. 6. George F. Luger, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving", 6th Edition, Pearson Education / PHI, 2009. 				
Course Designer(s)				
Vinai George Biju				
Course Reviewer				
Dr. SamikshaShukla				

MTCS345E03	PATTERN RECOGNITION						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
Objective of this course is to enable to students to learn the fundamentals of Pattern Recognition techniques, Statistical Pattern recognition techniques, Syntactical Pattern recognition techniques and Neural Pattern recognition techniques useful for computer vision applications.													
Prerequisite													
Nil													
Course Outcomes													
Course Outcome 1: Ability to understand the basic concepts of Pattern Recognition and its approaches										L2			
Course Outcome 2: Ability to Illustrate various statistical methods for supervised learning classification										L3			
Course Outcome 3: Ability to Evaluate the Clustering for Unsupervised learning classification										L5			
Course Outcome 4: Ability to apply various syntactic pattern classification methods.										L3			
Course Outcome 5: Ability to analyse neural networks and Pattern Recognition methods										L4			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	2	3											
CO2	2	2	3										
CO3	3	3	2	3									
CO4	2	2	2										
CO5				3	2	2							
Syllabus													
Unit - I	PATTERN RECOGNITION OVERVIEW									9	0	0	
Pattern recognition, Classification and Description – Patterns and feature Extraction with Examples – Training and Learning in PR systems – Pattern recognition Approaches													
Unit - 2	STATISTICAL PATTERN RECOGNITION									9	0	0	
Introduction to statistical Pattern Recognition – supervised Learning using Parametric and Non Parametric Approaches													
Unit - 3	LINEAR DISCRIMINANT FUNCTIONS & UNSUPERVISED LEARNING AND CLUSTERING									9	0	0	
Introduction-Discrete and binary Classification problems – Techniques to directly Obtain linear Classifiers - Formulation of Unsupervised Learning Problems – Clustering for unsupervised learning and classification													
Unit - 4	SYNTACTIC PATTERN RECOGNITION									9	0	0	
Overview of Syntactic Pattern Recognition – Syntactic recognition via parsing and other grammars – Graphical Approaches to syntactic pattern recognition – Learning via grammatical inference													
Unit - 5	NEURAL PATTERN RECOGNITION									9	0	0	

Introduction to Neural networks – Feedforward Networks and training by Back Propagation – Case Study - Content Addressable Memory Approaches and Unsupervised Learning in Neural PR
Text Books
7. Robert Schalkoff, “Pattern Recognition: Statistical Structural and Neural Approaches”, John Wiley & sons, Inc, 2012(Reprint edition).
Reference Books
9. Earl Gose, Richard Johnsonbaugh, Steve Jost, “Pattern Recognition and Image Analysis”, Prentice Hall of India,.Pvt Ltd, New Delhi, 2011.
10. Bishop C.M., “Neural Networks for Pattern Recognition”, Oxford University Press, 2005.
11. Duda R.O., P.E.Hart & D.G Stork, “Pattern Classification”, 2nd Edition, J.WileyInc 2001.
12. Duda R.O. & Hart P.E., “Pattern Classification and Scene Analysis”, J.WileyInc, 1973.
Course Designer(s)
AJIT DANTI
Course Reviewer
DrRaju G

MTCS345E04	NATURAL LANGUAGE PROCESSING					Hours			Credits			
						L	T	P	L	T	P	C
						3	-	-	3	-	-	3
Preamble												
To provide a general introduction to natural language processing, fundamentals of parsing words in natural language, advanced feature like structures and realistic parsing methodologies with methods to handle questions with recent trends in typical natural language processing applications												
Prerequisite												
Formal Languages and Automaton Theory Compiler Design												
Course Outcomes												
Course Outcome 1: Remember the approaches such as Automata Theory, Probability Theory, Predicate Logic and Statistical techniques.										L1		
Course Outcome 2: Describe the process of top down parsing and bottom up parsing of string and morphological analysis of lexicons										L2		
Course Outcome 3: Apply the techniques for handling questions and analyze the movement phenomenon in language.										L3		
Course Outcome 4: Describe shift reduce and deterministic parsers for ambiguity resolution and specifies language models.										L3		
Course Outcome 5: Identify the semantic analysis techniques of the natural language with finite state sequence modeling.										L2		
Mapping with Program Outcomes (POs)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3	3		2								
CO3	3	3	2	3								
CO4	2	1		1								
CO5		1	1						1	1		
Syllabus												
Unit - I	Introduction to Natural Language Processing									9	0	0
Introduction to Natural Language Processing, Different Levels of language analysis, Representation and understanding, Linguistic background. Language and Grammar- Processing Indian Languages												
Unit - 2	Grammars and Parsing									9	0	0
Grammars and parsing, Top down and Bottom up parsers, Transition Network Grammars, Feature systems and augmented grammars, Morphological analysis and the lexicon, Parsing with features, Augmented Transition Networks.												
Unit - 3	Grammars for Natural Language									9	0	0
Grammars for natural language, Movement phenomenon in language, Handling questions in context free grammars, Hold mechanisms in ATNs, Gap threading,												
Unit - 4	Ambiguity Resolution, Language Models									9	0	0
Human preference in parsing, Shift reduce parsers, Deterministic parsers, Statistical methods for Ambiguity resolution. Language Models: The Milton Model, The Meta Model Recent Trends in NLP, Principle based NLP, Reframing and Chunking Patterns, Research issues in NLP. A Case Study in Natural Language Based Web Search: In Fact System Overview, The GlobalSecurity.org Experience.												
Unit - 5	Recent Trends and Case Studies									9	0	0
Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Matrix, Approaches to Analyzing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. Automatic Document Separation: A Combination of Probabilistic												

Classification and Finite-State Sequence Modeling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results.

