BOS DOCMENT

2020-2024

Abstract

This document has detailed course structure for the academic year 2020-24 including the Programme Elective, Open Elective and Interdepartmental Corces . The curriculum is based on the model proposed by AICTE

Department of Civil

Engineering

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SCHOOL OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

SYLLABUS
B TECH- CIVIL ENGINEERING

2020-24

CHRIST (Deemed to be University), Bengaluru
Karnataka, India
www.christuniversity.in

Syllabus for Btech- Civil Engineering 2020-24 prepared by the Department of Civil Engineering, Faculty of Engineering and approved by the Academic Council, CHRIST (Deemed to be University), Bengaluru, India.

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2020

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DEPARTMENT OVERVIEW

Civil engineering courses are designed to meet the needs of modern Civil Engineering fields like Construction Technology, Geo-Technical Engineering, Irrigation Engineering, Transportation Engineering, Structural Engineering, Environmental Engineering, etc. By the time students complete this course, they will be fully trained to analyze and design the complicatedstructures.

DEPARTMENT VISION

Serve and excel in the constantly changing societal needs with ethics and integrity.

DEPARTMENT MISSION

- To create awareness of societal needs and ethics in the dynamic environment.
- To impart contemporary knowledge to achieve excellence in academics and profession through the experience of lifelong learning.
- To carry out research in collaboration with research organizations and industry to add value to the profession and society at large.
- Instil leadership qualities, communication skills and team sprit to meet challenges in the global environment

Programme Educational Objectives: Graduates of the program will possess the following:

1. Fundamental Knowledge: A competent professional being aware of societal needs, demonstrates by applying fundamental knowledge and technical skills to analyze and support the activities in the field.
2. Lifelong Learning: Facilitate programmes of lifelong learning, through skill-based courses and interaction with industry leading to professional expertise.
3. Research and Consultancy: Engage in research and consultancy projects of the department.
4. Leadership Qualities: Develop sense of social responsibility, leadership qualities, communication skills and team spirit.

Programme Specific Objectives: Graduates of the program will be able to:

1. Analyze and Design structural systems Statement: Analyze, design, construct and manage sustainable structural systems
2. Investigate civil engineering materials Statement: Investigate properties of civil engineering materials
3. Modern Surveying Statement: Plan for buildings, maps, and alignments for canals and roads using modern surveying instruments.

BTech Civil Engineering

PROGRAMMES OFFERED

- **Undergraduate Programmes** (BTech, 8 Semester Program)
  - Bachelor of Technology in Automobile Engineering (AE)
  - Bachelor of Technology in Civil Engineering (CE)
  - 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 & Engg.
  - Master of Technology in Communication Systems
  - Master of Technology in Information Technology
  - Master of Technology in Machine Design
  - Master of Technology in Power Systems
  - Master of Technology in Structural Engineering

- **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 Engg.
  - 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

ELIGIBLITY 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)
  - BTech Civil Engineering, (CE)
  - BTech Mechanical Engineering, (ME)
  - BTech Computer Science & Engineering, (CSE)
  - BTech Electronics & Communication Engineering. (ECE)
  - BTech Electrical and Electronics Engineering (EEE)
  - BTech Information Technology (ITE)

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 & 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/BTech or M. Sc in Civil with 55% aggregate.
  - For Master of Technology in Mechanical Engineering
    - A Pass in BE/BTech in mechanical engineering.
- **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.

SELECTION PROCESS

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

OR

2) Christ University Selection Process as given below:

Process	Particulars	Date	Venue/Centre
Entrance Test	Christ 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

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 University 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 University 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.

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.

$$\textbf{CGPA} = \frac{\sum [\textbf{GPA x Cr}]}{\sum \textbf{Cr}}$$

GRADING SCHEME FOR EACH PAPER: Undergraduate Courses

<table>
<tr><th>Percentage</th><th>Grade</th><th>Grade Point</th><th>Interpretation</th><th>Class</th></tr>
<tr><td>80 and above</td><td>A</td><td>4.0</td><td>Outstanding</td><td>First Class with Distinction</td></tr>
<tr><td>73-79</td><td>A-</td><td>3.67</td><td>Excellent</td><td rowspan="3">First Class</td></tr>
<tr><td>66-72</td><td>B+</td><td>3.33</td><td>Very Good</td></tr>
<tr><td>60-65</td><td>B</td><td>3.0</td><td>Good</td></tr>
<tr><td>55-59</td><td>B-</td><td>2.67</td><td>Average</td><td rowspan="2">Second Class</td></tr>
<tr><td>50-54</td><td>C+</td><td>2.33</td><td>Satisfactory</td></tr>
<tr><td>45-49</td><td>C</td><td>2.00</td><td>Pass</td><td rowspan="2">Pass Class</td></tr>
<tr><td>40-44</td><td>D</td><td>1.0</td><td>Pass</td></tr>
<tr><td>39 and below</td><td>F</td><td>0</td><td>Fails</td><td>Fail</td></tr>
</table>

PROGRAMME OVERVIEW

Engineering Science is a key area in the study of an Engineering Course. A sound knowledge of this area develops principles of physics, laws of Chemistry and mathematical analytical skills, thus enabling graduates to solve numerical problems encountered in daily life, particularly in the area of engineering.

An educational institution that does not respond to the present requirement and changes and does not lead to research will remain on the wayside of the higher education missing the opportunities for going beyond. Keeping our vision "Excellence and Service", Engineering Science introduces student to those areas of Science which, from a modern point of view, are most important in connection with practical problems.

PROGRAMME OBJECTIVE:

The B. Tech. course aims to fulfill the following broad objectives:

1. To make aware students about the importance and symbiosis between Science and Engineering.
2. Developing a respectable intellectual level seeking to expose the various concepts in Science.
3. To enhance the students reasoning, analytical and problem-solving skills.
4. To cultivate a scientific habit of thought and reasoning.
5. To develop a research culture in young minds.
6. Development of students' competence by evolving a learner centered curriculum.
7. To encourage the students to uphold scientific integrity and objectivity in professional endeavors.
8. To translate a given physical or other information and data into mathematical form.
9. Obtaining the solution by selecting and applying suitable mathematical models.

During the course students will learn to balance between the development of understanding and mastering of solution techniques with emphasis being on the development of student's ability to use Science and Mathematics with understanding to solve Engineering problems by retaining the philosophy of "learning by doing".

After the completion of this course prospective engineers will be able to apply the concepts of Science, Mathematics and basic Engineering in their professional courses and will be able to demonstrate effective problem-solving methodology. The upcoming engineers will become familiar with ways to think scientifically, mathematically and technically, recognize the need for applying science and mathematics methods to engineering problems and get a firm grasp for the interrelation between theory, computing and experiment.

TEACHING PEDAGOGY

Our teaching methodology ensures that students are being exposed to a holistic education experience in an active and dynamic learning environment, giving them the opportunity to identify and realize their potential, and to achieve excellence. In order to realize the objectives, a methodology based on the combination of the following will be adopted:

- Team/Classroom teaching.
- PowerPoint presentations and handouts.
- Simulated situations and role-plays.
- Project Based Learning
- 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.

(i) DETAILS OF ASSESSMENT

Following are the details of the modifications proposed for assessment pattern - BTech course AY 2017-18

	Category	Weightage for CIA	Weightage for ESE
1	Courses with theory and practical	70	30
2	Courses with only theory	50	50
3	Courses with only Practical	50	50

COURSES WITH THEORY AND PRACTICAL				
#	Component	Assessed for	Minimum marks to pass	Maximum marks
1	Theory CIA	30	-	30
2	Theory ESE	30	12	30

3	Practical CIA	35	14	35
4	Attendance	05	-	05
4	Aggregate	100	40	100

DETAIL OF MARK FOR COURSES WITH THOERY AND PRACTICAL										
THEORY						**PRACTICAL**				
#	**Component**	**Assessed for**	**Scaled down to**	**Minimum marks to pass**	**Maximum marks**	**Component**	**Assessed for**	**Scaled down to**	**Minimum marks to pass**	**Maximum marks**
1	CIA-1	20	**10**	-	**10**					
2	CIA-2	50	**10**	-	**10**	**Overall CIA**	**50**	**35**	**14**	**35**
3	CIA-3	20	**10**	-	**10**					
4	Attendance	05	**05**	-	**05**	**Attendance**	**NA**	**NA**	**-**	**-**
5	ESE	100	**30**	12	**30**	ESE	**NA**	**NA**	**-**	**-**
		TOTAL	**65**	**-**	**65**	**TOTAL**		**35**	**14**	**35**

Minimum marks required to pass in practical component is 40%.

- Pass in practical component is eligibility criteria to attend Theory End semester examination for the same course.
- A minimum of 40 % required to pass in ESE -Theory component of a course.
- Overall 40 % aggregate marks in Theory & practical component, is required to pass a course.
- There is no minimum pass marks for the Theory - CIA component.
- Less than 40% in practical component is refereed as FAIL
- Less than 40% in Theory ESE is declared as fail in the theory component.
- Students who failed in theory ESE have to attend only theory ESE to pass in the course.

IV. ASSESSMENT OF SEMINAR, INTERNSHIP and SERVICE LEARNING

Seminar
Passing marks 40% min
Do not have ESE and completely evaluated through continuous assessment only,
The evaluation (minimum 2 presentations) shall be based on the

- Topic / report :40%
- Presentation: 40%
- Response to the questions asked during presentation: 20%.

Service Learning
Passing marks 40% min

Do not have ESE and completely evaluated through continuous assessment only, Comprising

- Internal Assessment with components like tests/quiz/written assignments: 25 marks
- Field Work or equivalent assignment as approved by the department panel: 25 marks

Internship

Passing marks 40% min

Do not have ESE and completely evaluated through continuous assessment only

Continuous Internal Assessment *is based upon*

- No of Internship Days : 20 marks
- Type of Industry and Work Carried out : 10 marks
- Report on Internship : 10 marks
- Presentation on Internship : 10 marks

V. ASSESSMENT OF PROJECT WORK

Project work may be assigned to a single student (with due approval from department) or to a group of students not exceeding 4 per group.

Maximum Marks = 200

- Continuous Assessment 100 and the
- End Semester Examination (project report evaluation and viva-voce) : 100 marks.
- The continuous assessment and End Semester Examinations marks for Project Work and the Viva-Voce Examination will be distributed as indicated below.
- There shall be **3** review **and t**he student shall make presentation on the progress made before the committee constituted by the Department
- The total marks obtained in the 3 reviews shall be 100 marks.

CIA 100 MARKS						**ESE 100 MARKS**
REVIEW 1		**REVIEW 2**		**REVIEW 3**		
REVIEW COMMITTEE	GUIDE	REVIEW COMMITTEE	GUIDE	REVIEW COMMITTEE	GUIDE	EXAMINERES
20	05	20	10	20	25	**100**
TOTAL	**25**	**TOTAL**	**30**	**TOTAL**	**45**	

ESE 100 MARKS IS EVALUATED AS

- Initial Write Up : 15 marks
- Viva Voce : 25 marks
- Demonstration : 35 marks
- Project Report : 25 marks

VI. ASSESSMENT OF ENGINEERING GRAPHICS AND COMPUTER AIDED MACHINE DRAWING

- Continuous Internal Assessment (CIA): 50% (50 marks out of 100 marks)
- End Semester Examination (E2SE) : 50% (50 marks out of 100 marks)

Components of the CIA

CIA I : Assignments	: 10 marks
CIA II : Mid Semester Examination	: 25 marks
CIA III : Assignments	: 10 marks
Attendance	: 05 marks
Total	**: 50 marks**

End Semester Examination
3 hrs duration for 100 marks

1. ENGINEERING GRAPHICS

- Projections of points, lines and plane surfaces –Manual Drawing : 30 marks
- Projections of Solids - Computer Aided : 40 marks
- Development of surfaces and Isometric Projections - Computer Aided : 30 marks

COURSE STRUCTURE:

BTech Course Structure 2020-24

I SEMESTER – CHEMISTRY CYCLE											
#	Course Type	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
1	BSC	MA131	Mathematics – I	3	0	0	100	3	0	0	3
2	BSC	CH132P	Chemistry	3	0	2	100	3	0	1	4
3	ESC	EC133P	Basic Electronics	3	0	2	100	3	0	1	4
4	ESC	CS134P	Computer Programming	3	0	2	100	3	0	1	4
5	ESC	ME135	Basic Mechanical Engineering and Nano-science	3	0	0	100	3	0	0	3
6	HSMC	TE136P	Technical English	1	0	2	100	1	0	1	2
7	ESC	ME 151	Workshop Practice Lab	0	0	2	50	0	0	1	1
8	HSMC	HE171	Holistic Education-I	1	0	0	---	1	0	0	1
			Total				**650**				**22**

I SEMESTER – PHYSICS CYCLE											
#	Course Type	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
1	BSC	MA131	Mathematics – I	3	0	0	100	3	0	0	3

I SEMESTER – PHYSICS CYCLE											
#	Course Type	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
2	BSC	PH132P	Physics	3	0	2	100	3	0	1	4
3	ESC	EE133P	Basic Electrical Engineering	3	0	2	100	3	0	1	4
4	ESC	CE134P	Basics of Civil Engineering & Engineering Mechanics	3	0	2	100	3	0	1	4
5	ESC	EG135P	Engineering Graphics	2	0	2	100	2	0	1	3
6	BSC	BS136	Basic Biology	2	0	0	50	2	0	0	2
7	HSMC	HE171	Holistic Education-I	1	0	0	---	1	0	0	1
			Total				**550**				**21**

II SEMESTER – CHEMISTRY CYCLE											
#	Course Type	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
1	BSC	MA231	Mathematics – II	3	0	0	100	3	0	0	3
2	BSC	CH232P	Chemistry	3	0	2	100	3	0	1	4
3	ESC	EC233P	Basic Electronics	3	0	2	100	3	0	1	4

II SEMESTER – CHEMISTRY CYCLE											
#	**Course Type**	**Course Code**	**Course Name**	**Hours**			**Total Marks**	**Credits**			**Total Credits**
				L	T	P		**L**	**T**	**P**	
4	**ESC**	CS234P	Computer Programming	3	0	2	100	3	0	1	4
5	**ESC**	ME235	Basic Mechanical Engineering and Nano-science	3	0	0	100	3	0	0	3
6	**HSMC**	TE236P	Technical English	1	0	2	100	1	0	1	2
7	**ESC**	ME 251	Workshop Practice Lab	0	0	2	50	0	0	1	1
8	**HSMC**	HE271	Holistic Education-II	1	0	0	---	1	0	0	1
			Total				**650**				**22**

II SEMESTER – PHYSICS CYCLE											
#	**Course Type**	**Course Code**	**Course Name**	**Hours**			**Total Marks**	**Credits**			**Total Credits**
				L	T	P		L	T	P	
1	**BSC**	MA231	Mathematics – II	3	0	0	100	3	0	0	3
2	**BSC**	PH232P	Physics	3	0	2	100	3	0	1	4
3	**ESC**	EE233P	Basic Electrical Engineering	3	0	2	100	3	0	1	4
4	**ESC**	CE234P	Basics of Civil Engineering & Engineering Mechanics	3	0	2	100	3	0	1	4

II SEMESTER – PHYSICS CYCLE											
#	Course Type	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
5	ESC	EG235P	Engineering Graphics	2	0	2	100	2	0	1	3
6	BSC	BS236	Basic Biology	2	0	0	50	2	0	0	2
7	HSMC	HE271	Holistic Education-II	1	0	0	---	1	0	0	1
			Total				**550**				**21**

III Semester											
#	Course Type	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
1	BSC	MA331	Mathematics-III	3	0	0	100	3	0	0	3
2	PCC	CE331P	Computer-aided Civil Engineering Drawing	1	0	2	50	1	0	1	2
3	PCC	CE332	Disaster Preparedness and Planning	2	0	0	50	2	0	0	2

4	**PCC**	CE333P	Introduction to Solid Mechanics	3	0	2	100	3	0	1	4
5	**PCC**	CE334P	Surveying and Geomatics	3	0	2	100	3	0	1	4
6	**PCC**	CE335	Introduction to Fluid mechanics	3	1	0	100	3	0	0	4
7	**BSC**	BS336P	Engineering Biology Laboratory	0	0	2	50	0	0	1	1
8	**MC** Non-Credit	MC301	Environmental Science	2	0	0	0	0	0	0	0
9	**HSMC**	HE371	Holistic Education-III	1	0	0	0	1	0	0	1
			Total				**550**				**21**

IV Semester											
#	**Course Type**	**Course Code**	**Course Name**	**Hours**			**Total Marks**	**Credits**			**Total Credits**
				L	T	P		L	T	P	
1	**PCC**	CE431P	Hydraulic Engineering	3	0	2	100	3	0	1	4

2	**PCC**	CE432	Mechanics of Materials	3	1	0	100	3	1	0	4
3	**PCC**	CE433 P	Materials, Testing & Evaluation	3	0	2	100	3	0	1	4
4	**PCC**	CE434 P	Instrumentation & Sensor Technologies for Civil Engineering Applications	3	0	2	100	3	0	1	4
6	**HSMC**	HS402	Professional Ethics	2	0	0	50	2	0	0	2
7	**MC** Non-Credit	MC402	Cyber Security	2	0	0	0	0	0	0	0
8	**HSMC**	HE471	Holistic Education-IV	1	0	0	0	1	0	0	1
			Total				**500**				**19**

V Semester											
#	**Course Type**	**Course Code**	**Course Name**	**Hours**			**Total Marks**	**Credits**			**Total Credits**
				L	**T**	**P**		**L**	**T**	**P**	
1	**PCC**	CE531	Structural Engineering	3	1	0	100	3	0	0	4
2	**PCC**	CE532P	Geotechnical Engineering	3	0	2	100	3	0	1	4
3	**PCC**	CE533	Hydrology & Water Resources Engineering	3	1	0	100	3	1	0	4
5	**PEC**	CE534EC01	Program Elective – 1	3	0	0	100	3	0	0	3
6	**HSMC**	HS503	Project Management & Finance	2	0	2	100	2	0	1	3
7	**MC** Non-Credit		Indian Constitution	0	0	0	-	0	0	0	0
			Total				**550**				**18**

VI Semester												
#	Course Type	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	p	
1	PCC	CE631P	Environmental Engineering	3	0	2	100	3	0	1	4
2	PCC	CE632P	Highway Engineering	3	0	2	100	3	0	1	4
3	PEC	CE633EC02	Program Elective – 2	3	0	0	100	3	0	0	3
4	PEC	CE634EC03	Program Elective – 3	3	0	0	100	3	0	0	3
5	OE	CE635OE01	Open Elective - 1	3	0	0	100	3	0	0	3
6	PCC	CE651	Extensive Survey Project	1	0	2	50	1	0	1	2
			Total				**550**				**19**

VII Semester											
#	Course Type	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
1	PCC	CE731P	Engineering Economics, Estimation & Costing	3	0	2	100	3	0	1	4
2	PEC	CE732EC04	Program Elective – 4	3	0	0	100	3	0	0	3
3	PEC	CE733EC05	Program Elective – 5	3	0	0	100	3	0	0	3
4	OE	CE734OE02	Open Elective – 2	3	0	0	100	3	0	0	3
5	PROJ	CE771	Internship	0	0	2	50	0	0	2	2
6	PROJ	CE772	Field Practice	1	0	2	50	0	0	1	2
7	PROJ	CE773	Project Work – I	0	0	8	100	0	0	4	4
8	HSMC	HS704	Service Learning	1	0	2	50	1	0	1	2
			Total				**650**				**23**

VIII Semester											
#	Course Type	Course Code	Course Name	Hours			Total Marks	Credits			Total Credits
				L	T	P		L	T	P	
1	PEC	CE831	Program Elective – 6	3	0	0	100	3	0	0	3
3	PROJ	CE872	Seminar	0	0	2	50	0	0	1	1

4	**PROJ**	CE873	Project Stage-II	0	0	1 6	300	0	0	8	8
			Total				**450**				**12**

PROGRAM ELECTIVE

ELECTIVE- A-Construction Engineering & Management

Sl. No.	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	CE534EC-01A	Building Construction Practice	3	0	0	100	3	0	0	3
2	CE633EC-02A	Building information modelling	3	0	0	100	3	0	0	3
3	CE634EC-03A	Construction Cost Analysis	3	0	0	100	3	0	0	3
4	CE732EC-04A	Sustainable Construction Methods	3	0	0	100	3	0	0	3
5	CE733EC-05A	Contracts Management	3	0	0	100	3	0	0	3

ELECTIVE- B-Transportation Engineering

Sl. No.	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	CE535EC-01 B	Transportation Engineering	3	0	0	100	3	0	0	3
2	CE633EC-02 B	Traffic Engineering and Management	3	0	0	100	3	0	0	3
3	CE634EC-03 B	Urban Transportation Planning	3	0	0	100	3	0	0	3
4	CE732EC-04 B	Pavement Materials	3	0	0	100	3	0	0	3
5	CE733EC-05 B	Pavement Design	3	0	0	100	3	0	0	3

ELECTIVE- C-Environmental Engineering

Sl. No.	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	CE535EC-01 C	Transport of Water and Wastewater	3	0	0	100	3	0	0	3

2	CE633EC-02C	Environmental Laws and Policy	3	0	0	100	3	0	0	3
3	CE634EC-03C	Physio-Chemical Processes for Water and Wastewater Treatment	3	0	0	100	3	0	0	3
4	CE732EC-04C	Solid and Hazardous Waste Management	3	0	0	100	3	0	0	3
5	CE733EC-05C	Air and Noise Pollution and Control	3	0	0	100	3	0	0	3

ELECTIVE- D-Hydraulics

Sl. No.	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	CE535EC-01D	Irrigation Engineering and Hydraulic Structures	3	0	0	100	3	0	0	3
2	CE633EC-02D	Pipeline Engineering	3	0	0	100	3	0	0	3
3	CE634EC-03D	Open Channel flow	3	0	0	100	3	0	0	3
4	CE732EC-04D	River Engineering	3	0	0	100	3	0	0	3
5	CE733EC-05D	Hydraulic modelling	3	0	0	100	3	0	0	3
6	CE733EC-06D	Basics of Computational Hydraulics	3	0	0	100	3	0	0	3

ELECTIVE- E-Hydrology & Water Resources Engineering

Sl. No.	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	CE535EC-01E	Water Quality Engineering	3	0	0	100	3	0	0	3
2	CE633EC-02E	Surface Hydrology	3	0	0	100	3	0	0	3
3	CE634EC-03E	Environmental Fluid Mechanics	3	0	0	100	3	0	0	3

4	CE732EC-04E	Water Resources Field Methods	3	0	0	100	3	0	0	3
5	CE732EC-05B	Drone Based Surveying	3	0	0	100	3	0	0	3

ELECTIVE- F-Structural Engineering

Sl. No.	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	CE535EC-01F	Structural Analysis-I	3	0	0	100	3	0	0	3
2	CE633EC-02F	Structural Analysis-II	3	0	0	100	3	0	0	3
3	CE634EC-03F	Reinforced Concrete	3	0	0	100	3	0	0	3
4	CE732EC-04F	Prestressed Concrete	3	0	0	100	3	0	0	3
5	CE733EC-05F	Design of Steel Structures	3	0	0	100	3	0	0	3
6	CE733EC-06F	Concrete Technology	3	0	0	100	3	0	0	3

ELECTIVE- G-Geotechnical Engineering

Sl. No.	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	CE535EC-01G	Foundation Engineering	3	0	0	100	3	0	0	3
2	CE633EC-02G	Geotechnical Design	3	0	0	100	3	0	0	3
3	CE634EC-03G	Structural Geology	3	0	0	100	3	0	0	3
4	CE732EC-04G	Offshore Engineering	3	0	0	100	3	0	0	3
5	CE733EC-05G	Rock Mechanics	3	0	0	100	3	0	0	3

OPEN ELECTIVE - 1

Offered by Department of Civil Engineering

Sl. No.	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	CE636OE1	Solid Waste Management	3	0	0	100	3	0	0	3
2	CE636OE2	Environmental Impact Assessment	3	0	0	100	3	0	0	3
3	CE636OE3	Sustainable and Green Technology	3	0	0	100	3	0	0	3
4	CE636OE4	Disaster Management	3	0	0	100	3	0	0	3
5	CE636OE5	Air Pollution and Control	3	0	0	100	3	0	0	3

6	CE636OE 6	GIS & Remote Sensing Techniques and Applications	3	0	0	100	3	0	0	3

Offered by Department of Computer Science and Engineering

Sl. No .	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	CS636OE 1	Web Programming Concepts	3	0	0	100	3	0	0	3
2	CS636OE 2	Data Structures	3	0	0	100	3	0	0	3
3	CS636OE 3	Java Programming	3	0	0	100	3	0	0	3
4	CS636OE 4	Software Testing Techniques	3	0	0	100	3	0	0	3
5	CS636OE 5	Software Engineering Methodologies	3	0	0	100	3	0	0	3
6	CS636OE 6	User Interface Design Concepts	3	0	0	100	3	0	0	3

Offered by Department of Electronics and Communications Engineering

Sl. No .	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	EC636OE 1	Basics of Microprocessors	3	0	0	100	3	0	0	3
2	EC636OE 2	Introduction to Robotic Design	3	0	0	100	3	0	0	3
3	EC636OE 3	Principles of Communication	3	0	0	100	3	0	0	3
4	EC636OE 4	Basics of VLSI Design	3	0	0	100	3	0	0	3
5	EC636OE 5	Advanced Digital System Design	3	0	0	100	3	0	0	3
6	EC636OE 6	Basics of Digital Signal Processing	3	0	0	100	3	0	0	3

Offered by Electrical and Electronics Engineering

Sl. No.	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	EE636OE1	Energy Auditing and Management	3	0	0	100	3	0	0	3
2	EE636OE2	Nonconventional Energy Sources	3	0	0	100	3	0	0	3
3	EE636OE3	Introduction of Hybrid Electric Vehicles	3	0	0	100	3	0	0	3
4	EE636OE4	Electrical System Design for Residential and Commercial Buildings	3	0	0	100	3	0	0	3
5	EE636OE5	Smart Grids	3	0	0	100	3	0	0	3
6	EE636OE6	Robotics and Automation	3	0	0	100	3	0	0	3
7	EE636OE7	Power Quality	3	0	0	100	3	0	0	3
8	EE636OE8	Matrix Computations	3	0	0	100	3	0	0	3
9	EE636OE9	Electrical Machines and Drives	3	0	0	100	3	0	0	3

Offered by Department of Mechanical Engineering

Sl. No.	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	ME636OE 1	Industrial Robotics	3	0	0	100	3	0	0	3
2	ME636OE 2	Engineering Materials	3	0	0	100	3	0	0	3
3	ME636OE 3	Basic Automobile Engineering	3	0	0	100	3	0	0	3
4	ME636OE 4	Project Management	3	0	0	100	3	0	0	3
5	ME636OE 5	Basic Aerospace Engineering	3	0	0	100	3	0	0	3

6	ME636OE 6	Computer Application in Design	3	0	0	100	3	0	0	3
7	ME636OE 7	CAD/CAM	3	0	0	100	3	0	0	3
8	ME636OE 8	Non-Conventional Energy	3	0	0	100	3	0	0	3
9	ME636OE 9	Internal Combustion Engines	3	0	0	100	3	0	0	3
10	ME636OE 1 0	Finite Element Analysis	3	0	0	100	3	0	0	3

Offered by Department of Science and Humanities

Sl. No.	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	MA 636OE1	Fundamentals of Boundary Layer Theory	3	0	0	100	3	0	0	3
2	MA 636OE2	Non – Linear Programming Problems	3	0	0	100	3	0	0	3
3	MA 636OE3	Numerical Solution of Differential Equations	3	0	0	100	3	0	0	3
4	MA 636OE4	Mathematical Statistics	3	0	0	100	3	0	0	3
5	CH636OE 1	Electronic Materials	3	0	0	100	3	0	0	3
6	CH636OE 2	Catalyst Technology	3	0	0	100	3	0	0	3
7	CH636OE 3	Environmental Chemistry	3	0	0	100	3	0	0	3
8	PH636OE 1	Technical ceramics	3	0	0	100	3	0	0	3
9	PH636OE 2	Advances in materials science and engineering	3	0	0	100	3	0	0	3
10	PH636OE 3	Nuclear physics	3	0	0	100	3	0	0	3

OPEN ELECTIVE - 2

Sl. No.	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	HU736OE1	German Language	3	0	0	50	2	0	0	2
2	HU736OE2	Media Studies for Engineering	3	0	0	50	2	0	0	2
3	HU736OE3	Technical writing and editing	3	0	0	50	2	0	0	2
4	HU736OE4	Piano Grade	3	0	0	50	2	0	0	2
5	HU736OE5	Western Music Theory Grade	3	0	0	50	2	0	0	2
6	HU736OE6	French Language	3	0	0	50	2	0	0	2

7	HU736OE 7	Applied Theatre	3	0	0	50	2	0	0	2

DETAILED SYLLABUS

SEMESTER -I

Course Name: Mathematics I					
Course Code: MA131					
	L	**T**	**P**	**Category**	BSC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3

Course objectives: This course is outlined to those who intend to apply the subject at the proper place and time, while keeping him/her aware to the needs of the society where he/she can lend his/her expert service, and also to those who can be useful to the community without even going through the formal process of drilling through rigorous treatment of Mathematics. At the end of this course, students will • have a solid base of understanding elementary linear algebra as required for further undergraduate work in engineering. • be able to differentiate a function partially with respect to each of its variables in turn • be able to utilize methods of integration to compute length of arcs, surface area and volume of solids. • be skilled in using integration to compute problems important in physics and engineering • learn the meaning and computation of the curl and divergence of a vector field. • be able to solve first order differential equations that are separable, linear or exact.	
Prerequisites: Nil	
Units	**Teaching Hours**
Unit-1 Linear Algebra	
Fundamental concepts of Matrix, Rank of a Matrix, Consistency and solution of linear simultaneous equations, Eigen values and Eigen Vectors, Diagonalization	5
Unit-2 Differential Calculus – I	
Partial Differentiation: Partial derivatives, Total differential coefficient, differentiation of composite and implicit functions, Jacobians and properties. Leibnitz's Rule of differentiation under integral sign.	10
Unit-3 Integral Calculus – I	
Reduction formulae for the integration of $\sin^n x$, $\cos^n x$, $\sin^m x \cos^n x$ and evaluation of these integrals with standard limits - Problems. Derivative of arc length, Applications of integration to find surfaces of revolution and volumes of solids of revolution.	10
Unit-4 Differential Equation – I	
Solution of first order and first degree differential equations: Reducible to Homogeneous, Linear and Exact differential equation, Applications of differential equations. Orthogonal trajectories.	10
Unit-5 Vector Calculus – I	
Vector differentiation. Velocity, Acceleration of a particle moving on a space curve. Vector point function. directional derivative, Gradient, Divergence, Curl, Laplacian. Solenoidal and Irrotational vectors - Problems. Standard vector identities.	10
Self-study: NIL	

Site/Industrial Visits: NIL
Course outcomes: CO1: Checking the consistency of system of linear equations and hence finding solution {Level} {PO} CO2: Finding the differentiation of multivariable functions using the concept of total derivatives, Jacobian, Evaluating definite integrals by Leibnitz rule of differentiation under integral sign {Level} {PO} CO3: Evaluation of definite integrals as surface area and volume of solid of revolution using reduction formulae {Level} {PO} CO4: Solving first order nonlinear differential equations by reducing into homogenous, linear and exact forms {Level} {PO} CO5: Finding the velocity and acceleration of a moving particle, vector potential, scalar potential {Level} {PO}
Text Books: T1. Dr. B. S. Grewal, "Higher Engineering Mathematics", 39th Edition, Khanna Publishers, July 2005. T2. H. K. Das & Rajnish Verma, "Higher Engineering Mathematics", S. Chand & Company Ltd., 2011.
Reference Books: R1. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, 2005 R2. Thomas and Finney, "Calculus", 9th Edition, Pearson Education, 2004 R3. Peter V. O'Neil, "Advanced Engineering Mathematics", Thomson Publication, Canada, 2007 R4. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw – Hill, 2009. R5. Michael Artin, "Algebra", 2nd Edition, Prentice Hall of India Private Limited, New Delhi, 2002 R6. Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, Prentice Hall of India Private Limited, New Delhi, 2002 R7. George F. Simmons and Steven G. Krantz, "Differential Equation, Theory, Technique and Practice", Tata McGraw – Hill, 2006. R8. M. D. Raisinghania, "Ordinary and Partial Differential Equation", Chand (S.) & Co. Ltd., India, March 17, 2005.
Online Resources: NIL

<table>
<tr><td colspan="6">Course Name: Chemistry</td></tr>
<tr><td colspan="6">Course Code: CH132P / CH232P</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>BSC</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>2</td><td>CIA Marks</td><td>70</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>30</td><td>ESE Marks</td><td>30</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>1</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: This paper contains five units which are Chemical Energy Sources, Electrochemical Energy Systems, Corrosion Science, Surface Chemistry & Catalysis, Material Characterization Techniques and Water Technology
This paper aims at enabling the students to know various energy sources, corrosion and its control, basics of surface chemistry, their application in catalysis, water technology and material characterization.</td></tr>
<tr><td colspan="6">Prerequisites: Nil</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 Chemical Energy Sources</td></tr>
<tr><td colspan="5">Introduction to energy; Fuels - definition, classification, importance of hydrocarbons as fuels; Calorific value -definition, Gross and Net calorific values. Ultimate and proximate analysis of fuel, Determination of calorific value of a solid / liquid fuel using Bomb calorimeter. Cracking – Thermal Catalytic & fluidised cracking. Reformation, Knocking - mechanism, octane number, cetane number, prevention of knocking- anti-knocking agents, unleaded petrol, Power alcohol. synthetic petrol – Bergius process and Fischer Tropsch process.
Solar Energy : Physical and chemical properties of silicon, production of silicon for photovoltaic cell – Mettalurgical grade, Solar grade. Purification of silicon – Zone refining crystal pulling technique - Photovoltaic cells- Introduction, VB Theory, definition, working of a PV cell, Merits and demerits.</td><td>10</td></tr>
<tr><td colspan="6">Unit-2 Electrochemical Energy Systems</td></tr>
<tr><td colspan="5">Conductance, Ionic conductance, Transport number, Ionic mobility, activity coefficient and mean activity coefficients. Single electrode potential- origin, sign conventions. Derivation of Nernst equation. Standard electrode potential Construction of Galvanic cell–classification - primary, secondary and concentration cells, Concentration cell with and without transference, EMF of a cell, notation and conventions. Reference electrodes –calomel electrode, Ag/AgCl electrode. Measurement of single electrode potential. Numerical problems on electrode potential and EMF. Ion-selective electrode- glass electrode, Determination of pH using glass electrode.</td><td>8</td></tr>
<tr><td colspan="6">Unit-3 Corrosion Science</td></tr>
</table>

Corrosion - definition, Chemical corrosion and Electro-chemical theory of corrosion, Types of corrosion, Differential metal corrosion, Differential aeration corrosion (pitting and water line corrosion), Stress corrosion. Factors affecting the rate of corrosion, Corrosion control: Inorganic coatings – Anodizing and Phosphating, Metal coatings – Galvanization and Tinning, Corrosion Inhibitors, Cathodic and Anodic protection.	**9**
Unit-4 Surface chemistry & Catalysis	
Introduction - Terminologies in surface chemistry – Adsorption - Characteristics, Classification, Application , Factors affecting Adsorption – Surface Area, temperature, pressure and nature of gas, desorption Activation Energy life time, Adsorption isotherms-Freudlich, Langmuir, BET **Catalysis**: Introduction, classification- Homogeneous and Heterogeneous, Active Sites-Single & dual- Solid catalysts-Classification- Supported, Unsupported, Metal Organic Frameworks Imprint catalysts, Hybrid catalysts, shape selective catalyst, – terminologies in material preparation- Precursor, calcination, Ageing, agglomeration regeneration	**11**
Unit-5 Material Characterization & Water Technology	
Theory and Applications of X-ray Photo electron Spectroscopy (XPS), Powder Xray diffraction (pXRD) **Water Technology:** Impurities in water, Biochemical Oxygen Demand and Chemical Oxygen Demand. Numerical problems on BOD and COD. Sewage treatment. Purification of water- Desalination - Flash evaporation- Electro dialysis and Reverse Osmosis.	**7**
PRACTICALS	
List of Experiments :	**Practical Hours**
PART – A	
1. Determination of viscosity coefficient of a given liquid using Ostwald's viscometer.	**2**
2. Determination of copper by spectrophotometric method.	**2**
3. Conductometric estimation of an acid using standard NaOH solution	**2**
4. Determination of pKa value of a weak acid using pH meter.	**2**
5. Potentiometric estimation of FAS using standard $K_2Cr_2O_7$ solution.	**2**
PART – B	
1. Determination of Total Hardness of a sample of water using disodium salt of EDTA.	**2**

2. Determination of percentage of Copper in brass using standard sodium thiosulphate solution.	**2**
3. Determination of Calcium Oxide (CaO) in the given sample of cement by Rapid EDTA method	**2**
4. Determination of Iron in the given sample of Haematite ore solution using potassium dichromate crystals by external indicator method.	**2**
5. Determination of Chemical Oxygen Demand (COD) of the given industrial waste Water sample.	**2**
Self-study : NIL	
Site/Industrial Visits : NIL	

Course outcomes:
CO1: Students will be able to distinguish between renewable and non-renewable energy sources. {Level} {PO}
CO2: Students will gain an understanding of oxidation and reduction reactions which are relevant to study the concepts of corrosion science and electrochemistry. {Level} {PO}
CO3: Students will be able to explain basics of physical and chemical phenomena taking place at solid surfaces. {Level} {PO}
CO4: Students will be able to describe physiochemical techniques for material characterization. {Level} {PO}
CO5: Students will be able to explain the fundamentals of water and waste water treatment. {Level} {PO}

Textbooks:
T1. Dr. B.S. Jai Prakash, “Chemistry for Engineering Students”, Subhas Stores, Bangalore, Reprint 2015
T2. M. M. Uppal, “Engineering Chemistry”, Khanna Publishers, Sixth Edition, 2002
T3. Jain and Jain, “A textbook of Engineering Chemistry”, S. Chand & Company Ltd. New Delhi, 2009, Reprint- 2016

Reference Books:
R1. Atkins P.W. “Physical chemistry” ELBS 9 Edition 2009, London
R2. Stanley E. Manahan, “Environmental Chemistry”, Lewis Publishers, Reprint 2009
R3. B. R. Puri, L. R. Sharma & M. S. Pathania,” *Principles* of Physical Chemistry”, S. Nagin Chand & Co., 33rd Ed., Reprint- 2016
R4. Kuriakose J.C. and Rajaram J. “Chemistry in Engineering and Technology” Vol I & II, Tata Mc Graw – Hill Publications Co Ltd, NewDelhi, First edition Reprint 2010
R5. Ertl, H. Knozinger and J. Weitkamp, "Handbook of Heterogeneous Catalysis" Vol 1-5, Wiley - VCH.
R6. B. Viswanathan, S. Sivasanker, A.V. Ramaswamy, "Catalysis: Principles & Applications" CRC Press, March 2002, Reprint 2011.
R7. D K Chakrabarthy, B. Viswanathan,” Heterogeneous Catalysis” New Age Internatioanl Publishers,2008.
R8. J. Bassett, R.C. Denny, G.H. Jeffery, “Vogels textbook of quantitative inorganic analysis”,5th Edition
R9. Sunita and Ratan Practical Engineering Chemistry, S.K. Kataria & Sons, 2013.

Online Resources:
NIL

Course Name: Basic Electronics					
Course Code: EC133P / EC233P					
	L	**T**	**P**	Category	ESC
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**70**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**30**
Credits.	**3**	**0**	**1**	Exam Hours	**3**
Course objectives: This course aims at imparting knowledge about electronic and digital systems, semiconductor theory and operational amplifiers. This course also includes a practical component which allows the students to recognize the different elements used in electronics and digital systems.					
Prerequisites: NIL					

Units	Teaching Hours
Unit-1 Basic Semiconductor and Pn Junction Theory	
Atomic Theory – Atom, Electron Orbits and Energy Levels - Conduction in solids – Electron Motion and Hole Transfer, Conventional Current and Electron Flow –Conductors, Insulators and Semiconductors – Energy Band Diagrams – Variation of band gap with temperature. Intrinsic and Extrinsic Semiconductors – Doping, n type and p type material, Majority and minority carriers, Charge Carrier Density, Mass Action Law. Semiconductor Conductivity – Drift Current, Diffusion Current, Charge Carrier Velocity, Condyctivity.The pn Junction – Biased Junctions – Junction Currents and Voltages.VI Characteristics – Static and Dynamic Resistance.Zener diode characteristics, Zener and Avalanche breakdown**.**	9
Unit-2 Diode Applications	

Diode Approximations – DC Load Line Analysis - DC voltage applied to diodes (Si and zener diodes only). (Simple analysis using KCL and KVL). Rectifiers – Half Wave rectifier – Full Wave Rectifier – Bridge Rectifier : dc load current and voltage, rms load current and voltage, ripple factor, efficiency, PIV. Simple Capacitor Filter (Analysis not expected) – Simple Shunt Zener Voltage Regulator	9
Unit-3 Bipolar Junction Transistor	
Bipolar Junction Transistors: Transistor Construction – Operation – Common Base Configuration – Transistor Amplifying action – Common Collector – Common Emitter. Transistor currents. Common emitter current gain – Common Base Current gain – Relationship. Transistor Biasing: Operating Point – Significance – Fixed Bias and Voltage Divider Bias – Simple analysis.	9
Unit-4 Introduction To Operational Amplifiers	
Block diagram, Op-amp transfer characteristics, Basic Op-amp parameters and its value for IC 741- offset voltage and current, input and output impedance, Gain, slew rate, bandwidth, CMRR, Concept of negative feedback, Inverting and Non-inverting amplifiers, Summing Amplifier, Subtractor, Differential Amplifier, integrator, differentiator, Voltage follower, Introduction to Oscillators, the Barkhausen Criterion for Oscillations, Applications of Oscillator.	9
Unit-5 Digital Electronics	
Sampling theorem, Introduction, decimal system, Binary, Octal and Hexadecimal number systems, addition and subtraction, fractional number, Binary Coded Decimal numbers. Boolean algebra, Logic gates, Two Variable and three variable K – maps - Half-adder, Full-adder, Logic Design based on two and three input variables only.	9
PRACTICALS	
List of Experiments (If any):	**Practical Hours**
1. Use of basic voltage source and measuring instruments (Power supply, function generator, DSO, Digital Multimeter), familiarization of breadboard.Measurement of Voltage and Frequency using DSO	2
2. Study of step down transformer. Measuring the secondary voltage waveform on DSO and determination of peak and rms value	2
3. Identification and testing of electrical/electronic active and passive components	2
4. Color coding of resistors and capacitor coding	2
5. Study of Series and Parallel circuits to verify Kirchoff's Voltage Law and Current Law – using breadboard, DMM and DC power supply.	4
6. Half Wave Rectifier and Full Wave Rectifier : study of waveforms, determination of DC value of rectified wave	4

7.	Study of different types of logic gates – NOT, OR, AND, NAND, NOR and Ex-OR	4
8.	Verification of output of a logical expression using Basic gates/ NAND gates/NOR gates	2
9.	Soldering and de-soldering of electronic components on PCB	2
10.	Determination of forward and reverse bias characteristics of silicon diode	4
11.	Application of Zener diode as a basic voltage regulator	2

Self-study: NIL

Site/Industrial Visits: NIL

Course outcomes:
At the end of the course, the student will be able to:
CO1: Describe the basic semiconductor principles, working of p-n junction diode and transistors [L2] [PO1]
CO2: Demonstrate the operation of diodes in rectifiers, voltage regulator and clipper [L3] [PO1]
CO3: Explain the operation of bipolar junction transistor including the amplification and biasing [L2] [PO1, PO6]
CO4: Explain the operation and applications of Operational Amplifier [L2] [PO1]
CO5: Discuss conversions between binary, decimal, octal and hexadecimal number system [L2] [PO1]
CO6: Implement digital logic gates and its application as adders. [L3] [PO1, PO6]

Textbooks:
T1. David A. Bell, "Electronic Devices and Circuits" – Vth Edition, OUP, 2011
T2. N. P. Deshpande, "Electronic Devices and Circuits – Principles and Applications", TMH, 2017
T3. Robert L Boylestad& Louis Nashelsky, "Electronic Devices and Circuit Theory", 3rd Edition, 2015
T4. Morris Mano, "Digital Logic and Computer Design", PHI, EEE, 2014

Reference Books:
R1. Donald A. Neamen, "Electronic Circuits", 3rd Edition, TMH, 2017
R2. Thomas L. Floyd, "Electronic Devices", Seventh Edition, Pearson Education, 2012
R3. Albert Malvino, David. J. Bates, ―Electronic Principle, 8th Edition, Tata McGraw Hill, 2015

Online Resources:
NIL

Course Name: Computer Programming					
Course Code: CS134P / CS234P					
	L	**T**	**P**	Category	**ESC**
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**70**
Contact Hrs./Sem.	**45**	**0**	**30**	ESE Marks	**30**
Credits.	**3**	**0**	**1**	Exam Hours	**3**

Course objectives:
● To provide exposure to problem-solving through programming.
● To provide a basic exposition to the goals of programming
● To enable the student to apply these concepts in applications which involve perception, reasoning and learning.