Text Books

1. James Allen, "Natural Language Understanding", Second Edition, 2003, Pearson Education. Reprint 2013
2. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

Reference Books

1. Steven Bird, Ewan Klein, Edward Loper, "Natural Language Processing with Python", O'Reilly Media; First edition (July 10, 2009)
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing:
3. An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Prentice Hall, 2008

Course Designer(s)

Dr Samiksha Shukla

Course Reviewer

Dr Ganesh Kumar

MTCS345E05	BIO INFORMATICS						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
This course provides computational management and use of biological information to solve biological problems. This includes descriptions of genetic and biological databases and relevant tools available to retrieve and analyse the information through evolutionary analysis, data mining, protein structure/function and computational drug discovery.													
Prerequisite													
Basic Python / R Programming/													
Course Outcomes													
Recall various databases, tools, repositories and be able to use each one to extract specific biological information										L1			
Explain the basic principles that underpin Bioinformatics analyses, and apply these principles when analysing biological data;										L2			
Analyze and justify appropriate choices in technology, strategy, and analysis for a range of applications involving DNA, RNA, or protein sequence data.										L4			
Discover features on the sequence such as coding regions, restriction enzyme sites, etc. and interpret sequence analysis for biological functional regions.										L3			
Interpret correctly the outputs from tools used in the field of Drug Discovery and make meaningful predictions from these outputs.										L2			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	3	2	3	3	2	2						
CO2	2	3	2	3	2	2	2						
CO3	3	2	2	2	2	3	2						
CO4	2	2	3	2	3	2	2						
CO5	2	3	2	3	2	3	2						
Syllabus													
Unit - I	DATABASES & SEQUENCE ALIGNMENT TOOLS:									L-9	T-0	P-0	
Introduction to Bioinformatics, Bioinformatics resources and Databases: NCBI, EBI, ExPASy, RCSB. GenBank, DDBJ, EMBL, Uniprot-KB, SWISS-PROT. Format of databases- Gene bank flat file. Protein Data Bank (PDB) flat file; FASTA Format; Structure file formats- PDBLite, Pfam, ProDOM; Specialized databases: NCBI, Pubmed, OMIM. Substitution scores, substitution matrices, PAM, BLOSUM, FASTA, BLAST, Multiple Sequence Alignment, Progressive Alignment Methods, CLUSTALW, Motifs and Patterns, PROSITE, MeMe, PSI-BLAST, PHI-BLAST, Hidden Markov Models (HMMs).													
Unit - 2	PHYLOGENETIC ANALYSIS AND PREDICTIVE METHODS:									9	0	0	
Introduction to Phylogenetic analysis, Phylogenetic Data Analysis: Alignment, Substitution Model Building, Tree Building, and Tree Evaluation, Tree - Building Methods-Distance based and character based methods, Evaluating Trees and Data- Phylogenetic software (CLUSTALW), Predictive Methods using Nucleotide sequences: Framework, Masking repetitive DNA, Codon Bias Detection, Detecting Functional Sites in the DNA (promoters, transcription factor binding sites, translation initiation sites), Integrated Gene Parsing,													

finding RNA Genes, Web based tools (GENSCAN, GRAIL, GENEFINDER). Predictive Methods using Protein sequences: Protein Identity based on composition, Physical properties Based on sequence, secondary structure and folding classes, specialized structures or features, tertiary structure.				
Unit - 3	GENOME BIOINFORMATICS:	9	0	0
Sequencing methods, Bioinformatics tools and automation in Genome Sequencing, analysis of raw genome sequence data, Utility of EST database in sequencing, Bioinformatics in detection of Polymorphisms, SNPs and their relevance, Bioinformatics tools in Next Gen Sequencing (RNA Seq). Tools for comparative genomics: BLAST2, AVID, Vista, MUMmer, COG, VOG. Qualitative discussions on Machine Learning Tools (Artificial Intelligence, Genetic algorithm and Neural networks).				
Unit - 4	MOLECULAR MODELING & VIZUALIZATION:	9	0	0
Scope and applications of insilico modeling. Comparative modeling- molecular superposition and structural alignment, concept of energy minimization, interactions and formulation of force fields. Basic MD algorithm. Structure Visualization and Graphical representation of molecular structures: small molecules (low molecular weight - peptides, nucleotides, disaccharides, simple drugs molecules) and macromolecules. Usages of visualization software available in public domain like VMD, Rasmol, Pymol, SpdbViewer, Chime, Cn3D and GRASP. Rotameric Structures of Proteins, Canonical DNA Forms (DNA Sequence Effects).				
Unit - 5	PLASMID MAPPING, PRIMER DESIGN AND INSILICO DRUG DESIGN:	9	0	0
Restriction mapping, Utilities, DNA strider, MacVector and OMIGA, gene construction KIT, Vector NTI, Web based tools (MAP, REBASE); Primer design - need for tools, Primer design programs and software (PRIME3). Molecular modeling in drug discovery, deriving bioactive conformations, molecular docking, quantitative structure-activity relationship (QSAR), deriving the Pharmacophoric Pattern, Receptor Mapping, Estimating Biological Activities, Ligand - Receptor Interactions: Docking softwares (AUTODOCK, HEX) Calculation of Molecular Properties, Energy Calculations.				
Text Books				
<ol style="list-style-type: none"> Jonathan Pevsner, "Bioinformatics and Functional Genomics", 3rd Edition, Wiley, 2017 David M Mount, "Bioinformatics Sequence and Genome Analysis", 2nd Edition, Cold Spring, 2005 Kristian Stromgaard, Povl Krogsgaard-Larsen, Ulf Madsen "Textbook of Drug Design and Discovery" CRC Press; 5 edition 2016 				
Reference Books				
<ol style="list-style-type: none"> Supratim Choudhuri, " Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools", 1st Edn, Academic Press Co, 2014 <u>Conrad Bessant</u>, <u>Jan Shadforth</u>, <u>Darren Oakley</u> "Building Bioinformatics Solutions: with Perl, R and MySQL", 1st Edn, Oxford University Press, 2009 <u>Pavel Pevzner</u>, <u>Ron Shamir</u>, " Bioinformatics for Biologists", 1st Edn, Cambridge University Press, 2011 <u>Lee Banting</u>, <u>Tim Clark</u>, <u>David E. Thurston</u>, <u>Rob J. Deeth</u>, Drug Design 				

Strategies: Computational Techniques and Applications. Royal Society of
Chemistry; 2012

5. Jenny Gu, Philip E. Bourne Structural Bioinformatics, Wiley-Blackwell; 2009

Course Designer(s)

Vinai George Biju

Course Reviewer

DrSamikshaShukla

MTCS345E06	MULTIMEDIA SYSTEMS						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
<ul style="list-style-type: none"> To study the supporting operating systems. To study the multimedia concepts and various I/O technologies. To study multimedia systems and synchronization 													
Prerequisite													
NA													
Course Outcomes													
Demonstrate the different QoS										L1			
Illustrate the various RTS										L2			
Discuss different methods in File systems and networks										L3			
Establish different communication methods										L3			
Examine the synchronization mechanisms										L4			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	1		1		1					1			
CO2	3	2	1	1								1	
CO3	3	2	1	1								1	
CO4	3	2	1	1								1	
CO5	3	2	1	1				1				1	
Syllabus													
Unit - I		INTRODUCTION AND QOS								9	0	0	
Introduction-QOS Requirements and Constraints-Concepts-Resources- Establishment Phase-Run-Time Phase-Management Architectures.													
Unit - 2		OPERATING SYSTEMS								9	0	0	
Real-Time Processing-Scheduling-Interprocess Communication-Memory and Management-Server Architecture-Disk Management.													
Unit - 3		FILE SYSTEMS AND NETWORKS								9	0	0	
Traditional and Multimedia File Systems-Caching Policy-Batching-Piggy backing-Ethernet-Gigabit Ethernet-Token Ring-100VG AnyLAN-Fiber Distributed Data Interface (FDDI)-ATM Networks-MAN-WAN.													
Unit - 4		COMMUNICATION								9	0	0	
Transport Subsystem-Protocol Support for QOS-Transport of Multimedia-Computer Supported Cooperative Work-Architecture-Session Management-MBone Applications.													
Unit - 5		SYNCHRONIZATION								9	0	0	
Synchronization in Multimedia Systems-Presentation-Synchronization Types-Multimedia Synchronization Methods-Case Studies-MHEG-MODE-ACME.													
Text Books													
<ol style="list-style-type: none"> Ralf Steinmetz and Klara Nahrstedt, "Multimedia Systems", Springer, I Edition 2004. (Latest edition/ reprint available in market) K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovacovic, D. A. Milovacovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Prentice Hall, 1st Edition, 2002 (Latest edition/ reprint available in market) Ze-Nian Li and Mark S. Drew, "Fundamentals of Multimedia", Pearson, 2004. (Latest edition/ reprint available in market) 													
Reference Books													
<ol style="list-style-type: none"> Ralf Steinmetz and Klara Nahrstedt, "Media Coding and Content Processing", Prentice hall, 2002. 													

2. Vaughan T, "Multimedia", 9th Edition, Tata McGraw Hill, 1999.
3. Mark J.B., Sandra K.M., "Multimedia Applications Development using DVI technology", McGraw Hill, 1992.

Course Designer(s)

Alok kumar Pani

Course Reviewer

Dr Manohar M

MTCS345E07	ADVANCED COMPUTER ARCHITECTURE			Hours			Credits					
				L	T	P	L	T	P	C		
				3	0	0	3	0	0	3		
Preamble												
<ul style="list-style-type: none"> To have a thorough understanding of the basic structure and operation of a digital computer. To discuss in detail the operation of the instruction level parallelism. To study in detail the different instruction level parallelism in software approach. To study the different ways of communicating with I/O devices and standard I/O interfaces. To multiprocessor and thread level parallelism. 												
Prerequisite												
NA												
Course Outcomes												
Demonstrate fundamentals of computer design and performance measurement.										L2		
Demonstrate instruction level parallelism with hardware and software approaches.										L2		
Demonstrate the memory performance parameters.										L2		
Demonstrate multiprocessors and thread level parallelism.										L2		
Discuss the organization of computer-based systems and how a range of design choices are influenced by applications										L3		
Develop systems programming skills in the content of computer system design and organization.										L4		
Mapping with Program Outcomes (POs)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				1							
CO2	2				1							
CO3	2				1							
CO4	2				1							
CO5	2				1							
CO6	2				1							
Syllabus												
Unit - I	FUNDAMENTALS OF COMPUTER DESIGN									9	0	0
Measuring and Reporting performance - Quantitative principles of computer Design - Classifying instruction set Architecture - Memory addressing - Addressing modes - Type and size of operands - Operations in the instruction set - Operands and operations for media and signal processing - Instructions for control flow - Encoding an instruction set - Example Architecture - MIPS and TM32.												
Unit - 2	INSTRUCTION LEVEL PARALLELISM									9	0	0
Pipelining and Hazards - Concepts of ILP - Dynamic scheduling - Dynamic Hardware prediction - Multiple issues - Hardware based speculation - Limitations of ILP - Case studies: IP6 Microarchitecture												
Unit - 3	INSTRUCTION LEVEL PARALLELISM WITH SOFTWARE APPROACHES									9	0	0
Compiler techniques for exposing ILP - Static branch prediction - Static multiple issues: VLIW - Advanced compiler support - Hardware support for exposing parallelism - Hardware Vs software speculation. Mechanism - IA 64 and Itanium Processor.												
Unit - 4	MEMORY AND I/O									9	0	0
Cache performance - Reducing cache miss penalty and miss rate - Reducing hit time - Main												

memory and performance - Memory technology. Types of storage devices - Buses - RAID - Reliability, availability and dependability - I/O performance measures - Designing I/O system.				
Unit - 5	MULTIPROCESSORS AND THREAD LEVEL PARALLELISM	9	0	0
Symmetric and distributed shared memory architectures - Performance issues - Synchronization - Models of memory consistency - Multithreading-Case Study.				
Text Books				
1. John L. Hennessey and David A. Patterson," Computer Architecture: A Quantitative Approach", Fifth Edition, Morgan Kaufmann, 2012.				
Reference Books				
1. D. Sima, T. Fountain and P. Kacsuk, " Advanced Computer Architectures: A Design Space Approach", Pearson, 2011.				
2. Kai Hwang "Advanced computer architecture Parallelism Scalability Programmability" Tata Mcgraw Hill Edition 2015.				
3. Vincent P.Heuring, Harry F.Jordan, "Computer System Design and Architecture", Addison Wesley, 2nd Edition 2008.				
Course Designer(s)				
Dr Manohar M				
Course Reviewer				
Alok kumar Pani				