Units	**Teaching Hours**
Unit-1 Algorithms and Flowcharts, Constants, Variables and Datatypes, Operators, Managing Input and Output Operations	
Algorithms and flowcharts: Algorithms, Flowcharts, Examples on algorithms and flowcharts. Basic structure of a C program, C Tokens, Data types. Declaration of variables. Operators: Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment and Decrement operators, Conditional operator, Bitwise operators, Special operators, Arithmetic expressions, Evaluation of expressions, Precedence of Arithmetic operators, Type conversions in expressions, Operator precedence and associatively. Managing input and output operations: Reading a character, writing a character, Formatted Input, Formatted Output	9
Unit-2 Decision Making and Branching, Looping	
Decision making and branching: Decision making with if statement, Simple if statement, The if…else statement, Nesting of if…else statements, The else … if ladder, The switch statement, The ?: operator, The Goto statement Looping: The while statement, The do statement, The for statement, Jumps in Loops	9
Unit-3 Arrays, User Defined Functions	
Arrays: One-dimensional Arrays, Declaration of one-dimensional Arrays, Initialization of one-dimensional Arrays, Two-dimensional Arrays, Initializing two-dimensional Arrays. User-defined functions: Need for User-defined Functions, A multi-function Program, Elements of user - defined Functions, Definition of Functions, Return Values and their types, Function Calls, Function Declaration, Category of Functions, No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Returns a Value, Functions that Return Multiple Value, recursion –recursive functions, Limitations of recursion.	9
Unit-4 Pointers	

Understanding the pointers, Accessing the Address of a Variable, Declaring Pointer Variables, Initialization of Pointer Variables, accessing a Variable through its Pointer, Pointer Expressions, Pointer Increments and Scale Factor, Pointers and Arrays, Pointers and Character Strings, Pointers as Function Arguments.	9
Unit-5 Strings, Derived Types, Files	
Strings: String concepts: declaration and initialization, String I/O functions, Array of strings, String manipulation function, Structure: Basic of structures, structures and Functions, Arrays of structures, structure Data types, type definition. Files: Defining, opening and closing of files, Input and output operations, Standard Library Functions for Files	9
PRACTICALS	
List of Experiments:	**Practical Hours**
1. To understand and realize the use of C tokens, Keywords and Identifiers, Variables, Data types, Declaration of variables, using operators, I/O functions.	**4**
2. To understand and implement concepts of Decision-making statements.	**4**
3. To understand and implement concepts looping statements.	**6**
4. To understand and implement concepts of Arrays.	**4**
5. To understand and implement concepts of Pointers	**4**
6. To understand and implement concepts of User defined functions.	**4**
7. To understand and implement concepts of Strings and Structures.	**4**
Self-study: NA	
Site/Industrial Visits: NA	
Course outcomes: CO1: Solve problems using flowchart and algorithm. (Applying, PO1, PO3) CO2: Exhibit the concept of looping and decision-making statements to solve problems. (Applying, PO1, PO3) CO3: Demonstrate different Operations on arrays and user defined functions. (Applying, PO1, PO3) CO4: Illustrate the appropriate use of pointers. (Applying, PO1, PO3) CO5: Illustrate the appropriate use of strings, files, structures to solve real time problems. (Applying, PO1, PO3)	
Text Books: T1. Deitel and Deitel, "C How to Program", Prentice Hall 2010 (Reprint). T2. Herbert Schildt, " C++ : The Complete Reference", McGraw - Hill Osborne Media; 3rd edition 2012 (Reprint). T3. YashvantKanetkar, “Let Us C 13E”, BPB Publications – 13th Edition, 2013.	

Reference Books: R1. Shelly and Junt, “Computers and Commonsense”, 4th edition, Prentice Hall of India, 2010 (Reprint). R2. Dennis P. Curtin, Kim Foley, Kunal Sen, Cathleen Morin, “Information Technology: The Breaking wave”, Tata MC GrawHill Companies, 2010 (Reprint). R3. Peter Norton, “Introduction to Computers”, 2011 (Reprint).
Online Resources: W1.V. K. Myalapalli, J. K. Myalapalli and P. R. Savarapu, "High performance C programming," 2015 International Conference on Pervasive Computing (ICPC), Pune, 2015, pp. 1-6 W2. https://users.ece.cmu.edu/~eno/coding/CCodingStandard.html W3. https://www.w3resource.com/c-programming-exercises/

<table>
<tr><td colspan="6">Course Name: Basic Mechanical Engineering and Nanoscience</td></tr>
<tr><td colspan="6">Course Code: ME135/ME235</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>ESC</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives:
1. To elucidate and critically demonstrate the Energy sources and basic thermodynamic concepts behind energy transfer.
2. To distinguish and elaborate the different types of prime movers.
3. To describe the functioning of refrigeration and air-conditioning.
4. To evaluate and apply the concepts of nanoscience in real engineering applications.
5. To demonstrate and apply the process of machining and metal joining in basic applications.</td></tr>
<tr><td colspan="6">Prerequisites: Nil</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 Energy Resources, Thermodynamics and Heat transfer</td></tr>
<tr><td colspan="5">Energy Resources
Conventional Energy resources- Fossil fuel and nuclear fuel, Merits and demerits.
Non-conventional energy sources- Solar, Wind, hydraulic, Ocean-thermal, Geo-thermal, Tidal energy and biomass energy plants working principle.
Thermodynamics
Basic terms: State, path, process (reversible and irreversible), and cycle, System, surroundings and boundary. Closed system, Open system and Isolated Systems.
Laws of Thermodynamics (statements and brief description). Heat engine and Heat pump (Definition).
Heat Transfer
Modes of Heat transfer and their basic governing equations. Heat exchangers-types.
Fins – types and applications.</td><td>12</td></tr>
<tr><td colspan="6">Unit-2 I.C. Engine and Turbines</td></tr>
</table>

I.C. Engines Classification, I.C. Engines parts and their function, working of 2 Stroke and 4 stroke engines. Basic terms - Indicated power, brake power frictional power, thermal efficiency, mechanical efficiency (simple problems). **Steam Generators** Boilers, fire and water tube boilers (Lancashire and Babcock and Will Cox boiler-working with simple sketches). **Steam turbines** Classifications, Principle of operation of Impulse and reaction turbines. **Gas Turbines** Open cycle and closed cycle gas turbines working principle. **Water Turbines** Classification, working principle of Pelton wheel, Francis turbine and Kaplan turbine.	10
Unit-3 Refrigeration and Air-conditioning	
Refrigeration Types of refrigerants and properties of good refrigerant, Refrigerating effect and unit of Refrigeration (definition). Working principle of vapour Compression refrigeration and vapour absorption refrigeration (with sketch). Applications areas of refrigeration system. **Air Conditioning** Definition, types, Room air-conditioning working principle (with sketch), Applications.	6
Unit-4 Introduction to Nanotechnology	
Introduction to Nanotechnology Introduction to about Nanomaterials, characterization of nanomaterials-SEM, XRD, AFM and Mechanical properties, Advantages, limitations and applications of Nanomaterials.	7
Unit-5 Machine tools and Metal joining processes	
Machine tools Lathe Machine-Types, Parts and different operations like-turning, facing, grooving, parting off, taper turning, and threading (simple sketch) Drilling Machine-Types, Parts and different operations like-drilling, reaming, boring, counter boring, counter sinking and tapping (simple sketch). Milling Machine-Up milling, down milling, Plane milling, End milling, Slot milling and gear cutting (sketches only for following operations) **Metal joining** Definitions, classification of soldering, Brazing and welding. Differences between soldering, brazing and Welding. Description of Electric Arc welding and Oxy-Acetylene gas welding (Simple sketch).	10
Self-study: Unit-1: Distillation process of crude oil, Harnessing of Ocean-thermal Energy. Unit-2: 4 Stroke Diesel Engine, 2 Stroke petrol engine, Water turbines. Unit-3: Office air-conditioning systems. Unit-4: TEM, UTM techniques for characterization of Nanomaterials. Unit-5: Trepanning operation, Vertical milling machine, brazing and soldering applications.	

Site/Industrial Visits:
1. Heat Transfer Lab.
2. Fluid mechanics and Machinery Lab.
3. Metal Cutting Lab.
4. I.C. Engine Lab.

Course outcomes:
The students will be able to
CO1: Classify the energy resources and state the basic laws of the thermodynamics and illustrate with an example modes of heat transfer. [L1, L2] [PO1, PO2].
CO2: List the types of I.C. Engines and turbines, discuss the working principle of I.C. engines and turbines. [L1, L3] [PO1, PO2, PO3].
CO3: Define the terms refrigeration and air-conditioning, identify their application areas. [L1, L2, L3] [PO1, PO2, PO3].
CO4: Explain the fundamental concept of nanotechnology and describe the characterization methods for nanomaterials. [L1, L2] [PO1, PO2].
CO5: Summarize the operations performed by using machine tools and distinguish between
welding soldering and brazing process. [L1, L2, L4] [PO1, PO2, PO3, PO4].

Textbooks:
T1. K.R. Gopalkrishna, "A Textbook of Elements of Mechanical Engineering", Subhash Publishers, Bangalore, 2008.
T2. S. Trymbaka Murthy, "A Text Book of Elements of Mechanical Engineering", 3rd revised edition, I.K. International Publishing House Pvt. Ltd., New Delhi. 2010.
T3. P.K. Nag, "Engineering Thermodynamics" Tata McGraw-Hill Education, 2005.
T4. B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, "Nano Science and Nano Technology ", University Press IIM, 2002.

Reference Books:
R1. Dr. R. P. Reddy, "Elements of Mechanical Engineering", 1st Edition, Himalaya Publishing House, New Delhi, 2012.
R2. Hajra Choudhury S K, "Elements of Workshop Technology" 13th Edition, Volume 1, Machine Tools, India Book Distributing Company Calcutta, 2010.
R3. Hajra Choudhury S K, "Elements of Workshop Technology" 13th Edition, Volume 2, Machine Tools, India Book Distributing Company Calcutta, 2012.
R4. Charles P. Poole and Frank J. Owens, "Introduction to Nanotechnology", Wiley India Edition, 2012.

Online Resources:
W1. http://www.hds.bme.hu/letoltesek/targyak/BMEGEVGAG01_ENG/ime.pdf
W2. http://www.nptel.ac.in/downloads/112108148.

<table>
<tr><td colspan="6">Course Name: Technical English</td></tr>
<tr><td colspan="6">Course Code: TE136P / TE236P</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>HSMC</td></tr>
<tr><td>Contact Hrs./Week</td><td>1</td><td>0</td><td>2</td><td>CIA Marks</td><td>25</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>15</td><td>0</td><td>30</td><td>ESE Marks</td><td>25</td></tr>
<tr><td>Credits.</td><td>1</td><td>0</td><td>1</td><td>Exam Hours</td><td>2</td></tr>
<tr><td colspan="6">Course objectives: Upon Successful completion of this course, the student will have reliably demonstrated the ability to respond effectively, efficiently, and appropriately to writing in ways that demonstrate comprehension and evaluation of its purpose and meaning.</td></tr>
<tr><td colspan="6">Prerequisites: NIL</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 Vocabulary Building</td></tr>
<tr><td colspan="5">Concept of word formation, synonyms, antonyms, homophones, prefixes and suffixes, Misused and confused words.</td><td>8</td></tr>
<tr><td colspan="6">Unit-2 Basic Writing Skills</td></tr>
<tr><td colspan="5">Sentence structure, parts of speech, Fragments, Run-on errors, Phrases and clauses, Misplaced and Dangling modifiers, Structure of paragraphs Techniques of writing precisely.</td><td>8</td></tr>
<tr><td colspan="6">Unit-3 Identifying Common Errors in Writing</td></tr>
<tr><td colspan="5">Subject verb agreement(concord), articles, prepositions, Tenses, Redundancies, cliché's, Misused and confused words</td><td>9</td></tr>
<tr><td colspan="6">Unit-4 Essay Writing (Lang. Lab)</td></tr>
<tr><td colspan="5">ESSAY WRITING (Lang. Lab), Structure of an Academic essay, writing introduction, thesis statement, writing body paragraphs , writing concluding paragraph, unity, support, coherence and sentence skills , Different types of essay.</td><td>10</td></tr>
<tr><td colspan="6">Unit-5 Oral Communication</td></tr>
<tr><td colspan="5">(Interactive practical sessions in lang. lab), listening comprehensions, pronunciation, intonation, stress and rhythm, interview and formal presentation skills.</td><td>10</td></tr>
<tr><td colspan="6">Self-study: NA</td></tr>
<tr><td colspan="6">Site/Industrial Visits: NA</td></tr>
</table>

Course outcomes: At the end of the course, the student will be able to: CO1: acquire basic proficiency in all the English language skills: reading, listening comprehension, writing and speaking {Level} {PO} CO2: have a better understanding of the Mechanics of English language {Level} {PO} CO3: make an organized, and well-prepared oral presentation to meet the needs of individuals and small groups. {Level} {PO} CO4: write good academic essays {Level} {PO} CO5: take part in group discussions with a better speaking skill. {Level} {PO}
Textbooks: T1. Practical English Usage. Michael Swan. OUP. 1995 T2. Remedial English Grammar. F.T. Wood. Macmillan.2007
Reference Books: R1 On Writing Well. William Zinsser. Harper Resource Book. 2001 R2. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006. R3. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011. R4. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
Online Resources: NIL

Course Name: Workshop Practice					
Course Code: ME151 / ME251					
	L	**T**	**P**	Category	**ESC**
Contact Hrs./Week	**0**	**0**	**2**	CIA Marks	**25**
Contact Hrs./Sem.	**0**	**0**	**30**	ESE Marks	**25**
Credits.	**0**	**0**	**1**	Exam Hours	**2**
Course objectives: To provide the students with the hands-on experience on different trades of engineering like fitting, welding, carpentary & sheet metal.					

PRACTICALS	
List of Experiments:	**Practical Hours**
1. Safety Precautions and description of workshop tools and equipments.	1
2. Study of fitting tools and equipments.	2
3. Demonstrate and make a square fitting model.	4
4. Demonstrate and make a V fitting model.	2
5. Demonstrate and make a dovetail fitting model.	4
6. Study of electric arc welding tools and equipments.	1
7. Demonstrate and make a Butt Joint welding model.	2
8. Demonstrate and make a Lap Joint welding model.	2
9. Demonstrate and make a T-Joint welding model.	2
10. Demonstrate and make a L-Joint welding model.	2
11. Study of sheet metal tools and equipments.	1
12. Demonstrate and make a rectangular tray.	2
13. Study and demonstration of Carpentry tools, joints and operations.	1
14. Study and demonstration of MIG welding.	2
15. Study and demonstration of TIG welding.	2
Self-study: NA	
Site/Industrial Visits: NA	

Course outcomes: CO1: Demonstrate an understanding of and comply with workshop safety regulations. {L1,L2} {PO1,PO2, PO7, PO10} CO2: Select and perform a range of machining operations to produce a given project. {L1,L2,L3} {PO1,PO6,PO7,PO9,PO10} CO3: Identify and use marking out tools, handtools, measuring equipment and to work to prescribed tolerances. {L1, L2, L3} {PO1, PO2,PO6,PO9,PO10} CO4: Demonstrate a knowledge of welding process selection and capabilities. {L2, L3} {PO1, PO2,PO7,PO9,PO10} CO5: Demonstrate a knowledge of welding, joint design and the application of welding. {L2, L3, L4} {PO1, PO2, PO6, PO7, PO9, PO10}
Textbooks: T1. S. K. H. Choudhury, A. K. H. Choudhury, Nirjhar Roy, “The Elements of Workshop Technology”, Vol 1 & 2, Media Propoters and Publishers, Mumbai, 2018.
Reference Books: R1. P. Kannaiah and K.L. Narayana, “Manual on Workshop Practice”, Scitech Publications, (1999). R2. T Jeyapoovan, “Engineering Practices Lab - Basic Workshop Practice Manual,” ISBN: 81-259-1800-0 R3. H.S.Bawa, “Workshop Practice”, Tata McGraw Hill Publishing Company Limited, (2007)
Online Resources: W1. https://nptel.ac.in/noc/ W2. http://ecoursesonline.iasri.res.in

SEMESTER –II

<table>
<tr><td colspan="6" align="center">Course Name: Mathematics – II</td></tr>
<tr><td colspan="6" align="center">Course Code: MA231</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td align="right">Category</td><td>BSC</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td align="right">CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td align="right">ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td align="right">Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: Mathematics is a necessary avenue to scientific knowledge which opens new vistas of mental activity. A sound knowledge of engineering Mathematics is a ‘sine qua non’ for the modern engineer to attain new heights in all aspects of engineering practice. This course provides the student with plentiful opportunities to work with and apply the concepts, and to build skills and experience in mathematical reasoning and engineering problem solving. At the end of this course, the students will
be introduced to the tools of integration of multivariate functions over areas and volumes.
learn the technique of multidimensional change of variables to transform the coordinates over which integration proceeds by utilizing Jacobian. Specifically, students will learn how to transform between an integral over an area or volume in Cartesian coordinates to polar coordinates.
be able to solve higher order homogenous/ non-homogenous linear differential equations with constant coefficients
be able to solve Cauchy’s and Legendre’s equations.
learn the fundamental vector calculus integral theorems of Green, Stokes’ and Divergence. Students will also learn how these theorems represent conservation principles for physical vector fields important in gravitation and electric fields.
be able to perform operations with Laplace and inverse Laplace transforms to solve higher order differential equations</td></tr>
<tr><td colspan="6">Prerequisites: Nil</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 Differential Calculus – II</td></tr>
<tr><td colspan="5">Polar curves and angle between Polar curves. Pedal equations of polar curves, Radius of curvature – Cartesian, parametric, polar and pedal forms.</td><td>8</td></tr>
<tr><td colspan="6">Unit-2 Integral Calculus – II</td></tr>
</table>

Double integrals, Cartesian and polar co – ordinates, change of order of integration, change of variables between cartesian and polar co – ordinates, triple integration, area as a double integral, volume as a triple integral	**14**
Unit-3 Differential Equations – II	
Linear differential equations of second and higher order with constant coefficients. Method of variation of parameters. Legendre'a and Cauchy's homogeneous differential equations.	**10**
Unit-4 Laplace Transforms	
Definition - Transforms of elementary functions – Properties, Derivatives and integrals of transforms- Problems. Periodic function. Unit step function and unit impulse function, Inverse transforms, Solutions of linear differential equations.	**10**
Unit-5 Vector Calculus – II	
Vector Integration - Green's theorem in a plane, Gauss's divergence theorems, Stoke's, (without proof) and simple application.	**7**
Self-study: NA	
Site/Industrial Visits: NA	
Course outcomes: CO1: Find the angle between the polar curves and radius of curvature by applying differentiation {Level} {PO} CO2: Calculate the area and volume of solids using double and triple integration. {Level} {PO} CO3: Solve linear differential equations of higher order by using inverse differential operator, Method of undetermined coefficients and variation of parameters. {Level} {PO} CO4: Solve initial value problems using Laplace Transforms method {Level} {PO} CO5: Establish the relation between the line and surface integral, surface and volume integral using Green's, Stoke's and Gauss Divergence theorem {Level} {PO}	
Textbooks: T1. Dr. B. S. Grewal, "Higher Engineering Mathematics", 39th Edition, Khanna Publishers, July 2005. T2. H. K. Das & Rajnish Verma, "Higher Engineering Mathematics", S. Chand & Company Ltd., 2011.	

Reference Books:
R1. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, 2005
R2. Thomas and Finney, "Calculus", 9th Edition, Pearson Education, 2004
R3. Peter V. O'Neil, "Advanced Engineering Mathematics", Thomson Publication, Canada, 2007
R4. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw – Hill, 2009.
R5. George F. Simmons and Steven G. Krantz, "Differential Equation, Theory, Technique and Practice", Tata McGraw – Hill, 2006.
R6. M. D. Raisinghania, "Ordinary and Partial Differential Equation", Chand (S.) & Co. Ltd., India, March 17, 2005.
R7. Paras Ram, "Engineering Mathematics through Applications", 1st Edition, CBS Publisher, 2011.

Online Resources:
NIL

Course Name: Physics					
Course Code: PH132P / PH232P					
	L	**T**	**P**	Category	**BSC**
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**70**
Contact Hrs./Sem.	**45**	**0**	**15**	ESE Marks	**30**
Credits.	**3**	**0**	**1**	Exam Hours	**3 hrs**

Course objectives: This paper contains five UNITS which are Modern Physics, Quantum Mechanics, Conductivity in Metals (Electrical and Thermal), Elastic, Dielectric and Optical Properties of Materials, Lasers, Optical Fibers.
At the end of the course, the students would be able to
- Identify the fundamental aspects of modern physics and quantum mechanics.
- Compare classical and quantum free electron theory.
- Outline the salient properties of elastic and dielectric materials.
- Apply the concepts learnt in Laser, Fiber optics in the field of Engineering.
- Apply optical phenomenon in technology.

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1 Modern Physics	

Introduction, Planck's theory - Deduction of Wien's displacement law and Rayleigh Jean's law from Planck's law, Compton effect, de Broglie hypothesis – extension to electron particle. Phase velocity, group velocity, expression for group velocity based on superposition of waves, relation between group velocity and particle velocity. Problems.	**09**
Unit-2 Quantum Mechanics	
Heisenberg's uncertainty principle and its physical significance. Application of uncertainty principle (Non-existence of electron in the nucleus). Wave function. Properties and Physical significance of a wave function Schrodinger - Time independent wave equation – Application: Setting up of a one-dimensional Schrödinger wave equation of a particle in a potential well of infinite depth: Probability density and Normalization of wave function – Energy Eigen values and Eigen function. Problems.	**09**
Unit-3 Electrical and Thermal Conductivities of metals	
Classical free-electron theory. Introduction, assumptions and limitation of classical free-electron theory. Thermal Conductivity. Wiedemann - Franz law, calculation of Lorentz number. **Quantum free-electron theory** – Postulates of quantum fee electron theory, Fermi - Dirac Statistics. Fermi-energy – Fermi factor. Density of states. Carrier concentration in metals. Expression for electrical resistivity/conductivity - Merits of Quantum free electron theory. Problems.	**10**
Unit-4 Materials Science	
Elasticity: Introduction - Bending of beams – Single Cantilever – Application of Cantilever in AFM, Young's Modulus-Non uniform bending. Problems. **Dielectrics:** Dielectric constant and polarisation of dielectric materials. Types of polarisation. Equation for internal fields in liquids and solids (one dimensional). Clausius – Mossotti equation. Ferro and Piezo – electricity(qualitative). Frequency dependence of dielectric constant. Important applications of dielectric materials. Problems.	**09**
Unit-5 Applied Optics	
Lasers: Principle and production. Einstein's coefficients (expression for energy density). Requisites of a Laser system. Condition for Laser action. Principle, Construction and working of He-Ne and semiconductor diode Laser. Applications of Laser – Laser welding, cutting and drilling. Measurement of atmospheric pollutants. Problems. **Optical Fibers:** Introduction, Principle and Propagation of light in optical fibers. Angle of acceptance. Numerical aperture. Types of optical fibers and modes of propagation. Applications –optical fiber communication system. Problems.	**08**
PRACTICALS	

List of Experiments:	Practical Hours
PART – A	
1. Basic Measuring Instruments • Vernier Callipers • Screw Gauge • Travelling Microscope	02
2. Verification of Stefan's law	01
3. Planck's Constant (Determination of Planck's constant using LED or using the principle of photoelectric effect)	01
4. Determination of Fermi energy.	01
5. Young's modulus – Non-uniform bending.	01
6. Measurement of Dielectric Constant (Charging & discharging of capacitor).	02
7. Ultrasonic Interferometer.	01
8. Interference at a wedge.	02
9. Laser Diffraction (Determination of grating constant and number of rulings per inch using diffraction grating).	01
10. Frequency determination – Melde's apparatus	02
11. Photo Multiplier Tube – Demonstration only	**01**

Course outcomes:

1. To outline the principles of Classical Physics and Modern Physics.
2. To classify the materials according to the theories of Quantum Physics.
3. To apply the principles of Physics to solve the problems in different relevant topics.
4. To analyze different materials for various scientific applications.
5. To apply the principles of optics in the field of LASERS and Optical Fiber.
6. To evaluate the theories of quantum mechanics in various fields of LASERS, Materials sciences and future engineering applications.

Mapping with Program Outcomes:

Text Books:

T1. M.N. Avadhanulu and P.G. Kshirsagar, “A Text Book of Engineering Physics”, S.Chand & Company Ltd, 9th Edition 2012.

T2. John Wiley “Engineering Physics”, Wiley India Pvt. Ltd, 1st Edition 2014.

T3. S.O. Pillai, “Solid State Physics”, New Age International, 6th Edition 2009.

T4. S.P. Basavaraju, “Engineering Physics”, Revised Edition 2009.

T5. Charles Kittel, “Introduction to Solid State Physics” , 8th Edition.

T6. Arthur Beiser, “Concepts of Modern Physics” , Special Indian Edition 2009.

T7. Ajoy Ghatak, “Optics”,4th Edition 2009

Reference Books:

R1. R.K. Gaur and S.L. Gupta, "Engineering Physics", Dhanpatrai and Sons, New Delhi, 2001.

R2. Sehgal Chopra Sehgal, “Modern Physics ", Tata McGraw-Hill, 6th Edition, 2005.

R3. Halliday, Resnick and Krane, "Fundamentals of Physics Extended", John Wiley and Sons Inc., New York, 5th Edition, 1997.

R4. P. Mani, “Engineering Physics”, Dhanam publishers, Revised Edition 2011.

R5. H.J. Sawant, "Engineering Physics", Technical Publications, 1st Edition, 2010.

R6. V. Rajendran, “Engineering Physics”, Tata Mcgraw Hill Publishing Company Limited, 1st Edition, 2009.

R7. K. Eric Drexler, “Nanosystems - Molecular Machinery, Manufacturing and Computation”, John Wiely & Sons, 2005.

R8. J David, N Cheeke, “Fundamentals and Applications of Ultrasonic Waves”, CRC Press 1st Edition, 2002.

R9. Frederick J Bueche and Eugene Hecht “Schaum Outline of Theory and Problems of College Physics”, Tata McGraw-Hill, 11th Edition, 2012.

R10. M. Ali Omar, “Elementary Solid-State Physics”, Addison-Wesley 1st Edition, 1993.

Online Resources:

W1. https://en.wikipedia.org/wiki/Laser

W2. https://en.wikipedia.org/wiki/Ultrasound

W3. https://en.wikipedia.org/wiki/Optical_fiber

Course Name: Basic Electrical Engineering					
Course Code: EE133P /EE233P					
	L	**T**	**P**	Category	ESC
Contact Hrs./Week	**3**	**0**	**2**	CIA Marks	**70**
Contact Hrs./Sem.	**45**	**0**	**24**	ESE Marks	**30**
Credits.	**3**	**0**	**1**	Exam Hours	**3**

Course objectives: This course is aimed to solve and analyse DC and AC networks. It also covers the fundamental principles of alternator, transformer, motors, renewable energy systems and power converters. It also emphasise the concepts in smart grid and electrical vehicles to cope up with current trends in electrical engineering.

Prerequisites: NA

Units	**Teaching Hours**
Unit-1: DC circuits	
Basic electrical quantities, KCL, KVL, voltage and current division rules, circuit reduction using series, parallel and star-delta transformation of resistors. Superposition theorem, Thevenin's theorem, Source transformations- Electromagnetism- Faraday's laws, comparison of electric and magnetic circuits.	9
Unit-2: AC circuits	
Comparison of DC and AC, Generation of sinusoidal signal, Representation of AC, inductance and capacitance, behaviour of pure R, L and C in AC circuits, RL, RC and RLC series circuits- derivations, phasor diagrams, real power, reactive power, power factor and resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.	9
Unit-3: Power System Components	
Power system components-overview, Alternator-construction, working and generated voltage equation, Transformer – types, construction, working, emf equation, voltage regulation and efficiency, Switchgears (Fuse, MCB, relay), earthing, electric safety, standards and best practices. DC Motor- construction and working, torque and speed equations of shunt motors, Single phase induction motors - construction and working, BLDC motor and its applications in e-mobility.	9
Unit-4: Power Converters and Renewable Energy	
Power supplies and converters, SCR as a switch single phase rectifiers and inverters, DC power supply. Solar standalone system and its characteristics, Solar PV grid tied system description, Wind energy systems- types, types of renewable systems- stand alone, grid tied systems and hybrid and micro-grids.	9

Unit-5: Smart Grid and Electric Vehicles	
Introduction to smart grid, Home automation systems, Application of IoT in electrical systems, smart meters, communication systems in electrical systems, Artificial intelligence in power system. Introduction to electric vehicles- building blocks, charging stations. Different types of batteries and terminologies and BMS applications.	9
PRACTICALS	
List of Experiments:	**Practical Hours**
12. Verification of superposition theorem	2
13. Wiring practice – multiple switching and two way switching	2
14. Phase angle measurement in R, RL and RLC circuits	2
15. Energy measurement in single phase circuits – with R and RL loads	2
16. Power factor improvement	2
17. Regulation and efficiency of single phase transformer.	2
18. Speed – torque characteristics of a DC shunt motor	2
19. Speed – torque characteristics of single phase induction motor	2
20. Characteristics of solar PV modules	2
21. Electrical appliances control using Arduino	2
22. Variable DC voltage using DC-DC converter (Demonstration)	2
23. Power circuit control using relay and a contactor. (Demonstration)	2
Self-study: NA	
Site/Industrial Visits: NA	
Course outcomes: CO1: To solve DC networks CO2: To solve AC networks CO3: To understand working modes of alternator, transformer and motors CO4: To understand renewable energy systems and power converters CO5: To illustrate concepts smart grid and electrical vehicles	

Text Books:

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. V K. Mehta, Vivek Mehta, “Principles of Power System”, S. Chand, 2005, reprint 2015.
3. D. P. Kothari and K C. Singal, “Renewable Energy Sources and Emerging Technologies”, PHI, 2011.
4. James Larminie, John Lowry, ‘Electric Vehicle Technology Explained’, Wiley , 2015.

Reference Books:

1.Weedy, Cory, Ekanayake, 'Electric Power Systems', John Wiley & Sons; 5th edition, 2012.
2.Hina Fathima (Editor), 'Hybrid-Renewable Energy Systems in Microgrids: Integration, Developments and Control', Woodhead Publishing Series in Energy, 2018.
3.Nikos Hatziargyriou, 'Microgrids: Architectures and Control', Wiley, 2014
4.D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.

Online Resources:

W1. https://nptel.ac.in/courses/108108076/
W2. https://nptel.ac.in/downloads/108105053/

Course Name: Basics of Civil Engineering and Engineering Mechanics					
Course Code: CE134P / CE234P					
	L	**T**	**P**	**Category**	**ESC**
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	**3**

Course objectives:

- The students will understand the basics of civil engineering and Engineering Mechanics
- The students will understand the basic principles and laws of forces of nature, measurements, calculations and SI units.
- The students will understand mechanics that studies the effects of forces and moments acting on rigid bodies that are either at rest or moving with constant velocity along a straight path for static condition only.
- The students will understand the basic concepts of forces in the member, centroid, moment of inertia and Kinetics of bodies.

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1	

Introduction to Civil Engineering Scope of different fields of Civil Engineering: Surveying, Building Materials, Construction Technology, Structural Engineering, Geotechnical Engineering, Environmental Engineering, Hydraulics, Water Resources Engineering, Transportation Engineering. Role of Civil Engineers in Infrastructure Development. **Introduction to Engineering Mechanics** Basic idealizations-Particle, Continuum, Rigid body and Point force, Newtons laws of motion. Force, classification of force systems, Principle of Physical Independence of forces, Principle of Superposition of forces and Principle of Transmissibilty of forces, Moment, Couple and its characteristics. Composition and resolution of forces, Paralleologram Law of forces, Polygon law. Resultant of coplanar concurrent force systems.	9
Unit-2	
Composition of Coplanar Concurrent and Non Concurrent Force System. Resultant of coplanar concurrent force systems. Varignon's Theorem, Resultant of coplanar non concurrent force systems. **Equilibrium of force systems** Free body Diagram, Lami's Theorem, Equations of Equilibrium, Equilibrium of coplanar concurrent forces. **Support Reactions** Types of loads and supports, Types of beams, Statically determinate and indeterminate beams, Support Reactions in beams, Numerical Problems on support reactions for statically determinate beams (point load, Uniformly distributed load, Uniformly varying load and moments).	9
Unit-3	
Centroid and Moment of inertia Definition of centroid and centre of gravity, Centroid of simple plane figures and built-up sections. Moment of inertia / Second Moment of area, Parallel axis theorem and Perpendicular axis theorem, Moment of Inertia of composite areas, Polar Moment of inertia and radius of gyration.	9
Unit-4 Virtual Work and Energy Method	
Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.	9
Unit-5 Kinematics	
Definitions, Displacement, Average velocity, Instantaneous Velocity, Speed, Acceleration, Average Acceleration, Variable Acceleration, Acceleration due to gravity. Types of motion-Rectilinear, Curvilinear and Projectile motion. Relative motion and Motion under Gravity, Numerical Problems. Kinetics: D Alemberts Principle and its application in Plane motion.	9
PRACTICALS	

List of Experiments :	Practical Hours
1.To determine moisture content of fine Aggregates.	2
2.Sieve Analysis of Fine Aggregates.	2
3.Determination of Compressive Strength of Burnt Clay Bricks.	2
4. Determination of Fineness of Cement.	2
5. Setting out of rectangle in the field.	2
6. Setting out of polygon in the field.	2
7. To Verify the Polygon Law of Forces Using Universal Force Table.	2
8. To Verify Parallelogram Law of Forces Using Grave Sand's Apparatus.	2
9. To Determine Weight of Body Using Grave Sand's Apparatus.	2
10. To Verify Triangular law of Forces using Jib Crane Apparatus.	2
11. To determine the reactions for simply supported beam Using Parallel Force Apparatus.	2
12. To determine the center of gravity Using Parallel Force Apparatus.	2
Self-study: NA	
Site/Industrial Visits: Nil	

Course outcomes: After a successful completion of the course, the student will be able to:
CO1: Understand basics of Civil Engineering, its scope of study and materials of construction. (L1)(PO1)(PSO1)
CO2: Comprehend the action of Forces, Moments and other loads on systems of rigid bodies and Compute the reactive forces and the effects that develop as a result of the external loads. (L3) (PO1,PO2)(PSO2)
CO3: Compute Centroid and Moment of Inertia of regular and built up sections. (L3)(PO1)(PSO1)
CO4: Understand basic concepts of virtual work and energy method for a particle and rigid body (L2) (PO1, PO2, PSO1)
CO5: Express the relationship between the motion of bodies and equipped to pursue studies in allied courses in Mechanics. (L3) (PO1, PO2) (PSO1)

Textbooks:
T1. Bhavikatti S.S. *Elements of Civil Engineering*, 4th Edition and *Engineering Mechanics* ,2nd edition, New Delhi, Vikas Publishing House Pvt. Ltd, 2008.
T2. Shesh Prakash and Mogaveer, Elements *of Civil Engineering and Engineering Mechanics*, 1st edition, New Delhi, PHI learning Private Limited,2009.
T3. Jagadeesh T.R. and Jay Ram, *Elements of Civil Engineering and Engineering Mechanics*, 2nd edition, Bangalore, Sapana Book House, 2008.

Reference Books:

R1. Timoshenko, and Young, Engineering Mechanics, Tata McGraw-Hill, New Delhi, 2013.
R2. Meriam J. L, and Kraige, L. G, Engineering Mechanics, 5/E, Volume I, Wiley India Edition, India, Feburary 2018
R3. Irvingh H Shames, Engineering Mechanics, 4/E, PHI learning Private Limited, New Delhi, 2008
R4. Ferdinand P. Beer and E. Russel Johnston Jr., Mechanics for Engineers: Statics, McGraw-Hill Book Company, New Delhi. International Edition 2013
R5. Bansal R. K, Engineering Mechanics, Laxmi Publications (P) Ltd, New Delhi, 2015
Goyal and Raghuvanshi, Engineering Mechanics, New Edition, PHI learning Private Limited, New Delhi. 2011
R6. Rajasekaran, S, Sankarasubramanian, G., Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt., Ltd., 2011.
R6. Kukreja C.B., Kishore K. Ravi Chawla., Material Testing Laboratory Manual, Standard Publishers & Distributors 1996.
R7. Gambhir M.L., Concrete Manual, Dhanpat Rai & Sons, New Delhi, 2014
Duggal S.K., Surveying, Vol-I, Tata McGraw Hill - Publishing Co. Ltd. New Delhi.
R8. Punmia. B.C., Surveying Vol–1, Laxmi Publications, New Delhi.

Online Resources:

W1.https://nptel.ac.in/courses/112103109/
W2. https://nptel.ac.in/courses/122104015/

Course Name: Engineering Graphics					
Course Code: EG135P / EG235P					
	L	**T**	**P**	Category	**ESC**
Contact Hrs./Week	**2**	**0**	**2**	CIA Marks	**50**
Contact Hrs./Sem.	**30**	**0**	**30**	ESE Marks	**50**
Credits.	**2**	**0**	**1**	Exam Hours	**3**

Course objectives:

- To create an awareness and emphasise the need for Engineering Graphics.
- To teach basic drawing standards and conventions.
- To develop skills in three-dimensional visualization of engineering components.
- To develop an understanding of 2D and 3D drawings using the Solidworks software

Prerequisites: Nil	
Units	**Teaching Hours**
Unit-1 Introduction to Engineering Drawing& Orthographic Projections	
Introduction to Engineering Drawing Principles of Engineering Graphics and their significance, usage of Drawing instruments, BIS conventions, lettering, Scales – Plain, Diagonal and Vernier Scales. **Orthographic Projections (First Angle Projection Only)** Principles of orthographic projections, introduction to first angle and third angle projection, projections of points, lines (inclined to both planes) and planes. (No application problems)	**14**
Unit-2 Introduction of Computer Aided Engineering Drawing	
Introduction of Computer Aided Engineering Drawing (CAED) Introduction and customization of user interface consisting of set up of the drawing page and the printer, including scale settings, setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning, orthographic constraints, snap to objects manually and automatically, producing drawings by using various coordinate input entry methods to draw straight lines, applying various ways of drawing circles. Annotations, layering & other functions covering applying dimensions to objects, applying annotations to drawings, setting up and use of layers, layers to create drawings, create, edit and use customized layers, changing line lengths through modifying existing lines.	**2**
Unit-3 Projections of Regular Solids &Sections of solids	
Projections of Regular Solids Projection of solids inclined to both the Planes, draw simple annotation, dimensioning and scale (both manual and CAD software). **Sections of solids** Sections and sectional views of right angular solids - Prism, Cylinder, Pyramid, Cone– Auxiliary Views; (both manual and CAD software).	**20**
Unit-4 Development of surfaces & Isometric Projections	
Development of surfaces Development of surfaces of right regular solids - prism, pyramid, cylinder and cone; draw the sectional orthographic views of geometrical solids. **Isometric Projections** Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of simple and compound Solids, conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.	**20**
Unit-5 Overview of Computer Graphics & Introduction to Modeling and Assembly	

Overview of Computer Graphics Demonstrating knowledge of the theory of CAD software: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Projection of solids, Isometric of Simple and compound Solids, sections of solids and development of surfaces. **Introduction to Modeling and Assembly** Introduction to Computer aided modeling of solid part and assembly using CAD software Parametric and non-parametric solid and wireframe models, part editing and 2D drafting of assembly.	**20**
Self-study: Three Modeling of Simple Machine Parts	
Site/Industrial Visits: Nil	
Course outcomes: CO1: Understand the importance of BIS standards and scales and be able to use it in Engineering drawings and be Able to graphically construct geometric 2-Dimensional figures with hand tools and solve numericals related to them. {L1,L2}{PO1} CO2: Use the CAD software and be able to create basic 2D computer geometries like points, lines, and planes. {L1, L2}{PO1,PO2} CO3: Understand the concept of projection and sectioning of solids and be able to create the drawings manually. {L1, L2}{PO1,PO2} CO4: To create Drawings of surfaces of regular solids after development Manually. {L1, L2} {PO1, PO2} CO5: To create isometric drawings from Orthographic projections by using isometric scale Manually and using CAD software. {L1, L2} {PO2,PO5} CO6: To create projection of solids, sectioning development of surface using CAD software and be able to draw basic 3D shapes in CAD. {L1, L2} {PO2, PO5}	
Textbooks: T1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House T2. N S Parthasarathy and Vela Murali (2015) Engineering Drawing, Oxford University Press T3. Shah, M.B. & Rana B.C. (2009), Engineering Drawing and Computer Graphics, Pearson Education T4. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication	
Reference Books: R1. S. Trymbaka Murthy, "Computer Aided Engineering Drawing", I.K. International Publishing House Pvt. Ltd., New Delhi. R2. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech R3. K.R. Gopalakrishna, "Engineering Graphics", 15th Edition, Subash Publishers Bangalore	
Online Resources: Nil	

COURSE NAME: BASIC BIOLOGY
Course Code: BS136 / BS236

	L	T	P	Category	BSC
Contact Hrs./Week	**2**	**0**	**0**	CIA Marks	50
Contact Hrs./Sem.	**30**	**0**	**0**	ESE Marks	50
Total Contact Hrs.	**2**	**0**	**0**	Exam Hours	3

Course objectives:

To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline.

Prerequisites:

- **Fundamental understanding of biological processes.**

Units	**Teaching Hours**
Unit-1 Introduction to Cell structure and biomechanism	
Biological Engineering - Classifications-Taxonomy- Prokaryotes and Eukaryotes- Morphology, NucleusProtein structure and function - Organelles for Protein synthesis and transport- Cell division - mitosis, meiosis- Biochemical pathways - metabolism, energy conversion, TCA cycle, electron transport, ATP, glycolysis, photosynthesis- DNA structure - Replication-Transcription- Translation	9
Unit-2 Biosensors	
General principles - Construction of biosensors, immobilization of receptor components in biosensors- Types –metabolism, semiconductor, optical, piezoelectric, immunosensors - Applications – lab-on-a-chip, food and beverage, defence, environmental applications, Medical instruments	10
Unit-3 Modern Imaging Systems	
X ray, digital radiography – x-ray computed tomography- Nuclear medical imaging systems, Magnetic resonance imaging system, Ultrasonic imaging system, thermal imaging, haemodialysis system, anaesthesia and ventilator systems.	8
Unit-4 Biomechanics	
Key mechanical concepts - 9 fundamentals of biomechanics -Muscle action, Range of motion principle, Force motion principle - Tissue loads -Response of tissue to force -Biomechanics of passive muscle tendon unit- Biomechanics of bone - Biomechanics of ligaments - Mechanical characteristics of muscles- Force time principle - Stretch-shortening cycle	10
Unit-5 Materials for organs and devices	

Materials – polymers, metals, ceramics, hydrogels, degradable biomaterials - Host reaction to biomaterials and their evaluation -Application of biomaterials – heart valves, orthopaedic applications, Cochlear and dental implants, soft tissue replacements, Hard tissue replacements	8

Self-study: Self-study modules can be added**.** Not mandatory

Site/Industrial Visits: If you feel, an industrial visit can bridge the gaps in syllabus or course delivery then a visit can be added. Not mandatory

Course outcomes:
At the end of the course, the student will be able to do:

- Understand the morphology of prokaryotes and eukaryotes; functions of nucleus and cellular organelles; biochemical pathways of metabolism - energy conversion, TCA cycle, electron transport, ATP, glycolysis and photosynthesis.
- Explain the general operating principles and construction of biosensors; working of the types of biosensors - metabolism, semiconductor, optical, piezoelectric, and immune-based biosensors.
- Understand the general operating principles of medical imaging techniques - X-ray digital radiography, x-ray computed tomography, nuclear medical imaging systems, magnetic resonance imaging system, ultrasonic imaging, and thermal imaging.
- Understand key mechanical concepts- 9 fundamentals of biomechanics, muscle action, range of motion principle, force motion principle; biomechanics of passive tendon unit, bone and ligaments.
- Study biomaterials (polymers, metals, ceramics, hydrogels, degradable biomaterials); their interaction with host; applications in heart valves, orthopedic, cochlear and dental implants, soft and hard tissue replacements.