MTCS345E08	SOFTWARE PROCESS MANAGEMENT						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
<ul style="list-style-type: none"> To comprehend on CMMI levels and concepts To understand the process followed in software product development To gain the knowledge on the standard followed in the organizations for project development and delivery Hands on experience on data analysis in connection with software defect prevention 													
Prerequisite													
NA													
Course Outcomes													
Understand and practice the Software maturity framework and its application in delivering successful IT projects.										L1			
Evaluate a project to develop the scope of work, provide accurate cost estimates and to plan the various activities.										L4			
Understand the need of Software configuration management tools that identify the factors that put into baselines.										L1			
Identify the different software standards, software inspections, configuration management and its application in delivering successful IT projects.										L2			
Evaluate and Monitor the progress of a project and to assess the risk of slippage, revising targets or counteract drift.										L4			
Distinguish between the different types of project and follow the stages needed to negotiate an appropriate contract.										L4			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	2				1								
CO2	2				1								
CO3	2				1								
CO4	2				1								
CO5	2				1								
CO6	2				1								
Syllabus													
Unit - I	A SOFTWARE MATURITY FRAMEWORK									9	0	0	
Software Improvement, process maturity level, people in the optimizing level, need for the Optimizing process.													
Unit - 2	THE REPEATABLE PROCESS									9	0	0	
Managing software organizations: commitment discipline, the management system, establishing a project management system. The Project plan: project planning principles, contents, size measures, estimating, productivity factors, scheduling, project tracking, the developing plan, planning models, final Considerations. Software configuration management: Need for configuration management, software product nomenclature, basic configuration management function, baselines, configuration management responsibilities, need for automated tools, software quality management.													
Unit - 3	DEFINED PROCESS									9	0	0	
Software standards: definitions, reasons, benefits, examples of major standards, establishing software standard, standards versus guidelines. Software inspections : Types of reviews, objectives, basic inspection principles, the conduct of inspections, inspection training, reports and tracking, other considerations, initiating and													

inspection program, future directions.

Software configuration management : the Software configuration management plan, Software configuration management questioners, scm support functions, the requirement phase, design control, the implementation phase, operational data, the test phase, scm for tools, configuration accounting, the software configurations audit.

Unit - 4	MANAGED PROCESS	9	0	0
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Data gathering and analysis: the principles of data gathering, data gathering process, software measures, data analysis, other considerations. Managing software quality: The quality management paradigm, quality motivation, quality goals, quality plans, tracking and controlling software quality.

Unit - 5	THE OPTIMIZING PROCESS	9	0	0
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Defect Prevention: Defect prevention not an idea, the principles of SDP, process changes for defect prevention, defect prevention consideration, management role.

Automating the software process: The need for software automation, what to automate? Development environments, organizational plans to automate, technology transitions, productivity. Case Study.

Text Books

1. Introduction to the Personal Software Process by *Watts S. Humphrey*, published by Pearson Education 2012.
2. Software Change Management: Case Studies and Practical Advice by Donald J. Reifer Pearson Education 2012.
3. Managing the software process by Watts S. Humphrey, published by Pearson Education 2010.

Reference Books

1. Software Process Definition and Management Jürgen Münch Ove Armbrust Martin Kowalczyk Martín Soto - May 27, 2012 Springer Science & Business Media - Publisher
2. Software Process Modeling Silvia T. Acuna Natalia Juristo- January 27, 2010 Springer Science & Business Media - Publisher
3. A Discipline to Software Engineering by Watts S. Humphrey Pearson Education 2008.
4. Software Project Management in Practice by Pankaj Jalote, Pearson Education 2010.
5. Software Project Management Readings and Cases by Chris Kemerer 2010.

Course Designer(s)

Praveen Naik

Course Reviewer

Dr Natarajan K

MTCS345E09	VERY LARGE DATABASE MANAGEMENT SYSTEMS					Hours			Credits			
						L	T	P	L	T	P	C
						3	0	0	3	0	0	3
Preamble												
<ul style="list-style-type: none"> To learn the fundamentals of data models and to conceptualize and depict a database system using ER diagram. To understand the internal storage structures using different file and indexing techniques which will help in physical DB design. To know the fundamental concepts of transaction processing- concurrency control techniques and recovery procedure. To have an introductory knowledge about the emerging trends in the area of distributed DB- OO DB- Data mining and Data Warehousing and XML. 												
Prerequisite												
NA												
Course Outcomes												
Identify and define the information that is needed to design a database management system for a business information problem.										L2		
Create conceptual and logical database designs for a business information problem.										L3		
Build a database management system that satisfies relational theory and provides users with business queries, business forms, and business reports.										L4		
Understand the core terms, concepts, and tools of relational database management systems, distributed database, parallel database, spatial database, multimedia database and emerging technologies. .										L1		
Understand research issues in this field										L1		
Mapping with Program Outcomes (POs)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		1		1							
CO2	2		1		1							
CO3	2		1		1							
CO4	2		1		1							
CO5	2		1		1							
Syllabus												
Unit - I	DISTRIBUTED DATABASE									9	0	0
Distributed Databases Vs. Conventional Databases-Architecture-Fragmentation-Query Processing-Transaction Processing-Concurrency Control-Recovery.												
Unit - 2	OBJECT ORIENTED DATABASE									9	0	0
Introduction to Object Oriented Databases-Approaches-Modeling and Design-Persistence-Query Languages-Transaction-Concurrency-Multiversion Locks-Recovery												
Unit - 3	EMERGING SYSTEMS									9	0	0
Enhanced Data Models-Client/ Server Model-Data warehousing and Data mining-Web database-Mobile databases-Introduction to Big Data.												
Unit - 4	DATABASE DESIGN ISSUES									9	0	0
ER Model-Normalization-Security-Integrity-Consistency-Database Tuning-Optimization and Research Issues-Design of Temporal Databases-Spatial Databases												
Unit - 5	CURRENT ISSUES									9	0	0
Rules-Knowledge bases-Active and Deductive Databases-Parallel Databases-Multimedia Databases-Image Databases-Text Databases-Case Studies-Research Issues-IEEE/ACM journal/Proceedings study												

Text Books

1. R. Elmasri and S.B. Navathe, "Fundamentals of Database Systems", 6th Edition, Addison Wesley, 2010
2. Abraham Silberschatz, Henry. F. Korth, S.Sudharsan, "Database System Concepts", 6th Edition. Tata McGraw Hill, 2010
3. Carlos Coronel & Steven Morris, "Database Systems: Design, Implementation, & Management", February 4, 2014
4. Stefano Ceri & Giesppe Pelagatti, Distributed Databases - Principles and Systems, McGraw Hill Book Company, 2008.
5. C.J.Date, "An Introduction to Database system", Pearson Education, 7th Edition, 2009

Reference Books

1. Raghu Ramakrishnan & Johannes Gehrke, "Database Management Systems", 3rd Edition, TMH, 2003
2. Philip M. Lewis, Arthur Bernstein, Michael Kifer, "Databases and Transaction Processing: An Application-Oriented Approach", Addison-Wesley, 2002
3. Jim Buyens, Step by Step Web Database Development, PHI, 2009.