Program Outcomes (as per NBA)

Textbooks:

- F. Scheller, F. Schubert, (1991) *Biosensors, Volume 11 of Techniques and Instrumentation in Analytical Chemistry*, Elsevier.
- Vinod Kumar Khanna, (2015) *Implantable Medical Electronics: Prosthetics, Drug Delivery, and Health Monitoring*, Springer.
- Khandpur, (2003) *Handbook of Biomedical Instrumentation*, Tata McGraw-Hill Education
- David A. Winter, (2009) *Biomechanics and Motor Control of Human Movement*, John Wiley & Sons.
- Duane Knudson, (2013) *Fundamentals of Biomechanics*, Springer Science & Business Media.
- Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, (2012) *Biomaterials Science: An Introduction to Materials in Medicine*, Academic Press.

Reference Books:

- Bansi Dhar Malhotra, Anthony Turner, (2003) Advances in Biosensors: Perspectives in Biosensors, *Volume 5 of Advances in Biosensors*, Elsevier.

Online Resources:
NPTEL Online courses

SEMESTER-III

Course Name: Mathematics-III					
Course Code: MA331					
	L	**T**	**P**	**Category**	BSC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives:.					
Prerequisites: Sequences and series (Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions; Fourier series: Half range sine and cosine series, Parseval's theorem) higher order Partial Differential Equations, Complex Variables, (MA131, Mathematics-I and Mathematics-II)					

Units	**Teaching Hours**
Unit-1 Transform Calculus-1	
Polynomials – Orthogonal Polynomials – Lagrange's, Chebysev Polynomials; Trigonometric Polynomials; Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method.	10
Unit-2 Transform Calculus-2	
Fourier transforms, Z-transform and Wavelet transforms: properties, methods, inverses and their applications.	10
Unit-3 Discrete Mathematics	
Sets, relations and functions: Basic operations on sets, Cartesian products, disjoint union (sum), and power sets. Different types of relations, their compositions and inverses. Different types of functions, their compositions and inverses. Propositional Logic: Syntax and semantics, proof systems, satisfiability, validity, soundness, completeness, deduction theorem, etc. Decision problems of propositional logic. Introduction to first order logic and first order theory	12

Unit-4 Partially ordered sets	
Complete partial ordering, chain, lattice, complete, distributive, modular and complemented lattices. Boolean and pseudo Boolean lattices.	6
Unit-5 Introduction to Graphs	
Graphs and their basic properties – degree, path, cycle, subgraph, isomorphism, Eulerian and Hamiltonian walk, trees	7
Self-study:	
Site/Industrial Visits: Nil	
Course outcomes: **CO1:** Develop Parametric design and the conventions of formal engineering drawing.{L2}{PO1}{PSO3} **CO2**: Communicate a design idea/concept graphically/ visually.{L1}{PO1}{PSO4} **CO3:** Get a Detailed study of an engineering artifact.{L1}{PO1}{PSO3}	
TextBooks: T1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006. T2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2010. T3. B.S. Grewal, "Higher Engineering Mathematics, Khanna Publishers", 35th Edition, 2000. T4. Veerarajan T., "Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2008 T5. C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 2000. T6. R. C. Penner, Discrete Mathematics: Proof Techniques and Mathematical Structures, World Scientific, 1999. T7. R. L. Graham, D. E. Knuth, and O. Patashnik, Concrete Mathematics, 2nd Ed., Addison-Wesley, 1994.	

Reference Books: R1. K. H. Rosen, Discrete Mathematics and its Applications, 6th Ed., Tata McGraw-Hill, 2007. R2. J. L. Hein, Discrete Structures, Logic, and Computability, 3rd Ed., Jones and Bartlett, 2010. R3. N. Deo, Graph Theory, Prentice Hall of India, 1974. R4.S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 1999. R5. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.
Online Resources:NPTEL

Course Name: Computer-aided Civil Engineering Drawing					
Course Code: CE331P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	1	0	2	**CIA Marks**	50
Contact Hrs./Sem.	15	0	30	**ESE Marks**	50
Credits.	1	0	1	**Exam Hours**	3
Course objectives: The objective of this course aims at enabling the students to prepare Working drawing of Building Components and Building Drawing and Line diagram.					
Prerequisites: Fundamentals of mathematics					
Units					**Teaching Hours**

Unit-1 Introduction to Formal Drawing	
Basics of AutoCad, Symbols and sign conventions, Coordinate systems, Understanding Civil Engineering Drawings, Functional aspect of residential, institutional and commercial buildings and byelaws	9
Unit-2 Preparing Working Drawing	
Prepare working drawing of component of buildings i) Stepped wall footing and isolated RCC column footing, ii) Fully panelled and flush doors, iii) Half panelled and half-glazed window, iv) RCC staircase	9
Unit-3 Building Drawing	
Development of plan, elevation, section and schedule of openings from the given line diagram of residential buildings, i) Two-bedroom building, ii) Two storeyed building.	9
Unit-4 Single Line Diagram Drawing	
For a given single line diagram, preparation of water supply, sanitary and electrical layouts.	9
Unit-5 BIM	
Fundamentals of Building Information Modelling (BIM).	9
Self-study: Bubble drawing	
Site/Industrial Visits: Nil	

Course outcomes:

1.Understand conventions of formal engineering drawings and interpret the drawings [L2]
2.Draw working drawings of masonry and RCC Wall footing, panelled doors, windows and RCC staircase [L3]
3.Communicate a design idea/concept graphically/ visually for a residential Building. [L3]
4.Draw water supply, sanitary and electrical layout in a line diagram [L2, L3]
5.Understand concepts of Building Information Modeling using Revit Architecture. [L2]

Textbooks:

1. Subhash C Sharma & Gurucharan Singh (2005), *"Civil Engineering Drawing"*, Standard Publishers.
2. Ajeet Singh (2002), *"Working with AUTOCAD 2000 with updates on AUTOCAD 200I"*, Tata- Mc Graw-Hill Company Limited, New Delhi.
3. Venugopal (2007), "*Engineering Drawing and Graphics + AUTOCAD*", New Age International Pvt. Ltd.,

Reference Books: 1. Balagopal and Prabhu (1987), "*Building Drawing and Detailing*", Spades publishing KDR building, Calicut, 2. Malik R.S., Meo, G.S. (2009) *Civil Engineering Drawing,* Computech Publication Ltd New Asian. 3. Sikka, V.B. (2013), *A Course in Civil Engineering Drawing*, S.K.Kataria& Sons,
Online Resources: W1. https://nptel.ac.in/courses/124107001/ W2. https://www.ikbooks.com/openPdf/9789382332565

Course Name: Disaster Preparedness and Planning

<table>
<tr><td colspan="6">Course Code: CE332</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>PCC</td></tr>
<tr><td>Contact Hrs./Week</td><td>2</td><td>0</td><td>0</td><td>CIA Marks</td><td>25</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>30</td><td>0</td><td>0</td><td>ESE Marks</td><td>25</td></tr>
<tr><td>Credits.</td><td>2</td><td>0</td><td>0</td><td>Exam Hours</td><td>2</td></tr>
<tr><td colspan="6">Course objectives: To understand the scope and relevance of Disaster Management in a changing world and to realize the responsibilities of individuals and institutions in a multidisciplinary setting</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">Prerequisites: Nil</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 Introduction to Disaster Management</td></tr>
<tr><td colspan="5">Concepts and definitions: disaster, hazard, vulnerability, risk severity, frequency, capacity, impact, prevention and mitigation.</td><td>6</td></tr>
<tr><td colspan="6">Unit-2 Classification of Hazards and Disasters</td></tr>
<tr><td colspan="5">Classification system for Hazards and Disasters; Physical dimensions; Magnitude-Frequency Relations; Disaster effects and impacts; Case studies representing different hazard types such as Floods, Drought, Earthquake, Epidemics, Terrorism, Conflicts (indicative list); Role of Multi disciplines in Disaster Management. Concept of vulnerability</td><td>6</td></tr>
<tr><td colspan="6">Unit-3 Disaster Impacts</td></tr>
<tr><td colspan="5">Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters. Disaster Response Mechanisms. Humanitarian logistics and supply chain management.</td><td>6</td></tr>
<tr><td colspan="6">Unit-4 Disaster Risk Management</td></tr>
<tr><td colspan="5">Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programs in India and the activities of National Disaster Management Authority.</td><td>6</td></tr>
<tr><td colspan="6">Unit-5 Disasters, Environment and Development</td></tr>
</table>

Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.	6
Self-study: Exploring the data base and spatial techniques (GIS, Virtual globes, EM Dat, ENatech and GDACS)	
Site/Industrial Visits: Visit to emergency operation centers.	
CO1: Explain basic concepts and terminologies in disaster management (L2) CO2: Explain typology of hazards and disasters (L2) CO3: Compare disaster impacts (L4) CO4: Outline and Illustrate Disaster Risk Mitigation and Adaptation (L2) CO5: Relate development and disasters (L4)	
Text Books: T1. Coppola, D, *"Introduction to International Disaster Management "*Elsevier, 2015. T2. Paul, B.K, *"Environmental Hazards and Disasters: Contexts, Perspectives and Management"*, Wiley-Blackwell, 2011.	
Reference Books: R1. Cutter, S. L., Emrich, C. T., Webb, J. J. and Morath D "*Social Vulnerability to Climate Variability Hazards: A Review of the Literature*" Final Report to Oxfam America, Hazards and Vulnerability Research Institute, Columbia. R2. McClure, J., Henrich, L., Johnston, D. and Doyle, E.E.H, *Are two earthquakes better than one? How earthquakes in two different regions affect risk judgments and preparation in three locations*. IJDRR , 16; 192-199,2006.	
Online Resources: W1. http://www.training.fema.gov/emiweb/edu/ddemtextbook.asp W2. https://www.weadapt.org/ W3. https://nagt.org/nagt/search_nagt.html?search_text=hazards&search=Go W4. https://www.unisdr.org/ W5. https://emdat.be/ W6. http://bhuvan.nrsc.gov.in/bhuvan_links.php W7. https://www.usgs.gov/	

Course Name: Introduction to Solid Mechanics					
Course Code: CE333P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	3
Course objectives: The objective of this course is to introduce to continuum mechanics and material modelling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design.					
Prerequisites: Mathematics I, II, Physics, Basics of Civil Engineering & Engineering Mechanics					

Units	**Teaching Hours**
Unit-1 Simple Stresses and Strains	
Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section –composite bars – Temperature stresses. Strain Energy – Resilience – Gradual, sudden, impact and shock loadings – simple applications Compound Stresses and Strains Two-dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two-dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants. Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.	8
Unit-2 Bending moment and **Shear Force Diagrams**	
Simply Supported and Cantilever beams: Bending moment and Shear Force Diagrams, Determination of Maximum bending moment and shear force for a given loading (uniformly distributed load, Gradually Varying load and concentrated loads) **Fixed beams**: Analysis of Fixed beams by double integration method, Calculation of maximum BM and SF for various loadings	8
Unit-3 Flexural Stresses-Theory of Simple Bending	

Flexural Stresses-Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections. Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.	10
Unit-4 Slope and Deflection in statically determinate structures	
Slope and deflection- Relationship between moment, slope and deflection. Moment area method: Concepts and its application to determine slope and deflection in beams **Macaulay's method**: Concepts and Application of this method to determine slope and deflection in beams.	10
Unit-5 Torsion	
Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.	9
PRACTICALS	
MATERIALS TESTING LABORATORY:LIST OF EXPERIMENTS 1. Tension test on Mild steel and HYSD bars. 2. Compression test of Mild Steel, Cast iron and Wood. 3. Torsion test on Mild Steel circular sections. 4. Bending Test on Wood Under two point loading. 5. Shear Test on Mild steel. 6. Impact test on Mild Steel (Charpy & Izod). 7. Hardness tests on ferrous and non-ferrous metals – Brinell's, Rockwell and Vicker's. 8. Test on Bricks and Tiles. 9. Tests on Fine aggregates – Moisture content, Specific gravity, Bulk density, Sieve analysis and Bulking. 10. Tests on Coarse aggregates – Absorption, Moisture content, specific gravity, Bulk density and Sieve analysis . 11. Demonstration of Strain gauges and Strain indicators. **NOTE:** All tests to be carried out as per relevant BIS Codes	
Self-study: Nil	
Site/Industrial Visits: Nil	

Course outcomes: On completion of the course, the student will be able to
CO1: Demonstrate understanding of strain/displacement and Hooke's law relationships based on theory of elasticity and compute magnitude of combined stresses in individual members and in structures (L2, L3) (PO1) (PO2)
CO2: Compute bending moment and shear force in a (L3) (PO1, PO2)
CO3: Compute stresses in beams under symmetrical loading (L3) (PO1, PO2)
CO4: Compute deflection in beams under symmetrical loading (L3) (PO1, PO2)
CO5: Demonstrate understanding to solve torsion problems in bars and thin walled members (L2) (PO1)

Textbooks:

1. Timoshenko, S. and Young, D. H., *"Elements of Strength of Materials"*,5th ed DVNC, New York, USA, 2003
2. Kazmi, S. M. A., "*Solid Mechanics*" TMH, Delhi, India, 2017
3. Hibbeler, R. C. *Mechanics of Materials*. 6th ed. East Rutherford, NJ: Pearson Prentice Hall,2004
4. R. Subramanian, *Strength of Materials* , Oxford University Press, New Delhi, 2016

Reference Books:

1. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids.2nd ed. New York, NY: McGraw Hill, 1979
2. Laboratory Manual of Testing Materials - William Kendrick Hall, 2006
3. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf – TMH 2002.

Online Resources:
W1. https://nptel.ac.in/courses/105106049/
W2. https://nptel.ac.in/courses/105108072/2

Course Name: Surveying & Geomatics					
Course Code: CE334P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	**3**
Course objectives: In this course, the students will be taught to use the various instrumental techniques/methods to measure directions/ angles, distances of lines, and elevations by conducting different types of surveys like Compass, Theodolite and Levelling and analysing the data. They will also be introduced to advanced instrumental techniques like photogrammetry, remote sensing, GIS, Total station and GPS.					
Prerequisites: Nil					

Units	Teaching Hours
Unit-1 Introduction to Surveying	
Basics of Surveying: Introduction to Surveying, importance of surveying in civil engineering, Objective of Surveying, Classification of surveying, Principles of Chain, Compass, Plane Table, Theodoloie and Tacheometric Surveying, Triangulation, Trilateration, resection and intersection methods of surveying **Levelling**: Trigonometric and Spirit Levelling, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: **Characteristics, methods, uses; areas and volumes, Curves**: Types of curves, simple, compound and transition Reverse curves, Elements of simple circular curves, – Method of setting out of simple circular curve	9

Unit-2 Modern methods of field measurements	
Total Station Surveying and GPS Surveying: Working principle of Total Station, Advantages and Applications, corrections in total station data, Surveying with Total Station, Field Procedure for total station survey, Errors in Total Station Survey; **Global Positioning Systems-** Segments, GPS measurements, errors and biases, Surveying with hand held GPS, Projection systems and coordinate transformation	9
Unit-3 Photogrammetry	
Elementary Photogrammetry: Photogrammetry Surveying (8 Hours): Introduction, Types of Photogrammetry, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, flight planning; Stereoscopy: Determination of ground coordinates with parallax measurements. **Digital Photogrammetry:** Aero Triangulation, Bundle block adjustment, Ortho Mosaic generation, Drone Based Surveying for large scale stereoscopic Mapping, processing of Drone based data in open ware software's.	9
Unit-4 Remote Sensing	
Basics of Remote Sensing: Introduction–Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere (types of scattering and its effect on remote sensing images) and earth surface features, Typical reflectance curves of Water, Soil and Vegetation, remote sensing data acquisition: platforms and sensors; IRS satellite Constellation, Processing of Satellite Images: visual image interpretation keys, digital image: pre and post processing, classification techniques (Supervised, unsupervised and hybrid techniques), accuracy assessment of classified data	9
Unit-5 Geographic Information Systems (GIS)	
Fundamentals of GIS: Definitions: components of a GIS The four M's concept – Domain expertise for GIS, GIS objectives — Topology – Data structures –Database management –Errors in GIS **Vector and Raster Data Analysis Techniques**: Vector data models, Raster Data Models, GIS modelling, Spatial data analysis techniques, Integration of GPS, drone and Remote Sensing Data in GIS environment, GIS software packages (openware and commercial) thematic Map Generation.	9
PRACTICALS	
List of Experiments:	**Practical Hours**
1. To determine difference in elevation between two points using fly levelling, Profile of water supply line /highway	2

2. Determine independent coordinates of a traverse by theodolite surveying and elevation of objects by trigonometric levelling	2
3. Set out simple circular curves in the field by angular and linear methods.	2
4. Set out centerline of a recatngualr room using offsets from base line	2
5. Set out center lines of columns of a building using two base lines at right angles	2
6. Traversing and stakeouts using Total Station	2
7. Capture stereoscopic images from Drone.	2
8. Generate Digital Surface model (DSM), Digital Terrain Model (DTM) and Contour map from drone images using openware softwares	2
9. Land Use Land Cover (LULC) map preparation from satellite Images in QGIS	2
10. Thematic map Generation in QGIS	2
11. Overlay Analysis in QGIS	2
Self-study: Plane table surveying, Interpolation of contours.	
Site/Industrial Visits: Nil	
Course outcomes: **CO1:** Understand the concepts of conventional survey methods and principles. { L3}{PO1, PO5, PO9, PO10}{PSO5} **CO2**: Classify the modern survey instruments and operate total station for surveying and levelling { L5}{ PO1, PO5, PO9, PO10}{PSO5} **CO3:** Analyse the drone images using photogrammetric concepts {L4}{ PO1, PO5, PO9, PO10}{PSO5} **CO4:** **CO4:** Analyse the passive remote sensing images visually and digitally {L4}{ PO1, PO5, PO9, PO10}{PSO5} CO5: Perform overlay analysis using GIS concepts to prepare thematic maps {L4, L5} { PO1, PO5, PO9, PO10}{PSO5}	
Textbooks: 1. B.C. Punmia., *Surveying,* Vol-1& II, 16th edition, New Delhi, Laxmi Publications, 2018. 2. M. A. Reddy, *Text Book of Remote Sensing and Geographical Information Systems*, 4thEdition, Hyderabad, BS Publications, 2013. 3. B.C. Punmia, “Advanced Surveying”, Laxmi Publications, New Delhi, 2018 4. Remote Sensing and Image Interpretation – Lillesand, John Wiley and Sons, 2014 5. Reddy. M. A, “Text Book of Remote Sensing and Geographical Information Systems”, BS Publications, Hyderabad, Fourth Edition, 2013. 6. P.R Wolf & B.A. Dewitt Elementary photogrammetry, 4th edition, TMH publishing, 2014	

Reference Books:

1.S. Kumar, Basics of Remote Sensing sand GIS, New Delhi, Laxmi Publications, 2016.
2.T.P Kanitkar & S.V Kulkarni, Surveying Levelling, Part I & II, Pune, Vidhyarthi Gruha Prakashana, 2006.
3.Alak De, Plane Surveying, 1St edition, New Delhi, S. Chand and Company Ltd, 2000.
4.Arora S.K, Surveying, Vol-I & II, Standard Book House, Delhi, 2010.
5.Arther Bannister, Dr Stanley Raymond & Dr.Raymond Baker, Surveying, India, Pearson Education, 1998.
6.N.Basak, Surveying, India, Tata McGraw-Hill Education Pvt. Ltd, 2001.
7.A.M.Chandra, Plane surveying, 3rd edition, New Delhi, New Age International Ltd, 2015.
8.S.K.Ro., Fundamentals of Surveying, 2nd Edition, India, Prentice Hall of India, 2011.
9.C.Venkataramiah, "Textbook of Surveying", 2nd edition, New Delhi, Orient Blackswan, 2011.
10.Survey of India Publication on maps.

Online Resources:

W1. http://www.gisresources.com/
W2. https://onlinecourses.nptel.ac.in/noc17_ce09
W3. https://nptel.ac.in/courses/105107122/1
W4. www.surveyofindia.gov.in/

Course Name: Introduction to Fluid Mechanics					
Course Code: CE335					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	1	0	**CIA Marks**	50
Contact Hrs./Sem.	45	15	0	**ESE Marks**	50
Credits.	3	1	0	**Exam Hours**	3

Course objectives: To understand the importance of fluid mechanics in civil Engineering by knowing the properties of fluids and their engineering behaviour in terms of fluid statics, kinematics and Dynamics.

Prerequisites: Engineering Physics and Engineering Mathematics	
Units	**Teaching Hours**
Unit-1 Introduction to fluid mechanics and basic properties of fluids	
Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility	8
Unit-2 Hydrostatics:	
Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micromanometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.	13
Unit-3 Fluid Kinematics	
Classification of fluid flow: steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates	13
Unit-4 Fluid Dynamics	
Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation: venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced	13
Unit-5 Dimensional Analysis and Dynamic Similitude	
Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π-Theorem.	13
Self-study: Definitions, dimensional formulae and units of physical quantities, integration and differentiation. Concept of pressure, force, surface tension and capillarity and Archimedes' Principle. Self-study of flow measuring devices based on similar concepts which are discussed in class	
Site/Industrial Visits: NIL	

Course outcomes: The student will be able to

CO1: Classify the types of fluids based on Newton's law of viscosity {L2}{PO1}{PSO3}

CO2: Apply the Pascal's law and hydrostatic law to determine the pressure in a fluid flow. {L4}{PO1, PO2}{PSO3}

CO3: Analyse types of fluid flow {L4}{PO1, PO2}{PSO3}

CO4: Apply Continuity equation, Euler's Equation and Bernoulli's Equation to analyse pipe flow for various losses {L4}{PO1, PO2}{PSO3}

CO5: Establish relationship between model and prototype using the concepts of dimensional analysis and model laws in fluid flow {L4}{PO1, PO2}{PSO3}

Textbooks:

1. R. K. Bansal, *Fluid Mechanics and Hydraulic Machines*, New Delhi, Lakshmi Publications Revised Ninth Edition, 2018.
2. A.K. Jain, *Fluid Mechanics*, New Delhi, Khanna Publishers. 2016 edition.
3. P.N. Modi and S.M. Seth, *Fluid Mechanics and Hydraulics*, New Delhi, Standard Book House.21st edition, 2017.
4. Cengel. Y. A and Cimbala. J. M, *"Fluid Mechanics – Fundamentals and Applications"*, Tata McGraw Hill, New Delhi, Second Edition, 2011.
5. Fay, *"Introduction to Fluid Mechanics"*, 2002, PHI learning Private Limited

Reference Books:

1. Subramanya. K., "1000 Solved Problems in Fluid Mechanics: Includes Hydraulic Machines", Tata McGraw-Hill Education Pvt. Ltd, 2010 edition
2. Arora K.R., "Fluid Mechanics, Hydraulic and Hydraulics", Standard Book House, New Delhi, 2017 edition
3. Frank,.M White, Fluid Mechanics in SI Units, Mcgraw Higher Ed, 8th Edition, 2016
4. P. K. Kundu. P. K, Cohen. I. M and Dowling. D. R, *"Fluid Mechanics"*, Elsevier, New Delhi, Fifth Edition, 2012.
5. Arora K.R., *"Fluid Mechanics, Hydraulic and Hydraulics"*, 2018, Standard Book House, New Delhi
6. John F. Douglas et al., *"Fluid Mechanics", 1996,* Pearson Education, India.
7. Mohanty., *"Fluid Mechanics", 2008,* PHI learning Private Limited
8. Rao B. C. S., *"Fluid Mechanics and Machinery", 2016,* Tata McGraw-Hill Education Pvt. Ltd
9. Rathakrishnan., "Fluid Mechanics: An Introduction", 2014, PHI learning Private Limited
10. Som S.K., "Introduction to Fluid Mechanics and Fluid Machines", 2012, Tata McGraw-Hill Education Pvt. Ltd
11. Subramanya. K., "1000 Solved Problems in Fluid Mechanics: Includes Hydraulic Machines", 2016, Tata McGraw-Hill Education Pvt. Ltd
12. Yunus A Cengel, John M., Bhattacharya, "Fluid Mechanics", Tata McGraw-Hill Education Pvt. Ltd, 2008

Online Resources:

W1. https://onlinecourses.nptel.ac.in/noc17_me04/preview

<table>
<tr><td colspan="6" align="center">Course Name: Engineering Biology Laboratory</td></tr>
<tr><td colspan="6" align="center">Course Code: BS336P</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td align="right">Category</td><td>MC</td></tr>
<tr><td>Contact Hrs./Week</td><td>0</td><td>0</td><td>2</td><td align="right">CIA Marks</td><td>25</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>0</td><td>0</td><td>30</td><td align="right">ESE Marks</td><td>25</td></tr>
<tr><td>Credits.</td><td>0</td><td>0</td><td>1</td><td align="right">Exam Hours</td><td>2</td></tr>
<tr><td colspan="6">Course objectives: The aim of this course is to familiarize the student with the analysis and design of feedback amplifiers, oscillators, tuned amplifiers, wave shaping circuits, multivibrators and blocking oscillators.</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="6">Prerequisites: Nil</td></tr>
<tr><td colspan="6">• Blood Pressure Measurement using Arduino
• Measuring HRV using the data from pulse measurement in Matlab.
• Measure heart rate and SPO2 with Arduino
• Measuring BMI, heart rate, SPO2, HRV using MATLAB and indicating health of person.
• Analyzing breast cancer, EEG, ECG and CT images using MATLAB from online data sources and detecting irregularties (arrhythmia, tumor, cancer, epilepsy).
• Analyzing force developed in muscles when performing any given task (to move servo motor and subsequently robotic arm).
• Measuring water content in given soil using temperature, pH using Arduino.
• IR thermal imaging to determine effect of mobile radiation.
• Synthesis of biopolymers from starch.</td></tr>
<tr><td colspan="6">Self-study:</td></tr>
<tr><td colspan="6">Site/Industrial Visits: Nil</td></tr>
<tr><td colspan="6">Course outcomes:
CO1. Examine the various applications of bioengineering and using common tool boxes for analysing medical information.</td></tr>
<tr><td colspan="6">Textbooks:</td></tr>
<tr><td colspan="6">Reference Books:</td></tr>
</table>

Course Name: Environmental Science

Course Code: MC301

	L	T	P	Category	MC
Contact Hrs./Week	2	0	0	**CIA Marks**	50
Contact Hrs./Sem.	30	0	0	**ESE Marks**	0
Credits.	1	0	0	**Exam Hours**	**0**

Course objectives: To understand the scope and importance of environmental science towards developing a conscious community for environmental issues, both at global and local scale.

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1	
Introduction: Environment and Eco systems – Definition, Scope and importance. Components of environment. Concept and Structure of eco systems. Material Cycles – Nitrogen, Carbon, Sulphur, Phosphorous, Oxygen. Energy Flow and classification of Eco systems.	6
Unit-2	
Natural Resources: Classification and importance- Forest, Water, Mineral, Food, Energy. Management of natural resources – challenges and methods. Sustainable development – Goals, Agriculture, Industries	6
Unit-3	
Environmental Pollution: Causes and Impacts – Air pollution, Water pollution, Soil Pollution, Noise Pollution, Marine Pollution, Municipal Solid Wastes, Bio Medical and E-Waste. Solid Waste Management	6
Unit-4	
Climate change/Global Atmospheric Change: Global Temperature, Greenhouse effect, global energy balance, Global warming potential, International Panel for Climate Change (IPCC) Emission scenarios, Oceans and climate change. Adaptation methods. Green Climate fund. Climate change related planning- small islands and coastal region. Impact on women, children, youths and marginalized communities	6
Unit-5	

Environmental Protection- Technology, Modern Tools – GIS & Remote Sensing,. Institutional Mechanisms - Environmental Acts & Regulations, Role of government, Legal aspects. Role of Nongovernmental Organizations (NGOs) , Environmental Education & Entrepreneurship	6
Self-study:	
Site/Industrial Visits: Nil	
Course outcomes: **CO1.** Explain the components and concept of various ecosystems in the environment (L2) **CO2**. Explain the necessity of natural resources management (L2) **CO3.** Relate the causes and impacts of environmental pollution (L4) **CO4.** Relate climate change/global atmospheric changes and adaptation (L4) **CO5.** Appraise the role of technology and institutional mechanisms for environmental protection (L5)	
Textbooks: 1. Gopinath, R & Balasubramanya, N (2018), "Environmental Science and Engineering", CENGAGE. 2. Benny Joseph (2005), **"Environmental Studies"**, Tata McGraw – Hill Publishing 3. Company Limited. 4. R Rajagopalan, **"Environmental Studies – From Crisis to Cure**", Oxford 5. University Press, 2005, 6. Aloka Debi, **"Environmental Science and Engineering",** Universities Press (India)Pvt. Ltd. 2012.	
Reference Books: 1. Masters, G & Ela, W.P (2015), Introduction to environmental Engineering and Science, 3rd Edition. Pearson. 2. Raman Sivakumar, **"Principals of Environmental Science and Engineering",** Second Edition, Cengage learning Singapore, 2005. 3. P. Meenakshi, **"Elements of Environmental Science and Engineering",** Prentice Hall of India Private Limited, New Delhi, 2006. 4. S.M. Prakash, **"Environmental Studies",** Elite Publishers Mangalore, 2007 5. Erach Bharucha, **"Textbook of Environmental Studies"**, for UGC, University press, 2005. 6. Dr. Pratiba Sing, Dr. AnoopSingh and Dr. Piyush Malaviya, **"Textbook of Environmental and Ecology"**, Acme Learning Pvt. Ltd. New Delhi.	

SEMESTER-IV

Course Name: - Hydraulic Engineering					
Course Code: CE431P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	3
Course objectives: To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines. At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering					
Prerequisites: Introduction to Fluid Mechanics					

Units	**Teaching Hours**
Unit-1 Laminar and Turbulent Flow	
Laminar Flow- Laminar flow through circular pipes, annulus and parallel plates. Stoke's law, **Turbulent Flow**- Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.	9
Unit-2 Boundary Layer Theory	
Boundary Layer Analysis-Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and Turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control.	6
Unit-3 Open Channel Flow	

Introduction Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section. **Uniform Flow** Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient, Most economical section of channel, Computation of Uniform flow, Normal depth. **Non-Uniform Flow** Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. . Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump. **Measurement of Discharge and Velocity** – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile	10
Unit-4 Hydraulic Machines	
Hydraulic Machines: Introduction to hydraulic machines, Classification of turbines, impulse and reaction turbines. Design features, efficiency of turbines, operating and main characteristic curves Hydraulic Pumps: Introduction, Classification of pumps: centrifugal and reciprocating pumps, pumps in series and parallel, efficiency of the pumps, characteristic curves	12
Unit-5 **Computational Fluid Dynamics**	
Basic Equations of fluid dynamics, Grid generation, Introduction to in viscid incompressible flow, Boundary layer flow as applicable to C.F.D. Hydro informatics: Concept of hydro informatics –scope of internet and web-based modelling in water resources engineering.	**8**
PRACTICALS	

Laboratory Components:List of Experiments

1. Calibration of V-notch
2. Calibration of rectangular or Trapezoidal notch.
3. Calibration of Ogee weir
4. Calibration of Broad crested weir.
5. Calibration of Venturi flume.
6. Calibration of Venturi meter.
7. Determination of Darcy's friction factor for a straight pipe.
8. Determination of minor loss constants (Bend, Sudden contraction, sudden expansion).
9. Determination of vane coefficient for flat and hemispherical vanes.
10. Determination of hydraulic coefficient of a vertical orifice.
11. Performance tests on a single stage or multistage centrifugal pump (constant speed).
12. Performance tests on a Pelton wheel.
13. Performance tests on Francis
14. Performance tests on Kaplan turbine.

Self-study: NIL

Site/Industrial Visits: NIL

Course outcomes: -

Upon the completion of this course the student will be able to:

1. Differentiate laminar and turbulent flow (L2, L3) (PO1, PO2), (PSO3)
2. Explain the concept of boundary layer theory (L2, L3) (PO1, PO2), (PSO3)
3. Determine most economical channel section and analyse Hydraulic jump (L3, L4) (PO1, PO2), (PSO3)
4. Analyse Characteristics of hydraulic machines for efficiency (L4) (PO1, PO2), (PSO3)
5. Explain the importance of computational fluid dynamics in modeling of water resources. (L2) (PO1, PO2), (PSO3)
6. Calibrate flow measuring devices and hydraulic machines. (L5) (PO1, PO2, PO9, PO10), (PSO3)

Textbooks:

1. R. K. Bansal, Fluid Mechanics and Hydraulic Machines, New Delhi, Lakshmi Publications Revised Ninth Edition, 2018.
2. A.K. Jain, Fluid Mechanics, New Delhi, Khanna Publishers. 2016 edition.
3. P.N. Modi and S.M. Seth, Fluid Mechanics and Hydraulics, New Delhi, Standard Book House.21st edition, 2017.
4. K. Subramanya, "Theory and Applications of Fluid Mechanics", 2014, Tata McGraw Hill.

Reference Books:
1. Ven Te Chow, “Open Channel Hydraulics”, Tata McGraw Hill.
2. Burnside, C.D., “Electromagnetic Distance Measurement,” Beekman Publishers, 1971.
3. SS Rattan, “Fluid Mechanics & Hydraulic Machines”, 2014, Khanna Publishing House
4. CSP Ojha, R Berndtsson & P.N. Chandramouli, “Fluid Mechanics and Machinery,” 2016, Oxford Universiy
5. Sadhu Singh, “Fluid Machinery”, 2006, Khanna Publishing House, Delhi
6. Raghunath. H.M., “Fluid Mechanics & Machinery”, 2014, CBS Publishers
7. Arora.K.R., “Hydraulics & Fluid Mechanics”, 2000, Standard Book house, NewDelhi
8. Gupta. S.C., “Fluid Mechanics and Hydraulic Machines”, 2016, Pearson Education, India
9. Jain, A.K., “Fluid Mechanics”, 2012, Khanna Publishers, New Delhi.
10. James. F. Cruise, Vijay P. Singh, Mohsan M. Sherif, “Elementary Hydraulics”, (1st Edition, 2008) Thomson Learning.
11. John F. Douglas et al., “Fluid Mechanics”,3rd edition, 2008, Pearson Education, India.
12. Rao. B. C. S, “Fluid Mechanics and Machinery”, 2010, Tata McGraw-Hill Education Pvt. Ltd.
13. Som S.K., “Introduction to Fluid Mechanics and Fluid Machines”, 2014, Tata McGraw-Hill Education Pvt. Ltd
14. Subramanya K., “1000 Solved Problems in Fluid Mechanics: Includes Hydraulic Machines”, 2014, Tata Mc Graw-Hill Education Pvt. Ltd
15. Subramanya K., “Flow in Open Channels”, 2016, Tata McGraw-Hill Education Pvt. Ltd.

Online Resources:

https://nptel.ac.in/courses/105103096/

https://nptel.ac.in/courses/105/106/105106114/

https://nptel.ac.in/courses/105103021/

Course Name: - Mechanics of Materials					
Course Code: CE432					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	1	0	**CIA Marks**	50
Contact Hrs./Sem.	45	15	0	**ESE Marks**	50
Credits.	3	1	0	**Exam Hours**	3
Course objectives: The objective of this Course is to introduce to continuum mechanics and material modelling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design.					
Prerequisites: Engineering Mechanics, Mathematics II, Physics					

Units	**Teaching Hours**
Unit-1 Theories of Stress and Strain	
Description of finite deformation, Infinitesimal deformation; Analysis of statically determinate trusses; Stability of dams, retaining walls and chimneys; Stress analysis of thin, thick and compound cylinder; *Generalized state of stress and strain:* Stress and strain tensor, Yield criteria and theories of failure; Tresca, Von-Mises, Hill criteria, Heigh-Westerguard's stress space.	12
Unit-2 Momentum Balance and Stresses	
Forces and Moments Transmitted by Slender Members, Shear Force and Bending Moment Diagrams, Momentum Balance, Stress States / Failure Criterion	10
Unit-3 Mechanics of Deformable Bodies	
Force-deformation Relationships and Static Indeterminacy, Uniaxial Loading and Material Properties, Trusses and Their Deformations, Statically Determinate and Indeterminate Trusses, *Force-Stress-Equilibrium covering* Multiaxial Stress and Strain, *Displacement – Strain covering* Multiaxial Strain and Multiaxial Stress-strain Relationships, *Elasticity and Elasticity Bounds covering* Stress-strain-temperature Relationships and Thin-walled Pressure Vessels, Stress and strain Transformations and Principal Stress, Failure of Materials,	13
Unit-4 Theory of Bending	

<table>
<tr><td>Stress and Strains; Deflections and Torsion covering Pure Bending, Moment-curvature Relationship, Beam Deflection, Symmetry, Superposition, and Statically Indeterminate Beams, Shear and Torsion, Torsion and Twisting, Thermoelasticity, Energy methods, Variational Methods; Strain energy, elastic, complementary and total strain energy, Strain energy of axially loaded bar, Beam in bending, shear and torsion; General energy theorems, Castigliano’s theorem, Maxwell Bettie’s reciprocal theorem; Virtual work and unit load method for deflection, Application to problems of beams and frames.</td><td>13</td></tr>
<tr><td colspan="2">Unit-5 Structural Stability</td></tr>
<tr><td>Stability of columns, Euler’s formula, end conditions and effective length factor, Columns with eccentric and lateral load; Plasticity and Yield Design covering 1D-Plasticity – An Energy Approach, Plasticity Models, Limit Analysis and Yield Design</td><td>12</td></tr>
<tr><td colspan="2">Self-study: NIL</td></tr>
<tr><td colspan="2">Site/Industrial Visits: NIL</td></tr>
<tr><td colspan="2">Course outcomes: - Upon the completion of this course the student will be able to:
1.Analyse the stress and strain relationship of various structural members (L4, PO1, PO2)
2.Determine the forces and moments in slender members (L5, PO1, PO2)
3.Analyse the statically determinate and indeterminate trusses (L4, PO1, PO2)
4.Analyse statically indeterminate beams and frames subjected to Bending, torsional and temperature stresses. (L4, PO1, PO2)
5.Analyse the stability of columns and understand the energy approach in plastic theory. (L4, PO1, PO2)</td></tr>
<tr><td colspan="2">Textbooks:
1. Norris, C.H. and Wilber, J. B. and Utku, S. “Elementary Structural Analysis” McGraw Hill, Tokyo, Japan
2. R. Agor, “Structural Analysis”, Khanna Publishing House
3. BC Punmia & A.K. Jain, “Mechanics of Materials”, Laxmi Publications
4. Timoshenko, S. and Young, D. H., “Elements of Strength of Materials”, DVNC, New York, USA.
5. Kazmi, S. M. A., ‘Solid Mechanics” TMH, Delhi, India.</td></tr>
</table>

Reference Books: 1. Hibbeler, R. C., "Mechanics of Materials", 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004 2. Crandall, S. H., N. C. Dahl, and T. J. Lardner, "An Introduction to the Mechanics of Solids", 2nd ed. New York, NY: McGraw Hill, 1979 3. Gere, J. M., and S. P. Timoshenko, "Mechanics of Materials", 5th ed. Boston: PWS Kent Publishing, 1970. 4. Ashby, M. F., and D. R. H. Jones, "Engineering Materials, An Introduction to their Properties and Applications", 2nd ed. Butterworth Heinemann. 5. Collins, J. A. "Failure of Materials in Mechanical Design", 2nd ed. John Wiley & Sons, 1993. 6. Courtney, T. H. "Mechanical Behavior of Materials", McGraw-Hill, 1990. 7. Hertzberg, R. W. "Deformation and Fracture Mechanics of Engineering Materials", 4th ed. John Wiley & Sons, 1996. 8. Nash, W. A., "Strength of Materials", 3d ed. Schaum's Outline Series, McGraw-Hill, 1994.
Online Resources: NIL

Course Name: - Materials, Testing & Evaluation					
Course Code: CE433P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	30	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	3

Course objectives: Course deals with an experimental determination and evaluation of mechanical characteristics and advanced behaviour of metallic and non-metallic structural materials. The course deals with explanation of deformation and fracture behaviour of structural materials. The main goal of this course is to provide students with all information concerning principle, way of measurement, as well as practical application of mechanical characteristics.

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1 Introduction to Engineering Materials	
Stones, bricks, aggregates, timber, glass, plastics, ceramics and refractories, bitumen, asphalt, Cements, Structural Steel and other Metals, Paints and Varnishes, Acoustical material and geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties and uses, Concrete (plain, reinforced and steel fibre/ glass fibre-reinforced, light-weight concrete, High Performance Concrete, Polymer Concrete)	9
Unit-2 Building Components- Masonry and Concrete	
Classification of Foundations, Introduction to Different type of foundation, Masonry footings, isolated footings. Combined and strap RCC footings, Raft footing, and Pile foundations. MASONRY: Definition of terms used in masonry, Bonds in Brickwork, English Bond, Flemish Bond, Reinforced brickwork, Joints in Stone Masonry, Rubble Masonry, Coursed Rubble Masonry, Uncoursed rubble masonry, Random rubble masonry, Ashlar Masonry, Masonry design requirements as per IS 1905. FLOORS AND ROOFS: Types of flooring, Granolithic, Mosaic, Ceramic, Marble, Polished Granite, Industrial flooring, Flat Roof (R.C.C.), Sloped roof (R.C.C and Tile roof), Lean to roof, Wooden truss (King post and queen post trusses), steel trusses, Weather proof course for RCC Roof. STAIRS, PLASTERING AND PAINTING: Purpose of Plastering, Materials of plastering, Lime mortar, Cement Mortar, Methods of plastering, Stucco plastering, Lath plastering, Purpose of Painting, Types of Paints, Application of paints to new and old surfaces, Distemper, Plastic emulsion, Enamel, Powder coated painting to walls and iron and steel surfaces, Polishing of wood surface	10

Unit-3 Stairs, Doors and Windows	
Types (Classifications) and Technical terms in stairs, Requirements of a good stair. Geometric Design of RCC Dog Legged and open well stairs. (Plan and sectional elevation of stairs), Doors, Types, Panelled doors, Glazed doors, Flush doors, Collapsible and rolling shutters, Louvered doors, Revolving, sliding and swing doors, Windows, Types, Panelled, Glazed, Bat window, Dormer window, Louvered and corner window and Ventilators.	9
Unit-4 Introduction to Cost Effective Construction	
Necessity, Advantages, Pre-fabrication techniques, Pre cast doors and windows (Pre cast frames and shutters), Alternative Building Materials, Hollow concrete blocks, Stabilized mud blocks, Micro concrete tiles, Precast roofing elements, Miscellaneous topics: Form Work, Form work Details, RCC columns, Beams, Floors, Slip forming, Damp proof construction	7
Unit-5 Material Testing and Standard Evaluation Procedures	
Introduction to Material Testing: What is the "Material Engineering"?; Mechanical behaviour and mechanical characteristics; Elasticity – principle and characteristics; Plastic deformation of metals; Tensile test – standards for different material (brittle, quasi-brittle, elastic and so on) True stress – strain interpretation of tensile test; hardness tests; Bending and torsion test; strength of ceramic; Internal friction, creep – fundaments and characteristics; Brittle fracture of steel – temperature transition approach; Background of fracture mechanics; Discussion of fracture toughness testing – different materials; concept of fatigue of materials; Structural integrity assessment procedure and fracture mechanics **Standard Testing & Evaluation Procedures:** Laboratory for mechanical testing; Discussion about mechanical testing; Naming systems for various irons, steels and nonferrous metals; Discussion about elastic deformation; Plastic deformation; Impact test and transition temperatures; Fracture mechanics – background; Fracture toughness – different materials; Fatigue of material; Creep.	10
PRACTICALS	

Lab Component:List of Experiments

1. Gradation of coarse and fine aggregates
2. Different corresponding tests and need/application of these tests in design and quality
3. control
4. Tensile Strength of materials & concrete composites
5. Compressive strength test on aggregates
6. Tension I - Elastic Behaviour of metals & materials
7. Tension II - Failure of Common Materials
8. Direct Shear - Frictional Behaviour
9. Concrete I - Early Age Properties
10. Concrete II - Compression and Indirect Tension
11. Compression – Directionality
12. Soil Classification
13. Consolidation and Strength Tests
14. Tension III - Heat Treatment
15. Torsion test
16. Hardness tests (Brinell's and Rockwell)
17. Tests on closely coiled and open coiled springs
18. Theories of Failure and Corroboration with Experiments
19. Tests on unmodified bitumen and modified binders with polymers
20. Bituminous Mix Design and Tests on bituminous mixes - Marshall method
21. Concrete Mix Design as per BIS

Self-study: NIL

Site/Industrial Visits: NIL

Course outcomes: - Upon the completion of this course the student will be able to:

1.Understand the properties civil engineering materials (L2, PO1, PO2)
2.Understand and Choose the components and functions of buildings made up of masonry and concrete (L3, PO1, PO2)
3.Understand the types of doors, windows and staircases made up of various materials (L2, PO1,PO2)
4.Understand and Distinguish the prefabrication and precast techniques in construction (L4, PO1,PO2)
5.Understand and Apply the test procedures for material testing and analyse the properties of materials using standard methods and evaluation procedures(L3, PO1, PO2)

Textbooks:

1. H.E. Davis, G.E. Troxell, George F.W. Hauck,"Testing Of Engineering Materials" Fourth Edition McGraw Hill, New Delhi, 2010
2. Khanna & Justo, "Highway Materials and Pavement", Nemchand & Bros, Roorkee, 2000

Reference Books: 1. Chudley, R., Greeno, "Building Construction Handbook", 6th ed., Butterworth-Heinemann, 2006 2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, "Highway Materials and Pavement Testing", Nem Chand& Bros, Fifth Edition 3. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications 4. Kyriakos Komvopoulos, "Mechanical Testing of Engineering Materials", Cognella,2011 5. E.N. Dowling, "Mechanical Behaviour of Materials", Prentice Hall International Edition, 1993 6. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards, (post 2000)
Online Resources: NIL

Course Name: - Instrumentation & Sensor Technologies for Civil Engineering Applications					
Course Code: CE434P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	2	0	2	**CIA Marks**	70
Contact Hrs./Sem.	30	0	30	**ESE Marks**	30

Credits.	2	0	1	**Exam Hours**	3

Course objectives: The objective of this Course is to understand instrumentation, sensor theory and technology, data acquisition, digital signal processing, damage detection algorithm, lifetime analysis and decision making. For lab work, the course will allow students to prepare, deploy and analyze observations from standard instruments. Laboratory experiments shall be used on application of concepts introduced in the lectures.
Prerequisites: Nil

Units	**Teaching Hours**
Unit-1 Fundamentals of Measurement, Sensing and Instrumentation	
*D*efinition of measurement and instrumentation, physical variables, common types of sensors; Describe the function of these sensors; Use appropriate terminology to discuss sensor applications; and qualitatively interpret signals from a known sensor type, types of instrumentation, Sensor Specifics, Permanent installations, Temporary installations;	6
Unit-2 Sensor Installation and Operation	
Predict the response of sensors to various inputs; Construct a conceptual instrumentation and monitoring program; Describe the order and methodology for sensor installation; Differentiate between types of sensors and their modes of operation and measurement and Approach to Planning Monitoring Programs, Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Advanced topic, Sensor design, Measurement uncertainty	6
Unit-3 Data Analysis and Interpretation	
a) Fundamental statistical concepts, b) Data reduction and interpretation, c) Piezometer, Inclinometer, Strain gauge, etc. d) Time domain signal processing, e) Discrete signals, Signals and noise and f) a few examples of statistical information to calculate are: Average value (mean), On average, how much each measurement deviates from the mean (standard deviation), Midpoint between the lowest and highest value of the set (median), Most frequently occurring value (mode), Span of values over which your data set occurs (range)	8
Unit-4 Frequency Domain Signal Processing and Analysis	
Explain the need for frequency domain analysis and its principles; Draw conclusions about physical processes based on analysis of sensor data; Combine signals in a meaningful way to gain deeper insight into physical phenomena, Basic concepts in frequency domain signal processing and analysis, Fourier Transform, FFT (Fast Fourier Transform), Example problems: Noise reduction with filters, Leakage, Frequency resolution.	6

Unit-5 Civil Engineering Applications	
Application of instrumentation and sensing in civil engineering laboratories. Understanding various instruments from basics of instrumentation. Measurements and observations with equipment, analysis of observed data, Interpretation of results and errors involved in equipment and preparation of evaluation report.	4
PRACTICALS	

Lab Component:**List of Experiments**

Instrumentation of typical civil engineering members/structures/structural elements

1) Use of different sensors, strain gauges, inclinometers,
2) Performance characteristics
3) Errors during the measurement process
4) Calibration of measuring sensors and instruments
5) Measurement, noise and signal processing
6) Analog Signal processing
7) Digital Signal Processing
8) Demonstration & use of sensor technologies

Self-study: NIL

Site/Industrial Visits: NIL

Course outcomes: - Upon the completion of this course the student will be able to:

CO1. Understand the properties civil engineering materials

CO2. Understand the components and functions of buildings made up of masonry and concrete

CO3. Understand the types of doors, windows and staircases made up of various materials

CO4. Understand the prefabrication and precast techniques in construction

CO5. Understand the test procedures for material testing and analyse the properties of materials using standard methods and evaluation procedures

Textbooks:

1. J.G. Joshi,"Electronics Measurements & Instrumentation", Khanna Publishing House
2. A.K. Sahwney, "A Course in Electronics Measurements and Instrumentation”, Dhanpat Rai and Sons, New Delhi

Reference Books:

1. Alan S Morris, "Measurement and Instrumentation Principles", 3rd/e, Butterworth Hienemann,2001
2. David A. Bell, "Electronic Instrumentation and Measurements" 2nd/e, Oxford Press, 2007
3. S. Tumanski, “Principle of Electrical Measurement”, Taylor & Francis,2006
4. Ilya Gertsbakh, "Measurement Theory for Engineers", Springer, 2010

Online Resources:

NIL

<table>
<tr><td colspan="6">Course Name: - Professional Ethics</td></tr>
<tr><td colspan="6">Course Code: HS402</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>HSMC</td></tr>
<tr><td>Contact Hrs./Week</td><td>2</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>30</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>2</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: Basic elements of civil engineering professional practice are introduced in this course. Roles of all participants in the process-owners, developers, designers, consultants, architects, contractors, and suppliers - are described. Basic concepts in professional practice, business management, public policy, leadership, and professional licensure are introduced.</td></tr>
<tr><td colspan="6">Prerequisites: Nil</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 Principles of Planning and Management</td></tr>
<tr><td colspan="5">Managerial Roles, Essential Managerial Skills, Key personal characteristics for Managerial success. Evolution and various schools to management thoughts, continuing management themes – quality and performance excellence, global awareness, learning organization, Characteristics of 21st century Executives. Social responsibility of managers. Planning: steps in planning process; setting and managing objectives – MBO method, Strategies: importance, formulation of policies; Programs: Planning premises: concept, developing effective planning premises; Decision making, approaches to decision making, various techniques used for decision making. Organizing: organization structure, formal and informal organization. Traditional Organization Structures Directions in organizational Structures – Team structure, network structure, boundary less structure, Organizing Trends and Practices – Chain of command, unity of command, span of control, delegation and empowerment, decentralization and use of staff, organizational design and organizational configuration.</td><td>8</td></tr>
<tr><td colspan="6">Unit-2 Leadership and Control in Management</td></tr>
<tr><td colspan="5">Leadership: Leadership and vision, Leadership traits, classic Leadership styles. Leaders behaviour – Likert's four systems, Managerial Grid. Overlapping role of leader and managers. The organizational context of communication, Directions of communications, channels of communication, Barriers to communication. Motivation and rewards, rewards and performance. Hierarchy of need theory and two factor theory. Integrated model of motivation.
Controlling: Control function in management, The basic control process. Types of control – feed forward, concurrent and feedback controls. Factors in control effectiveness.</td><td>3</td></tr>
</table>

Unit-3 Professional Practice & Ethics	
Professional Practice: Respective roles of various stakeholders: Government (constituting regulatory bodies and standardization organizations, prescribing norms to ensure safety of the citizens); Standardization Bodies (ex. BIS, IRC)(formulating standards of practice); professional bodies (ex. Institution of Engineers(India), Indian Roads Congress, IIA/ COA, ECI, Local Bodies/ Planning Authorities) (certifying professionals and offering platforms for interaction); Clients/ owners (role governed by contracts); Developers (role governed by regulations such as RERA); Consultants (role governed by bodies such as CEAI); Contractors (role governed by contracts and regulatory Acts and Standards); Manufacturers/ Vendors/ Service agencies (role governed by contracts and regulatory Acts and Standards), **Professional Ethics** – Definition of Ethics, Professional Ethics, Business Ethics, Corporate , Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers (India); Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.	8
Unit-4 Contract Management	
General Principles of Contracts Management: Indian Contract Act, 1972 and amendments covering General principles of contracting; Contract Formation & Law; Privacy of contract; Various types of contract and their features; Valid & Voidable Contracts; Prime and sub-contracts; Joint Ventures & Consortium; Complex contract terminology; Tenders, Request For Proposals, Bids & Proposals; Bid Evaluation; Contract Conditions & Specifications; Critical /"Red Flag" conditions; Contract award & Notice To Proceed; Variations & Changes in Contracts; Differing site conditions; Cost escalation; Delays, Suspensions & Terminations; Time extensions & Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation; Performance and Excusable Non-performance; Contract documentation; Contract Notices; Wrong practices in contracting (Bid shopping, Bid fixing, Cartels); Reverse auction; Case Studies; Build-Own-Operate & variations; Public- Private Partnerships; International Commercial Terms;	6
Unit-5 Arbitration, Conciliation and Alternative Dispute Resolution (ADR) System	

Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996; UNCITRAL model law – Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision; Enforcement of foreign awards – New York and Geneva Convention Awards; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok Adalats	5
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: 1.Understand the importance of planning, management and organization in engineering firms 2.Understand the importance of leadership qualities and controlling the processes and work force in organization 3.Understand the importance of professional practice and ethics in engineering 4.Understand the basics of contract management 5.Understand the basics of arbitration laws and agreements	
Textbooks: **1.** R.R. Gaur, R. Sangal, G.P. Bagaria,” A Foundation Course in Human Values and Professional Ethics” Excel Books, Delhi **2.** Premvir Kapoor, “Professional Ethics and Human Values”, Khanna Book Publishing	

Reference Books:

1. CB Gupta, “A Textbook of Organizational Behaviour”, S. Chand Publications New Delhi
2. LM Prasad, “Organizational Behaviour”, Sutan Chand and Sons
3. **B**.S. Patil, "Legal Aspects of Building and Engineering Contracts", 1974.
4. The National Building Code, BIS, 2017
5. RERA Act, 2017
6. Meena Rao, "Fundamental concepts in Law of Contract", 3rd Edn. Professional Offset, 2006
7. Neelima Chandiramani, "The Law of Contract: An Outline", 2nd Edn. Avinash Publications Mumbai,2000
8. Avtar Singh, "Law of Contract", Eastern Book Co., 2002
9. Dutt, "Indian Contract Act", Eastern Law House,1994
10. Anson W.R., "Law of Contract, Oxford University Press,1979
11. Kwatra G.K., "The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration", 2005
12. Wadhera, "Intellectual Property Rights", Universal Law Publishing Co.,2005
13. T. Ramappa, “Intellectual Property Rights Law in India, Asia Law House", 2010

Online Resources:
NIL

<table>
<tr><td colspan="6" align="center">Course Name: - Cyber Security</td></tr>
<tr><td colspan="6" align="center">Course Code: MC402</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td align="right">Category</td><td>MC</td></tr>
<tr><td>Contact Hrs./Week</td><td>2</td><td>0</td><td>0</td><td align="right">CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>30</td><td>0</td><td>0</td><td align="right">ESE Marks</td><td>0</td></tr>
<tr><td>Credits.</td><td>2</td><td>0</td><td>0</td><td align="right">Exam Hours</td><td>0</td></tr>
<tr><td colspan="6">Course objectives: The objectives of this course is providing knowledge about different Cyber Crimes, Threats and Laws. Creating awareness about risk management and protection from the cyber threats.</td></tr>
<tr><td colspan="6">Prerequisites: NA</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="5">Unit -1 Security Fundamentals</td><td></td></tr>
<tr><td colspan="5">Architecture, Authentication, Authorization ,Accountability, Social Media, Social Networking and Cyber Security.
Cyber Laws, IT Act 2000-IT Act 2008-Laws for Cyber-Security, Comprehensive National Cyber-Security Initiative CNCI – Legalities.</td><td>6</td></tr>
<tr><td colspan="5">Unit -2 Cyber Attack and Cyber Services</td><td></td></tr>
<tr><td colspan="5">Computer Virus – Computer Worms – Trojan horse.
Vulnerabilities - Phishing - Online Attacks – Pharming - Phoarging – Cyber Attacks - Cyber Threats - Zombie- stuxnet - Denial of Service Vulnerabilities - Server Hardening-TCP/IP attack-SYN Flood.</td><td>6</td></tr>
<tr><td colspan="6">Unit-3 Cyber Security Management</td></tr>
<tr><td colspan="5">Risk Management and Assessment - Risk Management Process - Threat Determination Process -Risk Assessment - Risk Management Lifecycle.
Security Policy Management - Security Policies - Coverage Matrix
Business Continuity Planning – Disaster Types - Disaster Recovery Plan - Business Continuity Planning Process</td><td>6</td></tr>
<tr><td colspan="5">Unit-4 Vulnerability and Architechtural Intregration</td><td></td></tr>
</table>

Vulnerability - Assessment and Tools: Vulnerability Testing - Penetration Testing Black box- white box. Architectural Integration: Security Zones – Devices viz. Routers, Firewalls, DMZ. Configuration Management - Certification and Accreditation for Cyber	**6**
Unit-5 Authentication and Cryptography	
Authentication and Cryptography: Authentication - Cryptosystems - Certificate Services Securing Communications: Securing Services - Transport – Wireless - Steganography and NTFS Data Streams. Intrusion Detection and Prevention Systems: Intrusion - Defense in Depth - IDS/ IPS -IDS/IPS Weakness and Forensic Analysis. Cyber Evolution: Cyber Organization - Cyber Future**.**	**6**

Self-study: NIL

Site/Industrial Visits: NIL

Course outcomes: - Upon the completion of this course the student will be able to:

CO1 – Explain the concepts associated to Indian Information Technology Act 2000 and 2008 (L2)
CO2 – Illustrate the need for Security and outline Threats, Attacks, Legal issues. (L2)
CO3 – Experiment with various Risk, Vulnerable and Possible Controls (L3)

CO4 – Understand the Policies, Standards and Practices of Information Security (L2)
CO5 – Examine the IDS, Scanning, Tools and Access Control Devices in connection with authentication and cryptography (L4)

Textbooks:

T1. Jennifer L. Bayuk and Jason Healey and Paul Rohmeyer and Marcus Sachs, Cyber Security Policy Guidebook, Wiley; 1 edition , 2012, ISBN-10: 1118027809
T2. Dan Shoemaker and Wm. Arthur Conklin, Cybersecurity: The Essential Body Of Knowledge, Delmar Cengage Learning; 1 edition (May 17, 2011) ,ISBN-10: 1435481690
T3. Jason Andress, The Basics of Information Security: Understanding the Fundamentals of InfoSec in Theory and Practice, Syngress; 1 edition (June 24, 2011) , ISBN-10: 1597496537

Reference Books:

R1. Matt Bishop, "Computer Security Art and Science", Pearson/PHI, 2009.
R2. Stuart Mc Clure, Joel Scrambray, George Kurtz, "Hacking Exposed", 7th Edition Tata McGraw-Hill, 2012.
R3. Stallings, "Cryptography & Network Security - Principles & Practice", Prentice Hall, 3rd Edition 2002.
R4. Bruce, Schneier, "Applied Cryptography", 2nd Edition, Toha Wiley & Sons, 2007.
R5. Man Young Rhee, "Internet Security", Wiley, 2003.
R6. Pfleeger & Pfleeger, "Security in Computing", Pearson Education, 3rd Edition, 2003.

Online Resources:

1. W1. https://www.aicte-india.org/downloads/itact2000.pdf
2. Von Solms, Rossouw, and Johan Van Niekerk. "From information security to cyber security." *computers & security*38 (2013): 97-102.
3. Ahmad, Nazilah, et al. "Cyber Security Situational Awareness among Parents." *2018 Cyber Resilience Conference (CRC)*. IEEE, 2018.
4. Bhusan, Mayank, Rajkumar Singh Rathore, and Aatif Jamshed. *Fundamental of Cyber Security*. BPB Publications, 2018.
5. Klingensmith, Kurt, and Azad M. Madni. "Architecting Cyber-Secure, Resilient System-of-Systems." *Disciplinary Convergence in Systems Engineering Research*. Springer, Cham, 2018. 157-174.

SEMESTER-V

Course Name: - Structural Engineering					
Course Code: CE531					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	1	0	**CIA Marks**	50
Contact Hrs./Sem.	45	15	0	**ESE Marks**	50
Credits.	3	1	0	**Exam Hours**	3
Course objectives: course aims at providing students with a solid background on principles of structural engineering design. Students will be exposed to the theories and concepts of both concrete and steel design and analysis both at the element and system levels.					
Prerequisites: Mechanics of Solids					
Units					**Teaching Hours**
Unit-1 Introduction Energy Principles					

Introduction- concepts of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium; what is a structural engineer, role of engineer, architect, user, builder; what are the functions' what do the engineers design, first principles of process of design	12
Unit-2 Planning and Design Process	
Materials, Loads, and Design Safety; Behaviour and Properties of Concrete and Steel; Wind and Earthquake Loads	12
Unit-3 Materials and Structural Design Criteria	
Introduction to the analysis and design of structural systems. Analyses of determinate and indeterminate trusses, beams, and frames, and design philosophies for structural engineering. Laboratory experiments dealing with the analysis of determinate and indeterminate structures;	12
Unit-4 Design of Structural Elements	
Concrete Elements, Steel Elements, Structural Joints; Theories and concepts of both concrete and steel design and analysis both at the element and system levels. Approximate Analysis Methods as a Basis for Design; Design of Reinforced Concrete Beams for Flexure; Design of Reinforced Concrete Beams for Shear; Bond, Anchorage, and Serviceability; Reinforced Concrete Columns; Reinforced Concrete Slabs; Introduction to Steel Design; Tension Members and Connections; Bending Members; Structural Systems	12
Unit-5 System Design Concepts	
Special Topics that may be Covered as Part of the Design Project Discussions; Cable Structures; Prestressed Concrete Bridges; Constructability and Structural Control; Fire Protection	12
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: 1.Understand concepts of energy principles, safety, sustainable development in performance 2. Understand Planning and Design Process 3.Understand Materials and Structural Design Criteria 4.Design RC beams and columns, Structural steel compression and tension members 5.Understand System Design Concepts	

Textbooks: 1.Nilson, A. H. *Design of Concrete Structures.* 13th edition. McGraw Hill, 2004 2.McCormac, J.C., Nelson, J.K. Jr., *Structural Steel Design*. 3rd edition. Prentice Hall, N.J., 2003. 3.Galambos, T.V., Lin, F.J., Johnston, B.G., *Basic Steel Design with LRFD*, Prentice Hall, 1996 4. Segui, W. T., *LRFD Steel Design*, 2nd Ed., PWS Publishing, Boston. 5.Salmon, C.G. and Johnson, J.E., *Steel Structures: Design and Behavior*, 3rd Edition, Harper & Row, Publishers, New York, 1990. 6.MacGregor, J. G., *Reinforced Concrete: Mechanics and Design*, 3rd Edition, Prentice Hall, New Jersey, 1997. 7.Nawy, E. G., *Reinforced Concrete: A Fundamental Approach*, 5th Edition, Prentice Hall, New Jersey. 8.Wang C-K. and Salmon, C. G., *Reinforced Concrete Design*, 6th Edition, Addison Wesley, New York. 9.Nawy, E. G. *Prestressed Concrete: A Fundamental Approach*, Prentice Hall, NJ, (2003). **10.**Related Codes of Practice of BIS
Reference Books: 1. Smith, J. C., *Structural Analysis*, Harpor and Row, Publishers, New York. 2. W. McGuire, R. H. Gallagher and R. D. Ziemian. “Matrix Structural Analysis", 2nd Edition, John Wiley and Sons, 2000. 3. NBC, *National Building Code*, BIS (2017). **4.** ASCE, *Minimum Design Loads for Buildings and Other Structures, ASCE 7-02*, American Society of Civil Engineers, Virginia, 2002.
Online Resources: NIL

Course Name: - Geotechnical Engineering					
Course Code: CE532P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	3
Course objectives: The objective of this subject is to study and understand the basic concepts of Soil mechanics and Properties, behavior of soil and their significance under Compaction, Consolidation and Shear strength.					
Prerequisites: Basics of civil engineering, engineering Mechanics, Strength of Materials, Fluid Mechanics					

Units	Teaching Hours
Unit-1	
Chapter 1: Introduction–Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Basic Definitions and Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight, voids ratio- moisture content, unit weight- percent air voids, saturation- moisture content, moisture content-specific gravity etc. Chapter 2: *Plasticity Characteristics of Soil* - Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system.	07
Unit-2	

Chapter 1: Permeability of Soil - Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant-head method, falling-head method.Field method: pumping- in test, pumping- out test. Permeability aspects: permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis-Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets. *Chapter 2: Effective Stress Principle* - Introduction, effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition.	06
Unit-3	
Chapter 1: Compaction of Soil-Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control. *Chapter 2: Consolidation of Soil* - Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.	09
Unit-4	
Chapter 1: Shear Strength - Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, *Chapter 2: types of shear tests*- Direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters. unconfined compression test, vane shear test	08
Unit-5	
Chapter 1: Stability of Slopes - Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts. *Chapter 2: Soil Exploration*- Introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advance soil exploration methods.	07
PRACTICALS	

Lab Experiments: 1. Field Density using Core Cutter method. 2. Field Density using Sand replacement method. 3. Natural moisture content using Oven Drying method. 4. Field identification of Fine Grained soils. 5. Specific gravity of Soils. 6. Grain size distribution by Sieve Analysis. 7. Grain size distribution by Hydrometer Analysis. 8. Consistency limits by Liquid limit 9. Consistency limits by Plastic limit 11. Permeability test using Constant-head test method. 12. Permeability test using Falling-head method. 13. Compaction test: Standard Proctor test. 14. Direct Shear Test 15. Unconfined Compression Strength Test.
Self-study: Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system.
Site/Industrial Visits: NIL
Course outcomes: - Upon the completion of this course the student will be able to: CO1 Understand the different types of soil based on their formation mechanism, various phase diagrams and behaviour of soils based on their moisture contents. CO2 Determine the permeability of soils through various laboratory and field tests and Plot various stress distribution diagrams along the depth of the soil mass CO3 Determine the compactive effort required to obtain necessary degree of compaction in-situ and evaluate ground settlements against time with consolidation CO4 Understand the significance of shear strength parameters in various geotechnical Analyses and evaluate the stiffness of soil using shear strength parameters. CO5 Evaluate factor of safety of infinite slopes based on different ground conditions and specify a strategy for site investigation to identify the soil deposits and determine the depth and spatial extent within the ground
Textbooks: T1 Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy T2 Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri. T3 Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning

Reference Books: 1. Soil Mechanics by Craig R.F., Chapman & Hall 2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons R3. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ R4. Principles of Foundation Engineering, by Braja M. Das, Cengage Learning
Online Resources: W1. http://nptel.ac.in/courses/105103097/ W2. https://www.geoengineer.org/online-library/soil-mechanics

<table>
<tr><td colspan="6">Course Name: - Hydrology and Water Resources Engineering</td></tr>
<tr><td colspan="6">Course Code: CE533</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>PCC</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>1</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>15</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>1</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: The objective of this subject is to study the basics and importance of Hydrology and Water Resources</td></tr>
<tr><td colspan="6">Prerequisites: Fluid Mechanics, Hydraulics and Hydraulic Machines.</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 Introduction to Hydrology & Water Resources Engineering</td></tr>
<tr><td colspan="5">INTRODUCTION: Definition of hydrology. Importance of hydrology. Global water availability. India’s water availability. Practical applications of hydrology. Hydrologic cycle (Horton’s qualitative and engineering representations).
WATER RESOURCES: Introduction. Water wealth. River basins and their potential. Importance of water resources projects in India. Water resources development in Karnataka.
PRECIPITATION: Definition. Forms and types of precipitation. Measurement of rain fall using Symon’s and Syphon type of rain gauges. Optimum number of rain gauge stations. Consistency of rainfall data (double mass curve method). Computation of mean rainfall (arithmetic average, Thiessen’s polygon and Isohyetal methods). Estimation of missing rainfall data (Arithmetic average, normal ratio and regression methods). Presentation of precipitation data (moving average curve, mass curve, rainfall hyetographs, intensity – duration - frequency curves).</td><td>12</td></tr>
<tr><td colspan="6">Unit-2 Losses from Precipitation</td></tr>
<tr><td colspan="5">Losses From Precipitation: Introduction. Evaporation: Definition, Process, factors affecting, measurement using IS Class A Pan. Estimation using empirical formulae. Infiltration: Definition, factors affecting infiltration capacity, measurement (double ring infiltrometer). Harton’s infiltration equation, infiltration indices Runoff: Definition. Concept of catchment. Water budget equation. Components. Factors affecting. Rainfall - runoff relationship using simple regression analysis. Evapotranspiration: AET, PET, Factors affecting evapotranspiration, Measurement of evapotranspiration, Pennman’s equation and BlaneyCriddle’s formula and problems.</td><td>12</td></tr>
</table>

Unit-3 Hydrographs and Ground Water Hydrology	
Hydrographs: Definition. Components of Hydrograph. Unit hydrograph and its derivation from simple storm hydrogaphs. Base flow separation. S–curve and its uses **Ground Water Hydrology and Well Hydraulics:** Scope and importance of ground water hydrology. Aquifer parameters. Steady radial flow into wells in unconfined and confined aquifers. Types of wells, Methods of construction.	12
Unit-4 Stream Flow Measurement and Reservoir Sedimentation	
Stream Flow Measurement: Introduction. Measurement of stage. Measurement of discharge by Area–Velocity method and slope area method. Simple stage discharge relation. **Reservoir Sedimentation**: Introduction. Process of erosion. Factors affecting erosion. Sediment yield. Reservoir Sediment control. Determination of Sediment Yield at a reservoir site	12
Unit-5 Flood Routing and Rainwater Harvesting	
Flood Routing and Hydrological Statistics – Introduction to hydrological flood routing, reservoir and channel routing methods, flood frequency studies and forecasting, analysis of extreme events **Rainwater Harvesting**: Introduction. Small scale and small tank harvesting. Urban rain water harvesting. Methods of ground water recharge	12
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: 1.Explain the components of hydrological cycle and analyse the precipitation data. (L2) (PO1, PO2) 2.Estimate evaporation, infiltration, evapo-transportation and runoff (L3) (PO1, PO2, PO4) 3.Develop and interpret hydrographs and estimate yield of aquifers (L5) (PO1, PO2, PO4) 4.Explain the stream flow measurement techniques, reservoir sedimentation process, analyse the stream flow data sets and determine sediment yield in reservoirs. (L2, L4) (PO1, PO2) 5.Analyse inflow and outflow hydrographs using flood routing and compare rain water harvesting methods(L3, L4) (PO1, PO2, PO4)	
Textbooks: 1. Jayarami Reddy, “A Textbook of Hydrology”, Lakshmi Publications, New Delhi 2. Raghunath. H.M., “Hydrology”, Wiley Eastern Publication, New Delhi 3. Subramanya K, “Engineering Hydrology”, Tata McGraw Hill, New Delhi	

Reference Books:

1. Mays, "Ground Resources Engineering", 2016, Wiley India Pvt. Ltd
2. Das and Saikia, Hydrology, PHI learning Private Limited, 2014.
3. S.K.Garg, Hydrology and Water Resources Engineering, 22nd edition, Khanna Publishers, New Delhi, 2014.
4. Linsley, Kohler and Paulhus, Applied Hydrology, Wiley Eastern Publication, New Delhi, 2000.
5. Patra. K. C., Hydrology and water Resources Engineering, 2nd edition, Narosa publishing House, New Delhi, 2015.
6. Sharma R.K., and Sharma, Hydrology and Water Resources Engineering, Oxford and IBH, New Delhi
7. Todd, Ground Water Hydrology, 3rd edition, Wiley Eastern Publication, New Delhi, 2005.
8. Ven Te Chow, Handbook of Hydrology, McGraw Hill publishers, 2010.
9. Viessman, Jr. and Lewis, Introduction to Hydrology, 5th edition, PHI learning Private Limited, 2011.

Online Resources:

https://nptel.ac.in/content/syllabus_pdf/105107129.pdf

http://www.nptelvideos.in/2012/11/advanced-hydrology.html

Course Name: Project Management and Finance					
Course Code: HS503					
	L	**T**	**P**	Category	HSMC
Contact Hrs./Week	**2**	**0**	**2**	CIA Marks	**50**
Contact Hrs./Sem.	**30**	**0**	**30**	ESE Marks	**50**
Credits.	**2**	**0**	**1**	Exam Hours	**3**

Course objectives: The purpose of this course is to lay the foundation for a solid understanding of project management concepts and principles and to familiarize students with the complexity and challenge of managing public or private projects with tight schedules and limited resources. Students will gain a sound understanding of project management concepts and principles by applying relevant tools and techniques and by making extensive use of case studies and simulation exercises to assimilate that knowledge The course aims at the following learning targets • To understand the concepts of project definition, life cycle, and systems approach; • To develop competency in project scooping, work definition, and work breakdown structure (WBS) • To handle the complex tasks of time estimation and project scheduling, including PERT and CPM • To develop competencies in project costing, budgeting, and financial appraisal	
Prerequisites:	
Units	**Teaching Hours**
Unit-1	
Introduction to Project: Definition of a Project, Sequence of Activities, Unique activities, Complex Activities, Connected Activities, One Goal, Specified Time, Within Budget, According to Specification. Defining a Program, Project parameters: Scope, Quality, Cost, Time, Resources; The scope triangle: Time, Cost, and Resource Availability, Project Classification **Project Management:** Principles of Project Management: Defining, Planning, Executing, Controlling, Closing; Project Management Life Cycle: Phases of Project Management, Levels of Project Management	9
Unit-2:	
Quality Management: Continuous Quality Management Model, Process Quality Management Model; Risk Management, Risk Analysis; Relationship between Project Management and other Methodologies **Project Activities:** Work Breakdown Structure, Uses of WBS, Generating the WBS: Top-Down/ Bottom-Up Approach, WBS for Small Projects, Intermediate WBS for large projects; Criteria to Test for Completeness in the WBS: Measurable Status, Bounded, Deliverable, Cost/Time Estimate, Acceptable Duration Limits, Activity Independence; Approaches to Building the WBS: various approaches, Representing WBS	9
Unit-3:	

Activity Duration, Resource Requirements, & Cost: Duration: Resource Loading versus Activity Duration, Variation in Activity Duration, Methods for Estimating Activity Duration, Estimation Precision; Resources; Estimating Cost, JPP Session to Estimate Activity Duration & Resource Requirements, Determining Resource Requirements **Fundamentals of Project Network Diagram:** Project Network Diagram, Benefits to Network- Based Scheduling, Building the Network Diagram Using the PDM, Analyzing the Initial Project Network Diagram.	9
Unit-4:	
Network Analysis – PERT: Introduction to Project Evaluation and Review Technique, Event, Activity, Dummy, Network rules, Graphical guidelines for network, Common partial situations in network, numbering the events, Cycles; Developing the Network, Planning for network construction, modes of network construction, steps in developing network, hierarchies; Time Estimates in PERT, Uncertainties and use of PERT, Time estimates, Frequency distribution, Mean, Variance & standard deviation, Probability distribution, Beta distribution, Expected time; Time Computations in PERT, Earliest expected time, Formulation for TE, Latest allowable occurrence time, Formulation for TL, Combined tabular computations for TE, TL; Slack, Critical Path, Probability of meeting schedule date. **Network Analysis- CPM:** Introduction to Critical Path Method, Procedure, Networks, Activity time estimate, Earliest event time, Latest allowable occurrence time, Combined tabular computations for TE and TL, Start & Finish times of activity, Float, Critical activities & Critical path. Crashing of project network, Resource leveling and Resource allocation	9
Unit-5:	
Schedules Based on Resource Availability: Resources, Leveling Resources, Acceptability Leveled Schedule, Resource Leveling Strategies, Work Packages: Purpose of a Work Package, Format of a Work Package **Joint Project Planning Session:** Planning the Sessions, Attendees, Facilities, Equipments, Complete Planning Agenda, Deliverables, Project Proposal	9
Self-study:	
Site/Industrial Visits:	
Course outcomes: By the end of the course, students should be able to the following tools and techniques of effective project management: • objective setting and project design • planning, scheduling, and budgeting • progress control and monitoring • risk assessment and management They will also develop a better appreciation for the critical role that human resources skills play in ensuring timely and successful project completion	

Textbooks: 1. "Effective Project Management", Robert K. Wysocki, Robert Beck. Jr., and David B. Crane; - John Wiley & Sons 2. "Project Planning and Control with CPM and PERT" Dr. B.C. Punamia&K.K.Khandelwal; - Laxmi Publications, New Delhi
Reference Books: 1. "Project Management" S. Choudhury, - TMH Publishing Co. Ltd, New Delhi 2. "Total Project Management- The Indian Context" P. K. Joy, - Macmillan India Ltd., Delhi 3. "Project Management in Manufacturing and High Technology Operations" AdedejiBodundeBadiru, - John Wiley and Sons 4. "Course in PERT & CPM" R.C.Gupta, - DhanpatRai and Sons, New Delhi 5. "Fundamentals of PERT/ CPM and Project Management" S.K. Bhattacharjee; - Khanna Publishers, New Delhi
Online Resources:

SEMESTER -VI

Course Name: - Environmental Engineering					
Course Code: CE631P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	3
Course objectives: The objective of this course is to study the Design of sewers and Materials of sewers, appurtenances and characterization, Effluents and its Treatment, the importance of Environmental science and Environmental studies cannot be disputed.					
Prerequisites: Engineering Chemistry, Fluid Mechanics, Hydrology and Water resources Engineering and Water Supply engineering.					

Units	**Teaching Hours**
Unit-1 Introduction	
Introduction: Necessity for sanitation, methods of domestic wastewater disposal, types of sewerage systems and their suitability. Dry weather flow, factors affecting dry weather flow, flow variations and their effects on design of sewerage system; computation of design flow, estimation of storm flow, rational method and empirical formulae of design of storm water drain. Time of concentration	9
Unit-2 Design of Sewers	

: Hydraulic formulae for velocity, effects of flow variations on **Design of Sewers** velocity, self-cleansing and non-scouring velocities, Design of hydraulic elements for circular sewers flowing full and flowing partially full (No derivations). **Materials of Sewers:** Sewer materials, shapes of sewers, laying of sewers, joints and testing of sewers, ventilation and cleaning of sewers.	9
Unit-3 Sewer Appurtenances and Wastewater Characterization	
Sewer Appurtenances: Catch basins, manholes, flushing tanks, oil and grease traps, Drainage traps. Basic principles of house drainage. Typical layout plan showing house drainage connections, maintenance of house drainage **Wastewater Characterization:** Sampling, significance, techniques and frequency. Physical, Chemical and Biological characteristics, Aerobic and Anaerobic activity, CNS cycles. BOD, COD and their significance & problems.	9
Unit-4 Disposal of Effluents and Treatment of Wastewater	
Disposal of Effluents: Disposal of Effluents by dilution, self-purification phenomenon. Oxygen sag curve, Zones of purification, Sewage farming, sewage sickness, Effluent Disposal standards for land, surface water & ocean. Numerical Problems on Disposal of Effluents. Streeter Phelps equation. **Treatment of Wastewater:** Flow diagram of municipal wastewater treatment plant. Preliminary & Primary treatment: Screening, grit chambers, skimming tanks, and primary sedimentation tanks – Design criteria & Design examples	11
Unit-5 Waste water Treatment systems	
Secondary Treatment: Suspended growth and fixed film bioprocess. Trickling filter–theory and operation, types and designs. Activated sludge process- Principle and flow diagram, Modifications of ASP, F/M ratio. Design of ASP. Anaerobic Sludge digestion, Sludge digestion tanks, Design of Sludge drying beds. Low cost waste treatment method. Septic tank, Oxidation Pond and Oxidation ditches – Design. Reuse and recycle of wastewater.	7
PRACTICALS	

Environment Engineering Laboratory

ANALYSIS OF WATER QUALITY PARAMETERS: -

1. Determination of Alkalinity, Acidity and pH.
2. Electrical conductivity. Determination of Chlorides and Sulphates.
3. Determination of Dissolved Oxygen
4. Determination of Calcium, Magnesium and Total Hardness
5. Determination of Fluorides SPANDS Method.
6. Determination of Iron. Phenanthroline method.
7. Jar Test for Optimum Dosage of Alum, Turbidity determination by Nephelometer
8. Determination of sodium and potassium by flame photometer.
9. Determination of percentage of available chlorine in bleaching powder, Residual Chlorine and Chlorine Demand.
10. MPN Determination

ANALYSIS OF WASTE-WATER QUALITY PARAMETERS: -

1. Determination of Solids in Sewage: Total Solids, Suspended Solids, Dissolved Solids, Volatile Solids, Fixed Solids, Settle able Solids.
2. Determination of BOD.
3. Determination of COD.
4. Determination Nitrates by spectrophotometer.

Self-study: sludge disposal methods

Site/Industrial Visits: Municipal wastewater treatment plant

Course outcomes: - Upon the completion of this course the student will be able to:

1.Appreciate the necessity for sanitation; identify types of sewerage systems, estimate the flow and factors affecting.

2.Classify and compare different sewer appurtenances and plan sewer system.

3.Interpret the quality of the effluent and treated water.

4.Compare and relate different wastewater treatment methods.

5.Interpret reuse and recycle of wastewater, categorize low cost waste treatment methods.

6.Analyse and interpret water and wastewater quality of different sources.

Textbooks:

1. B C Punmia, "Environmental Engineering vol-II", Laxmi Publications 2nd, 2016
2. S.K. Garg, "Environmental Engineering vol-II, Water supply Engineering", Khanna Publishers, – New Delhi, 28th edition and 2017
3. Fair, Geyer and Okun "Water and Wastewater Engineering Vol – II", John Willey Publishers, New York.
4. Metcalf and Eddy Inc: "Wastewater Treatment, Disposal and Reuse", Tata McGraw Hill Publications

Reference Books:

1. Karia G.L., and Christian R.A, "Wastewater Treatment Concepts and Design Approach", Prentice Hall of India Pvt. Ltd., New Delhi. 3rd, Edition, 2017
2. Hammer and Hammer "Water Technology",
3. Howard S. Peavy, Donald R. Rowe, George Tchnobanoglous "Environmental Engineering", McGraw Hill International Edition.
4. "Manual of Water and Wastewater Analysis", NEERI Publication.
5. "Standard Methods for Examination of Water and Wastewater (1995)", American Publication – Association, Water Pollution Control Federation, American Water Works Association, Washington DC.
6. IS Standards: "2490-1974, 3360-1974, 3307-1974",
7. Sawyer and McCarthy "Chemistry for Environment Engineering",
8. "Standard Methods for Examination of Water and Wastewater (1995)", American Publication – Association, Water Pollution Control Federation, American Water Works Association, Washington DC.
9. IS Standards: "2490-1974, 3360-1974, 3307-1974",

Online Resources:

https://nptel.ac.in/courses/105/106/105106119/

Course Name: - Highway Engineering					
Course Code: CE632P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	3

Course objectives: The objective of this subject is to build a Strong, Stable and Deep concept in Highway Engineering, and also to have a clear picture in the details of Design, Construction and Maintenance of Highway structures coming under this field.

Prerequisites: Surveying, Strength of Materials and Soil Mechanics.

Units	**Teaching Hours**
Unit-1 Principles of Transportation Engineering & Highway Development and Planning	
Principles of Transportation Engineering: Importance of Transportation. Different modes of transportation, characteristics and comparison of different modes. Jayakar committee recommendations and implementation **Highway Development and Planning**: Road Types and clasication, road patterns. Planning surveys, Master plan – saturation system of road planning, phasing road development programme Road Development in India, 1st, 2nd & 3rd 20-year road development plan and problems only on 3rd 20-year road plan. Present scenario of road development in India (NHDP & PMGSY) and in Karnataka (KSHIP & KRDCL) –problems on best alignment among alternate proposals and phasing, Road Development Plan Vision 2021. Introduction to Transportation Planning, Travel demand modeling, Data collection, Trip generation, Trip distribution, Modal split and traffic assignment.	12
Unit-2 Highway Alignment Surveys and Geometric Design	
Highway Alignment and Surveys: Ideal alignment, factors affecting alignment, Engineering Surveys For New And Realignment Projects. **Highway Geometric Design-1:** Importance, Factors controlling the design of geometric elements, highway cross section elements – pavement surface characteristics, camber, width of carriageway, shoulder width, formation width, right of way, typical cross section of roads. **Highway Geometric Design-2:** Sight distance, Types and importance - Design of horizontal and vertical alignment – Numerical problems on above (No derivation of formulae).	10
Unit-3 Pavement Materials and Design	

<table>
<tr><td>Pavement Materials: Properties and requirements of subgrade soils, HRB and IS soil classification. Determination of CBR and Modulus of subgrade reaction of soil. Properties and requirements of road aggregates, Bitumen – Tar – Emulsion – Cutback, just mention the types of tests on aggregates, bitumen and cut back for evaluating the required properties. Numerical problems on above.
Pavement Design: Types of pavements – Design factors, Determination of ESWL by equal stress criteria and problems. IRC method of flexible pavement design based on CSA method using IRC: 37 – 2001. Stresses in rigid pavement and design of rigid pavement as per IRC: 58 –2011 excluding design of joints.</td><td>8</td></tr>
<tr><td colspan="2">Unit-4 Pavement Construction and Highway Drainage System</td></tr>
<tr><td>Pavement Construction: Specifications, construction steps and quality control tests for earthwork in cutting, filling and preparation of subgrade, Granular sub base course, Granular base / sub-base courses such as WBM, WMM, CRM, bituminous binder course (BM and DBM), common types of bituminous surfacing courses such as surface dressing, premixed carpet (PMC) and bituminous concrete and Rigid pavement (DLC and PQC).
Highway Drainage System: Surface and Sub-subsurface drainage system for road pavements, types, functions and basic design principles.</td><td>8</td></tr>
<tr><td colspan="2">Unit-5 Highway Economics and Financing and Pavement Maintenance</td></tr>
<tr><td>Highway Economics and Financing: Highway user benefits – VOC using charts only – Highway costs – Economic analysis by annual cost method and benefit cost ratio method, NPV and IRR methods. Numerical problems on above. Highway financing – BOT, BOOT and Annuity concepts
Pavement Maintenance: Pavement failures, Types, Causes and remedies. Maintenance of highways. Principles of pavement evaluation – functional and structural evaluation</td><td>7</td></tr>
<tr><td colspan="2">PRACTICALS</td></tr>
<tr><td colspan="2">Highway Materials Laboratory
Aggregates: Crushing, abrasion, impact and Shape tests (Flaky, Elongation, Angularity number) Specific gravity and water absorption.
Bituminous Materials and Mixes: Specific Gravity, Penetration, Ductility, Softening point, Flash and fire point, Viscosity, Marshall Stability test.
Demonstration: Benkelmen Beam deflection and bitumen extractor</td></tr>
<tr><td colspan="2">Self-study: OpenRoads, Civil Design Software for Road Networks.</td></tr>
<tr><td colspan="2">Site/Industrial Visits: NIL</td></tr>
</table>

Course outcomes: - Upon the completion of this course the student will be able to:

1.Understand the importance of transportation for growth of country, compute trip generation and application of gravity model for trip distribution (L2, L3)
2.Analyse and design geometric features of the highway (L2, L4, L6)
3.Testing of pavement materials and design of pavement mix proportion as per Indian standards (L2, L4, L6)
4.Understand the pavement construction as per Indian standards and highway drainage system (L2)
5.Understand highway economic, financing, and maintenance (L2)

Textbooks:

1. Kadiyali, L.R., “Highway Engineering, Khanna Publishers”, New Delhi.
2. Khanna, S.K. and Justo, C.E.G., ‘Highway Engineering”, Nem Chand and Bros, Roorkee (2003).
3. Subramanyam, K.P., “Transportation Engineering–I”, Scitech Publications, Chennai.