Course Designer(s)

Dr Sundara Pandiyan

Course Reviewer

Dr Ragavendra S

MTCS345E10	WEB TECHNOLOGY						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
This course is designed to introduce programming experience to techniques associated with the World Wide Web. The course will introduce web-based media-rich programming tools for creating interactive web pages. Basic animation programming is also introduced with an emphasis on media-rich content creation, distribution and tracking capabilities.													
Prerequisite													
NA													
Course Outcomes													
Build web applications using PHP, JSP and Servlets and client side script technologies like HTML, CSS and JavaScript with Apache web server.										L3			
Design and Integrate database environment to web applications being developed. Describe sessions conceptually and implement using cookies and URL.										L3			
Examine the XML applications with DTD and style sheets that span multiple domains and across various platforms.										L4			
Examine the reasons and effects of nonstandard client-side scripting language characteristics, such as limited data types, dynamic variable types and properties, and extensive use of automatic type conversion.										L4			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	2		1		1								
CO2	2		1		1								
CO3	2		1		1								
CO4	2		1		1								
Syllabus													
Unit - I	INTRODUCTION									9	0	0	
Introduction - Network concepts - Web concepts - Internet addresses - Retrieving Data with URL - HTML - DHTML: Cascading Style Sheets - Scripting Languages: JavaScript.													
Unit - 2	COMMON GATEWAY INTERFACE									9	0	0	
Common Gateway Interface: Programming CGI Scripts - HTML Forms - Custom Database Query Scripts - Server Side Includes - Server security issues													
Unit - 3	XML AND RICH INTERNET APPLICATIONS									9	0	0	
XML- XSL, XSLT, DOM, RSS, Client Technologies- Adobe Flash, Flex, Microsoft Silverlight.													
Unit - 4	SERVER SIDE PROGRAMMING-I									9	0	0	
Server side Programming - PHP- Passing variables between pages, Using tables, Form elements. Active server pages - Java server pages													
Unit - 5	SERVER SIDE PROGRAMMING-II & APPLICATIONS									9	0	0	
Java Servlets: Servlet container - Exceptions - Sessions and Session Tracking - Using Servlet context - Dynamic Content Generation - Servlet Chaining and Communications. Simple applications - Internet Commerce - Database connectivity.													
Text Books													
1. Deitel, Deitel and Neito, "INTERNET and WORLD WIDE WEB - How to program", Pearson education asia, 4 th Edition, 2011													
2. Beginning PHP, Apache, MySql Web Development, Timothy, Elizabeth, Jason, Wrox, 2012													

Reference Books
<ol style="list-style-type: none">1. Eric Ladd and Jim O'Donnell, et al, "USING HTML 4, XML, and JAVA1.2", PHI publications, 2003.2. Jeffy Dwight, Michael Erwin and Robert Nikes "USING CGI", PHI Publications, 1999
Course Designer(s)
Karthikeyan H
Course Reviewer
Manjunath C

MTCS345E11	XML AND WEB SERVICES						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
<ul style="list-style-type: none"> • Be able to understand and write well-formed XML documents • Be able to write the schema for the given XML documents in both DTD and XML Schema languages • Be able to format XML data to the desired format • Be able to parse XML documents by using DOM, SAX, and StAX • Be able to create, deploy, and call Web services 													
Prerequisite													
NA													
Course Outcomes													
Demonstrate and apply with the fundamentals of XML and Web Services and apply them in real world applications.										L2			
Summarize architecture web service										L3			
Explain the web service building blocks										L2			
Understanding XML in e business										L1			
Understanding XML security and management										L1			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	2		1		1								
CO2	2		1		1								
CO3	2		1		1								
CO4	2		1		1								
CO5	2		1		1								
Syllabus													
Unit - I	XML TECHNOLOGY FAMILY									9	0	0	
XML - Benefits - Advantages of XML over HTML - EDI - Databases - XML based standards - Structuring with schemas - DTD - XML schemas - XML processing -DOM - SAX - Presentation technologies - XSL - XFORMS - XHTML -Transformation - XSLT - XLINK - XPATH - Xquery													
Unit - 2	ARCHITECTING WEB SERVICES									9	0	0	
Business motivations for web services - B2B - B2C - Technical motivations -Limitations of CORBA and DCOM - Service Oriented Architecture (SOA) -Architecting web services - Implementation view - Web services technology stack -Logical view - Composition of web services - Deployment view - From application server to peer to peer - Process view - Life in the runtime.													
Unit - 3	WEB SERVICES BUILDING BLOCKS									9	0	0	
Transport protocols for web services - Messaging with web services - Protocols -SOAP - Describing web services - WSDL - Anatomy of WSDL - Manipulating WSDL - Web service policy - Discovering web services - UDDI - Anatomy of UDDI - Web service inspection - Ad hoc discovery - Securing web services.													
Unit - 4	IMPLEMENTING XML IN E-BUSINESS									9	0	0	
B2B - B2C applications - Different types of B2B interaction - Components of E -Business XML systems - EBXML - RosettaNet - Applied XML in vertical industry - Web services for mobile devices.													
Unit - 5	XML CONTENT MANAGEMENT AND SECURITY									9	0	0	
Semantic web - Role of meta data in web content - Resource description framework - RDF schema - Architecture of semantic web - Content management workflow -XLANG - WSFL - Securing web services													

Text Books

1. Ron Schmelzer and Travis Vandersypen, "XML and Web Services Unleashed", 1st Edition, Pearson Education.
2. Keith Ballinger, ".NET Web Services Architecture and Implementation", Pearson Education