Reference Books:

1. “IRC:37-2012 Tentative guidelines for the design of flexible pavements.
2. Bindra, SP; "A Course on Highway Engineering" New Delhi, Dhanpat Rai andSons
3. Chakroborty and Das, “Principles of Transportation Engineering”, PHI learning Private Limited
4. Duggal AK, “Maintenance of Highway – a Reader”, TTTI, Sector 26, Chandigarh
5. Duggal AK, Puri VP., "Laboratory Manual in Highway Engineering", Delhi, New Age Publishers (P) Ltd
6. Khanna S. K., and Justo CEG, “Highway Material Testing Laboratory Manual”, Nem Chand and Bros. Roorkee.
7. Mannering, “Principals of Highway Engineering and Traffic Analysis”, Wiley India Pvt. Ltd
8. MORT & H, IRC, “Specifications for Roads and Bridges”, New Delhi (2001).
9. Partha Chakra Borthy, “Principles of Transportation Engineering”, Prentice-Hall
10.Ponnuswamy S., “Bridge Engineering”, Tata McGraw-Hill Education Pvt. Ltd.
11.Rao, GV’ Transportation Engineering
12.Sehgal, SB; and Bhanot, KL; "A Text Book on Highway Engineering and Airport" Delhi, S Chand and Co
13.Sharma, RC; and Sharma, SK; "Principles and Practice of Highway Engineering", New Delhi, Asia Publishing House
14.Vaswani, NK, "Highway Engineering" Roorkee Publishing House.
15.Yoder. E.J., “Principals of pavement Design”, John Wiley and Sons”, New Delhi‘
16.Priyani, VB, "Highway and Airport Engineering" Anand, Charotar Book Stall

Online Resources: https://nptel.ac.in/courses/105101087/

<table>
<tr><td colspan="6">Course Name: - Extensive Survey Project</td></tr>
<tr><td colspan="6">Course Code: CE651</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>PCC</td></tr>
<tr><td>Contact Hrs./Week</td><td>1</td><td>0</td><td>2</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>15</td><td>0</td><td>30</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>1</td><td>0</td><td>1</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: To familiarise the students in Extensive Survey Training Involving Investigation and Design of the tank projects, Highway Alignment and water supply schemes.</td></tr>
<tr><td colspan="6">Prerequisites: Surveying, Fluid Mechanics, Soil Mechanics, Hydrology and Water Resources Engineering, Water Supply Engineering, Auto Cad and Auto Plotter software</td></tr>
<tr><td colspan="6">Field Work: Survey of Engineering Projects (7 days)
Alignment of New Tank Project, Old Tank Project, Highway, measurements for Mapping of Village/Town for water supply scheme and Capturing of site by drones.</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">UNIT-1 Highway Project</td></tr>
</table>

1. Preliminary and detailed investigations of exiting road 2. topographic surveying of strip of land for proposed alignment 3. design of highway geometric elements 4. Analysis of drone images 5. Plotting of longitudinal and cross sections of existing and proposed road	6
UNIT-2 Water Supply Project	
1. **E**xamination of sources of water supply, 2. Calculation of quantity of water required based on existing and projected population. 3. Analysis of drone images 4. Preparation of village map by any suitable method of surveying, location of sites for ground level and overhead tanks	8
UNIT-3 New Tank Project	
1. Alignment of center line of the proposed bund, Longitudinal and cross sections of the center line. 2. Capacity surveys. 3. Details at Waste weir and sluice points. 4. Analysis of drone images 5. Canal alignment. 6. Plotting of longitudinal and cross section of bund and canal	10
UNIT-4 Old Tank Project	
1. Alignment of center line of the existing and proposed bund, Longitudinal and cross sections of the center line. 2. Analysis of drone images 3. Capacity surveys. 4. Plotting of existing and proposed longitudinal and cross sections of bund	6
Self-study: NIL	
Site/Industrial Visits: NIL	

Course Outcomes - Upon the completion of this course the student will be able to:

1.Analyse existing highway and modify and align the same w.r.t codal recommendations. (L4,
L5, L6) {PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO12, PSO3}

2.Predict the population of village/town, estimate the demand for water, design the water supply network. (L4, L5, L6) {PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO12, PSO3}

3.Design the earthen bund and channel for new tank project (L4, L5, L6) { PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO12, PSO3}

4.Investigate the old tank project and propose a new alignment for the same (L4, L5, L6) { PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO12, PSO3}

Textbooks:

1. B.C. Punmia., Surveying, Vol-1& II, 16th edition, New Delhi, Laxmi Publications, 2016.
2. L.R. Kadiyalli & N.B. Lal, Principles & Practices of Highway Engineering, 4th edition, New Delhi, Khanna Publishers, 2004.
3. S.K. Khanna, C.E.G. Justo & A. Veeraragavan, Highway Engineering, 9th edition, Uttarakhand, Nem Chand and Brothers, 2011.
4. P.N. Modi., Irrigation, Water Resources, and Water-Power Engineering, 9th edition, New Delhi, Standard Book House, 2014.
5. B.C. Punmia et al, Irrigation and Water-Power Engineering, 16th edition, Laxmi Publications, New Delhi, 2016.
6. S.K. Garg, Water supply Engineering, 29th Edition, New Delhi, Khanna Publishers, 2014.

Reference Books:

1. Asawa, C L, “Irrigation Engineering”, New Age Internations (P) Ltd 2008, New Delhi
2. Garg S.K., “Irrigation Engineering and Hydraulic Structures”, Khanna Publications, 2011, New Delhi
3. Sharma, RK; “Text Book of Irrigation Engineering and Hydraulics Structures”, New Delhi : S. Chand and Co, 2002
4. Arora K R., “Irrigation Water-Power & Water Resource Engineering”, Standard Publishers, 2012, New Delhi
5. F. L. Mannering, Principals of Highway Engineering and Traffic Analysis, 5th Edition, Wiley India Pvt. Ltd, 2012.
6. IRC, Specifications for Roads and Bridges, New Delhi, 2001.
7. Peavy. H.S, Rowe. D.R and Tchobanoglous. G, “Environmental Engineering”, McGraw Hill, New Delhi, 2013.

Online Resources:

https://nptel.ac.in/courses/126105010/

https://www.autodesk.in/campaigns/autocad-tutorials

https://docs.qgis.org/3.4/en/docs/training_manual/index.html

SEMESTER -VII

Course Name: - Engineering Economics, Estimation & Costing					
Course Code: CE731P					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	2	**CIA Marks**	70
Contact Hrs./Sem.	45	0	30	**ESE Marks**	30
Credits.	3	0	1	**Exam Hours**	3
Course objectives: Whatever type of Dwelling, Building or Construction is to be undertaken, some form of cost estimate is required to determine the economic feasibility of the project and arrange appropriate finance. Before construction commences, a more detailed estimate is usually prepared in order that the actual cost of the project may be forecast with confidence. This paper summarises the estimating methods to be adopted. At the end of this course the student shall be able to estimate the material quantities, prepare a Bill of quantities, make Specifications and prepare tender documents. Student should also be able to Prepare value Estimates.					
Prerequisites: Building Materials and Construction, Building Planning and Drawing and Computer Aided Design and Drawing.					

Units	**Teaching Hours**
Unit-1 Estimation	
Estimation: Study of various drawings with estimates, important terms, units of measurement, abstract Methods of taking out quantities and cost – center line method. Preparation of detailed and abstract estimates for the following Civil Engineering works – Buildings – RCC framed structures with flat, sloped RCC roofs with all Building components	9
Unit-2 Estimation & Specifications	
Estimate: Different type of estimates, approximate methods of estimating buildings, cost of materials. Estimation of wooden joineries such as doors, windows & ventilators **Estimates:** Steel truss, manhole and septic tanks. **Specifications:** Definition of specifications, objective of writing specifications, essentials in specifications, general and detail specifications of common item of works in buildings.	9

Unit-3 Rate Analysis	
Rate Analysis: Definition and purpose. Working out quantities and rates for the following standard items of works – earth work in different types of soils, cement concrete of different mixes, bricks and stone masonry, flooring, plastering, RCC works, centering and form work for different RCC items, wood and steel works for doors, windows and ventilators.	11
Unit-4 Measurement of Earthwork for Roads	
Measurement of Earthwork for Roads: Methods for computation of earthwork – h cross sections – mid section formula or average end area or mean sectional area, trapezoidal & prismoidal formula with and without cross slopes.	8
Unit-5 Contracts	
Contracts: Types of contract – essentials of contract agreement – legal aspects, penal provisions on breach of contract, PPP Models, FIDIC contracts. Definition of the terms – Tender, earnest money deposit, security deposit, tender forms, documents and types. Comparative statements, acceptance of contract documents and issue of work orders. Duties and liabilities, termination of contract, completion certificate, quality control, right of contractor, refund of deposit. Administrative approval – Technical sanction. Nominal muster roll, measurement books – procedure for recording and checking measurements –preparation of bills	8
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: CO1: Estimate the quantities of various materials required for construction of a given project. CO2: Outline general and detailed specifications of common item of works in buildings as per National Building Code. CO3: Develop rate analysis, for the standard items of work, as per Central Public Works Department CO4: Estimate the quantity of Earthwork for Roads, CO5: Develop quantities and prepare the tender conditions and documents for various works.	
Textbooks: 1. Practical Information for Quantity Surveyors, Property Valuers, Architects, Engineers and Builders (PVG)by Late P. T. Joglekar | 1 January 2017 2. Basin P L "Quantity Surveying", S. Chand & Company: New Delhi. 3. Birde, G S "Textbook of Estimating & Costing", Dhanpat Rai and Sons: New Delhi. 4. Chakraborty, M; "Estimating, Costing and Specification in Civil Engineering", Calcutta 5. Dutta, BN; "Estimating and Costing"	

Reference Books: 1. Kohli D D and R.C. Kohli "A Textbook on Estimating, Costing and Accounts", S. Chand: New Delhi. 2. Kohli, D; and Kohli, RC; "A Textbook on Estimating and Costing (Civil) with Drawings", Ambala Ramesh Publications 3. Nanavati J "Professional Practice for Civil Engineers", 4. Pasrija, HD; Arora, CL and S. Inderjit Singh, "Estimating, Costing and Valuation (Civil)", Delhi, New Asian Publishers 5. Rangwala S C "Estimating & Specification", S.C. Rangwala: Charotar publishing house, Anand. 6. Rangwala, BS; "Estimating and Costing". Anand, Charotar Book Stall
Online Resources: https://nptel.ac.in/courses/105/103/105103023/

Course Name: INTERNSHIP					
Course Code: CE771					
	L	**T**	**P**	**Category**	PROJ
Contact Hrs./Week	0	0	4	**CIA Marks**	50
Contact Hrs./Sem.	0	0	30	**ESE Marks**	50
Credits.	0	0	2	**Exam Hours**	3
Duration of internship: 60 days (2nd semester summer vacation to 6th semester summer vacation)					

Course Description: 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.

Regulations to carryout internship:

1. The student shall undergo an Internship for 60 days starting from the end of 2nd semester examination and completing it during the initial period of 7th 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 advice.
4. The Internship shall be completed by the end of 7th semesters.
5. After completion of Internship, students shall submit a report to the department with the approval of both internal and external guides/mentors.
6. There will be an assessment of the internship, in the form of report assessment by the guide/ mentor and a presentation on the internship given to department constituted panel. 50 IA and 50 External marks for Internship.
7. The guide shall be the internal examiner and IA marks out of 50 are to be awarded by the internal guide after evaluating the Internship Report submitted by the student.
8. Viva-Voce on internship shall be conducted at the college and the date of Viva-Voce shall be fixed in consultation with the external Guide.
9. Viva-Voce on internship shall be conducted by both internal and external guides and jointly evaluate the internship report for 50 marks. The expenses of external guide are to be borne by the student/college.
10. In case of the non-availability of external guide for the conduct of viva-voce, the Principal shall appoint a senior faculty of the department to conduct viva-voce along with the internal guide, and they jointly evaluate the internship report for 50 marks.
11. The students are permitted to carry out the internship outside India with the following conditions:
    a. The entire expenses are to be borne by the student or college and the University will not give any financial assistance.
    b. The Internal Guide has to visit at least once during the student's internship; the expenses of the visit are to borne by the student/college.
    c. The external guide from the industry has to be an examiner for the viva voce on Internship, and the expenses are to be borne by the student/ college.
    d. The University will not provide any kind of Financial Assistance to any student for internship and for the conduct of Viva-Voce on internship. The College shall facilitate and monitor the student internship program. The internship report of each student shall be submitted to the Head of the Department of the college with the approval of the Guide.

Course Objective:

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

Course Outcomes - Upon the completion of this course the student will be able to: CO1 – Demonstrates professional responsibility based on real life experience and exposure (L2) (PO1, PO2, PO3, PO4, PO6, PO8, PO9, PO10) CO2 – Demonstrates discipline outcomes in the work setting. (L2) L2) (PO1, PO2, PO3, PO4, PO6, PO8, PO9, PO10) CO3 – Demonstrate effective listening, oral and written presentation skills (L2) L2) (PO1, PO2, PO3, PO4, PO6, PO8, PO9, PO10)
Submission &Presentation: Knowledge gained in the internship shall be presented in the department in presence of a committee (Panel of faculty members) constituted by HOD. Internship marks are to be awarded by the external and internal guide. Students shall submit the internship report in the prescribed standard format which is acceptable to the industry as well as the parent institute.
Course Outcomes - Upon the completion of this course the student will be able to: CO1 – Discover potential research areas in the field of specialization (L2) CO2 – Make use of results of the study to develop report for oral and written presentation (L3)

Course Name: Field Practice					
Course Code: CE772					
	L	**T**	**P**	Category	**PROJ**
Contact Hrs./Week	**0**	**0**	**2**	**CIA Marks**	**50**
Contact Hrs./Sem.	**0**	**0**	**30**	**ESE Marks**	
Credits.	**0**	**0**	**1**	**Exam Hours**	**3**

Course objectives:
- To provide exposure to Site Practices.
- To provide insights on adopting codal provision in practice
- To enable the student to apply theoretical concepts in applications which involve perception, reasoning and learning.

Units	**Teaching Hours**
Unit-1 Sub Soil	
Marking of Plan, excavation, termite treatment, PCC, stone masonry, footing, Coloumn	9
Unit-2 Superstructure	
Masonry, Opening (door & window), lintel and slab casting	9
Unit-3 Bar Bending & Reinforcement	
Footing, Column, Beam, Slab, Welding	9
Unit-4 Plastering	
Internal and external, tiles cladding, flooring, Finishing-Painting	9
Unit-5 Building Services	
Electrical layout, Plumbing Layout, Sanitary layout	9
Site/Industrial Visits: significant sites nearby	

Course outcomes: student would be able to

CO1: Compare theoretical concepts with practices and Choose best building practices (L4,
CO2: Carryout construction practices according to Codal provisions (L5,
CO3: Discuss the shortfalls of existing practice (L5,

Reference Books:

1.Bhargava D.K, specifications of buildings and methods of measurement
2.Walter Griffin "Civil Engineering Handbook" Anmol Publication,2013.
3.Sanjeev Mathur" Building Construction Handbook" SBS publishers,2012.

Online Resources:

IS 6313-2,2001	Code of Practice for Anti-Termite Measures in Buildings, Part 2: Pre-constructional Chemical Treatment Measures
IS 11134,1984	Code of practice for setting out of buildings
SP 20,1991	Handbook on Masonry Design and Construction
SP 21,2005	Summaries of Indian Standards for Building Materials
SP 25,1984	Handbook on Causes and Prevention of Cracks in Building
SP 62,1997	Handbook on Building Construction Practices
SP 1650,1973	Standard colours for building and decorative finishes
IS 456,2000	Code of practice for plain and reinforced concrete (fourth revision)
IS 2212 ,1991:	Code of practice for brickworks

<table>
<tr><td colspan="6" align="center">Course Name: Project Work – I</td></tr>
<tr><td colspan="6" align="center">Course Code: CE773</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td align="right">Category</td><td>PROJ</td></tr>
<tr><td>Contact Hrs./Week</td><td>0</td><td>0</td><td>4</td><td align="right">CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>0</td><td>0</td><td>60</td><td align="right">ESE Marks</td><td></td></tr>
<tr><td>Credits.</td><td>0</td><td>0</td><td>2</td><td align="right">Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives:
The object of Project Work I is to enable the student to take up investigative study in the broad field of Civil Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor</td></tr>
<tr><td colspan="6">About the Topic: Topic for the Project Work may be from any Civil Engineering and interdisciplinary area related to Civil Engineering as mentioned in content at B.E. (Civil). Project/Practical work at B.E. (Civil) will comprise of literature survey/problem formulation /preparation of experimental setup as the case may be of the identified problem.</td></tr>
<tr><td colspan="6">1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.</td></tr>
<tr><td colspan="6">Course Outcomes - Upon the completion of this course the student will be able to:
CO1 Discover potential research areas in the field of specialization and outline survey of several available literature in the preferred field of study (L2) (PO1 to PO12)
CO2 Compare and contrast the several existing solutions for research challenge and formulate and propose a plan for creating a solution for the research plan identified (L2, L4, L6) (PO1 to PO12)
CO3 Demonstrate an ability to work in teams and manage the conduct of the study and develop report for oral and written presentation (L2) (PO1 to PO12)</td></tr>
</table>

Course Name: - Service Learning					
Course Code: HS704					
	L	**T**	**P**	**Category**	HSMC
Contact Hrs./Week	1	0	2	**CIA Marks**	100
Contact Hrs./Sem.	15	0	30	**ESE Marks**	0
Credits.	1	0	1	**Exam Hours**	0
Course objectives: The course enables the students to get educational experience by participating in an organized service activity that meets identified community needs and reflect on the service activity in such a way as to gain further understanding of the course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility in traffic & environment engineering.					
Prerequisites: Nil					
OPTION A					

Units	**Teaching Hours**
Unit-1 Traffic Engineering	
Traffic Engineering Studies and Analysis, methods of traffic study, equipment, data collection, analysis and interpretation (including case studies) of Spot speed, Volume studies, Speed and delay, Volume, Origin – destination, Parking, Flow/density/speed relationships. Intersection design, Intersection and highway capacity analysis, accident analysis, road safety.	6
Unit-2 Indian Road Congress -Relevant Codes	

IRC 83:1985-Guidelines on Design and Installation of Road Traffic Signals, IRC 9:1972- Traffic census of Urban Roads, IRC 102.1988-Traffic Studies for Planning Bypasses, IRC SP.19.2001-Manual for Survey, Investigation and Preparation of Reports	6
Unit-3 Design, Applications and Case studies	
Signal design: Webster & IRC Methods –Problems, Applications and Case studies in signal & intersection design.	6
Unit-4 Field Work	
Identification of junction/intersection, data collection, analysis and evaluation.	6
Unit-5 Report Work	
Design of junction/intersection/traffic signal and preparation of report	6
Self-study: NIL	
Site/Industrial Visits: NIL	

Course outcomes: - Upon the completion of this course the student will be able to:
CO1: Address real traffic problems in real communities.
CO2: Analyze, evaluate, and design transportation system components.
CO3: Interpret and use experimental and field data;
CO4: Work in small teams with individuals.
CO5: Make oral and written presentations of analyses and designs to supervisors, other Engineers and the general public

Textbooks:

1. L.R. Kadiyali, *Traffic Engineering and Transport Planning*, New Delhi, Khanna Publishers, 2011.
2. S.K. Khanna, C.E.G. Justo and A. Veeraragavan, *Highway Engineering*, 10th Edition, Roorkee, India, Nem Chand and Bros, 2017.

Reference Books:

1. IRC 83:1985-Guidelines on Design and Installation of Road Traffic Signals.
2. IRC 9:1972- Traffic census of Urban Roads.
3. IRC 102:1988-Traffic Studies for Planning Bypasses.
4. IRC SP.19:2001-Manual for Survey, Investigation and Preparation of Reports

Online Resources:
NIL

OPTION B

Units	**Teaching Hours**
Unit-1 Water Quality	

Objectives of water quality management. Concept of safe water, wholesomeness & palatability, water borne diseases. Examination of Water: - Objectives – Physical chemical and Microbiological Examinations, (IS: 3025 and IS: 1622) using analytical and instrumental techniques	6
Unit-2 Standards & Significance	
Drinking water standards BIS & WHO guidelines. Health significance of Fluoride, Nitrates and heavy metals like Mercury, Cadmium, Arsenic etc. Sampling of water for examination	6
Unit-3 Analysis of Water Quality Parameters	
Determination of Alkalinity, Acidity, pH, Electrical conductivity, Chlorides and Sulphates, Dissolved Oxygen, Calcium, Magnesium, Total Hardness, Fluorides, Iron, sodium, potassium and Turbidity- Procedures and demo	6
Unit-4 Field Work	
Identification of village, sampling, experiments, data collection, analysis and evaluate.	6
Unit-5 Report Work	
Design of junction/intersection/traffic signal and preparation of report	6
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: CO1: Test the given water sample. CO2: Interpret and use experimental and field data. CO3: Work in small teams with individuals. CO4: Make oral and written presentations of analyses and designs to supervisors, other Engineers and the general public.	
Textbooks: 1. S. K. Garg, *Environmental Engineering, Vol.II*, Khanna Publishers, New Delhi, 29th revised edition 2014 2. B. C. Punmia, and A. K. Jain, *Environmental Engineering, Vol.II,* Lakshmi Publications, 2nd reprint, 2014 3. G.L. Karia, R.A.Christian., *Wastewater Treatment Concepts and Design Approach*, PHI Learning Private Limited, New Delhi, 2009. 4. *Manual on Wastewater Treatment,* CPHEEO, Ministry of Urban Development, New Delhi (http://urbanindia.nic.in/publicinfo/manual_sewage.htm)	
Reference Books:	
Online Resources: NIL	

Course Name: - SEMINAR

Course Code: CE872					
	L	**T**	**P**	**Category**	PROJ
Contact Hrs./Week	0	0	0	**CIA Marks**	50
Contact Hrs./Sem.	0	0	30	**ESE Marks**	0
Credits.	0	0	2	**Exam Hours**	3

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

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

Course Objective: Students are encouraged to use various teaching aids such as overhead 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.

About the Topic: The topic for the Seminar may be related to Civil Engineering area and interdisciplinary area related to Civil Engineering.

Submission &Presentation: Seminar shall be presented in the department in presence of a committee (Panel of faculty members) constituted by HOD. The seminar marks are to be awarded by the committee. Students shall submit the seminar report in the prescribed standard format.

Course Outcomes - Upon the completion of this course the student will be able to:
CO1 – Discover potential research areas in the field of specialization (L2) (PO1, PO2, PO3, PO4, PO6, PO8, PO9, PO10)
CO2 – Make use of results of the study to develop report for oral and written presentation (L3) (PO1, PO2, PO3, PO4, PO6, PO8, PO9, PO10)

Assessment of Comprehension

Continuous Internal Assessment: 50 Marks

- Presentation assessed by Panel Members

Course Name: - Project Work II					
Course Code: CE873					
	L	**T**	**P**	**Category**	PROJ
Contact Hrs./Week	0	0	16	**CIA Marks**	100
Contact Hrs./Sem.	0	0	120	**ESE Marks**	100
Credits.	0	0	08	**Exam Hours**	3

Course Description: In the fourth year Engineering studies, the student is supposed to apply whatever he has learned through all these years and make a project out of it. If the student is well aware of all the concepts that all the previous semesters have taught him, definitely he can make his project better.

Course objectives:

1. To solve development problems of the society Science and Technology
2. Enrich collegiate education through finding solutions to real life problems.
3. Improve understanding and develop methodology of solving complex issues.

About the Topic: Topic for the Project Work may be from any Civil Engineering and interdisciplinary area related to Civil Engineering as mentioned in content at B.E. (Civil). Project/ Practical work at B.E. (Civil) will comprise of literature survey/problem formulation /preparation of experimental setup as the case may be of the identified problem.

Submission of the Project:

The project report shall be presented in the following form.

1. Definition of the problem.
2. Exhaustive literature survey.
3. Analysis based on type of problem. (as given above)
4. Conclusions, scope for further work.
5. References.

The Project Report shall be submitted in the prescribed standard format (04 copies) to the HOD, after the certification of the concerned guide and HOD.

Course Outcomes - Upon the completion of this course the student will be able to:

1. Discover potential research areas in the field of specialization and outline survey of several available literature in the preferred field of study (L2) (PO1 to PO12)
2. Compare and contrast the several existing solutions for research challenge and formulate and propose a plan for creating a solution for the research plan identified (L2, L4, L6) (PO1 to PO12)
3. Demonstrate an ability to work in teams and manage the conduct of the study and develop report for oral and written presentation (L2) (PO1 to PO12)

Assessment of Project Work
• Continuous Internal Assessment:100 Marks
  • Presentation assessed by Panel Members
  • Assessment by Guide
• End Semester Examination:100 Marks
  • Viva Voce
  • Demonstration
  • Project Report

Programme Electives

ELECTIVE- A-Construction Engineering & Management

Course Name: - Building Construction Practice					
Course Code: CE534EC-01A					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives:					
Prerequisites: Nil					

Units	**Teaching Hours**
Unit-1	
Specifications, details and sequence of activities and construction co-ordination – Site Clearance – Marking – Earthwork. Masonry – stone masonry – Bond in masonry - concrete hollow block masonry – flooring – damp proof courses – construction joints – movement and expansion joints – precast pavements	9
Unit-2	

. Building foundations – basements – temporary shed – centering and shuttering – slip forms – scaffoldings – de-shuttering forms – Fabrication and erection of steel trusses – frames – braced domes – laying brick — weather and water proof – roof finishes – acoustic and fire protection	9
Unit-3	
Sub Structure Construction- Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement-Tunnelling techniques – Piling techniques - well and caisson - sinking cofferdam - cable anchoring and grouting-driving diaphragm walls, sheet piles - shoring for deep cutting - well points -Dewatering and stand by Plant equipment for underground open excavation	9
Unit-4	
Super Structure Construction- Launching girders, bridge decks, off-shore platforms – special forms for shells - techniques for heavy decks – in-situ pre-stressing in high rise structures	9
Unit-5	
Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors - Erection of articulated structures, braced domes and space decks	9
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to:	
Textbooks:	
Reference Books:	
Online Resources: NIL	

Course Name: - Building Information Modeling (BIM)					
Course Code: CE633EC-02A					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	2	0	1	**CIA Marks**	50
Contact Hrs./Sem.	30	0	30	**ESE Marks**	50
Credits.	2	0	1	**Exam Hours**	3
Course objectives:					
Prerequisites: Nil					

Units	Teaching Hours
Unit-1 Introduction to BIM	
Definition of BIM, its need and evolution with modern technique, Basic components of BIM, 3D modeling, materials, costing, time management and project scheduling.	9
Unit-2 Model-based Cost Estimating	
Importing/ linking the estimation to the 3D Model: making data base model for materials and costing with various specifications.	9
Unit-3 Construction Scheduling and 4D Simulation	
Planning and scheduling various stages for any construction project. linking the scheduling to the real time progress and linking the scheduling to the 3D model	9
Unit-4 Design Coordination	
Setting up the information data base model form IS code to simplify the design and 3D model design verification	9
Unit-5 Viewing of the Building Model	
Managing Views, Controlling Object Visibility, Working with Section and Elevation Views, Creating and Modifying 3D Views, Using Dimensions and Constraints, Working with Dimensions, Applying and Removing Constraints	**9**
Self-study: NIL	
Site/Industrial Visits: NIL	

Course outcomes: - Upon the completion of this course the student will be able to:

1.Understand basic principles of BIM (L2)
2.Interfacing costing with BIM (L3, L4)
3.Interfacing Scheduling with BIM (L3, L4)
4.Interfacing Structural model with BIM (L3, L4)
5.Manage and control views of BIM (L3)

Textbooks:
Reference Books:
Online Resources: NIL

Course Name: - Construction Cost Analysising					
Course Code: CE634EC-03A					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives:					
Prerequisites: Nil					

Units	Teaching Hours
Unit-1	
Introduction to the application of scientific principles to costs and estimates of costs in construction engineering Engineering economics Basic principles – Time value of money, Quantifying alternatives for decision making, Cash flow diagrams, Equivalence- Single payment in the future (P/F, F/P), Present payment compared to uniform series payments (P/A, A/P), Future payment compared to uniform series payments (F/A, A/F), Arithmetic gradient, Geometric gradient	9
Unit-2	
Comparison of alternatives: Present, future and annual worth method of comparing alternatives, Rate of return, Incremental rate of return, Break-even comparisons, Capitalized cost analysis, Benefit-cost analysis.	9
Unit-3	
Concepts and statistical measurements of the factors involved in direct costs, general overhead costs, cost markups and profits; and the fundamentals of cost recording for construction cost accounts and cost controls. Depreciation, Inflation and Taxes: Depreciation, Inflation, Taxes.	9
Unit-4	
Equipment economics: Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis	9
Unit-5	
Cost estimating: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes, Parametric estimate, Life cycle cost	9
Self-study: NIL	
Site/Industrial Visits: NIL	

Course outcomes: -
Textbooks:
Reference Books:
Online Resources:

Course Name: - Sustainable Construction Methods					
Course Code: CE732EC-04A					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives:					
Prerequisites: Nil					

Units	Teaching Hours
Unit-1	
Types of foundations and construction methods; Basics of Formwork and Staging	9
Unit-2	
Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls)	9
Unit-3	
Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures	9
Unit-4	
Basics of construction methods for Bridges; Identification of cutting-edge sustainable construction materials, technologies, and project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity.	9
Unit-5	
Examination of the current LEED for New Construction rating system, and case study analysis of highly successful recent "green construction projects" through student team assignments and presentations. Preparation for the LEED Green Associate professional licensing exam.	9
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes: -	

Textbooks:
Reference Books:
Online Resources:

Course Name: - Construction Contract Management					
Course Code: CE733EC-05A					
	L	**T**	**P**	**Category**	
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives: To familiarize the students with Construction contracts and make them understand the various intricacies including legal aspects					
Prerequisites: Construction Planning and Management					

Units	**Teaching Hours**
Unit-1	
Introduction, Importance of Contracts, Overview of Contract Management, Overview of Activities in Contract Management; Planning and People- Resource Management.	8
Unit-2	
Types of Contracts, Parties to a Contract; Contract Formation, Formulation of Contract, Contract Start-Up, Managing Relationships; Common contract clauses, notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price.	9
Unit-3	
Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Notices under contracts; Conventional and Alternative Dispute Resolution methods. Various Acts governing Contracts.	10
Unit-4	
Contract Administration and Payments- Contract Administration, Payments; Contract Management in Various Situations- Contract of Supply of Goods- Design, Supply and Installation Contracts, Contract Management in Consultancy.	10
Unit-5	
Managing Risks and Change- Managing Risks, Managing Change; Contract Closure and Review-Ending a Contract, Post-Implementation Review; Legal Aspects in Contract Management.	8
Self-study: NIL	

Site/Industrial Visits: Project site visit for study of non-financial contracts.
Course outcomes: - Upon the completion of this course the student will be able to: 1. Understand the various aspects of contracts and stakeholder involvement. 2. Understand the legal framework of construction contracts. 3. Correlate the contractual concepts to relate to project problems. 4. Apply knowledge of contracts in discussions on construction contracts.
Textbooks: 1. Civil Engineering Contracts and Estimates - B. S. Patil – Universities Press- 2006 Edition, reprinted in 2009**.** **2.** The Indian Contract Act (9 of 1872), 1872- Bare Act- 2006 edition, Professional Book Publishers. 3. Law of contract Part I and Part II, Dr. R.K. Bangia- 2005 Edition, Allahabad Law Agency. 4. Arbitration, Conciliation and Alternative Dispute Resolution Systems- Dr. S.R. Myneni- 2004 Edition, reprinted in 2005- Asia Law House Publishers.
Reference Books: 5. The Arbitration and Conciliation Act (1996), 1996 (26 of 1996)- 2006 Edition, Professional Book Publisher. 6. The Workmen Compensation Act, 1923 (8 of 1923) Bare Act- 2005- Professional Book Publishers. 7. Standard General Conditions for Domestic Contracts- 2001 Edition- Published by Ministry Of Statistics and Program Implementation, Government of India. 8. FIDIC Document (1999).
Online Resources: Dispute Resolution Board foundation manual-www.drbf.org.

ELECTIVE- B-Transportation Engineering

Course Name: Transportation Engineering					
Course Code: CE535EC-01B					
	L	**T**	**P**	Category	PEC
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**
Course objectives: The objective of this subject is to build a Strong, Stable and Deep concept in Highway Engineering, and also to have a clear picture in the details of Design, Construction and Maintenance of Highway structures coming under this field.					
Prerequisites:					

Units	**Teaching Hours**
Unit-1	
PRINCIPLES OF TRANSPORTATION ENGINEERING: Importance of Transportation. Different modes of transportation, characteristics and comparison of different modes. Jayakar committee recommendations and implementation	9
Unit-2	
HIGHWAY ALIGNMENT AND SURVEYS: Ideal alignment, factors affecting alignment, engineering surveys for new and realignment projects. HIGHWAY GEOMETRIC DESIGN-1: Importance, Factors controlling the design of geometric elements, highway cross section elements – pavement surface characteristics, camber, width of carriageway, shoulder width, formation width, right of way, typical cross section of roads. HIGHWAY GEOMETRIC DESIGN-2: Sight distance, Types and importance - Design of horizontal and vertical alignment – Numerical problems on above (No derivation of formulae).	9
Unit-3	
PAVEMENT MATERIALS: Properties and requirements of subgrade soils, HRB and IS soil classification. Determination of CBR and Modulus of subgrade reaction of soil. Properties and requirements of road aggregates, Bitumen – Tar – Emulsion – Cutback, Just mention the types of tests on aggregates, bitumen and cut back for evaluating the required properties. Numerical problems on above. PAVEMENT DESIGN: Types of pavements – Design factors, Determination of ESWL by equal stress criteria and problems. IRC method of flexible pavement design based on CSA method using IRC: 37 – 2001. Stresses in rigid pavement and design of rigid pavement as per IRC: 58 –2011 excluding design of joints.	

Unit-4	
PAVEMENT CONSTRUCTION: Specifications, construction steps and quality control tests for earthwork in cutting, filling and preparation of subgrade, Granular sub base course, Granular base / sub-base courses such as WBM, WMM, CRM, bituminous binder course (BM and DBM), common types of bituminous surfacing courses such as surface dressing, premixed carpet (PMC) and bituminous concrete and Rigid pavement (DLC and PQC). HIGHWAY DRAINAGE SYSTEM: Surface and Sub-subsurface drainage system for road pavements, types, functions and basic design principles.	9
Unit-5	
HIGHWAY ECONOMICS AND FINANCING: Highway user benefits – VOC using charts only – Highway costs – Economic analysis by annual cost method and benefit cost ratio method, NPV and IRR methods. Numerical problems on above. Highway financing – BOT, BOOT and Annuity concepts PAVEMENT MAINTENANCE: Pavement failures, Types, Causes and remedies. Maintenance of highways. Principles of pavement evaluation – functional and structural evaluation	
Self-study:	
Site/Industrial Visits:	
Course outcomes: On completion of the course, the student would be able to: Understand the importance of transportation for growth of country, geometric requirement of highway. The student would also design the pavement materials and thickness; understand the procedure of highway construction and financing.	
Text Books: 1. Kadiyali, L.R., “Highway Engineering, Khanna Publishers”, New Delhi. 2. Khanna, S.K. and Justo, C.E.G., ‘Highway Engineering”, Nem Chand and Bros, Roorkee (2003). 3. Subramanyam, K.P., “Transportation Engineering–I”, Scitech Publications, Chennai.	

Reference Books:

1. “Relevant IRC codes”
2. Bindra, SP; "A Course on Highway Engineering" New Delhi, Dhanpat Rai andSons
3. Chakroborty and Das, “Principles of Transportation Engineering”, PHI learning Private Limited
4. Duggal AK, “Maintenance of Highway – a Reader”, TTTI, Sector 26, Chandigarh
5. Duggal AK, Puri VP., "Laboratory Manual in Highway Engineering",Delhi, New Age Publishers (P) Ltd
6. Khanna S. K., and Justo CEG, “Highway Material Testing Laboratory Manual”, Nemchand and Bros. Roorkee.
7. Khanna, SK and Justo, CEG, "Highway Engineering" Roorkee Nem Chand andBros.
8. Mannering, “Principals of Highway Engineering and Traffic Analysis”, Wiley India Pvt. Ltd
9. MORT & H, IRC, “Specifications for Roads and Bridges”, New Delhi (2001).
10. Partha Chakra Borthy, “Principles of Transportation Engineering”, Prentice-Hall
11. Ponnuswamy S., “Bridge Engineering”, Tata McGraw-Hill Education Pvt. Ltd
12. Priyani, VB, "Highway and Airport Engineering" Anand, Charotar Book Stall
13. Rao, GV’ Transportation Engineering
14. Sehgal, SB; and Bhanot, KL; "A Text Book on Highway Engineering and Airport" Delhi, S Chand and Co
15. Sharma, RC; and Sharma, SK; "Principles and Practice of Highway Engineering", New Delhi, Asia Publishing House
16. Vaswani, NK, "Highway Engineering" Roorkee Publishing House.
17. Yoder. E.J., “Principals of pavement Design”, John Wiley and Sons”, New Delhi‘

Online Resources:

Course Name: Traffic Engineering and Management					
Course Code: CE633EC-02B					
	L	**T**	**P**	Category	PEC
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**
Course objectives: To make students gain insight into how the Traffic forecast, Accident Analysis and Traffic Flow and Probabilistic Aspects of Traffic Flow					
Prerequisites:					

Units	**Teaching Hours**
Unit-1	
Traffic Forecast: General travel forecasting principles, different methods of traffic forecast - Mechanical and analytical methods, Demand relationships, methods for future projection; Design Hourly Volume For Varying Demand Conditions: Concept of Design vehicle units and determination of PCU under mixed traffic conditions,	09
Unit-2:	
Price-volume relationships, demand functions. Determination of design hourly volume; critical hour concept; Highway Capacity: Factors affecting capacity, level of service; Capacity studies - Capacity of different highway facilities including unsignalized and signalized intersections. Problems in Mixed Traffic flow; Case studies	09
Unit-3:	
Accident Analysis: Analysis of individual accidents and statistical data; Methods of representing accident rate; Factors in traffic accidents; influence of roadway and traffic conditions on traffic safety; accident coefficients; Driver strains due to roadway and traffic conditions	09
Unit-4:	
Traffic Flow Theory: Fundamental flow relationship and their applications, Traffic flow theories and applications; Shock waves; Queuing theory and applications	09
Unit-5:	

Probabilistic Aspects of Traffic Flow: Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, delay models, applications; Simulation: Fundamental principle, application of simulation techniques in traffic engineering - formulation of simulation models, Case studies. Formulation of system models.	09
Self-study :	
Site/Industrial Visits :	
Course outcomes:	
Textbooks: 1. KAdiyali LR., "Traffic Engineering and Transport Planning", Khanna Publishers, 2011	
Reference Books: 1. Martin Whol, and Brian Martin., "Traffic System analysis for engineers and planners", Mc Graw Hill Series 2. *Johnson R and G Bhattacharya, "Statistics – Principles and methods"- John Wiley & sons, New* York, 1985	
Online Resources:	

Course Name: Urban Transport Planning					
Course Code : CE634EC-03B					
	L	**T**	**P**	Category	PEC
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**
Course objectives: To make the students to understand the basic knowledge in the field of Transportation Planning and Travel demand forecasting.					
Prerequisites:					

Units	Teaching Hours
Unit-1	
INTRODUCTION: Scope of Urban transport planning – Inter dependency of land use and traffic – System Approach to urban planning. **STAGES IN URBAN TRANSPORT PLANNING**: Trip generation – Trip production - Trip distribution – Modal split – Trip assignment.	9
Unit-2:	
URBAN TRANSPORT SURVEY - Definition of study area-Zoning-Types of Surveys – Inventory of transportation facilities – Expansion of data from sample. **TRIP GENERATION:** Trip purpose – Factors governing trip generation and attraction – Category analysis – Problems on above.	9
Unit-3:	
TRIP DISTRIBUTION: Methods – Growth factors methods – Synthetic methods – Fractor and Furness method and problems on the above **MODAL SPLIT:** Factors affecting – characteristics of split – Model split in urban transport planning – problems on above	9

Unit-4:	
TRIP ASSIGNMENT: Assignment Techniques – Traffic fore casting – Land use transport models – Lowry Model – Garin Lowry model – Applications in India – (No problems on the above).	9
Unit-5:	
URBAN TRANSPORT PLANNING FOR SMALL AND MEDIUM CITIES: Introduction – Difficulties in transport planning – Recent Case Studies.	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: Upon the completion of this course the student will be able to: CO1- Understand transportation planning process, problems and challenges, techniques. (L1, L2) CO2- Understand different surveys required for data collection towards urban transportation planning. (L2) CO3- Prepare demand generation and attraction regression models. (L3, L6) CO4- Prepare demand distribution models and modal split models for mode choice analysis. (L3, L6) CO5- Understand about transit planning, design and scheduling. (L2)	
Text Books: 1. B.G. Hutchinson, *Principles of urban transport system planning*, Washington D.C, Scripta Book Co. & McGraw Hill Book Co, 1974. 2. Jotin Kristey and Kentlal, *Transportation engineering: An Introduction*, 3rd Edition, New Delhi, Pearson Publishers, 2002. 3. L.R. Kadiyali, *Traffic Engineering and Transport Planning*, New Delhi, Khanna Publishers, 2011.	
Reference Books:	
Online Resources:	

Course Name: Pavement Materials					
Course Code: CE732EC-04B					
	L	**T**	**P**	Category	PEC
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**
Course objectives: To make the students to understand the properties and use of various materials and construction procedures for flexible and rigid pavements.					
Prerequisites:					

Units	**Teaching Hours**
Unit-1	
AGGREGATES: Origin, classification, requirements, properties and tests on road aggregates, concepts of size and gradation – design gradation, maximum aggregate size, aggregate blending to meet specification. **BITUMEN AND TAR:** Origin, preparation, properties and chemical constitution of bituminous road binders; requirements.	9
Unit-2:	
BITUMINOUS EMULSIONS AND CUTBACKS: Preparation, characteristics, uses and tests. Adhesion of bituminous Binders to Road Aggregates: Adhesion failure, mechanism of stripping, tests and methods of improving adhesion. **BITUMINOUS MIXES:** Mechanical properties, dense and open textured mixes, flexibility and brittleness, (no Hveem Stabilometer & Hubbar – Field Tests) bituminous mix, design methods using Rothfuch's Method only and specification using different criteria- voids in mineral aggregates, voids in total mix, density, flow, stability, percentage voids filled with bitumen.	9
Unit-3:	
EQUIPMENT IN HIGHWAY CONSTRUCTION: Various types of equipment for excavation, grading and compaction – their working principle, advantages and limitations. Special equipment for bituminous and cement concrete pavement and stabilized soil road construction. **SUBGRADE:** Earthwork grading and construction of embankments and cuts for roads. Preparation of subgrade, quality control tests	9
Unit-4:	
FLEXIBLE PAVEMENTS: Specifications of materials, construction method and field control checks for various types of flexible pavement layers	9
Unit-5:	

CEMENT CONCRETE PAVEMENTS: Specifications and method of cement concrete pavement construction; Quality control tests; Construction of various types of joints.	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: At the completion of this module, students should be able to: • Conduct tests on aggregates, bitumen and tar. • Select suitable equipment for highway construction operations. • Attain thorough knowledge on specifications of materials, constructions methods and field control checks for flexible and rigid pavement**.**	
Textbooks: 1. Freddy L. Roberts and P.S Kandhal, **,** *Hot Mix Asphalt Materials, Mixture Design and Construction*, 2nd edition, NAPA Education Foundation Lanham, Maryland, 1996. 2. L.R. Kadiyali & N.B. Lal, *Principles & Practices of Highway Engineering*, 4th edition, New Delhi, Khanna Publishers, 2004. 3. S.K. Khanna, C.E.G. Justo & A. Veeraragavan, *Highway Engineering*, 9th edition, Uttarakhand, Nem Chand and Brothers, 2011. 4. S.C**.** Sharma, *Construction Equipment and its Management*, 5th edition, New Delhi, Khanna Publishers, 2002.	
Reference Books: 1. Specifications for Roads and Bridges, 5th edition, MORTH, 2011.	
Online Resources:	

<table>
<tr><td colspan="6" align="center">Course Name: Pavement Design</td></tr>
<tr><td colspan="6" align="center">Course Code: CE733EC-05B</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td align="right">Category</td><td>PEC</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td align="right">CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td align="right">ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td align="right">Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: Student gains knowledge on designing rigid and flexible pavements for different serviceability conditions of roads.</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">INTRODUCTION: Desirable characteristics of pavement, types and components, Difference between Highway pavement and Air field pavement – Design strategies of variables – Functions of sub-grade, sub base – Base course – surface course – comparison between Rigid and flexible pavement. FUNDAMENTALS OF DESIGN OF PAVEMENTS: Design life – Traffic factors – climatic factors – Road geometry – Subgrade strength and drainage, Stresses and deflections, Boussinesqs theory – principle, Assumptions –Limitations and problems on above - Busmister theory – Two layered analysis – Assumptions – problems on above.</td><td>9</td></tr>
<tr><td colspan="6">Unit-2:</td></tr>
<tr><td colspan="5">DESIGN FACTORS: Design wheel load – contact pressure – ESWL concept – Determination of ESWL by equivalent deflection criteria – Stress criteria – EWL concept.
FLEXIBLE PAVEMENT DESIGN: Assumptions – McLeod Method – Kansas method – Tri-axial method - CBR method – IRC Method (old) -CSA Method using IRC 37-2012, problems on above.</td><td>9</td></tr>
<tr><td colspan="6">Unit-3:</td></tr>
<tr><td colspan="5">STRESSES IN RIGID PAVEMENT: Principle – Factors - wheel load and its repetition – properties of sub grade - properties of concrete. External conditions – joints – Reinforcement – Analysis of stresses – Assumptions –Westergaard’s Analysis – Modified Westergaard equations – Critical stresses– Wheel load stresses, Warping stress – Frictional stress – combined stresses(using chart / equations) - problems on above.</td><td>9</td></tr>
<tr><td colspan="6">Unit-4:</td></tr>
<tr><td colspan="5">DESIGN OF RIGID PAVEMENT: Design of C.C. Pavement by IRC: 38 –2011 for dual and Tendem axle load – Reinforcement in slabs – Requirements of joints – Types of joints – Expansion joint – contraction joint– warping joint – construction joint – longitudinal joint, Design of joints, Design of Dowel bars, Design of Tie bars – problems of the above.</td><td>9</td></tr>
</table>

<table>
<tr><td colspan="2">Unit-5:</td></tr>
<tr><td>FLEXIBLE PAVEMENT FAILURES, MAINTENANCE AND EVALUATION: Types of failures, causes, remedial/maintenance measures n flexible pavements – Functional Evaluation by visual inspection and unevenness measurements - Structural Evaluation by Benkelman Beam Deflection Method, Falling weight deflectometer, GPR Method. Design factors for Runway Pavements - Design methods for Airfield pavements and problems on above. RIGID PAVEMENT FAILURES, MAINTENANCE AND EVALUATION: Types of failures, causes, remedial/maintenance measures in rigid pavements – Functional Evaluation by visual inspection and unevenness measurements. Design factors for Runway Pavements – Design methods for Airfield pavements.</td><td>9</td></tr>
<tr><td colspan="2">Self-study :</td></tr>
<tr><td colspan="2">Site/Industrial Visits :</td></tr>
<tr><td colspan="2">Course outcomes: Upon the completion of this course the student will be able to:
CO1 – Identify the pavement components and compare highway and airport pavements (L1, L2)
CO2 – Calculate stresses and ESWL in flexible pavements (L3)
CO3 – Design the flexible pavement using empirical, semi-empirical methods and IRC method (L4)
CO4 – Analyse the warping, friction, wheel load stress and calculate the combined stress (L4)
CO5 – Design rigid pavements by IRC method and evaluate the pavements (L4)</td></tr>
<tr><td colspan="2">Text Books:
1. L.R. Kadiyali & N.B. Lal, Principles & Practices of Highway Engineering, 4th edition, New Delhi, Khanna Publishers, 2004.
2. S.K. Khanna, C.E.G. Justo & A. Veeraragavan, Highway Engineering, 9th edition, Uttarakhand, Nem Chand and Brothers, 2011.
3. Yang H. Huang, Pavement Analysis & Design, 2nd edition, Kentucky, Pearson Publications, 2004.</td></tr>
<tr><td colspan="2">Reference Books:
1. Yoder and Witzack, Principles of Pavement Design, 2nd edition, John Wileys and Sons, 1991.
2. Srinivasa Kumar, Pavement Design, Telangana, Orient Blackswan Private Limited, 2013.</td></tr>
<tr><td colspan="2">Online Resources:</td></tr>
</table>

ELECTIVE- C-Environmental Engineering

<table>
<tr><th colspan="6">Course Name: Transport of Water and Wastewater</th></tr>
<tr><th colspan="6">Course Code: CE535EC-01C</th></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>PEC</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: To make students gain insight into how the water and wastewater gets transported through conduits and open channels, and use the same for the design, operation and maintenance of these systems.</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">Water Supply Systems: Storage requirements, impounding reservoirs, intake structures, pipe hydraulics, design of distribution systems, distribution and balancing reservoirs.</td><td>09</td></tr>
<tr><td colspan="6">Unit-2:</td></tr>
<tr><td colspan="5">Pipe materials, appurtenances, design for external loads, maintenance and operation.</td><td>09</td></tr>
<tr><td colspan="6">Unit-3:</td></tr>
<tr><td colspan="5">Sanitary Sewerage Systems: Flow estimation, sewer materials, hydraulics of flow in sewers, sewer lay out, sewer transitions, materials for sewers, appurtenances, manholes.</td><td>09</td></tr>
<tr><td colspan="6">Unit-4:</td></tr>
<tr><td colspan="5">sewer design, conventional and model based design, sewage pumps and pumping stations, corrosion prevention, operation and maintenance, safety.</td><td>09</td></tr>
<tr><td colspan="6">Unit-5:</td></tr>
<tr><td colspan="5">Storm water Drainage Systems: Drainage layouts, storm runoff estimation, hydraulics of flow in storm water drains, materials, cross sections, design of storm water drainage systems, inlets, storm water pumping, operation and
maintenance</td><td>09</td></tr>
<tr><td colspan="6">Self-study :</td></tr>
<tr><td colspan="6">Site/Industrial Visits :</td></tr>
</table>

Course outcomes:

- **Design water treatment and distribution systems**
- **Design Waste water treatment systems.**
- **Design Storm water drainage systems.**

Text Books:

1. Garg. S. K., "Water supply Engineering", Khanna Publishers
2. B C Punmia, "Environmental Engineering vol-II", Laxmi Publications 2nd, 2016
3. S.K. Garg, "Environmental Engineering vol-II, Water supply Engineering", Khanna Publishers, – New Delhi, 28th edition and 2017
4. Fair, Geyer and Okun "Water and Wastewater Engineering Vol – II", John Willey Publishers, New York.
5. Metcalf and Eddy Inc: "Wastewater Treatment, Disposal and Reuse", Tata McGraw Hill Publications

Reference Books:

1. Barry R., "The construction of buildings, vol.5 Building Services", East-West press, New Delhi
2. Earnest W, Steel: "Water supply and Sewage"
3. Karia G.L., and Christian R.A, "Wastewater Treatment Concepts and Design Approach", Prentice Hall of India Pvt. Ltd., New Delhi. 3rd, Edition, 2017
4. Hammer and Hammer "Water Technology",
5. Howard S. Peavy, Donald R. Rowe, George Tchnobanoglous "Environmental Engineering", McGraw Hill International Edition.
6. "Manual of Water and Wastewater Analysis", NEERI Publication.

Course Name: Environmental Laws and Policy					
Course Code: CE633EC-02C					
	L	**T**	**P**	Category	PEC
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: To make students gain insight into how the water and wastewater gets transported through conduits and open channels, and use the same for the design, operation and maintenance of these systems.

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Overview of environment, nature and eco system, Concept of laws and policies.	09
Unit-2:	
Origin of environmental law, Introduction to environmental laws and policies, Environment and Governance.	09
Unit-3:	
sustainable development and environment, understanding climate change, carbon crediting, carbon footprint etc., Introduction to trade and environment.	09
Unit-4:	
International environmental laws, Right to Environment as Human Right, International Humanitarian Law and Environment.	09
Unit-5:	
Environment and conflicts management, Famous international protocols like Kyoto.	09

Self-study :

Site/Industrial Visits :

Course outcomes:
- **Understand Environmental Policies/laws.**
- **Understand Environmental Economics.**
- **Understand Environmental Treaty.**

Text Books:

2. Felix Fitzroy and Elissaios papyrakis, "An Introduction to Climate Change Economics and Policy", CRC press, 2 Edition.

Reference Books: R1. Tom Tietenberg., "Environmental and Natural resource Economics", ISBN-13:978-0321485717, Prentice Hall.
Online Resources:

<table>
<tr><td colspan="6" align="center">Course Name: Physico-Chemical Processes for water and wastewater treatment</td></tr>
<tr><td colspan="6" align="center">Course Code: CE634EC-03C</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td align="right">Category</td><td>PEC</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td align="right">CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td align="right">ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td align="right">Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: The Objective of this course is to provide an in depth understanding of physical and physico-chemical processes used for water and wastewater treatment systems and to provide capability to design such systems</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
</table>

<table>
<tr><td>Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="2">Unit-1</td></tr>
<tr><td>Water purification in natural systems, physical processes, chemical processes and biological processes. Primary, secondary and tertiary treatment. Unit operations, unit processes. Aeration and gas transfer</td><td>9</td></tr>
<tr><td colspan="2">Unit-2</td></tr>
<tr><td>Sedimentation, different types of settling, sedimentation tank design. Coagulation and flocculation, coagulation processes, stability of colloids, destabilization of colloids, destabilization in water and wastewater treatment, transport of colloidal particles, design aspects. Filtration: filtration processes, Hydraulics of flow through porous media, Rate control patterns and methods, Filter effluent quality parameters, mathematical model for deep granular filters, slow sand filtration, rapid sand filtration, precoat filtration, design aspects</td><td>9</td></tr>
<tr><td colspan="2">Unit-3</td></tr>
</table>

Disinfection: Types of disinfectants, Kinetics of disinfection, chlorination and its theory, Design of Chlorinators. Precipitation: Hardness removal, Iron, Mn, and heavy metal removal; Adsorption, adsorption equilibria and adsorption isotherm, rates of adsorption, Sorption kinetics in batch reactors, continuous reactors, factors affecting adsorption. Ion Exchange-exchange processes, materials and reactions, methods of operation, Application, design aspects. Membrane Processes, Reverse osmosis, Ultrafiltration, Electrodialysis	9
Unit-4	
Wastewater characterization: Sampling, significance, techniques and frequency. Physical, Chemical and Biological characteristics, Aerobic and Anaerobic activity, CNS cycles. BOC, COD and their significance and problems Effluent standards and Treatment flow diagram: Effluent disposal standards for land, surface water and ocean. Treatment of wastewater: Flow diagram of municipal wastewater treatment	9
Unit-5	
Preliminary treatment: Design criteria and example of screening, grit chambers, skimming tanks Primary treatment: Design criteria and example of primary sedimentation tanks Secondary treatment: Suspended growth – Activated sludge process (ASP) - its principles, F/M ratio, modifications of ASP, Design of ASP; Fixed film process: Trickling filter theory and design, types of trickling filters. Tertiary treatment of wastewater; Sludge digestion: Anaerobic sludge digestion – Sludge digestion tanks, Design of Sludge drying beds.	9
Self-study:	
Site/Industrial Visits:	
Course outcomes: • Design Suitable water treatment units. • Design Suitable waste water treatment units • Relate standards of water and waste water regulation and its scientific basis.	

Text Books:

1. S. K. Garg, Environmental Engineering, Vol.I Khanna Publishers, New Delhi, 29th revised edition 2014
2. S. K. Garg, Environmental Engineering, Vol.II Khanna Publishers, New Delhi, 29th revised edition 2014
3. B. C. Punmia, and A. K. Jain, Environmental Engineering, Vol.II, Lakshmi Publications, 2nd reprint, 2014
4. G.L. Karia, R.A.Christian., Wastewater Treatment Concepts and Design Approach, PHI Learning Private Limited, New Delhi, 2009.
5. Manual on Wastewater Treatment, CPHEEO, Ministry of Urban Development, New Delhi (http://urbanindia.nic.in/publicinfo/manual_sewage.htm)

Reference Books: 1. Metcalf and Eddy Inc: Waste Water Treatment, Disposal and Reuse, Tata McGraw Hill Publications., Edition 5, 2013 2. M. L.Davis., Water and Wastewater Engineering – Design Principles and Practise, McGraw Hill Education (India) Private Limited, New Delhi, 2013. 3. M. J. Hammer, M. J.Hammer.Jr., Water and Wastewater Technology, PHI Learning Private Limited, 7th edition, New Delhi, 2012.
Online Resources:

Course Name: Solid Waste and Hazardous Waste Management					
Course Code: CE732EC-04C					
	L	**T**	**P**	Category	PEC
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**
Course objectives: Objective of this paper is to provide managing solid wastes. It is designed as a source of information on solid waste management, including the Principles of Solid waste management, Processing and Treatment, Final disposal, Recycle and Reuse.					
Prerequisites:					

Units	**Teaching Hours**
Unit-1	
INTRODUCTION: Definition, Land Pollution – scope and importance of solid waste management, functional elements of solid waste management. **SOURCES:** Classification and characteristics – municipal, commercial & industrial. Methods of quantification	9
Unit-2:	
COLLECTION AND TRANSPORTATION: Systems of collection, collection equipment, garbage chutes, transfer stations – bailing and compacting, route optimization techniques and problems. **TREATMENT/PROCESSING TECHNIQUES:** Components separation, volume eduction, size reduction, chemical reduction and biological processing problems. **INCINERATION:** Process – 3 T's, factors affecting incineration process, incinerators – types, prevention of air pollution, pyrolsis, design criteria for incineration.	9
Unit-3:	

COMPOSTING: Aerobic and anaerobic composting, factors affecting composting, Indore and Bangalore processes, mechanical and semi mechanical composting processes. Vermi composting **SANITARY LAND FILLING:** Different types, trench area, Ramp and pit method, site selection, basic steps involved, cell design, prevention of site pollution, leachate & gas collection and control methods, geo-synthetic fabricsin sanitary landfills.	9
Unit-4:	
DISPOSAL METHODS: Open dumping – selection of site, ocean disposal, feeding to hogs, incineration, pyrolsis, composting, sanitary land filling, merits and demerits, biomedical wastes and disposal. **RECYCLE AND REUSE:** Material and energy recovery operations, reuse in other industries, plastic wastes, environmental significance and reuse	9
Unit-5: Hazardous waste	
Risk assessment, Environmental legislation, Characterization and site assessment, Waste minimization and resource recovery, Transportation of hazardous waste, Physical, chemical and biological treatment, Ground water contamination, Landfill disposal, Current Management Practices, Environmental audit, Pollution Prevention, Facility Development and operation, Site Remediation: Quantitative risk assessment, site and subsurface characterization, Containment, remedial alternatives.	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: On completion of the course the students will be able to: • Understand the implications of the production, resource management and environmental impact of solid waste management. • Understand components of solid waste management infrastructure systems to minimize the above effects. • Be aware of the significance of recycling, reuse and reclamation of solid wastes. Be familiar with relationships between inappropriate waste management practices and impacts on water, soil and sediment quality.	
Text Books: 1. Bhide and Sunderashan "Solid Waste Management in developing countries", 2. Tchobanoglous "Integrated Solid Waste Management", McGraw Hill.	
Reference Books: 1. Peavy and Tchobanoglous "Environmental Engineering", 2. Garg S K "Environmental Engineering", Vol II 3. "Biomedical waste handling rules – 2000". 4. Pavoni J.L. "Handbook on Solid Waste Disposal"	
Online Resources:	

Course Name: Air and Noise Pollution and Control					
Course Code: CE733EC-05C					
	L	**T**	**P**	Category	PEC
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: Objective of this is to know the sources, characteristics and effects of air and noise pollution and the methods of controlling the same. The student is expected to know about source inventory and control mechanism like.

- The atmosphere and its components
- How air pollutants are categorized
- The sources of air pollution
- The difference between criteria pollutants and hazardous air pollutants
- How pollution affects health and welfare

Prerequisites:

Units	**Teaching Hours**
Unit-1	
INTRODUCTION: Definition – Classification and Characterization of Air Pollutants, Emission Sources, Behavior and Fate of air Pollutants, Chemical Reactions in the Atmosphere, Photo-chemical Smog, Coal-induced smog, Air Pollution Inventories. **EFFECTS OF AIR POLLUTION:** On Human Health, Animals, Plants and Materials – Major Environmental Air Pollution Episodes – London Smog, Los Angeles Smog & Bhopal Gas Tragedy	9
Unit-2	
SAMPLING, ANALYSIS AND CONTROL: Sampling and Measurement of Gaseous and Particulate matter, Stack Sampling, Analysis of Air Pollutants, Smoke and Smoke Measurement, Air Pollution Control Methods– Particulate, Emission Control, Gravitational Settling Chambers, Cyclone Separators, Fabric Filters, Electrostatic Precipitators, Wet Scrubbers, Selection of a Particulate Collecting Equipment, Control of Gaseous Emissions, Adsorption by Liquids, Adsorption by Solids, Combustion Odours and their control	9
Unit-3	

AIR POLLUTION DUE TO AUTOMOBILES: Air Pollution due to Gasoline Driven and Diesel Driven Engines, Effects, Direct and Indirect Methods of control **STANDARDS AND LEGISLATION:** Air Quality and Emission Standards– Legislation and Regulation, Air Pollution Index.	
Unit-4	
Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes.	9
Unit-5	
special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Noise control methods	
Self-study:	
Site/Industrial Visits:	
Course outcomes: • Identify the major sources and sinks of air pollutants. • Understand the key chemical transformations of air pollution. • Relate air pollution regulation and its scientific basis. • Understand Sources of Noise Pollution • Understand methods to control noise pollutions	
Text Books: 1. "Air Pollution – Sampling and Analysis – APHA" 2. "Environmental Engineering and Management" Dhamija S K and kataria S K andSons, Delhi 3. De AK, "Engineers Chemistry", New Age Publication, Delhi.	
Reference Books: 1. Deswal and SS Deswal; "Environmental Engineering", Dhanpat Rai andCompany (P) Ltd., Delhi 2. Harper and Row "Air Pollution –Its origin and control", Wark. K.and Warner. F. publishers, New York 3. Henry C. Perkins "Air Pollution", McGraw Hill Ltd. 4. Kendeigh SC, "Ecology", Prentice Hall of India, Delhi 5. Odum EP, "Fundamentals of Ecology", Amarind publication Co., Delhi	
Online Resources:	

ELECTIVE- D-Hydraulics

Course Name: - Irrigation Engineering and Hydraulic Structures

Course Code: CE535EC-01D					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3

Course objectives: To make Students to realize the importance and use of Water Resources, Hydraulic structures and its uses and a basic understanding of Irrigation and Hydraulic structures design

Prerequisites: Surveying, Fluid Mechanics, Soil Mechanics and Hydrology and Water Resources Engineering.

Units	**Teaching Hours**
Unit-1 Irrigation and Water Requirements of Crops	

Introduction: Definition. Benefits and ill effects of irrigation. Sources of water for irrigation. Systems of irrigation: Surface and ground water, flow irrigation, Lift irrigation, Bhandhara irrigation. Methods of irrigation in India– Potential and development **Irrigation and Water Requirements of Crops:** Definition of duty, Delta and Base period, Relationship between Duty, Delta and Base period, Factors affecting duty of water. Crops and crop seasons in India, Crops grown in Karnataka, their seasons, local names. Agro-climatic zones of Karnataka. Irrigation efficiency, frequency of irrigation	9
Unit-2 Canals and Diversion Works	
Canals: Definition. Types of canals, Alignment of canals. Design of canals by Kennedy's and Lacey's method **Diversion Works**: Definition. Layout. Types of weirs and Barrages. Design of Impermeable floors – Bligh's and Lane's theories – Simple design problems. Khosla's theory – Method of independent variables, Exit gradient (No design problem)	9
Unit-3 Canals and Reservoirs	
Canal Works: Canal regulators: Classification and suitability. Canal drops: Classification. Hydraulic design principles for notch type drop. Cross drainage works: Classification. Hydraulic design principles for an aqueduct **Reservoirs**: Definitions, Reservoir sedimentation, Investigation for reservoir sites. Storage zones. f storage capacity and yield of a reservoir using mass curve.	9
Unit-4 Gravity Dams and Spillways	
Gravity Dams: Definition. Forces acting on a Gravity dam. Modes of failures. Elementary and practical profile. Low and high gravity dams. Analysis problems, Principal stresses. Drainage galleries. **Spillways**: Definition. Types of Spillways. Principles & Design for an Ogee Spillway. Energy dissipaters: Types and introduction to IS Stilling basins.	9
Unit-5 Earthen Dams	
Earthen Dams: Introduction. Types of earthen dams. Failure of earthen dams. Preliminary design. Drainage arrangements. Phreatic line. Stability analysis under sudden draw down using Sweedish slip circle method.	9
Self-study: NIL	
Site/Industrial Visits: NIL	

Course outcomes: - Upon the completion of this course the student will be able to:

1. Determine crop water requirements using evapotranspiration concepts (L3) (P01, PO2, PO3, PSO3)
2. Do hydraulic design of alluvial canals and canal works based on empirical formulae and analytical methods. (L5) (PO1, PO2, PO3, PSO3)
3. Do hydraulic design of impervious floor of weirs and barrages using Bligh's and Khosla's Theory. (L5) (PO1, PO2, PO3, PSO3)
4. Determine reservoir capacity estimation and demand (L4) (PO1, PO2, PO3, PSO3)
5. Analyse stability of gravity dams, earthen dams and spillway gates(L5) (PO1, PO2, PO3, PSO3)

TEXT BOOKS:

1. Punmia B.C., and Pande Lal., "Irrigation and Water Power Engineering", Laxmi Publications,2016, New Delhi
2. Garg S.K., "Irrigation Engineering and Hydraulic Structures", Khanna Publications, 2011, New Delhi
3. Sharma, RK; "Text Book of Irrigation Engineering and Hydraulics Structures", New Delhi : S. Chand and Co, 2002
4. Arora K R., "Irrigation Water Power & Water Resource Engineering", Standard Publishers, 2012, Ne Delhi
5. Modi P.N., "Irrigation, Water Resources, and Water Power Engineering", Standard Book House, 2012 New Delhi

REFERENCE BOOKS:

1. Asawa, C L, "Irrigation Engineering", New Age Internations (P) Ltd 2008, New Delhi
2. Basak N.N., "Irrigation Engineering", Tata McGraw-Hill Education Pvt. Ltd, 2010, New Delhi
3. Michael A.M., "Irrigation Theory and Practices", Vikas Publications, 2008 New Delhi
4. Sharma, SK; "Principles and Practice of Irrigation Engineering", Prentice Hall of India Pvt. Ltd. 2008, New Delhi.

Online Resources:
https://nptel.ac.in/courses/126105010/
https://nptel.ac.in/content/storage2/courses/105105110/pdf/m3l04.pdf

<table>
<tr><td colspan="6">Course Name: Pipeline Engineering</td></tr>
<tr><td colspan="6">Course Code: CE633EC-02D</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>PEC</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives:
Designing and operating pipelines for transmission and distribution of water</td></tr>
<tr><td colspan="6">Prerequisites: Nil</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">Analysis of flow in water transmission and water distribution systems (pump & gravity); optimal design and operation of systems for achieving different goals (including latest tools available for optimization);</td><td>9</td></tr>
<tr><td colspan="6">Unit-2</td></tr>
<tr><td colspan="5">Extended period simulations, Software for WDN analysis and design, Rehabilitation of pipeline systems;</td><td>9</td></tr>
<tr><td colspan="6">Unit-3</td></tr>
<tr><td colspan="5">Water auditing, online monitoring and control, leak and burst detection; transient analysis and surge protection;</td><td>9</td></tr>
<tr><td colspan="6">Unit-4</td></tr>
<tr><td colspan="5">Appurtenances (valves / flow meters etc.); Selection of pipe material.</td><td>9</td></tr>
<tr><td colspan="6">Unit-5</td></tr>
<tr><td colspan="5">Jointing details; Pipe laying and testing; Structural design for buried and surface mounted pipes</td><td>9</td></tr>
<tr><td colspan="6">Self-study: NIL</td></tr>
<tr><td colspan="6">Site/Industrial Visits: NIL</td></tr>
<tr><td colspan="6">Course outcomes:
• To Design Economic and Effective water distribution Network
• To Choose Suitable Pipe material and appurtenances
• To Understand Pipe Laying and Testing Methodologies</td></tr>
<tr><td colspan="6">Text Books:
T1 B C Punmia, “Environmental Engineering vol-I”, Laxmi Publications 2nd, 2016
T2 S.K. Garg, “Environmental Engineering vol-I, Water supply Engineering”, Khanna Publishers, – New Delhi, 28th edition and 2017</td></tr>
</table>

Reference Books: R1. Karia G.L., and Christian R.A, “Wastewater Treatment Concepts and Design Approach”, Prentice Hall of India Pvt. Ltd., New Delhi. 3rd, Edition, 2017 R2. Hammer and Hammer “Water Technology”, R3. Howard S. Peavy, Donald R. Rowe, George Tchnobanoglous “Environmental Engineering”, McGraw Hill International Edition..
Online Resources: NIL

Course Name: Open Channel Flow					
Course Code: CE634EC-03D					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives: 1. Provide an introduction to the field of river flow mechanics which is the basic of flow mechanism in a river. This is the most important part of the Water Resources engineering. 2. Help students to develop an understanding of solution of free surface of flow which is an important part of fluid mechanics. 3. Illustrate the design methods of cross section of channels for different flow and geometry conditions. 4. Provide idea on flow computation, velocity distribution in a river or artificial channel with complex geometry, plan form and flow conditions (steady and unsteady).					
Prerequisites:					

Units	**Teaching Hours**
Unit-1	
Open- channel flow and its classifications, measurement of velocity, velocity distribution, pressure distribution, specific energy, Specific force and critical state of flow, section factor for critical flow Uniform flow, determination of roughness coefficients and the factors affecting the roughness, composite roughness of a channel with different rough surfaces.	09
Unit-2	

Computation of uniform flow, flood discharge, determination of normal depth and velocity, flow in composite roughness Design of channels for uniform flow in non-erodible and erodible with grassed channels Dynamics of Gradually varied flow and classification of flow profile, methods of computation	09
Unit-3	
Dynamics of spatially varied flow - analysis of flow profile and computation by method of numerical integration Rapidly varied flow, classification, flow over spillway, Hydraulic Jump, types with characteristics of jump, the surface profile and location of the jump, jumps as energy decapitator, Rapidly varied flow through non-prismatic channels	09
Unit-4	
Unsteady flow, dynamics of gradually varied unsteady flow, solution of unsteady flow equations, rapidly varied unsteady flow, positive and negative surges, flood routing, principle and methods of flood routing.	09
Unit-5	
Compound channels, flow computation of a two stage channels by different methods. Meandering channels ad braided channels. Stage-discharge curves for meandering channels and braided channels.	09
Self-study: ADD	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: CO1 Know the fundamental of free surface flow. CO2 Compute the flow velocity distribution, roughness in a channel with given geometry, plan form and flow conditions CO3 Able to understand the characteristic of non-uniform flow and unsteady flow in a Channel	
Textbooks: 1. V. T. Chow, Open Channel Hydraulics, McGraw-Hill Publishing Company, , New Delhi, 1993 , Most of the syllabus is covering 2. M. Hanif Chaudhry, Open-Channel Flow, Springer, USA, 2nd edition, 2008 , Most of the syllabus is covering	

Reference Books: 1. H. Chanson, The Hydraulics of Open Channel Flow, Elsevier , Numerical application on open channel flow 2. K. Subramanya, Flow in Open Channel, Tata McGraw Hill , Good examples on problems in open channel flow
Online Resources: NIL, add NPTEL

Course Name: River Engineering					
Course Code: CE732EC-04D					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives: - Knowledge about river behavior is essential for practicing hydraulic and water resources engineers.					
Prerequisites:					
Units				**Teaching Hours**	

Unit-1	
River Morphology (Bars; Bends and Meanders, Thalweg; Braiding; Bifurcations etc.); Sediment Transport Mechanics (Bed forms, Bed Load transport, Transport of suspended sediment, Critical Shear stress, Sediment Transport Equations)	09
Unit-2	
Aggradation and Degradation; Local Scour at Bridge Piers and other Hydraulic Structures. Measurements in Rivers (Stage measurements, Channel geometry, Discharge, Sediment samplers and suspended and bed load measurement)	09
Unit-3	
Physical river Models (fixed and movable bed models; sectional models, distorted Models), Mathematical models for aggradations, degradation and local scour	09
Unit-4	
River Protection and Training Works (Revetments, Dikes, Gabions, Spurs, Bank Protective measures and Bed control structures), Design of river training and flood protection structures	09
Unit-5	
Diversion and Cofferdams; River regulations systems; Dredging and Disposal, River restoration	09
Self-study: ADD	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: CO1	
Textbooks: 1.	
Reference Books: 1.	
Online Resources: NIL, add NPTEL	

<table>
<tr><td colspan="6" align="center">Course Name: - Hydraulic Modelling</td></tr>
<tr><td colspan="6" align="center">Course Code: CE733EC-05D</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td align="right">Category</td><td>PEC</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td align="right">CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td align="right">ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td align="right">Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: The main objective of this course is to introduce various concepts which will help in designing physical hydraulic models.
Ability to know about design principles of various types hydraulic structures
Ability to perform stability analysis of concrete gravity dams
Ability to design a dam by using CAD</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">Basics of Hydraulic Modelling (similarity mechanics, model laws, distinction between numerical and hydraulic models, classification of hydraulic modelling, materials used in the model, scale effect, design, construction, operation and interpretation of the results)</td><td>09</td></tr>
<tr><td colspan="6">Unit-2</td></tr>
<tr><td colspan="5">Role of instrumentation and data processing; Gravity dominated models (modelling of energy dissipaters, overflow spillways, siphon spillways, bridge piers, vortex formation, cavitation, flow induced vibrations); Gravity friction models: (pumped flow models, ship models, surge tank models)</td><td>09</td></tr>
<tr><td colspan="6">Unit-3</td></tr>
<tr><td colspan="5">Friction dominated models; River models with fixed and mobile bed; Basin and reservoir models; Tidal models with fixed and mobile bed; estuarine models; harbor and breakwater models, models of offshore structures</td><td>09</td></tr>
<tr><td colspan="6">Unit-4</td></tr>
<tr><td colspan="5">Design of water storage structures (1)High dams-gravity dams(zonal method design), over flow and non over flow section.(2) Low dams-weirs, Earthen dams, vented dams (Barrage), instrumentation and maintenance of dam structures.

Collection and conveyance of water. Design of intakes, conveyance system of Irrigation, drinking and hydro power. Design of canal network.</td><td>09</td></tr>
</table>

Unit-5	
Hydraulic design of pressure pipes, hydrostatic tests on pipes, design of distribution systems- pressure in distribution systems, mono graphs, Hardy cross and numerical methods Hybrid and Analogue models; Scope and limitations of hydraulic modelling, complementary aspects of numerical and hydraulic modelling.	09
Self-study: ADD	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: CO1 Design the canal network CO2 design different type of water storage structures CO3 instrumentation and maintenance of dam structures CO4 Hydraulic design of pressure pipes	
Textbooks: 1. Creager, Justin & Hinds, Engineering for Dams, Vols - I, II, III 2. Varshney, Hydraulic and Irrigation Structures, Nem Chand & B (2007)	
Reference Books: 1. Varshney, Hydraullic and Irrigation Structures, Vols - I, II, III 2. Creager, Justin & Hinds, Engineering for Dams, Nem Chand & B (2007)	
Online Resources: NIL, add NPTEL	

<table>
<tr><td colspan="6" align="center">Course Name: - Basics of Computational Hydraulics</td></tr>
<tr><td colspan="6" align="center">Course Code: CE733EC-06D</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td align="right">Category</td><td>PEC</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td align="right">CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td align="right">ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td align="right">Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives:
Provide knowledge on application of computational fluid mechanics to different branch of engineering and science
Provide knowledge on conservation law and the numerical approach to solve by converting different form of partial differential equation to algebraic equations.
Provide some experience in the software engineering skills associated with the implementation of these techniques in practical MATLAB computer codes.
Illuminate some of the difficulties like consistency, convergence and stability check that is encountered in the numerical solution of fluid flow problems.</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">Introduction to Computational Fluid Dynamics, Application to different Branch of Science and Engineering, Governing equations for fluid flow: Continuity equation, momentum equation and energy equation

Derivation of governing equations for flow and transport in surface and sub-surface (saturated and unsaturated flow); Equations for reactive transport; Coupled surface and sub-surface flow models</td><td>09</td></tr>
<tr><td colspan="6">Unit-2</td></tr>
<tr><td colspan="5">Basics of finite difference, finite element and finite volume methods (consistency, stability, convergence, order of accuracy, computational efficiency)

Finite difference approach, Classification of partial differential equations, Parabolic, Hyperbolic and elliptic equations, Discretization of the 1-Dimensional, 2-Dimensional partial differential equations and its solutions. Finite difference formulations, Finite difference method: introduction, discretization methods, consistency, error and stability analysis, fundamentals of fluid flow modeling</td><td>09</td></tr>
<tr><td colspan="6">Unit-3</td></tr>
</table>

Finite difference applications, Solution of Navier-Stokes equation for incompressible flows using SIMPLE algorithm Application of numerical methods for solving flow and transport equations, fully coupled and iteratively coupled models	09
Unit-4	
Model simplification, Parameter estimation (Model calibration and validation) Explicit finite difference schemes, implicit finite difference schemes, Initial and Boundary conditions, significance of model boundary conditions, review of applied numerical methods	09
Unit-5	
Model simplification, Parameter estimation (Model calibration and validation) Computational Fluid Dynamics (CFD) software for three-dimensional turbulent flow modelling, Software for sub-surface flow simulation	09
Self-study: ADD	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: CO1 Understand the governing equations based on conservation principals in fluid flow problems CO2 Able to know the use of finite difference method applied to fluid flow problems CO3 Able to check the output from numerical method as compared to the observed data	
Textbooks: 1. K. A Hoffmann, Computational Fluid Dynamics, Engineering Education System, 2000 , Details of the course 2. J.D. Anderson, Computational Fluid Dynamics, Springer,USA, 2nd edition, 2008 , Details of the course	
Reference Books: 3. M.B. Abbott and D.R. Basco, Computational Fluid Dynamics, Cambridge university press , More on application of CFD 4. Vreugdenhil, Cornelis B, Computational Hydraulics An Introduction, Springer , More on application of CFD	
Online Resources: NIL, add NPTEL	

ELECTIVE- E-Hydrology & Water Resources Engineering

Course Name: - Water Quality Engineering					
Course Code: CE535EC-01E					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives: The main objective of this course for civil engineers is to enable them to understand and implement techniques for the supply of treated water to the public in an economic way.					
Prerequisites: Engineering Chemistry, Fluid Mechanics and Hydrology and Water Resources Engineering.					

Units	Teaching Hours
Unit-1	
Human activities and environmental pollution. Combating Climate Change towards promoting a sustainable environment in developmental activities. Requirement of Water for various beneficial uses. Need for protected water supply. **Demand of water:** Types of water demands- domestic demand in detail, institutional and commercial, public uses, fire demand. Per capita consumption –factors affecting per capita demand. Population forecasting, different methods with merits & demerits- variations in demand of water. Fire demand – estimation by Kuichling's formula, Freeman formula & national board of fire under writers' formula, peak factors, design periods & factors governing the design periods	07

Unit-2	
Sources: Surface and subsurface sources – suitability with regard to quality and quantity **Collection and conveyance of water:** Intake structures –different types of intakes; factor of selection and location of intakes. Pumps-Necessity, types – power of pumps; factors for the selection of a pump. Pipes– Design of the economical diameter for the rising main; Nomograms – use; Pipe appurtenances.	06
Unit-3	
Objectives of water quality management. Concept of safe water, wholesomeness & palatability, water borne diseases. Examination of Water: - Objectives – Physical chemical and Microbiological Examinations, (IS: 3025 and IS: 1622) using analytical and instrumental techniques. Drinking water standards BIS & WHO guidelines. Health significance of Fluoride, Nitrates and heavy metals like Mercury, Cadmium, Arsenic etc. Sampling of water for examination.	09
Unit-4	
Water treatment: Objectives – Treatment flow-chart. Aeration-Principles, types of Aerators **Sedimentation:** Theory, settling tanks, types, design. Coagulant aided sedimentation, jar test, chemical feeding, flash mixing, and clari-flocculator. **Filtration**: Mechanism – theory of filtration, types of filters, slow sand, rapid sand and pressure filters including construction, operation, cleaning and their design – excluding under drainage system – back washing of filters. Operational problems in filters **Disinfection:** Theory of disinfection, types of disinfection, Chlorination, chlorine demand, residual chlorine, use of bleaching powder. UV irradiation treatment – treatment of swimming pool water **Softening:** Definition, methods of removal of hardness by lime soda process and zeolite process RO & Membrane technique.	08
Unit-5	
Miscellaneous treatment: Removal of color, odor, taste, use of copper sulfate, adsorption technique, fluoridation and defluoridation. **Distribution systems:** System of supply, Rainwater harvesting, service reservoirs and their capacity determination, methods of layout of distribution systems Pipe appurtenances, various valves, type of fire hydrants, pipefitting, Layout of water supply pipes in buildings	07
Self-study:	
Site/Industrial Visits: NIL	

Course outcomes: - Upon the completion of this course the student will be able to:
CO1 Identify different human activities, their impact on the environment and type of water demand on the forecasted population (L2, L3).
CO2 Identify reliable water sources, and analyse different collection and conveying system (L3, L4)
CO3 Infer water quality aspects and parameters as per BIS (L2)
CO4 Classify different water treatment systems and design suitable Water treatment units based on requirement (L2, L6)
CO5 Understanding miscellaneous treatment methods and water Distribution systems (L2)

Textbooks:

1. Garg. S. K., "Water supply Engineering", Khanna Publishers., 25th revised edition, 2014
2. Punmia. B C., and Ashok Jain, "Environmental Engineering-I" , 2nd edition
3. "Manual on Water supply and treatment" –CPHEEO, Ministry of Urban Development, New Delhi.
4. Sawyer and MC Carty "Chemistry for Environmental Engineering and Science", 5th edition.

Reference Books:

1. Rao P.V, *"Textbook of Environmental Engineering",* Prentice Hall of India, New Delhi, 2013
2. Nazaroff. W. W and Choen L.A, *"Environmental Engineering Science",* Wiley Student Edition, New Delhi, 2013.
3. Masters G. M and Ela W. P, *"Introduction to Environmental Engineering and Science",* Prentice Hall of India, New Delhi, 2013.
4. Naik. S. C and Tiwari. T. N, *"Society and Environment",* Oxford and IBH, New Delhi, 2012.
5. Peavy. H.S, Rowe. D.R and Tchobanoglous. G, *"Environmental Engineering",* McGraw Hill, New Delhi, 2013.

Online Resources:

Course Name: - Surface Hydrology					
Course Code: CE633EC-02E					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives: The course will introduce wide range of environmental fluid flow, such as porous media, land runoff, channel flow, and effluent discharge. Provides systematic analysis tools and skills for study fluid mechanics in natural and constructed environmental flows					
Prerequisites: Nil					
Units					**Teaching Hours**

Unit-1 Introduction	
Review of basic hydrology; Hydrometeorology, Evapotranspiration; Infiltration, Runoff and hydrograph analysis;	9
Unit-2	
Flood routing - lumped, distributed and dynamic approaches;	9
Unit-3	
Hydrologic statistics; Frequency analysis and probability	9
Unit-4	
Introduction to environmental hydrology, Urban hydrology	9
Unit-5	
Design issues in hydrology	9
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes: - Students would learn about procedures for analysis of various hydrometeorological and hydrological processes in river basins, and environmental extremes (floods).	

Textbooks:

1. Jayarami Reddy, "A Textbook of Hydrology", Lakshmi Publications, New Delhi
2. Raghunath. H.M., "Hydrology", Wiley Eastern Publication, New Delhi
3. Subramanya K, "Engineering Hydrology", Tata McGraw Hill, New Delhi

Reference Books:

1. Das and Saikia, Hydrology, PHI learning Private Limited, 2014.
2. S.K.Garg, Hydrology and Water Resources Engineering, 22nd edition, Khanna Publishers, New Delhi, 2014.
3. Linsley, Kohler and Paulhus, Applied Hydrology, Wiley Eastern Publication, New Delhi, 2000.
4. Patra. K. C., Hydrology and water Resources Engineering, 2nd edition, Narosa publishing House, New Delhi, 2015.
5. Sharma R.K., and Sharma, Hydrology and Water Resources Engineering, Oxford and IBH, New Delhi
6. Todd, Ground Water Hydrology, 3rd edition, Wiley Eastern Publication, New Delhi, 2005.
7. Ven Te Chow, Handbook of Hydrology, McGraw Hill publishers, 2010.
8. Viessman, Jr. and Lewis, Introduction to Hydrology, 5th edition, PHI learning Private Limited, 2011.

Online Resources:
NIL

Course Name: - Environmental Fluid Mechanics					
Course Code: CE634EC-03E					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3

Course objectives: The course will introduce wide range of environmental fluid flow, such as porous media, land runoff, channel flow, and effluent discharge. Provides systematic analysis tools and skills for study fluid mechanics in natural and constructed environmental flows

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1 Introduction	
Review of basic hydraulics concept. Fundamental Equation; Derivation of dimensional cross-sectional average continuity and momentum equations. Steady flow in pipes; wall roughness, uniform flow, design	9
Unit-2 Open Channel Flow	
Flow resistance in free surface hydrodynamics, uniform flow, stage-discharge curves in natural cross-sections, Steady-state profiles, Subcritical and super critical flows, boundary conditions, hydraulic jump, Gradually varied flow, unsteady flows, flood waves, celerity of propagation, simplified models	9
Unit-3 Transport Process in Rivers	
Basic concept, Concentration of scalar tracer. One dimensional advection-diffusion equations, turbulent diffusion, Mass and heat transport in rivers	9
Unit-4 Sediment Transport	
Sediment characterization and types of transport. Review of empirical relationships for sediment load, settling velocity and equilibrium concentration, Morphological evolution – erosion and deposition	9
Unit-5 Turbulent Flow	
Instability characteristics, averaging Reynolds and turbulent kinetic equations, effluent discharge, boundary layer	9

Self-study: NIL

Site/Industrial Visits: NIL

Course outcomes: - Upon the completion of this course the student will be able to: Calculate steady state profiles of Open channel flows with variable geometry and discharge Perform preliminary design of hydraulic structures typically used in hydropower systems Perform hydrological analyses needed for design of hydropower systems Assess river flow alteration due to hydropower operation
Textbooks:
Reference Books:
Online Resources: NIL

Course Name: - Water Resources Field Methods

Course Code: CE732EC-04E

	L	T	P	Category	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3

Course objectives: The main objective of this course for civil engineers is to enable them to understand techniques of sampling water from different sources

Prerequisites: Engineering Chemistry, Fluid Mechanics and Hydrology and Water Resources Engineering.