Reference Books

1. David Chappell, "Understanding .NET A Tutorial and Analysis", AddisonWesley
2. Kennard Scibner and Mark C. Stiver, "Understanding SOAP", SAMS publishing May 2006.
3. Alexander Nakhimovsky and Tom Myers, "XML Programming: WebApplications and Web Services with JSP and ASP", Apress. 2002

Course Designer(s)

Karthikeyan H

Course Reviewer

Manjunath C

MTCS361E01	INTERNET OF THINGS						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
This course introduces the basic concepts of IoT, the functionalities of different types of sensors, actuators and micro controllers. It covers the protocols used in different layers and gives insight on programming IoT for different domains.													
Computer Networks Basics of Programming													
Course Outcomes													
Explain the fundamental building blocks of an IoT environment from a logical and physical perspective.										Understand			
Experiment with Arduino and Raspberry Pi to choose the appropriate hardware for different IoT projects.										Build			
Summarize various IoT protocols in Application and Network layers by outlining their advantages and disadvantages.										Analyze			
Develop IoT solutions using Arduino and Raspberry Pi to solve real life problems.										Analyze, Apply			
Survey successful IoT products and solutions to analyze their architecture and technologies.										Analyze			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	2												
CO2	2	1	1										
CO3	3	2	2	1									
CO4	2	2			1								
CO5	3	3	3	3	2				1				
Syllabus													
Unit - I	INTRODUCTION AND BACKGROUND									9	0	0	
Definition and Characteristics of IoT, Physical Design of IoT: Things in IoT, Logical Design of IoT: IoT functional Blocks, IoT Communication Blocks, IoT communication APIs, IoT Enabling Technologies: WSN, Cloud Computing, Big Data Analysis, Communication Protocols, Embedded Systems.													
Unit - 2	IOT HARDWARE, DEVICES AND PLATFORMS									9	0	0	
Basics of Arduino: The Arduino Hardware, The Arduino IDE, Basic Arduino Programming, Basics of Raspberry pi: Introduction to Raspberry Pi, Programming with Raspberry Pi, CDAC IoT devices: Ubimote, Wi-Fi mote, BLE mote, WINGZ gateway, Introduction to IoT Platforms, IoT Sensors and actuators.													
Unit - 3	IOT PROTOCOLS									9	0	0	
IoT Data Link Protocols, Network Layer Routing Protocols, Network Layer Encapsulation Protocols, Session Layer Protocols, IoT Security Protocols, Service Discovery Protocols, Infrastructure Protocols.													
Unit - 4	IOT PROGRAMMING									9	0	0	
Arduino Programming: Serial Communications, Getting input from sensors, Visual, Physical and Audio Outputs, Remotely Controlling External Devices, Wireless Communication. Programming with Raspberry Pi: Basics of Python Programming, Python packages of IoT, IoT Programming with CDAC IoT devices.													
Unit - 5	DOMAIN SPECIFIC IOT									9	0	0	
Home automation, Smart cities, Smart Environment, IoT in Energy, Logistics, Agriculture, Industry and Health & Life style secors. Case Studies: A Case study of Internet of Things													

Using Wireless Sensor Networks and Smartphones, Security Analysis of Internet-of-Things: A Case Study of August Smart Lock, OpenIoT platform.

Text Books

1. Vijay Madiseti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
2. Margolis, Michael. "Arduino Cookbook: Recipes to Begin, Expand, and Enhance Your Projects." O'Reilly Media, Inc., 2011.
3. Monk, Simon. Raspberry Pi cookbook: Software and hardware problems and solutions. " O'Reilly Media, Inc.", 2016.

Reference Books

1. The Internet of Things: Applications to the Smart Grid and Building Automation by – Olivier Hersent, Omar Elloumi and David Boswarthick – Wiley Publications -2012.
2. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.
4. Al-Fuqaha, Ala, et al. "Internet of things: A survey on enabling technologies, protocols, and applications." IEEE Communications Surveys & Tutorials 17.4 (2015): 2347-2376.
5. Tsitsigkos, Alkiviadis, et al. "A case study of internet of things using wireless sensor networks and smartphones." Proceedings of the Wireless World Research Forum (WWRF) Meeting: Technologies and Visions for a Sustainable Wireless Internet, Athens, Greece. Vol. 2325. 2012.
6. Ye, Mengmei, et al. "Security Analysis of Internet-of-Things: A Case Study of August Smart Lock."

Course Designer(s)

Naveen J

Course Reviewer

Bijeesh T. V

MTCS361E02	MACHINE LEARNING						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
To understand the concepts of machine learning To appreciate supervised and unsupervised learning and their applications To understand the theoretical and practical aspects of Probabilistic Graphical Models To appreciate the concepts and algorithms of reinforcement learning To learn aspects of computational learning theory													
Prerequisite													
NIL													
Course Outcomes													
Describe the fundamental concepts, applications and Regression analysis of Machine Learning.										Remembering			
Investigation of Supervised learning algorithms.										Analyzing			
Experiment the unsupervised techniques and principles of machine learning										Analyzing			
Experiment probabilistic graphics model for the datasets.										Analyzing			
Execute the sampling and learning techniques of machine learning.										Applying			
Describe the fundamental concepts, applications and Regression analysis of Machine Learning.										Remembering			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	1				1								
CO2	1	1			1								
CO3	1	1			1								
CO4	1	1			1								
CO5	1												
CO6	1	1											
Syllabus													
Unit - I		INTRODUCTION									9	0	0
Machine Learning - Machine Learning Foundations -Overview - applications - Types of machine learning - basic concepts in machine learning Examples of Machine Learning - Applications - Linear Models for Regression - Linear Basis Function Models - The Bias-Variance Decomposition - Bayesian Linear Regression - Bayesian Model Comparison													
Unit - 2		SUPERVISED LEARNING									9	0	0
Linear Models for Classification - Discriminant Functions -Probabilistic Generative Models - Probabilistic Discriminative Models - Bayesian Logistic Regression. Decision Trees - Classification Trees- Regression Trees - Pruning. Neural Networks -Feed-forward Network Functions - Error Backpropagation - Regularization - Mixture Density and Bayesian Neural Networks - Kernel Methods - Dual Representations - Radial Basis Function Networks. Ensemble methods- Bagging- Boosting.													
Unit - 3		UNSUPERVISED LEARNING									9	0	0
Clustering- K-means - EM - Mixtures of Gaussians - The EM Algorithm in General -Model selection for latent variable models - high-dimensional spaces -- The Curse of Dimensionality -Dimensionality Reduction - Factor analysis - Principal Component Analysis - Probabilistic PCA- Independent components analysis													
Unit - 4		PROBABILISTIC GRAPHICAL MODELS									9	0	0
Directed Graphical Models - Bayesian Networks - Exploiting Independence Properties - From Distributions to Graphs -Examples -Markov Random Fields - Inference in Graphical Models - Learning -Naive Bayes classifiers-Markov Models - Hidden Markov Models - Inference - Learning- Generalization - Undirected graphical models- Markov random fields-													

Conditional independence properties - Parameterization of MRFs - Examples - Learning - Conditional random fields (CRFs) - Structural SVMs				
Unit - 5	ADVANCED LEARNING	9	0	0
Sampling - Basic sampling methods - Monte Carlo. Reinforcement Learning - K-Armed Bandit - Elements - Model-Based Learning - Value Iteration - Policy Iteration. Temporal Difference Learning- Exploration Strategies- Deterministic and Non-deterministic Rewards and Actions- Eligibility Traces- Generalization- Partially Observable States- The Setting- Example. Semi - Supervised Learning. Computational Learning Theory - Mistake bound analysis, sample complexity analysis, VC dimension. Occam learning, accuracy and confidence boosting				
Text Books				
8. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2006				
9. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012				
10. Ethem Alpaydin, "Introduction to Machine Learning", Prentice Hall of India, 2005				
11. Hastie, Tibshirani, Friedman, "The Elements of Statistical Learning" (2nd ed), Springer, 2008				
12. Stephen Marsland, "Machine Learning -An Algorithmic Perspective", CRC Press, 2009				
Reference Books				
13. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.				
Course Designer(s)				
Dr. Raghavendra S.				
Course Reviewer				
DrManohar M				

MTCS361E03	MOBILE APPLICATION DEVELOPMENT						Hours			Credits			
							L	T	P	L	T	P	C
							3	0	0	3	0	0	3
Preamble													
This course imparts the knowledge and skills necessary for developing mobile applications using the Android platform.													
Prerequisite													
Java, Database Management Systems													
Course Outcomes													
Understand the basics of Android devices and Platform.										L2			
Acquire knowledge on basic building blocks of Android programming required for App development.										L2			
Understand persistence Data storage mechanism in Android										L2			
Understand advanced application concepts like networking, Animations and Google Maps services										L2			
Develop and publish Android applications in to Android Market										L3			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1					3								
CO2	2		2		2								
CO3	2		2		2								
CO4	2		2		2								
CO5	2		2		2								
Syllabus													
Unit - I		INTRODUCTION								9	0	0	
Introduction: Introduction to mobile application development, trends, introduction to various platforms, introduction to smart phones Android platform: Android platform features and architecture, versions, comparison added features in each versions. ART(Android Runtime),ADB(Android Debug Bridge). Development environment/IDE: Android studio and its working environment, gradle build system, emulator setup Application anatomy: Application framework basics: resources layout, values,asset XML representation and generated R.Javafile ,Android manifest file. Creating a simple application.													
Unit - 2		ANDROID UI DESIGN								9	0	0	
GUI for Android: Introduction to activities, activities life-cycle, Android v7 support library form API21 for lower version support Intent :intent object, intent filters ,adding categories, linking activities, user interface design components, Views and View Groups: Basic views, picker views, adapter views, Menu, App Bar etc, basics of screen design; different layouts. App widgets.Lollipop Material design: new themes, new widgets, Card layouts. Recycler View, Fragments: Introduction to activities, activities life-cycle.													
Unit - 3		DATA PERSISTENCE								9	0	0	
Shared preferences-File Handling-Managing data using SQLite database CONTENT PROVIDERS - user content provider, android provided content providers. Introduction to JSON file formats, Using webservice to connect to remote DB Use JSON for data communication to Web Services, Fetching data from JSON & loading into Activities, Creating a simple applications using content provider and persisting data into database													
Unit - 4		BACK GROUND RUNNING PROCESS, NETWORKING AND TELEPHONY SERVICES								9	0	0	
Services-Introduction to services-local service-remote service and binding the service-communication between service and activity-Multi-Threading-Handlers and AsyncTask-													

Android network programming- Telephony services- SMS and telephony applications				
Unit - 5	ADVANCED APPLICATIONS	9	0	0
Location based services-Google maps services using Google API-Overview on Tweened animations, Property animations- android media-Google App engine - connecting Android apps-Cloud Storage-Android application development guidelines-publishing android applications				
Text Books				
<ol style="list-style-type: none"> 1. Dawn Griffiths, David Griffiths, "Head First: Android Development" ,OReilly2015, ISBN: 9781449362188 2. Greg Milette,AdamStroud,"PROFESSIONAL Android™ Sensor Programming",John Wiley and Sons, Inc2012, ISBN/978111265055,9781280678943,978111227459 				
Reference Books				
<ol style="list-style-type: none"> 3. Paul Deital,HarveyDeital, Alexander Wald, "Android 6 for Programmers ,App Driven approach",2015, Prentice Hall ,ISBN: 9780134289366 				
Course Designer(s)				
Mahesh D S				
Course Reviewer				
Bijeesh T V				