Units	**Teaching Hours**
Unit-1	
Human activities and environmental pollution. Combating Climate Change towards promoting a sustainable environment in developmental activities. Requirement of Water for various beneficial uses. Need for protected water supply. Scientific principles of measurement technologies and protocols used for water-resources measurements and experimental design of field-scale water-resources and environmental studies	09
Unit-2	
Planning field studies; instruments and protocols for surface-water, ground-water, and water-quality sampling; description of data quality	09
Unit-3	

Objectives of water quality management. Concept of safe water, wholesomeness & palatability, water borne diseases. Examination of Water: - Objectives – Physical chemical and Microbiological Examinations, (IS: 3025 and IS: 1622) using analytical and instrumental techniques. Drinking water standards BIS & WHO guidelines.	09
Unit-4	
Disinfection: Theory of disinfection, types of disinfection, Chlorination, chlorine demand, residual chlorine, use of bleaching powder. UV irradiation treatment – treatment of swimming pool water	09
Unit-5	
Laboratory field trips to streamflow monitoring stations and groundwater monitoring wells nearby.	09
Self-study:	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: CO1 Identify different human activities, their impact on the environment and type of water demand on the forecasted population (L2, L3). CO2 Identify reliable water sources, and analyse different collection and conveying system (L3, L4) CO3 Infer water quality aspects and parameters as per BIS (L2) CO4 Carry out Sampling from different sources of water bodies.	
Textbooks: 1. Garg. S. K., "Water supply Engineering", Khanna Publishers., 25th revised edition, 2014 2. Punmia. B C., and Ashok Jain, "Environmental Engineering-I" , 2nd edition	
Reference Books: R1 "Manual on Water supply and treatment" –CPHEEO, Ministry of Urban Development, New Delhi. R2 Sawyer and MC Carty "Chemistry for Environmental Engineering and Science", 5th edition.	
Online Resources:	

Course Name: Drone Based Surveying					
Course Code: CE732EC-05B					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives: Objective of the course is to make the students familiarize with advanced mapping techniques and 3D modeling for large scale mapping.					
Prerequisites: Engineering Mathematics and Engineering Physics					
Units				**Teaching Hours**	
Unit-1					

Basics of Photogrammetry: Application of Photogrammetry in Civil Engineering, Introduction to Photography, Lens formula, lens distortions, types of photographs (Vertical, Tilted and Oblique Photographs), Scale of Photograph, relief Displacement, Parallax equations for stereoscopic vision, Base Lining of Photographs, Instruments and accessories for stereo vision. Rectification of Photographs by Interior, relative and Absolute orientation of stereo pairs. Aero triangulation for Bundle block adjustment, Flight Planning for aerial Photographs.	9
Unit-2	
Introduction to Drones: Type of Drones (Hobby and Survey Grade drones), Working of Drones, Assembly of Drones, Simulation of Drone flying, Controls in Drone flying, DGCA Rules and regulations on Drone flying. Flight Planning for drone mapping using Mobile Apps. Field Practice to capture Overlapping images using drones	9
Unit-3	
Post Processing of Drone Images: Importing images to Openware software platform, Ortho Mosaic Preparation, Point cloud classification, Digital Surface Model, Exporting Ground Points, Digital Terrain Model, Contour Map Generation using various interpolation techniques.	12
Unit-4	
Introduction to QGIS: GIS functionalities in QGIS, Data interoperability, handling of vector and raster data, Geoprocessing tools, Georeferencing, image classification, digital elevation model from drone data sets, contour map preparation.	8
Unit-5	
CASE STUDIES using QGIS: Route Alignment, watershed delineation, reservoir capacity estimation, Land use Land cover (LULC) map preparation, thematic map generation using overlay analysis.	7
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: 1. Explain the photogrammetric concepts and determine ground coordinates from the phot coordinates. (L2, L3), {PO1, PO2, PO5, PO9, PO10, PSO3} 2. Classify drones, understand the assembly of drones, drone flying (L3), {PO1, PO2, PO5, PO9, PO10, PSO3} 3. Rectify and analyse the drone images (L4), {PO1, PO2, PO5, PO9, PO10, PSO3} 4. Apply GIS concepts for civil engineering applications using drone images (L5), {PO1, PO2, PO5, PO9, PO10, PSO3} 5. Develop 3D models of drone images for civil engineering applications (L5), {PO1, PO2, PO5, PO9, PO10, PSO3}	

Textbooks:

1. M. A.Reddy, Text Book of Remote Sensing and Geographical Information Systems, 4thEdition, Hyderabad, BS Publications, 2013.
2. B.C. Punmia, “Advanced Surveying”, Laxmi Publications, New Delhi, 2018
3. Remote Sensing and Image Interpretation – Lillesand, John Wiley and Sons, 2014
4. Reddy. M. A, “Text Book of Remote Sensing and Geographical Information Systems”, BS Publications, Hyderabad, Fourth Edition, 2013.
5. P.R Wolf & B.A. Dewitt Elementary photogrammetry, 4th edition, TMH publishing, 2014

Reference Books:

1. C.P Young and Loe, “Concepts and Techniques of Geographic Information System”, PHI EEE edition, 2006
2. Korte “GIS studies” 2016, Thomson Publications, New Delhi.
3. Punmia B C, Ashok K Jain &Arun K Jain “Higher Surveying”, 2018, Laxmi Publications, New Delhi
4. Ravi Gupta “Remote Sensing Geology”, 2016, Springer Verlog (NY)
5. Subramanian R “Surveying & Levelling”, 2016, Oxford University Press

Online Resources:

https://docs.qgis.org/3.4/en/docs/training_manual/index.html

ELECTIVE- F-Structural Engineering

<table>
<tr><td colspan="7" align="center">Course Name: Structural Analysis – I</td></tr>
<tr><td colspan="7" align="center">Course Code: CE535EC-01F</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td colspan="2" align="right">Category</td><td>PEC</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td colspan="2" align="right">CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td colspan="2" align="right">ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td colspan="2" align="right">Exam Hours</td><td>3</td></tr>
<tr><td colspan="7">Course objectives: To enable the students with the comprehensive methods of structural analysis with emphasis on structural elements of different geometry and boundary conditions.</td></tr>
<tr><td colspan="7">Prerequisites: Mathematics, Physics, Engineering Mechanics.</td></tr>
<tr><td colspan="5">Units</td><td colspan="2">Teaching Hours</td></tr>
<tr><td colspan="7">Unit-1</td></tr>
<tr><td colspan="5">INTRODUCTION TO STRUCTURAL SYSTEMS: History of Structural Analysis, Structural Engineering, Steps in Structural Engineering and Requirements of Structural analysis, Forms of structures, one, two, three dimensional structural systems, Various loads to be considered in the analysis, Assumptions in Structural analysis, Conditions of equilibrium, Degree of freedom, Determinate and indeterminate structures [Static and Kinematics]Linear and Nonlinear structures and Concept of Superposition for linear systems.
DEFLECTION OF BEAMS: Moment area method, Conjugate beam method.
ANALYSIS OF PLANE TRUSSES: Analysis of statically determinate Plane trusses by method of joints.</td><td colspan="2" align="center">09</td></tr>
<tr><td colspan="7">Unit-2</td></tr>
<tr><td colspan="5">STRAIN ENERGY: Strain energy and complimentary strain energy, Strain energy due to axial load, bending and shear, Theorem of minimum potential energy, Law of conservation of energy, Principle of virtual work, The first and second theorem of Castigliano, problems on beams, frames and trusses, Betti's law, Clarke - Maxwell's theorem of reciprocal deflection. Deflection of beams and trusses using strain energy and unit load methods</td><td colspan="2" align="center">09</td></tr>
<tr><td colspan="7">Unit-3</td></tr>
<tr><td colspan="5">ARCHES AND CABLES: Two hinged parabolic arch, two hinged Circular Arch. Three hinged circular and parabolic arches with supports at same levels and different levels, Determination of thrust, shear and bending moment, Analysis of cables under point loads and UDL, length of cables (Supports at same levels and at different levels).</td><td colspan="2" align="center">09</td></tr>
</table>

Unit-4	
ANALYSIS OF BEAMS: Consistent deformation method – Propped cantilever and fixed beams, Strain Energy method – Propped cantilever and fixed beams. Clapeyron's theorem of three moments – continuous beams and fixed beams	09
Unit-5	
ROLLING LOAD AND INFLUENCE LINES: Rolling load analysis for simply supported beams for several point loads and UDL. Influence line diagram for reaction, SF and BM at a given section for the cases mentioned	09
Self-study: NIL	
Site/Industrial Visits: NIL	

Course outcomes:- The students who successfully complete this course will have the ability to:

- Determine the static determinacy and indeterminacy in a structure, and also be able to calculate the degree of static indeterminacy and kinematic indeterminacy.
- Determine the deflection in a structure by Area Moment Method, Conjugate Beam Method, Energy Method, Unit Load Method and using Castigilano's theorem.
- Determine the Support reactions, Shear Force and Bending Moments by using the concept of Consistent Deformation for Propped Cantilevers and Fixed Beams and using Clapeyron's theorem of three moments for continuous beams.
- Determine the Shear Force and Bending Moments for Rolling Loads using Influence Line Method for simply supported rigid beams.

Textbooks:

1. S. S.Bhavikatti, Structural Analysis Vol. I & II,Fourth Edition,New Delhi, Vikas Publishing House Pvt., 2011.
2. G. S.Pandit., S.P.Gupta and R.Gupta, Theory of Structures, Vol. – I,Sixth Reprint, New Delhi, Tata McGraw Hill, 2011.
3. B.C.Punmia,A. K. Jain and A. K. Jain Theory of Structures, Twelfth Edition, New Delhi,Laxmi Publication, 2010.
4. C. S.Reddy,Basic Structural Analysis,Third Edition,New Delhi,Tata McGraw Hill, 2012.

Reference Books:

1.S.Kinney, Indeterminate Structural Analysis, New Delhi,Oxford Publishing House, 1957.
2.C. K.Wang, Indeterminate Structural Analysis, New Delhi,Tata McGraw Hill, 2010.
3.A.Ghali, A. M.Nevilleand T. G.Brown, Structural Analysis A Unified Classical And Matrix Approach, Sixth Edition, London, Spon Text, 2013.
4.R. C. Hibbeler, Structural Analysis, Sixth Edition, New Delhi, Pearson, 2011.
5.D. L.Schodek and M.Bechthold, Structures, Seventh Edition, New Delhi,PHI Learning, 2014.
6.K. M.Leetand C. M.Uang, Fundamentals of Structural Analysis, New Delhi, Tata McGraw Hill, 2003.
7.D.Menon, Structural Analysis, New Delhi, Narosa Publishing House, 2010.
8.D. S. P. Rao, Structural Analysis – A Unified Approach, Hyderabad, United Press, 1996.
9.S. D.Rajan, Introduction to Structural Analysis & Design, New Delhi, Wiley India, 2001.
10.H. H.West and L.F.Geschwindner, Fundamentals of Structural Analysis, Second Edition, New Delhi, Wiley Student Edition, 2011.
11.W. M. C. McKenzie, Examples in Structural Analysis, London, CRC Press, 2013.
12.C. H.Norris and J. B.Wilbur, Elementary Structural Analysis, Fourth Edition, New Delhi, Tata McGraw Hill, 2003.
13.F.Arbabi, Structural Analysis and Behaviour, New Delhi, McGraw Hill Education, 2014.
14.H.Laursen, Structural Analysis, Third Edition, New Delhi, McGraw Hill Education, 2014.
15.B.Bedenik and C.Besant, Analysis of Engineering Structures,West Sussex, Harwood Publishing, 1999.
16.Thandavamoorthy, Structural Analysis, First Edition, New Delhi,Oxford University Press, 2011.
17.A. K.Jain, Advanced Structural Analysis- With Finite Element and Computer Applications, Second Edition, Nem Chand, Roorkee, 2009.
18.S.K.Roy and S.Chakrabarty, Fundamentals of Structural Analysis With Computer Analysis and Applications, Second Edition, New Delhi, S. Chand & Co, 2011.
19.V. N.Vazirani and M. M.Ratwani,Analysis of Structures Vol. II- Theory, Design & Details of Structures,Sixteenth Edition, New Delhi, Khanna Publishers, 2011.

Online Resources:

Course Name: Structural Analysis – II

Course Code: CE633EC-02F

	L	T	P	Category	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3

Course objectives: To enable the students to take an integral look at the theories of structural analysis with proper emphasis on structural elements of different geometry and boundary conditions.

Prerequisites: Mathematics, Physics, Engineering Mechanics and Structural Analysis I.

Units	Teaching Hours
Unit-1 Slope Deflection Method	

Introduction, Sign convention, Development of slope-deflection equations and Analysis of Beams and Orthogonal Rigid jointed plane frames (non-sway) with kinematic redundancy less than/equal to three. (Members to be axially rigid) Analysis of rigid jointed plane frames (sway, members assumed to be axially rigid and kinematic redundancy ≤ 3) by slope deflection method	10
Unit-2 Moment Distribution Method	
Introduction, Definition of terms- Distribution factor, Carry over factor, Development of method and Analysis of beams and orthogonal rigid jointed plane frames (non-sway) with kinematic redundancy less than/ equal to three. (Members to be axially rigid) Analysis of rigid jointed plane frames (sway, members assumed to be axially rigid and kinematic redundancy ≤ 3) by moment distribution methods	10
Unit-3 Kani's Method	
Introduction, Basic Concept, Analysis of Continuous beams and Analysis of rigid jointed non-sway plane frames.	10
Unit-4 Flexibility and Stiffness Method of Analysis	
Flexibility Matrix Method of Analysis: Introduction, Development of flexibility matrix for plane truss element and axially rigid plane framed structural elements and Analysis of plane truss and axially rigid plane frames by flexibility method with static indeterminacy ≤3. **Stiffness Matrix Method of Analysis**: Introduction, Development of stiffness matrix for plane truss element and axially rigid plane framed structural elements. And Analysis of plane truss and axially rigid plane frames by stiffness method with kinematic indeterminacy ≤3.	20
Unit-5 Basic Principles of Dynamics	
Basic principles of Vibrations and causes, periodic and a periodic motion, harmonic and non-harmonic motion. Period and frequency, Forced and Free Vibration, Damping and Equations of Single Degree of Freedom System with and without damping .	10
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes:- Upon the completion of this course the student will be able to: 1.Analyse and determine stress resultants and member deformation of continuous beams and orthogonal portal frames by slope deflection method (L2, L4, L5) 2.Analyse and determine stress resultants and member deformation of continuous beams and orthogonal portal frames by moment distribution method (L2, L4, L5) 3.Analyse and determine stress resultants and member deformation of continuous beams, orthogonal portal frames and multi stored frames by Kani's method (L2, L4, L5) 4.Analyse and determine stress resultants and member deformation by matrix method using flexibility and stiffness approach (L2, L4, L5) 5.Understand the natural frequency and time period for single degree of freedom system subjected to free vibration (L2)	

Textbooks:

5. Bhavikatti, S S "Structural Analysis" Vol. I & II, Vikas Publishing House Pvt. Ltd.
6. Gupta S.P., Pandit G.S and Gupta R., "Theory of Structures", Vol. 2, Tata McGraw Hill Publication Company Ltd
7. Punmia B.C., and Jain R.K., "Strength of Materials and theory of structures", Vol I & II, Laxmi Publication New Delhi
8. Ramamurtham "Theory of structures",Dhanpat Rai Publishing company

Reference Books:

20. Ashok K. Jain, "Advanced Structural Analysis", Nem Chand & Bros., Roorkee, India.
21. Aslam Kassimali, "Structural Analysis", Thomson Learning.
22. Clough R.W. and Penzin J., "Dynamics of Structures", Tata Mc Graw Hill Publications
23. Negi and Janjid, "Structural Analysis", Tata Mc Graw Hill Publications
24. Norris C.H., Wilbur J.B., "Elementary Structural Analysis", Mc Graw Hill International Book Edition.
25. Prakash Rao D.S., "Structural Analysis", a Unified Approach, University Press.
26. Sterling Kinney. J., "Indeterminate Structural Analysis", Oxford and IBH Publishing Co
27. Thandava Murthy, "Analysis of Structures", Oxford University Press, Edition 2005
28. Wang C.K., "Intermediate Structural Analysis", Mc Graw Hill Publications
29. Reddy C.S. "Basic Structural Analysis", Second Edition, Tata McGraw Hill Publication Company Ltd.

Online Resources:

1. https://nptel.ac.in/courses/105105109/14
2. https://swayam.gov.in/course/3740-structural-analysis-ii
3. https://www.thestructuralengineer.info/online-library

Course Name: - Reinforced Concrete					
Course Code: CE634EC-03F					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	1	0	**CIA Marks**	50
Contact Hrs./Sem.	45	15	0	**ESE Marks**	50
Credits – 4	3	1	0	**Exam Hours**	3

<table>
<tr><td colspan="2">Course objectives:
• To learn the different methods adopted in design of RCC structures.
• To learn to calculate building loads from IS 875: 1987.
• To understand the design provisions recommended in IS 456: 2000.
• To learn the design principles and procedure of design of beams, slabs, columns, footings and staircase.
• To learn the reinforcement detailing as per SP 34.</td></tr>
<tr><td colspan="2">Prerequisites: Structural Analysis I, Structural Analysis II and Concrete Technology.</td></tr>
<tr><td>Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="2">Unit-1 General Features of Reinforced Concrete and Principles of Limit State Design and Ultimate Strength of R.C. Section</td></tr>
<tr><td>GENERAL FEATURES OF REINFORCED CONCRETE: Introduction, Design Loads, Materials for Reinforced Concrete and Code requirements, Design Philosophy – Limit State Design principles. Philosophy of limit state design, Principles of limit states, Factor of Safety, Characteristic and design loads, Characteristic and design strength.
PRINCIPLES OF LIMIT STATE DESIGN AND ULTIMATE STRENGTH OF R.C. SECTION: General aspects of Ultimate strength, Stress block parameters for limit state of collapse, Ultimate strength of RC sections for flexure and shear, Concepts of anchorage and development length.
FLEXURE AND SERVICEABILITY LIMIT STATES: General Specification for flexure design of beams-practical requirements, size of beam, cover to reinforcement-spacing of bar. General aspects of serviceability-Deflection limits in IS: 456 – 2000</td><td>12</td></tr>
<tr><td colspan="2">Unit-2 DESIGN OF BEAMS</td></tr>
<tr><td>Design procedures for critical sections for moment and shears. Anchorages of bars check for development length, Reinforcement requirements, Slenderness limits for beams to ensure lateral stability, Design examples for simply supported and Cantilever beams for rectangular and flanged sections. Design of beams under torsion.</td><td>15</td></tr>
<tr><td colspan="2">Unit-3 DESIGN OF SLABS & STAIRCASES</td></tr>
<tr><td>Design of Slabs: General consideration of design of slabs, Rectangular slabs spanning one direction, Rectangular slabs spanning in two directions for various boundary conditions. Design of simply supported, cantilever and continuous slabs as per IS: 456 – 2000.
Design of Staircases: General features, types of staircase, loads on staircases, effective span as per IS code provisions, distribution of loading on stairs, Design of staircases.</td><td>15</td></tr>
<tr><td colspan="2">Unit-4 DESIGN OF COLUMNS</td></tr>
<tr><td>General aspects, effective length of column, loads on columns, slenderness ratio for columns, minimum eccentricity, design of short axially loaded columns, design of column subject to combined axial load and uniaxial moment using SP – 16 charts.</td><td>9</td></tr>
</table>

Unit-5 DESIGN OF FOOTINGS	
Introduction, load for footing, Design basis for limit state method, Design of isolated rectangular footing for axial load and uniaxial moment, design of pedestal. .	9
Self-study: NIL	
Site/Industrial Visits: Reinforced Concrete Building Construction Site	

Course outcomes: - Upon the completion of this course the student will be able to:

CO1 – Understand the various methods of RCC design, the flexural and shear behavior of reinforced concrete. (L2)

CO2 – Design singly and doubly reinforced beam sections as per IS 456:2000. (L6)

CO3 – Design one way, two-way and cantilever slabs as per IS 456:2000. (L6)

CO4 – Design columns for axial load & uniaxial bending and rectangular & square isolated footings as per IS 456:2000. (L6)

CO5 – Design different types of staircases as per IS 456:2000. (L6)

Textbooks:

T1. Varghese P C, "Limit state Design of Reinforced Concrete" PHI Learning, 2013.

T2. Unnikrishnan Pillai S, Devadas Menon, "Reinforced Concrete Design", Tata McGraw Hill, 2011.

T3. B.C Punmia, Ashok Jain, "Limit State Design of Reinforced Concrete", Laxmi Publications, 2011

Reference Books:

R1: Subramanian N, "Design of Reinforced Concrete Structures" Oxford publications, 2012.

R2: IS 456: 2000, "Plain and reinforced concrete – Code of practice."

R3: SP 16: 1980, "Design aids for reinforced concrete to IS 456: 1978." Only Design charts pertaining to column design.

R4: Park R and Pauly T "Reinforced Concrete Structures" Wiley-Intercedence Publication, 1989.

Online Resources:

W1. Design of reinforced concrete structures http://nptel.ac.in/courses/105105105/

W2. Concrete Structures 2nd Edition - https://link.springer.com/content/pdf/10.1007%2F978-3-319-24115-9.pdf

<table>
<tr><td colspan="6">Course Name: - Prestressed Concrete</td></tr>
<tr><td colspan="6">Course Code: CE732EC-04F</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>PEC</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: At the end of this course the student shall have knowledge of Methods of Prestressing, Advantages of Prestressing Concrete, the losses involved and the design methods for Prestressed Concrete Elements under codal provisions</td></tr>
<tr><td colspan="6">Prerequisites: Engineering Mechanics, Strength of materials, Concrete Technology and Structural Analysis I.</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">Materials: High strength concrete and steel, Stress-Strain characteristics and properties.
Basic Principles of Prestressing: Fundamentals, Load balancing concept, Stress concept, centre of Thrust. Pre-tensioning and post tensioning systems, tensioning methods and end anchorages
Analysis of Sections for Flexure: Stresses in concrete due to pre-stress and loads, stresses in steel due to loads, Cable profiles</td><td>9</td></tr>
<tr><td colspan="6">Unit-2</td></tr>
<tr><td colspan="5">Losses of Pre-Stress: Various losses encountered in pre-tensioning and post tensioning methods, determination of jacking force.
Deflections: Deflection of a pre-stressed member – Short term and long-term deflections, Elastic deflections under transfer loads and due to different cable profiles. Deflection limits as per IS 1343. Effect of creep on deflection, load verses deflection curve, methods of reducing deflection</td><td>12</td></tr>
<tr><td colspan="6">Unit-3</td></tr>
<tr><td colspan="5">Limit State of Collapse: Flexure-IS Code recommendations–Ultimate flexural strength of sections. Shear - IS Code recommendations, shear resistance of sections, shear reinforcement. Limit state of serviceability – control of deflections and cracking.
Design of Beams: Design of pre-tensioned and post-tensioned symmetrical and asymmetrical sections. Permissible stress, design of prestressing force and eccentricity, limiting zone of pre-stressing force cable profile</td><td>9</td></tr>
<tr><td colspan="6">Unit-4</td></tr>
</table>

Design of End Blocks: Transmission of prestress in pretensioned members, transmission length, Anchorage stress in post-tensioned members. Bearing stress and bursting tensile force-stresses in end blocks-Methods, I.S. Code, provision for the design of end block reinforcement.	8
Unit-5	
Design of Bridges: General aspects – pretensioned prestressed bridge decks – Post tensioned prestressed bridge decks – Principles of design only	7
Self-study: NIL	
Site/Industrial Visits: NIL	

Course outcomes: - Upon the completion of this course the student will be able to:
CO1: Analyse prestressed concrete elements based on basic principles of prestressing (L2, L4)
CO2: Analyse and determine the losses in prestressing and deflection. (L2, L4, L5)
CO3: Analyse and determine moment of resistance and Shear resistance. (L2, L4, L5)
CO4: Design the anchorage zone reinforcement of prestressed concrete members as per IS 1343 codal provisions. (L6)
CO5: Design of prestressed concrete bridge decks. (L6)

Textbooks:

1. Krishna Raju N "Pre-stressed Concrete", Tata Mc. Graw Publishers.
2. Dayarathnam P "Pre-stressed Concrete", Oxford and IBH Publishing Co

Reference Books:

1. Krishna Raju N "Prestressed Concrete", N. Krishna Raju, TataMcgrawhill, 3rd edition, 1995.
2. Pandit. G.S. and Gupta. S.P. "Prestressed Concrete", CBS Publishers, 1993.
3. Rajagopalan N "Pre-stressed Concrete"
4. Sinha N C & S.K. Roy "Fundamental of pre-stressed concrete"
5. T.Y. Lin and Ned H. Burns "Design of pre-stressed concrete structures", John Wiley & Sons, New York.
6. IS: 1343: 2012

Online Resources:
NPTEL LINKS

Course Name: Design of Steel Structures					
Course Code: CE733EC-05F					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3

Course objectives: The objective this course is to study the Design of Structural Steel members subjected to Compressive, Tensile and Bending loads, as per current codal provisions including connections

Prerequisites: Strength of Materials, Structural Analysis-I, Structural Analysis-I

Units	Teaching Hours
Unit-1 Introduction to Steel Structures Bolted & Welded Connections	
Advantages and Disadvantages of Steel structures, Loads and Load combinations, Design considerations, Limit State Method (LSM) of design, Failure criteria for steel, Codes, Specifications and section classification. **Connections:** Introduction, Behavior of Bolted joints, Design strength of ordinary Black Bolts, Design strength of High Strength Friction Grip bolts (HSFG), Pin Connections, Simple Connections, Welding process, Welding electrodes, Advantages of Welding, Types and Properties of Welds, Types of joints, Weld symbols, Weld specifications, Effective areas of welds, Design of welds, Simple joints, Moment resistant connections,	10
Unit-2 Types of Connections	
Beam to Beam, Beam to Column connections – bolted and welded. Framed and seated connections (moment resistant connections not included).	8

Unit-3 Plastic Analysis of Steel Structures	
Introduction, Plastic theory, Plastic hinge concept, Plastic collapse load, conditions of plastic analysis, Theorem of Plastic collapse, Methods of Plastic analysis, Plastic analysis of continuous beams	8
Unit-3 Design of Tension and Compression Members	
Tension members: Introduction, Types of tension members, Design of strands, Slenderness ratio, Behavior of tension members, Modes of failure, Factors affecting the strength of tension members, Design of tension member. **Compression members**: Introduction, Failure modes, Behaviour of compression members Sections used for compression members, Effective length of compression members, Design of compression members, Built upcompression members.	10
Unit-5 Design of Beams	
Introduction, Beam types, , Lateral stability of beams, factors affecting lateral stability, Behaviour of simple and built-up beams in bending(without vertical stiffeners), Design strength of laterally supported beams in Bending, Design of beams	9
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes: On completion of the course the student would able to: 1.Analyse and design simple bolted and welded joints as per IS800-2007 2.Analyse and design Framed and seated connections 3.Compute plastic section modulus and plastic moment capacity of a rolled and built up section 4.Analyse and design tension member and compression members as per IS800-2007 5.Analyse and design laterally supported beam as per IS800-2007	
Textbooks: T1. Subramanian N. "D*esign of Steel Structures*", Oxford University Press, New Delhi. 2012 T2. Duggal S.K, "*Design of Steel Structures*", Tata McGraw Hill, New Delhi, 2009 T3. Bhavikatti. S.S, *"Design of Steel Structures By Limit State Method as Per IS:800 -2007"*, I.K. International Publishing House, New Delhi, Third Edition, 2012	
Reference Books: 1. Segui. W. T, *"Design of Steel Structures"*, Cengage Learning, New Delhi, 2007 2. Gaylord. Jr. E. H, Gaylord. C. N and Stallmeyer. J. E, *"Steel Structures"*, Tata McGraw Hill, New Delhi, 2010. 3. Arya and Ajmani *"Design of Steel Structures"*, Nem Chand & Bros. Roorkee, 2009 4. S Ramamrutham "Design of Steel Structures", Dhanpat Rai Publishing Company, 2015	

Online Resources:
https://nptel.ac.in/courses/105105162/

Course Name: Concrete Technology					
Course Code: CE733EC-06F					
	L	**T**	**P**	Category	PEC
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**
Course objectives: This paper is designed to give an insight into the role of admixtures, mix design, in preparation of concrete, durability of concrete, testing of hardened concrete. Special concretes like Ready mixed concrete, fibre reinforced concrete, light weight, High density and High-performance concrete.					
Prerequisites:					
Units					**Teaching Hours**
Unit-1					

Importance of Bogue's compounds, Structure of a Hydrated Cement Paste, Volume of hydrated product, porosity of paste and concrete, transition Zone, Elastic Modulus, factors affecting strength and elasticity of concrete, Rheology of concrete in terms of Bingham's parameter.	5
Unit-2:	
ADMIXTURES: CHEMICAL ADMIXTURES- Mechanism of chemical admixture, Plasticizers and super Plasticizers and their effect on concrete property in fresh and hardened state, Marsh cone test for optimum dosage of superplasticizer, retarder, accelerator, Air-entraining admixtures, new generation superplasticiser. **MINERAL ADMIXTURE**-Fly ash, Silica fume, GCBS, and their effect on concrete property in fresh state and hardened state.	10
Unit-3:	
MIX DESIGN - Factors affecting mix design, design of concrete mix by BIS method using IS10262 and current American (ACI)/ British (BS) methods. Provisions in revised IS10262-2004	12
Unit-4:	
DURABILITY OF CONCRETE - Introduction, Permeability of concrete, chemical attack, acid attack, efflorescence, Corrosion in concrete. Thermal conductivity, thermal diffusivity, specific heat. Alkali Aggregate Reaction, IS456-2000 requirement for durability. **Test on Hardened concrete** - Effect of end condition of specimen, capping, H/D ratio, rate of loading, moisture condition. Compression, tension and flexure tests. Tests on composition of hardened concrete-cement content, original w/c ratio. NDT tests concepts-Rebound hammer, pulse velocity methods.	15
Unit-5:	
READY MIXED concrete - manufacture, transporting, placing, precautions, Methods of concreting- Pumping, under water concreting, shotcrete, High volume fly ash concrete concept, properties, typical mix Self compacting concrete concept, materials, tests, properties, application and typical mix. **Fiber reinforced concrete** - Fibers types and properties, Behavior of FRC in compression, tension including pre-cracking stage and post-cracking stages, behavior in flexure and shear, Ferro cement - materials, techniques of manufacture, properties and application. **Light weight, High density & high-performance concrete** - Lightweight concrete-materials properties and types. Typical light weight concrete mix High density concrete and high-performance concrete-materials, properties and applications, typical mix. **OTHER CONCRETES** - Self Compacting Concrete, Reactive powder concrete, and bacterial concrete	18
Self-study :	
Site/Industrial Visits :	

Course outcomes:
1. **Text Books:** 2. Gambhir M.L "Concrete Manual", Dhanpat Rai & Sons, New Delhi 3. Krishna Raju N "Concrete Mix Design", Sehgal Publishers 4. Mehta P K & P J M Monteiro, "Concrete", Prentice Hall, New Jersey (Special Student Edition by Indian Concrete Institute Chennai) 5. Neville, A.M "Properties of Concrete", ELBS Edition, Longman Ltd., London 6. Shetty M S "Concrete Technology", 7. "ACI: Code for Mix Design" 8. "IS: 10262-2004"
Reference Books: 1. Aitcin P C "High Performance Concrete", E and FN, London. 2. John Newman "Advanced Concrete Technology Constituent materials", Ban Seng Choo- London 3. John Newman "Advanced Concrete Technology Processes", Ban Seng Choo, - London. 4. Power T.C "Properties of Fresh Concrete", E and FN, London 5. Prasad. J C GK Nair, "Non-Destructive Test and Evaluation of Materials", Mc Graw Hill. 6. Santha Kumar A R, "Concrete Technology", Oxford University Press.
Online Resources:

ELECTIVE- G-Geotechnical Engineering

Course Name: - Foundation Engineering					
Course Code: CE535EC-01G					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50

Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives: The objective of this subject is to learn certain fundamental related to Subsoil exploration, Drainage and Dewatering, Stresses in Soil and Flow nets, Lateral Earth Pressure, Stability of Earth Slopes, Safe Bearing capacity of Soil and Foundation settlement.					
Prerequisites: Engineering Mechanics, Strength of Materials and Soil Mechanics.					

Units	**Teaching Hours**
Unit-1 Subsurface Exploration	
Subsurface Exploration: Importance of exploration program, Methods of exploration: Boring, sounding tests, geophysical methods- Electrical resistivity and Seismic refraction methods. Types of samples undisturbed, disturbed and representative samples Samplers, sample disturbance, area ratio, Recovery ratio, clearance stabilization of boreholes -Typical bore log. Number and depth of borings for various civil engineering structures, soil exploration report. **Drainage and Dewatering:** Location of ground water table in fine and coarse-grained soils. Control of ground water during excavation: Dewatering- Ditches and sumps, well point system, Shallow well system, Deep well system, Vacuum method, Electro- Osmosis method.	9
Unit-2 Stresses in Soils	
Stresses in Soils: Boussinesq's and Westergaard's theories for concentrated, circular, rectangular, line and strip loads. Comparison of Boussinesq's and Westergaard's analysis. Pressure distribution diagrams, contact pressure, Newmark's chart. Shallow foundations and deep foundations. **Flownets:** Laplace equation (no derivation) assumptions and limitations only, characteristics and uses of flow nets, Methods of drawing flow nets for Dams and sheet piles. Estimating quantity of seepage and Exit gradient. Determination of phreatic line in earth dams with and without filter. Piping and protective filter, graded filter.	8
Unit-3 Lateral Earth Pressure	
Lateral Earth Pressure: Active and Passive earth pressures, Earth pressure at rest, Earth pressure coefficient. Earth pressure theories-Rankine's and Coulomb's –assumptions and limitations, Graphical solutions for active earth pressure (cohesionless soil only) –Culmann's and Rebhann's methods. Lateral earth pressure in cohesive and cohesion less soils, Earth pressure distribution. Lateral earth pressure for different conditions of retaining walls.	8
Unit-4 Stability of Earth Slopes and Bearing Capacity	

Stability of Earth Slopes: Types of slopes, causes and type of failure of slopes. Definition of factor of safety, Stability of finite and infinite slopes- Method of slices, Friction Circle method, Fellineous method, Taylor's stability number **Bearing Capacity:** Definitions of ultimate, net and safe bearing capacities, Allowable bearing pressure. Terzaghi's and Brinch Hansen's bearing capacity equations-assumptions and limitations Bearing capacity of footing subjected to eccentric loading. Effect of ground water table on bearing capacity. Plate load test, Standard penetration test, cone penetration test**.**	10
Unit-5 Foundation Settlement	
Foundation Settlement: Settlement Analysis, Data for settlement analysis, computation of settlement. BIS specifications for total and differential settlements of footings and rafts. Types of foundation settlements, effects and remedies. **Depth of Foundation:** Introduction to deep foundations, types of piles Selection and Testing of Piles.	10
Self-study: NIL	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: CO1 Understand the soil investigation methods and solutions, drainage and dewatering methods. (L2) CO2 Understanding the concept of flow nets in soils and Analyze the pressure distribution in soils. (L4) CO3 Understand the concepts of lateral earth pressure theories and Pressure distribution in soils. (L2 & L3) CO4. Determine the stability of slopes by various methods and the bearing capacity of soils.(L4) CO5 Determine the foundation settlements and pile capacity in soils (L4 & L5)	
Textbooks: 1. K.R Arora, "*Soil Mechanics and Foundations Engineering*", 9th edition, UBS Publishers and Distributors, New Delhi, 2014. 2. V.N.S. Murthy, "*Soil Mechanics and Foundation Engineering*", 4th Edition, UBS Publishers and Distributors, New Delhi, 2009. 3. B.C. Punmia, "*Soil Mechanics and Foundation Engineering*", 16th Edition Laxmi Publications Co, New Delhi,2015.	

1. Reference Books:
2. Karl Terzaghi, Soil Mechanics and Engineering Practices, 3rd edition, Wiley & Sons publishers and distributes, 2017
3. Alam Singh and G. R. Chowdhary, “Soil Engineering in Theory and Practice”, CBS Publishers and Distributors Ltd., New Delhi, 1994.
4. J. E. Bowles, “Foundation Analysis and Design”, 5th Edition, McGraw Hill Pub. Co. New York, 1996.
5. Braja M. Das, “Principles of Geotechnical Engineering”, 5th Edition, Thomson Business Information India Pvt. Ltd., India, 2002.
6. Craig R. F, “Soil Mechanics”, Van Nostrand Reinhold Co. Ltd, 1987.
7. Gopal Ranjan and A.S.R. Rao, “Basic and Applied Soil Mechanics”, New Age International (P) Ltd., New Delhi, 2000.
8. Iqbal H. Khan, “Textbook of Geotechnical Engineering”, 2nd Edition, PHI, India, 2005.
9. Lambe, “Soil Mechanics SI Version”, Wiley India Pvt. Ltd
10. T. G. Sitaram and T. N. Ramamurthy, “Geotechnical Engineering”, S. Chand & Co. New Delhi
11. C. Venkatrahmaiah, “Geotechnical Engineering”, 3rd Edition, New Age International (P) Ltd., New Delhi, 2006.
12. K.H Head, Manual of Soil Laboratory Testing -Vol. I, II, III, Princeton Press, London
13. K.V.S. Apparao. and V.C.S. Rao, Soil Testing-Laboratory Manual & Question Bank, University Science Press, New Delhi, 2011.
14. BIS Codes of Practice: IS 2720(Part-1-8), IS 2720 (Part – 10 - 17)

Online Resources:

W1. https://onlinecourses.nptel.ac.in/noc18_ce16/preview

W2. https://www.geoengineer.org/online-library

Course Name: - Geotechnical Design					
Course Code: CE633EC-02G					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3

Course objectives: This subject gives detailed information on the design of foundations for buildings and roads along with the materials and specifications

Prerequisites: Strength of Materials, Basic materials, Engineering Geology and Geotechnical Engineering

Units	**Teaching Hours**
Unit-1	
Building foundation design: Design of footing, isolated footing and steel grillage, combined footings of rectangular, Trapezoid cantilever types. Mat or raft foundation of dry and saturated soil floating foundations.	07
Unit-2	
Design of Piles, Pile caps and pile foundations buildings.	06
Unit-3	
Design of retaining structures, Design of retaining walls with surcharge loads. Retaining walls resting on piles	09
Unit-4	
Design of bridge abutments, Design of foundation for transmission towers: - Design of basement walls	08

Unit-5	
Bridges structures Analysis and Design : Design of wells foundation and caissons of different types, Design of bridge pairs resting on piles.	07
Self-study: Design of bridge pairs resting on piles	
Site/Industrial Visits: Site visit to design and construction of pile and pile caps	

Course outcomes: - Upon the completion of this course the student will be able to:

CO1 Design of footing, isolated footing and steel grillage, combined footings of rectangular, Trapezoid cantilever types.
CO2 Design of Piles, Pile caps and pile foundations buildings.
CO3 Design of retaining structure and retaining walls
CO4 Design of bridge abutment and basement wall
CO5 Design of wells foundation and caissons of different types

Textbooks:

3. Swami Saran, Analysis and Design of Sub structures, Oxford and IBH Publishing Co. PVT. Ltd, New Delhi.
4. Analysis and Design of Substructures: Limit State Design by Swami Saran
5. Tomlinson, Foundation Design and Construction, Prentice Hall Publication

Reference Books:

R1. C. Venkatrahmaiah, *Geotechnical Engineering*, 3rd Edition, New Age International (P) Ltd., New Delhi, 2016.
R2. Gopal Ranjan and A.S.R. Rao, *Basic and Applied Soil Mechanics*, New Age International (P) Ltd., New Delhi, 2000.
R3. Karl Terzaghi, *Soil Mechanics and Engineering Practices*, 3rd edition, Wiley & Sons publishers and distributes, 2017.
1.

Online Resources:

W1. http://nptel.ac.in/courses/105103097/

W2. https://www.geoengineer.org/online-library/soil-mechanics

Course Name: - Structural Geology					
Course Code: CE634EC-03G					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives: The main objective of structural geology is to use measurements of present-day rock geometries to uncover information about the history of deformation (strain) in the rocks, and ultimately, to understand the stress field that resulted in the observed strain and geometries.					
Prerequisites: Engineering Geology, Basics of Civil Engineering, Strength of Materials and Geotechnical Engineering					
Units					**Teaching Hours**
Unit-1					
Description, classification, and origin of earth structures					07
Unit-2					

Ways in which the continental crust can deform; link scales of structure from the field, outcrops, hand specimen, thin section by integrating analytical techniques with practical examples.	06
Unit-3	
Theoretical and meso to microscale analysis of structures developed through a linked series of lectures and practicals; practical 2D strain analysis; 3D strain concepts; incremental strain, kinematics and polyphase deformations; fold construction and classes; fault evolution and section balancing	09
Unit-4	
Fault rock microstructures; fault and fold mechanics, current concepts in plate tectonics, cross-section construction techniques.	08
Unit-5	
Structural interpretation of seismic data, structural styles in different tectonic settings (thrust and fold belts, rifts, strike and slip, gravity tectonics, inversion), structural geology of reservoir units.	07
Self-study: current concepts in plate tectonics, cross-section construction techniques.	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: CO1 Acquire knowledge on the geometry and type of structures present in earth CO2 Understand and describe the features formed in rocks when subjected to stress. CO3 Understand the impact of structural geology to active tectonic settings CO4 Understand micro and macro scale deformation mechanisms (viz., brittle, ductile). CO5 Interpret graphs and models used in structural geology to understand and demonstrate poly phase deformations	
Textbooks: T1 Ghosh, S.K., Structural Geology: Fundamentals and Modern Developments, Elsevier; First edition. T2. Haakon Fossen, Structural Geology, Cambridge University Press; 2 edition (3 March 2016) T3 David D Pollard and Raymod C Fletcher, Fundamental of Structural Geology, Cambridge University Press (1 September 2005)	

Reference Books: 1. Sherbbon Hills, Elements of Structural Geology, Springer; 2nd Revised edition edition (1 February 1972) 2. Marland P Billings, Structural Geology, Pearson Education; Third edition (26 July 2016
Online Resources: **NIl**

Course Name: - Offshore Engineering					
Course Code: CE732EC-04G					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3
Course objectives: Offshore engineering is a sub-field of geotechnical engineering. It is concerned with foundation design, construction, maintenance and decommissioning for human-made structures in the sea. Oil platforms, artificial islands and submarine pipelines are examples of such structures.					
Prerequisites: Geotechnical Engineering, Fluid Mechanics and Engineering Geology					

Units	Teaching Hours
Unit-1	
Introduction to offshore structures- Fixed Platforms, Gravity Platforms, Jacket Platforms, Semi submirisible structures, Complaint Structures, anatomy of oil rig on soil and water and codes of practice.	07
Unit-2	
Offshore project management- Risk Management - Group session and discussion, Costs and schedule control, Management of facilities risks and safety. Design Considerations- Pre-feasibility and feasibility checklists - Group session and discussion - Plan and value improvement practices Works Preparation-Introduction and planning for success - Principles and elements- Phases, organization and teamwork. (b) Construction Issues – Modularization- Safety- Quality. **(c)** Lifting & Installation - Heavy lifts offshore and cranes - Lifting offshore (center of gravity, weight control).	06
Unit-3	
Deep water, offshore site investigations - A desk study, which includes data compilation.Geophysical surveys, either shallow and deep seabed penetration. Geotechnical surveys, which includes sampling/drilling and in situ testing and geophysical methods	09
Unit-4	
Offshore sediment sampling, in-situ testing and geological aspects.	08
Unit-5	
Development of design stratigraphies - Definition, scope, branches and inter- relationship of Stratigraphy. Principles of Stratigraphy. Doctrine of uniformitarianism (Hutton). Stratigraphic classification and nomenclature. Standard Geological time scale.	07
Self-study: Principles of Stratigraphy.	
Site/Industrial Visits: NIL	

Course outcomes: - Upon the completion of this course the student will be able to: • CO1 Understand Offshore project management constraints, • CO2 Dealing with internal (company) and external requirements (government, partners, contractors, etc.), • CO3 Comply with core requirements for major projects in terms of planning, costs and risks, • CO4 Master the specific vocabulary of offshore projects and toll gating processes. • CO5Developes the design stratigraphy's for various structures
Textbooks: T1. Mohamed A. El-Reedy, Offshore Structures: Design, Construction and Maintenance Gulf Professional Publishing; 1 edition (21 August 2012) T2. Ben C. Gerwick Jr, Construction of Marine and Offshore Structures CRC Press; 3 edition (5 March 2007) T3. James F. Wilson Dynamics of Offshore Structures, John Wiley & Sons Inc 2nd Edition 2002.
Reference Books: 1. Michael E. Mccormick, Ocean Engineering Mechanics, Cambridge University Press 31 Oct 2009 2. Sukumar Dr. Laik Offshore Petroleum Drilling And Productioncambridge University Press 31 Oct 2009
Online Resources: https://nptel.ac.in/courses/114106015/ https://nptel.ac.in/courses/114106011/

Course Name: - Rock Mechanics

Course Code: CE733EC-05G					
	L	T	P	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3

Course objectives: The objective of Rock Mechanics to introduce various types of rocks, laboratory tests on rocks, strength modulus and stress strain behavior of rocks, engineering classification of rocks, stability of rocks and rock foundations.