MTCS361E04	INTRODUCTION TO DATA SCIENCE						Hours			Credits			
							L	T	P	L	T	P	C
							3	-	-	3	-	-	3
Preamble													
<ul style="list-style-type: none"> • Able to apply fundamental algorithmic ideas to process data. • Learn to apply hypotheses and data into actionable predictions. • Document and transfer the results and effectively communicate the findings using visualization techniques. 													
Prerequisite													
Advanced Data Base Management Systems Advanced Algorithms													
Course Outcomes													
Understand the foundations of data processing										Understand			
Apply the clustering methods for modelling the data										Apply			
Analysis of Statistical models and data distributions using R Programming										Analyze			
Analysis of distributed file system and Map reducing technique using Hadoop										Analyze			
Evaluating the results of data science experiment using R Programming.										Evaluate			
Mapping with Program Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	2											
CO2	3	3	3										
CO3	2	2	2		3								
CO4	2	2	2		3								
CO5	2	2	2		3								
Syllabus													
Unit - I	INTRODUCTION TO DATA SCIENCE									9	-	-	
Data science process - roles, stages in data science project - working with data from files - working with relational databases - exploring data - managing data - cleaning and sampling for modeling and validation - introduction to NoSQL.													
Unit - 2	MODELING METHODS									9	-	-	
Choosing and evaluating models - mapping problems to machine learning, evaluating clustering models, validating models - cluster analysis - K-means algorithm, Naïve Bayes - Memorization Methods - Linear and logistic regression - unsupervised methods.													
Unit - 3	INTRODUCTION TO R									9	-	-	
Reading and getting data into R - ordered and unordered factors - arrays and matrices - lists and data frames - reading data from files - probability distributions - statistical models in R - manipulating objects - data distribution.													
Unit - 4	MAP REDUCE									9	-	-	
Introduction - distributed file system - algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce - Hadoop - Understanding the Map Reduce architecture - Writing HadoopMapReduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.													
Unit - 5	DELIVERING RESULTS									9	-	-	
Documentation and deployment - producing effective presentations - Introduction to graphical analysis - plot() function - displaying multivariate data - matrix plots - multiple plots in one window - exporting graph - using graphics parameters. Case studies.													
Text Books													
1. Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 2014.													

2. Jure Leskovec, AnandRajaraman, Jeffrey D. Ullman, "Mining of Massive Datasets", Cambridge University Press, 2014.
3. Mark Gardener, "Beginning R - The Statistical Programming Language", John Wiley & Sons, Inc., 2012.

Reference Books

1. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013.
2. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, AbhijitDasgupta, "Practical Data Science Cookbook", Packt Publishing Ltd., 2014.
3. Nathan Yau, "Visualize This: The FlowingData Guide to Design, Visualization, and Statistics", Wiley, 2011.
4. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.

Course Designer(s)

Dr. SundaraPandiyas S

Course Reviewer

Dr. Manohar M

MTCS361E05	BUSINESS ANALYTICS					Hours			Credits			
						L	T	P	L	T	P	C
						3	0	0	3	0	0	3
Preamble												
<p>1. Understand the role of business analytics within an organization.</p> <p>2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.</p> <p>3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.</p> <p>4. To become familiar with processes needed to develop, report, and analyze business data.</p> <p>5. Use decision-making tools/Operations research techniques.</p> <p>6. Mange business process using analytical and management tools. 7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.</p>												
Prerequisite												
NIL												
Course Outcomes												
Demonstrate knowledge of data analytics.										L2		
Demonstrate the ability of think critically in making decisions based on data and deep analytics.										L2		
Demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.										L2		
Demonstrate the ability to translate data into clear, actionable insights										L2		
Illustrate the advances concepts of Business Analytics										L2		
Mapping with Program Outcomes (POs)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1			1							
CO2	2	1			1							
CO3	2	1			1							
CO4	2	1			1							
CO5	2	1			1							
Syllabus												
Unit - I	Introduction									9	0	0
Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.												
Unit - 2	Regression Analysis									9	0	0
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.												
Unit - 3	Organization Structures of Business analytics									9	0	0

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.				
Unit - 4	Forecasting Techniques	9	0	0
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Model Curriculum of Engineering & Technology PG Courses [Volume -II] [29] Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.				
Unit - 5	Decision Analysis and Recent Trends	9	0	0
Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.				
Text Books				
1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.				
Reference Books				
2. Business Analytics by James Evans, persons Education.				
Course Designer(s)				
AICTE Model Curriculum				
Course Reviewer				

MTCS381	INTERNSHIP	Hours			Credits			
		L	T	P	L	T	P	C
		0	0	4	0	0	2	2

Preamble

INTERNSHIP POLICY, GUIDELINES AND PROCEDURES

INTRODUCTION

Internships are short-term work experiences that will allow a student to observe and participate in professional work environments and explore how his interests relate to possible careers. They are important learning opportunities through industry exposure and practices. More specifically, doing internships is beneficial because they provide the opportunity to:

- Get an inside view of an industry and organization/company
- Gain valuable skills and knowledge
- Make professional connections and enhance student's network
- Get experience in a field to allow the student to make a career transition

Regulations

1. The student shall undergo an Internship for 30 days starting from the end of 2nd semester examination and completing it during the initial period of 3rd semester.
2. The department shall nominate a faculty as a mentor for a group of students to prepare and monitor the progress of the students
3. The students shall report the progress of the internship to the mentor/guide at regular intervals and may seek his/her advise.
4. The Internship shall be completed by the end of 7th semesters.
5. The students are permitted to carry out the internship outside India with the following conditions, the entire expenses are to be borne by the student and the University will not give any financial assistance.
6. Students can also undergo internships arranged by the department during vacation.
7. After completion of Internship, students shall submit a report to the department with the approval of both internal and external guides/mentors.
8. There will be an assessment for the internship for 2 credits, in the form of report assessment by the guide/mentor and a presentation on the internship given to department constituted panel

MTCS382	DISSERTATION PHASE -I	Hours			Credits			
		L	T	P	L	T	P	C
		0	0	20	0	0	20	10
Preamble								
<ul style="list-style-type: none"> ❖ Assessment of Project Work(Phase I) <ul style="list-style-type: none"> ▪ Continuous Internal Assessment:100 Marks <ul style="list-style-type: none"> ◆ Presentation assessed by Panel Members ◆ Guide ◆ Mid semester Project Report 								

MTCS483	DISSERTATION PHASE -II	Hours			Credits			
		L	T	P	L	T	P	C
		0	0	32	0	0	32	16
Preamble								
<ul style="list-style-type: none"> ❖ Assessment of Project Work(Phase II) and Dissertation <ul style="list-style-type: none"> ▪ Continuous Internal Assessment:100 Marks <ul style="list-style-type: none"> ◆ Presentation assessed by Panel Members ◆ Assessed by Guide ◆ Mid Semester Project Report ▪ End Semester Examination:100 Marks <ul style="list-style-type: none"> ◆ Viva Voce ◆ Demonstration ◆ Project Report ▪ Dissertation (Exclusive assessment of Project Report): 100 Marks <ul style="list-style-type: none"> ◆ Internal Review : 50 Marks ◆ External review : 50 Marks 								