Prerequisites: Geotechnical Engineering, Build Materials, Engineering Geology

Units	**Teaching Hours**
Unit-1	
Introduction: Definition, Importance, History Of Rock Mechanics,Distribution Of Rocks – Archean Rocks, Cuddapah Rocks, Vindhyan Rocks,Palaeozoick Rocks, Mesozoic Rocks, Gondwana Rocks, Deccan Traps,Steriographic Presentation Of Geological Data – Representation And Plottingline And Plane	07
Unit-2	
Laboratory Tests On Rocks : Tests For Physical Properties,Compressive Strength, Tensile Strength, Direct Shear, Triaxial Shear, Slakedurability, Schmidt Rebound Hardness, Sound Velocity, Swelling Pressure& Free Swell, Void Index	06
Unit-3	
Strength, Modulus And Stress Strain Behaviour Of Rocks: Factors Influencing Rock Behaviour, Strength Criteria For Isotropic Intactrocks, Modulus Of Isotropic Intact Rocks, Compressive Strength Andmodulus From Spt, Stress Strain Models – Elastic Model, Elasto Plasticmodel, Visco Elastic Model	09
Unit-4	
Engineering Classification Of Rock And Rock Mass: Rqd, Rmr System, Terzaghi's Rock Load Classification, Deere Miller, Cmrsand Rsr System. Classification Based On Strength And Modulus, Clasificationbased On Strength And Failure Strain, Rock Discontinuity Qualitativedescription, Friction In Rocks – Amonton's Law Of Friction,	08
Unit-5	

Stability Of Rock Slopes: Modes Of Failure – Rotational, Plane Andwedge Failures, Plane Failure Method Of Analysis, Wedge Method Ofanalysis, Toppling Failure, Protection Against Slope Failure. Rock Foundation: Stimation Of Bearing Capacity – Intact, Fracturedrocks, Stress Distribution In Rocks, Factor Of Safety, Sliding Sability Of Damfoundation, Settlement In Rocks, Bearing Capacity Of Piles In Rock, Measuresfor Strengthening Rock Mass – Concrete Shear Keys, Bored Concrete Piles,Tensioned Cable Anchors, Concrete Block At Toe	07
Self-study: Type of rocks available in Karnataka region and India	
Site/Industrial Visits: NIL	
Course outcomes: - Upon the completion of this course the student will be able to: CO1 Define the properties (viz., physical, mechanical) of rocks and failure criterion of rock mass. CO2 Use engineering rock mass classification (RMR, Q-system, RQD) CO3 Analyse the stress distribution insitu and around an opening in underground structures (viz., mine openings, tunnels). CO4Determine the relation between strain and displacement components of rockmass. CO5Perform field Instrumentation techniques and laboratory studies and Understand the fundamentals of ground subsidence.	
Textbooks: T1. Engineering Rock Mechanics: An Introduction to the Principles by J. A. Hudson and J. P. Harrison T2. Rock Mechanics: For Underground Mining by Barry H.G. Brady T3. Fundamentals of Rock Mechanics, 4th Edition, John Conrad Jaeger, Neville G. W. Cook, Robert Zimmerman	
Reference Books: R1. Deb Debasis and Verma Abhiram Kumar, Fundamentals and Applications of Rock Mechanics, PHI Learning Pvt. Ltd. (2016 R2. Richard E. Goodman , Introduction to Rock Mechanics, Wiley India Pvt Ltd; Second edition (16 March 2010) **I.**	
Online Resources: https://nptel.ac.in/courses/105106055/ http://home.iitk.ac.in/~sarv/New%20Folder/Presentation-1.pdf	

OPEN ELECTIVE

DEPARTMENT OF CIVIL ENGINEERING

CE636-ELECTIVE

Sl No	Course Name
CE636OE1	Solid Waste Management
CE636OE2	Environmental Impact Assessment
CE636OE3	Sustainable and Green Technology
CE636OE4	Disaster Management
CE636OE5	Air Pollution and Control
CE636OE6	GIS & Remote Sensing Techniques and Applications
CE636OE7	Road Safety and Traffic Management

Course Name: Solid Waste Management					
Course Code: CE636OE1					
	L	**T**	**P**	Category	OE
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**
Course objectives: Objective of this paper is to provide managing solid wastes. It is designed as a source of information on solid waste management, including the Principles of Solid waste management, Processing and Treatment, Final disposal, Recycle and Reuse.					
Prerequisites:					

Units	Teaching Hours
Unit-1	
INTRODUCTION: Definition, Land Pollution – scope and importance of solid waste management, functional elements of solid waste management. **SOURCES:** Classification and characteristics – municipal, commercial & industrial. Methods of quantification	9
Unit-2:	
COLLECTION AND TRANSPORTATION: Systems of collection, collection equipment, garbage chutes, transfer stations – bailing and compacting, route optimization techniques and problems.	9
Unit-3:	
TREATMENT/PROCESSING TECHNIQUES: Components separation, volume reduction, size reduction, chemical reduction and biological processing problems. **INCINERATION:** Process – 3 T's, factors affecting incineration process, incinerators – types, prevention of air pollution, pyrolsis, design criteria for incineration.	9

Unit-4:	
COMPOSTING: Aerobic and anaerobic composting, factors affecting composting, Indore and Bangalore processes, mechanical and semi mechanical composting processes. Vermi composting **SANITARY LAND FILLING:** Different types, trench area, Ramp and pit method, site selection, basic steps involved, cell design, prevention of site pollution, leachate & gas collection and control methods, geo-synthetic fabricsin sanitary landfills.	9
Unit-5:	
DISPOSAL METHODS: Open dumping – selection of site, ocean disposal, feeding to hogs, incineration, pyrolsis, composting, sanitary land filling, merits and demerits, biomedical wastes and disposal. **RECYCLE AND REUSE:** Material and energy recovery operations, reuse in other industries, plastic wastes, environmental significance and reuse.	9
Self-study :	
Site/Industrial Visits :	

Course outcomes: On completion of the course the student would able to:

- Define and explain important concepts in the field of solid waste management, such as waste hierarchy, waste prevention, recirculation, municipal solid waste etc.
- Suggest and describe suitable technical solutions for biological and thermal treatment.
- Suggest, motivate and describe a way to tackle the problem from a system analysis approach.
- Describe the construction and operation of a modern landfill according to the demands
- Discuss social aspects connected to handling and recirculation of solid waste from a local as well as global perspective.

Analyse and describe the potential as a secondary raw material, and thereby associated problems and possibilities in a sustainable society.

Text Books:

1. Bhide and Sunderashan “Solid Waste Management in developing countries”,
2. Tchobanoglous “Integrated Solid Waste Management”, Mc Graw Hill.

Reference Books:

1. Peavy and Tchobanoglous “Environmental Engineering”,
2. Garg S K **“**Environmental Engineering”, Vol II
3. “Biomedical waste handling rules – 2000”.
4. Pavoni J.L. “Hand book on Solid Waste Disposal”

Online Resources:

Course Name: Environmental Impact Assessment					
Course Code: CE636OE2					
	L	**T**	**P**	Category	OE
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: Over the past three decades, environmental impact assessment has been an important foundation for public and private development and planning decisions. In development disputes, the interaction between communities and government and special interests and the private sector shape the fabric of neighborhoods, cities and regions around the world. The objective of this paper is to create the awareness about environmental impact on earth and for assessment among the students community this paper has been introduced as elective	
Prerequisites:	
Units	**Teaching Hours**
Unit-1	
Development Activity and Ecological Factors EIA, EIS, FONSI. Need for EIA Studies, Baseline Information, Step-by-step procedures for conducting EIA, Limitations of EIA	12

Unit-2:	
Framework of Impact Assessment. Development Projects-Environmental Setting, Objectives and Scope, Contents of EIA, Methodologies, Techniques of EIA.	12
Unit-3:	
Assessment and Prediction of Impacts on Attributes Air, Water, Noise, Land Ecology, Soil, Cultural and Socio-economic Environment. EIA guidelines for Development Projects, Rapid and Comprehensive EIA	12
Unit-4:	
EIA guidelines for Development Projects, Rapid and Comprehensive EIA. Public Participation in Environmental Decision making. Practical Considerations in preparing Environmental Impact Assessment and Statements	12
Unit-5:	
Salient Features of the Project Activity-Environmental Parameter Activity Relationships- Matrices. EIA for Water resource developmental projects, Highway projects: Nuclear-Power plant projects, mining project (Coal, Iron ore).	12
Self-study :	
Site/Industrial Visits :	
Course outcomes: At the end of the course subject, the student will have the knowledge on the framework of impact assessment, complex relationship between Environmental impact assessment, Environmental impact statement and finding of no significant impact. And also, on the assessment and prediction of impacts on air, land, soil, water, socio-economic attributes and environmental impact assessment of development projects pertaining to mining, highway and nuclear power plant projects.	
Text Books: 1. Anjaneyalu. Y"Environment Impact Assessment", 2. Jain R.K"Environmental Impact Analysis", Van Nostrand Reinhold Co.	
Reference Books: 1. "Guidelines for EIA of developmental Projects Ministry of Environment and Forests, GOI", 2. Larry W. Canter "Environment Impact Assessment",McGraw Hill Publication.	
Online Resources:	

<table>
<tr><td colspan="7">Course Name: Sustainable and Green Technology</td></tr>
<tr><td colspan="7">Course Code: CE636OE3</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td colspan="2">Category</td><td>OE</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td colspan="2">CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td colspan="2">ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td colspan="2">Exam Hours</td><td>3</td></tr>
<tr><td colspan="7">Course objectives: This course teaches the students the engineering and design processes in alternative and renewable energy systems.</td></tr>
<tr><td colspan="7">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td colspan="2">Teaching Hours</td></tr>
<tr><td colspan="7">Unit-1</td></tr>
<tr><td colspan="5">Introduction to definitions and concepts underlying sustainability
State of the world using measures of sustainability</td><td colspan="2">9</td></tr>
<tr><td colspan="7">Unit-2:</td></tr>
<tr><td colspan="5">Mass conservation & closed energy cycles, Green Design & Green Manufacturing Concepts
Energy Balance – The case of electric batteries and fuel cells</td><td colspan="2">9</td></tr>
<tr><td colspan="7">Unit-3:</td></tr>
<tr><td colspan="5">Mass and Energy Transport Systems, Economic Concepts: Net Present Value (NPV) calculations</td><td colspan="2">9</td></tr>
<tr><td colspan="7">Unit-4:</td></tr>
<tr><td colspan="5">Optimization Problems & resource allocation in sustainability, Value Stream Mapping (VSM) – Theory and practice</td><td colspan="2">9</td></tr>
<tr><td colspan="7">Unit-5:</td></tr>
<tr><td colspan="5">Life Cycle Analysis (LCA): Theory – Applications – Examples</td><td colspan="2">9</td></tr>
<tr><td colspan="7">Self-study :</td></tr>
<tr><td colspan="7">Site/Industrial Visits :</td></tr>
</table>

Course outcomes:

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

- Define the various types of sustainability.
- Demonstrate the use of the concepts underlying the use sustainability.
- Able to apply the various measures of sustainability.
- Synthesize the concepts of green design and engineering.
- Calculate energy balance with a focus on batteries and fuel cells.
- Describe and report the underlying concepts used to discuss various sustainability concepts
- Perform the life cycle analysis calculation (LCA) utilized in sustainability.

Evaluate and judge various levels of sustainability for different applications

Text Books:

1. Dresner, Simon. (2008) The Principles of Sustainability 2nd edition. Styluspub Publishing Inc., Sterling, Virgina.
2. Epstein, Marc (2008) Making Sustainability Work. Berrett-Koehler, Publishers, San Francisco, California.

Reference Books:

1. AME, Association for Manufacturing Excellence (2007) Green Manufacturing: Case Studies in Lean Manufacturing and Sustainability. Productivity Press, Inc.
2. Doppelt, Robert. (2010) The Power of Sustainability Thinking. Stylus Publishers, Sterling, Virginia.
3. Dornfeld, David (2010) Green Manufacturing: Fundamentals & Applications. Springer. Berlin, Germany.
4. Epstein, Matt and John Elkington (2008) Making Sustainability Work: Best Practices in Managing and Measuring Corporate Social, Environmental, and Economic Impacts. Berrett_Koehler Publishers, San Francisco, California.
5. Hansen, J. (2009) Storms of My Grandchildren: The Truth About the Coming Climate Catastrophe and Our Last Chance to Save Humanity. Bloomsbury Press.
6. Hardisty, P.E. (2010) Environmental and Economic Sustainability. CRC Press.
7. Hitchcock, Darcy and Marsha Willard. (2008) The Step-By-Step Guide to Sustainability Planning. Stylus Publishing, Sterling, Virginia.
8. ISO 14040 "Environment Management – Life Cycle Assessment – Principles and Framework" Geneva, Switzerland (2007)
9. Krosinsky, Cary and Nick Robing (2008) Sustainability Investing. Stylus Publishing, Sterling, Virginia.
10. LEED: "Building Ratings System for New Construction & Major Renovations"Version 3.1: U.S. Green Building Council 2009.
11. Matthew, R.A. (2010) Global Environmental Change and Human Security. MIT Press.
12. McKenny, M., Schock, R. and Yonavjak, L. (2007) Environmental Science: Systems Solutions 4th edition Jones and Bartlett Publishers.
13. Pierce, J. and G. Randeis (2010) Contemporary Bioethics: A Reader with Cases. Oxford University Press.

Online Resources:

<table>
<tr><td colspan="6">Course Name: Disaster Management</td></tr>
<tr><td colspan="6">Course Code: CE636OE4</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>OE</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: To study the emerging approaches in Disaster Reduction &Management. The emphasis will be on programmes of National &International organizations for Disaster preparedness, Mitigation and awareness to prevent or reduce losses that occur due to hazards, disaster and emergencies.</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">Principles of Disaster Management, Natural Disasters such as Earthquake, Floods, Fire, Landslides, Tornado, Cyclones, Tsunamis, Nuclear, Chemical, Terrorism, Extra Terrestrial and other natural calamities. Hazards, Risks and Vulnerabilities. Assessment of Disaster Vulnerability of a location and vulnerable groups, National policy on disaster Management,</td><td>9</td></tr>
<tr><td colspan="6">Unit-2:</td></tr>
<tr><td colspan="5">Prevention, Preparedness and Mitigation measures for various Disasters, Post Disaster Relief & Logistics Management, Emergency Support Functions and their coordination mechanism, Resource & Material Management, Management of Relief Camp, Information systems & decision making tools, Voluntary Agencies & Community Participation at various stages of disaster, management, Integration of Rural Development Programmes with disaster reduction and mitigation activities.</td><td>9</td></tr>
<tr><td colspan="6">Unit-3:</td></tr>
<tr><td colspan="5">Renewable and non-renewable resources, Role of individual in conservation of natural resources for sustainable life styles. Use and over exploitation of Forest resources, Deforestation, Timber extraction, Mining, Dams and their effects on forest and tribal people. Use and over exploitation of surface and ground water resources, Floods, Drought, Conflicts over water, Dams- benefits and problems. Causes, effects and control measures of Air pollution, Water pollution, soil pollution, Noise pollution, Thermal pollution, Nuclear hazards.</td><td>9</td></tr>
<tr><td colspan="6">Unit-4:</td></tr>
</table>

Global Environmental crisis, Current global environment issues, Global Warming, Greenhouse Effect, role of Carbon Dioxide and Methane, Ozone Problem, CFC"s and Alternatives, Causes of Climate Change Energy Use: past, present and future, Role of Engineers.	9
Unit-5:	
Mitigation- Institutions- the work of-. Meteorological observatory – Seismological observatory - Volcano logy institution - Hydrology Laboratory - Industrial Safety inspectorate - Institution of urban & regional planners -. Chambers of Architects. Engineering Council-. National Standards Committee **Integration of public policy**: Planning and design of infrastructure for disaster management, Community based approach in disaster management, methods for effective dissemination of information, ecological and sustainable development models for disaster management. **Role of Media** Monitoring Management- programme of disaster research &mitigation of disaster of following organizations. International Council for Scientific Unions (ICSU)- Scientific committee on problems of the Environment (SCOPE), International Geosphere-Biosphere programme (IGBP) – World federation of Engineering Organizations(WFED)-National Academy of Sciences-World Meteorological organizations(WMO)-Geographical Information System(GIS)- International Association of Seismology & Physics of Earth's Interior(IASPEI)-Various U.N agencies like UNCRD, IDNDR, WHO, UNESCO, UNICEF,UNEP.	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: After completing this session, you the student will be able to • Affirm the usefulness of integrating management principles in disaster mitigation work • Distinguish between the different approaches needed to manage pre- during and post- disaster periods • Explain the process of risk management Relate to risk transfer	
Text Books: 1. Disaster Management By G. K. Ghosh A.P.H. Publishing Corporation 2. Environmental Studies, R Rajgopalan, Oxford University Press	
Reference Books: 1. Modern Encyclopaedia of Disaster and Hazard Management By B C Bose Rajat publications. 2. Disaster Management By R.B. Singh Rawat Publications. 3. Disaster Management By B Narayan A.P.H. Publishing Corporation. 4. Environmental Studies, Daniels, Wiley Publication 5. Environmental Studies, Basak, Pearson Publication	

Online Resources:

Course Name: Air Pollution and Control					
Course Code : CE651OE5					
	L	**T**	**P**	Category	OE
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: Over the past three decades, environmental impact assessment has been an important foundation for public and private development and planning decisions. In development disputes, the interaction between communities and government and special interests and the private sector shape the fabric of neighborhoods, cities and regions around the world. The objective of this paper is to create the awareness about environmental impact on earth and for assessment among the students community this paper has been introduced as elective

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Development Activity and Ecological Factors EIA, EIS, FONSI. Need for EIA Studies, Baseline Information, Step-by-step procedures for conducting EIA, Limitations of EIA	9
Unit-2:	
Frame work of Impact Assessment. Development Projects- Environmental Setting, Objectives and Scope, Contents of EIA, Methodologies, Techniques of EIA.	9
Unit-3:	
Assessment and Prediction of Impacts on Attributes Air, Water, Noise, Land Ecology, Soil, Cultural and Socio-economic Environment. EIA guidelines for Development Projects, Rapid and Comprehensive EIA	9
Unit-4:	
EIA guidelines for Development Projects, Rapid and Comprehensive EIA.Public Participation in Environmental Decision making. Practical Considerations in preparing Environmental Impact Assessment and Statements	9
Unit-5:	
Salient Features of the Project Activity-Environmental Parameter Activity Relationships- Matrices. EIA for Water resource developmental projects, Highway projects: Nuclear-Power plant projects, mining project (Coal, Iron ore).	9
Self-study :	
Site/Industrial Visits :	

Course outcomes:
At the end of the course subject the student will have the knowledge on the frame work of impact assessment, complex relationship between Environmental impact assessment, Environmental impact statement and finding of no significant impact. And also, on the assessment and prediction of impacts on air, land, soil, water, socio-economic attributes and environmental impact assessment of development projects pertaining to mining, highway and nuclear power plant projects.

Text Books:

1. Anjaneyalu. Y“Environment Impact Assessment”,
2. Jain R.K“Environmental Impact Analysis”, Van Nostrand Reinhold Co.

Reference Books:

1. “Guidelines for EIA of developmental Projects Ministry of Environment and Forests, GOI”,
2. Larry W. Canter “Environment Impact Assessment”, McGraw Hill Publication.

Online Resources:

<table>
<tr><td colspan="6">Course Name: GIS & Remote Sensing Techniques and Applications</td></tr>
<tr><td colspan="6">Course Code: CE636OE6</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>OE</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: The objective of this paper is to provide knowledge and importance of different methods of Photogrammetry and sensors, as well as to their fields of application in civil engineering.</td></tr>
<tr><td colspan="6">Level Of Knowledge: Advanced</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 PHOTOGRAMMETRY</td></tr>
<tr><td colspan="5">PHOTO GRAMMETRY: Introduction – Basic Principles – Photo theodolite – Definitions – Horizontal and Vertical angle from teerestial photograph – Horizontal position of a point from photo graphic measurement from camera horizontal axis – Elevation of point by photographic measurement – focal length. AERIAL CAMERA – SCALE OF PHOTOGRAPH: Determination of height of lens for a vertical photograph – Relief displacement – Scale of tilted photograph – computation of a length o line between points of different elevation from measurement on a tilted photograph.</td><td>9</td></tr>
<tr><td colspan="6">Unit-2: APPLICATION OF PHOTO GRAMMETRY</td></tr>
<tr><td colspan="5">DETERMINATION OF FLYING HEIGHT FOR A TILTED PHOTOGRAPH: Tile distortion – Relief displacement – Combined effect of tile and relief – flight planning for Aerial Photogrammetry, Ground control– Stereoscopic vision – Drift mosaics, Relevant numerical examples in the above topics.</td><td>9</td></tr>
<tr><td colspan="6">Unit-3: REMOTE SENSING</td></tr>
<tr><td colspan="5">REMOTE SENSING: Introduction – Historical sketch of Remote Sensing – Idealized remote sensing – Basic principles of remote sensing – Electromagnetic energy Electromagnetic spectrum- Wave length regions and their application in remote sensing – characteristics of solar radiation – Basic radiation law – EM radiation and atmosphere – Interaction of EM radiation with earth surface – Remote sensing observation platforms – sensors –Application of Remote Sensing.</td><td>9</td></tr>
<tr><td colspan="6">Unit-4: GEOGRAPHICAL INFORMATION SYSTEM</td></tr>
<tr><td colspan="5">GEOGRAPHICAL INFORMATION SYSTEM, DEFINITION: The four M’s concept – contributing disciplines for GIS, GIS objectives – components of a GIS – Topology – Data models – Data structures – Data base management – Errors in GIS – GIS software packages – Linkage of GIS to remote sensing – Application areas of GIS and Remote sensing.</td><td>9</td></tr>
</table>

Unit-5: FIELD ASTRONOMY	
FIELD ASTRONOMY: Definitions of astronomical terms – co-ordinate systems – Terrestrial attitude and longitude – Spherical Trigonometry and Spherical Triangle – Astronomical Triangle – relationship between coordinates – Earth and Sun units of time. -Relationship between degrees and hours of the time. Conversion of local time standard time and vice versa. Conversion of Mean time interval to Sindereal time interval and vice-versa –Estimation of local mean midnight at any place on the same date. Determination of LST from given value of LMT – Determination of LMT from the given value of LST-LMT of star across median given GST and GMN – Determination of Azimuth, latitude and longitude – Relevant numerical examples.	9
Self-study :	
Site/Industrial Visits :	

Course outcomes:

By the end of the module students should have acquired a knowledge of:
history of GIS; mapping spatial information; data types and structures; data quality; errors and variation; data analysis within GIS; acquisition of remotely sensed data; interpretation and analysis of remotely sensed data; applications of GIS and remote sensing in environmental assessment, management and modeling.

Text Books:

1. Korte “GIS studies” Thomson Publications, New Delhi.
2. Lille Sand “Remote Sensing & Interpretation”, WileyPublications.
3. Paul R Wolf “Element of Photogrammetry”, McGrawHillInternation
4. Punmia B C, Ashok K Jain &Arun K Jain “Higher Surveying”, Lakshmi Publication.

Reference Books:

1. Ravi Gupta “Remote Sensing Geology”, Springer Verlog (NY)
2. 2. Subramanian R “Surveying & Levelling”, Oxford University Press.

Online Resources:

Course Name: Road Safety and Traffic Management					
Course Code: CE636OE7					
	L	**T**	**P**	Category	OE
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: The objective of this paper is to explain the causes of accidents, statistical measures of accident data analysis and computer application in data analysis, Explain different parameters responsible for providing road safety in the construction of new

Roads and reconstruction and explain road safety audit principle and procedure, various traffic management techniques and their effectiveness.

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Road accidents, Causes, Scientific Investigations and Data Collection:-. Analysis of Individual Accidents to Arrive at Real Causes; Statistical Methods of Analysis of Accident Data, Application of Computer Analysis of Accident Data.	9
Unit-2:	
Ensuring Traffic Safety in Designing New Roads:-Ways of Ensuring Traffic Safety in Road Design considering the Features of Vehicle Fleet, Psychological Features of Drivers, Natural and Meteorological Conditions, Structure of Traffic Streams, Orientation of a Driver on the Direction of a Road beyond the Limits of Actual Visibility and Roadway Cross Section & Objects on the Right-of-Way.	9
Unit-3:	

Ensuring Traffic Safety in Road Reconstruction: -Road Reconstruction and Traffic Safety, Reconstruction Principles, Plotting of Speed Diagram for Working out Reconstruction Projects, Use of Accident Data in Planning Reconstruction of Roads, Examples of Reconstruction of Selected Road Sections for Improving Traffic Safety, Improving Traffic Conditions on Grades, Sharp Curves, Redesign of Intersections, Channelized At-Grade Intersections, Bus Stops, Parking & Rest Areas and Effectiveness of Minor Road Improvements. **Ensuring Traffic Safety in Road Operation:** -Ensuring Traffic Safety during Repair and Maintenance, Prevention of Slipperiness and Influence of Pavement Smoothness, Restriction speeds on Roads, Safety of Pedestrians, Cycle Paths, Informing Drivers on Road Conditions with Aid of Signs, Traffic Control Lines & Guide Posts, Guardrails & Barriers and Road Lighting.	9
Unit-4:	
Road Safety Audit:- Principles- Procedures and Practice, Code of Good Practice and Checklists. Road Safety Issues and Various Measures through Engineering, education and enforcement measures for improving road safety.	9
Unit-5:	
Traffic Management Techniques:- Local area management. Transportation system management. Low cost measures, area traffic control. Various types of medium and long term traffic management measures and their uses. Evaluation of the effectiveness and benefits of different traffic management measures, management and safety practices during road works. Economic evaluation of improvement measures by "before and after studies" - Case studies.	9
Self-study :	
Site/Industrial Visits:	
Course outcomes: After the completion of the course students should be • Able to acquire knowledge statistical methods and computer application of accident analysis. • Capable of analyzing the factors affecting the construction of new roads and reconstruction of existing roads • Able to remember the process of road safety audit and the measures of improving road safety.	

Textbooks: 1. Kadiyali, L.R., `**Traffic Engineering and Transport Planning**', Khanna Publications, New Delhi, 2009. 2. C. JotinKishty& B. Kent Lall, **"Transportation Engineering-An Introduction"**, Third Edition, Prentice Hall of India Private Limited, New Delhi, 2006
Reference Books: 1. BABKOV, V.F. `**Road conditions and Traffic Safety'**, MIR, publications, Mascow - 1975. 2. K.W. Ogden, `Safer Roads – **A Guide to Road Safety Engg**.'Averbury Technical, Ashgate Publishing Ltd., Aldershot, England, 1996. 3. Latest Editions of Relevant Indian Roads Congress (IRC) Publications for Design of Roads and Road Safety. 4. Khanna and Justo, 'Textbook of Highway Engineering', Nemchand Brothers, Roorkee,2001.
Online Resources:

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

OPEN ELECTIVE

Code	Course Name
CS636OE1	Web Programming Concepts
CS636OE2	Data Structures
CS636OE3	Java Programming
CS636OE4	Software Testing Techniques
CS636OE5	Software Engineering Methodologies
CS636OE6	User Interface Design Concepts

Course Name: WEB PROGRAMMING CONCEPTS

Course Code: CS636OE1

	L	T	P	Category	OE
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

Prerequisites:

Units	Teaching Hours
Unit-1 INTRODUCTION TO WEB PROGRAMMING	
Introduction to HTML5, CSS3, Exploring Visual Studio 2013: Support for HTML5, CSS3 & Java Script, Simple Practice Exercises.	9
Unit-2:HTML5	
Getting Started with HTML5, Understanding HTML, XHTML, and HTML5, Creating an HTML Document, Embedding Content, Working with Hyperlinks, Adding Images, Practice exercises.	9
Unit-3: JAVASCRIPT	
Understanding Java Script, Using statements, Working with functions, Scoping variables, Conditional Programming, Handling Errors, Writing Testing, Debugging Java Script, Working with objects, Practice Exercises.	9
Unit-4: CSS3	
Introducing CSS3, Defining & Applying a style, Creating style sheets, Understanding selectors, specificity, and cascading, Working with CSS properties, Practice Exercises.	9
Unit-5: MORE ON HTML5 & JQUERY	
HTML5 Semantics, Working with tables, Practice Exercises, Introduction to jQuery, Working with jQuery, Practice Exercises.	9

Self-study:

Site/Industrial Visits:

Course outcomes: Upon completion of the course, the student should be able to:

- Demonstrate understanding of the basics of web programming concepts.
- Implement Javascript Scripts for real time applications.
- Apply and use CSS3 for HTML elements.
- Design and Implement jQuery scripts.

Textbooks:

1. Training Guide Programming in HTML5 with JavaScript and CSS3 (MCSD) (Microsoft Press Training Guide), 2013

Reference Books:

1.Matt West, "HTML5 Foundations", Wiley Publishers: 2012
2.Bruce Lawson, Remy Sharp, "Introducing HTML 5", Pearson 2011
3.Ian Lunn, "CSS3 Foundations",Wiley Publishers, 2012
4.Jon Duckett, "JavaScript and JQuery: Interactive Front-End Web Development", Wiley Publishers: 2014

Online Resources:

Course Name: DATA STRUCTURES

Course Code : CS636OE2

	L	T	P	Category	OE
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

- 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

Prerequisites:

Units	Teaching Hours
Unit-1	
Data Structures- Definitions, Classification – Linear, Non Linear, ADT. Dynamic memory allocation- functions malloc, calloc, free. Use of pointers in structures data type.	9
Unit-2:	
Stacks – Definitions, Implementation using array, Application – Infix, postfix expressions. Queues – Definitions, Implementation using array, Application- Token system, circular queue, priority queue.	9
Unit-3:	
Linked lists – Definitions, node, Implementation.Doubly linked list. Trees – Binary trees, Traversals, Expression trees, Binary Search trees, Applications- Dictionary. Implementation of stacks and queues using linked list.	9
Unit-4:	
Graphs – Definitions, Directed, Undirected, Traversals. Implementation of DFS, BFS. Application of DFS - Acyclic, Strongly connected components. Djikstra's algorithm for shortest path.	9
Unit-5:	

Case study: Real time application of priority queue, stacks in function recursion, binary search tree, Graph traversal – DFS and BFS.	9
Self-study:	
Site/Industrial Visits:	
Course outcomes: Upon completion of the course, the student should be able to: • Demonstrate an understanding ofthe importance of organization of data according to purpose. • Select appropriate data structures in solving real world problems. • Use various graph algorithms for solving problems. • Use efficient algorithms for storing, sorting and accessing dat	
Textbooks: 1. Mark Allen Weiss , "Data Structures and Algorithm Analysis in Java", 3rd Edition.	
Reference Books: 1.Michael T. Goodrich , Roberto Tamassia , Michael H. Goldwasser , "Data Structures and Algorithms in Java™", Sixth Edition, Wiely Publications. 2.Duane A. Bailey , "Java Structures- Data Structures in Java for the Principle Programmer", Edition	
Online Resources:	

Course Name: JAVA PROGRAMMING					
Course Code: CS636OE3					
	L	**T**	**P**	Category	OE
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: Introduce the Java programming language, its syntax, structures and libraries. Develop object oriented design and programming techniques. Practice robustness and transparency in software design and implementation using Java platform. Learn the Java programming language: its syntax, idioms, patterns, and styles.
• Become comfortable with object oriented programming: Learn to think in objects
• Learn the essentials of the Java class library
• Introduce internet applications using Java

Prerequisites:

Units	Teaching Hours
Unit-1	
INTRODUCTION TO JAVA PROGRAMMING Java As a Programming Platform – History of Java. Characteristics of Java. The Java Buzzwords, The Java Environment – JVM, JDK & JRE– Installing the Java Development Kit – Using an Integrated Development Environment – OOP Principles. Comparison of Java with C and C++.Features of Java. **LANGUAGE FUNDAMENTALS** Data Types, Variables, Expressions, Keywords, Operators and Control Flow Statements.Arrays – Java File Structure.Creating and Running Java Programs.Comments in Java.	9
Unit-2:	
CLASS AND OBJECTS Creating class and Objects, Methods, this keyword, Constructors, the finalize()method. Access Control.Static Blocks.Final keyword.Nested and Inner Classes. Command Line Arguments **INHERITANCE IN JAVA** Inheritance in classes, Using super, Method Overriding, Dynamic Method Dispatch.Abstract Classes, Using final with inheritance, The Object Class.	9
Unit-3:	

<table>
<tr><td>INTERFACES AND PACKAGES
Inheritance in java with Interfaces – Defining Interfaces, Implementing Interfaces, Extending Interfaces.Creating Packages, CLASSPATH variable, Access protection, Importing Packages.
EXCEPTION HANDLING IN JAVA
Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try-catch-finally mechanism, throw statement, throws statement. Java's Built-in Exceptions.</td><td>9</td></tr>
<tr><td colspan="2">Unit-4:</td></tr>
<tr><td>COLLECTIONS
Collections Overview, The Collection Interfaces, The Collection Classes, accessing a Collection via an Iterator, Storing user defined classes in Collections.
INPUT / OUTPUT IN JAVA
I/O Basics, Streams, Byte Streams and Character Streams, The Predefined Streams, Reading Console Input, Writing Console Output, File, Byte Stream and Character Stream Classes.</td><td>9</td></tr>
<tr><td colspan="2">Unit-5:</td></tr>
<tr><td>Building Simple Internet Applications using Java – Internet Basics – HTML Basics –
Glassfish/Tomcat Server – Building Simple JSP Applications.</td><td>9</td></tr>
<tr><td colspan="2">Self-study :</td></tr>
<tr><td colspan="2">Site/Industrial Visits :</td></tr>
<tr><td colspan="2">Course outcomes:
Upon completion of the course, the student should be able to:
Explain the basic principles and features of java programming.
Illustrate the use of Interfaces and packages.
Design and Implement robust, object-oriented applications in Java and with the Java Development Kit (JDK) Standard Edition (Java SE) tools.
Differentiate a different I/O streams in Java.
Build a Simple Internet Applications using JSP and Glassfish.</td></tr>
<tr><td colspan="2">Text Books:
1. Schildt Herbert, "Java 2: The Complete Reference", Eighth/Ninth Edition, Oracle Press, 2014
2. GiulioZambon, "Beginning JSP, JSF and Tomcat: Java Web Development", (Beginning Apress), 2012</td></tr>
<tr><td colspan="2">Reference Books:
1. Deitel, "Java: How to Program", 9th Edition, 2011
2. Bruce Eckel, "Thinking in Java", 4th Edition</td></tr>
<tr><td colspan="2">Online Resources:
http://docs.oracle.com/javase/tutorial/</td></tr>
</table>

Course Name: SOFTWARE TESTING TECHNIQUES					
Course Code : CS636OE4					
	L	**T**	**P**	Category	OE
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

1. To learn test case design for testing then software
2. To develop test scripts for various testing schemes

Prerequisites:

Units	**Teaching Hours**
Unit-1 INTRODUCTION	
Testing as an Engineering Activity – Role of Process in Software Quality – Testing as a Process – Basic Definitions – Software Testing Principles – The Tester's Role in a Software Development Organization – Origins of Defects – Defect Classes – The Defect Repository and Test Design – Defect Examples – Developer/Tester Support for Developing a Defect Repository.	9
Unit-2: TEST CASE DESIGN	
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.	9
Unit-3: LEVELS OF TESTING	
The Need for Levels of Testing – Unit Test – Unit Test Planning – Designing the Unit Tests. The Test Harness – Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – scenario testing – defect bash elimination -System Testing – types of system testing - Acceptance testing – performance testing - Regression Testing – internationalization testing – ad-hoc testing - Alpha – Beta Tests – testing OO systems – usability and accessibility testing	9
Unit-4: TEST MANAGEMENT	

People and organizational issues in testing – organization structures for testing teams – testing services - Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process - Reporting Test Results – The role of three groups in Test Planning and Policy Development – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group.	9
Unit-5: CONTROLLING AND MONITORING	
Software test automation – skills needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation - Test metrics and measurements – project, progress and productivity metrics – Status Meetings – Reports and Control Issues – Criteria for Test Completion – SCM – Types of reviews – Developing a review program – Components of Review Plans– Reporting Review Results. – Evaluating software quality – defect prevention – testing maturity model – Case Studies.	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: By the end of the course the student will be able to • Illustrate on the principles and basics of testing with respect to software quality. • Analyze the process involved in design of software testing in relation to requirements of the same. • Compare and contrast different levels of software testing strategies. • Discover the bugs in the software code using context based testing. • Demonstrate the testing mechanism on a piece of software code. • Relate and discuss on the testing management and controlling.	
Textbooks: 1. Boris Beizer, "Software Testing Techniques", Second Edition, Dreamtech, 2009 2. SrinivasanDesikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson education, 2008.	
Reference Books: 1.Elfriede Dustin, "Effective Software Testing", First Edition, Pearson Education, 2008. **2.**Edward Kit, "Software Testing in the Real World" Pearson Education, 2008. 3.AdityaP.Mathur, "Foundations of Software Testing", Pearson Education, 2011.	
Online Resources:	

<table>
<tr><td colspan="6">Course Name: SOFTWARE ENGINEERING METHODOLOGIES</td></tr>
<tr><td colspan="6">Course Code : CS636OE5</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>OE</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: To be aware of
• Different life cycle models
• Requirement dictation process
• Analysis modeling and specification
• Architectural and detailed design methods
• Implementation and testing strategies
• Verification and validation techniques
• Project planning and management
• Use of CASE tools</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 SOFTWARE PROCESS</td></tr>
<tr><td colspan="5">Introduction –S/W Engineering Paradigm – life cycle models (water fall, incremental, spiral, WINWIN spiral, evolutionary, prototyping, object oriented) - system engineering – computer based system – verification – validation – life cycle process – development process – system engineering hierarchy.</td><td>9</td></tr>
<tr><td colspan="6">Unit-2: SOFTWARE REQUIREMENTS</td></tr>
<tr><td colspan="5">Functional and non-functional - user – system –requirement engineering process – feasibility studies – requirements – elicitation – validation and management – software prototyping – prototyping in the software process – rapid prototyping techniques – user interface prototyping -S/W document. Analysis and modeling – data, functional and behavioral models – structured analysis and data dictionary.</td><td>9</td></tr>
<tr><td colspan="6">Unit-3: DESIGN CONCEPTS AND PRINCIPLES</td></tr>
<tr><td colspan="5">Design process and concepts – modular design – design heuristic – design model and document. Architectural design – software architecture – data design – architectural design – transform and transaction mapping – user interface design – user interface design principles. Real time systems - Real time software design – system design – real time executives – data acquisition system - monitoring and control system. SCM – Need for SCM – Version control – Introduction to SCM process – Software configuration items.</td><td>9</td></tr>
<tr><td colspan="6">Unit-4: TESTING</td></tr>
</table>

<table>
<tr><td>Taxonomy of software testing – levels – test activities – types of s/w test – black box testing – testing boundary conditions – structural testing – test coverage criteria based on data flow mechanisms – regression testing – testing in the large. S/W testing strategies – strategic approach and issues - unit testing – integration testing – validation testing – system testing and debugging.</td><td>9</td></tr>
<tr><td colspan="2">Unit-5: SOFTWARE PROJECT MANAGEMENT</td></tr>
<tr><td>Measures and measurements – S/W complexity and science measure – size measure – data and logic structure measure – information flow measure. Software cost estimation – function point models – COCOMO model- Delphi method.- Defining a Task Network – Scheduling – Earned Value Analysis – Error Tracking - Software changes – program evolution dynamics – software maintenance – Architectural evolution. Taxonomy of CASE tools – Case Study.</td><td>9</td></tr>
<tr><td colspan="2">Self-study :</td></tr>
<tr><td colspan="2">Site/Industrial Visits :</td></tr>
<tr><td colspan="2">Course outcomes:
• Implement the different life cycle models.
• Demonstrate the ability to manage a project including planning, scheduling and risk assessment/management.
• Author a formal specification for a software system and software testing plan.
• Demonstrate proficiency in rapid software development techniques.
• Identify specific components of a software design that can be targeted for reuse.
• Demonstrate proficiency in software development cost estimation.</td></tr>
<tr><td colspan="2">Text Books:
1. Roger S. Pressman, “Software engineering- A practitioner’s Approach”, McGraw-Hill International Edition, 6th Edition 2012.</td></tr>
<tr><td colspan="2">Reference Books:
1. Ian Sommerville, “Software engineering”, Pearson education Asia, 9th Edition 2013.
2. PankajJalote, “An Integrated Approach to Software Engineering”, Narosa publishing house 2011.
3. James F Peters and WitoldPedryez, “Software Engineering – An Engineering Approach”, John Wiley and Sons, New Delhi, 2010.
4. Ali Behforooz and Frederick J Hudson, “Software Engineering Fundamentals”, OUP India 2012.</td></tr>
<tr><td colspan="2">Online Resources:
http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Soft%20Engg/New_index1.html</td></tr>
</table>

<table>
<tr><td colspan="6">Course Name: USER INTERFACE DESIGN CONCEPTS</td></tr>
<tr><td colspan="6">Course Code : CS636OE6</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td>OE</td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: Introduce students to the concept of usability and the process of User-Centered Design as a method of achieving good usability outcomes in software development.</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 BASICS, ORGANIZATION, NAVIGATION</td></tr>
<tr><td colspan="5">What Users Do: A Means to an End - The Basics of User Research - Users' Motivation to Learn - The Patterns - Organizing the Content: Information Architecture and Application Structure: The Big Picture - The Patterns - Getting Around: Navigation, Signposts, and Way finding: Staying Found - The Cost of Navigation - Navigational Models - Design Conventions for Websites - The Patterns</td><td>9</td></tr>
<tr><td colspan="6">Unit-2: PAGE LAYOUT, PAGE ELEMENTS AND USE CASES</td></tr>
<tr><td colspan="5">Organizing the Page: Layout of Page Elements: The Basics of Page Layout - The Patterns - Lists of Things - Use Cases for Lists: Back to Information Architecture - Some Solutions - The Patterns</td><td>9</td></tr>
<tr><td colspan="6">Unit-3: ACTION AND COMMANDS, TREES, CHART</td></tr>
<tr><td colspan="5">Doing Things: Actions and Commands: Pushing the Boundaries - The Patterns - Showing Complex Data: Trees, Charts and Other Information Graphics: The Basics of Information Graphics - The Patterns</td><td>9</td></tr>
<tr><td colspan="6">Unit-4: FORMS, CONTROLS AND SOCIAL MEDIA</td></tr>
<tr><td colspan="5">Getting Input from Users: Forms and Controls: The Basics of Form Design - Control Choice - The Patterns - Using Social Media: What This Chapter Does Not Cover - The Basics of Social Media - The Patterns</td><td>9</td></tr>
<tr><td colspan="6">Unit-5: MOBILE, VISUAL APPEAL</td></tr>
<tr><td colspan="5">Going Mobile: The Challenges of Mobile Design - The Patterns - Making It Look Good: Visual Style and Aesthetics - Same Content, Different Styles - The Basics of Visual Design - What This Means for Desktop Applications - The Patterns.</td><td>9</td></tr>
<tr><td colspan="6">Self-study :</td></tr>
<tr><td colspan="6">Site/Industrial Visits :</td></tr>
</table>

Course outcomes:

At the end of this course student will:

- Apply an evidence based approach to requirements gathering, specification and evaluation.
- Analyse and interpret results of User Centred Design activities to model users, goals, tasks, system environment and domain.
- Construct prototype user interfaces demonstrating the application of user interface design principles and guidelines.

Textbooks:

1. Jenifer Tidwell, “Designing Interfaces” Second Edition, 2011
2. Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, “About Face: The Essentials of Interaction Design”, 4th edition, 2014

Reference Books:

1.Don Norman , “The Design of Everyday Things”, Revised and Expanded Edition 2013,

2.Steve Krug, “Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability”, 3rd Edition 2014.

3.Joel Spolsky, “User Interface Design for Programmers 2006 Susan Weinschenk, 100 Things Every Designer Needs to Know About People”, April 24, 2011.

Online Resources:

OPEN ELECTIVE

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Course Code	Course Name
EC636OE1	Basics of Microprocessors
EC636OE2	Introduction to Robotic Design
EC636OE3	Principles of Communication
EC636OE4	Basics of VLSI Design
EC636OE5	Advanced Digital System Design
EC636OE6	Basics of Digital Signal Processing

Course Name: BASICS OF MICROPROCESSORS					
Course Code: EC636OE1					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**
Course objectives: To learn the architecture programming and interfacing of microprocessors.					
Prerequisites:					

Units	**Teaching Hours**
Unit-1 MICROPROCESSOR	
Intel 8086 Microprocessor - Internal architecture – Block diagram – Minimum and maximum mode operation – Interrupt and Interrupt applications – DMA data transfer –8086 memory organization – even and odd memory banks – segment registers - logical and physical address – advantages and disadvantages of physical memory.	9
Unit-2: 8086 MICROPROCESSOR I/O INTERFACING	
Intel 8086 microprocessor – Architecture – Instruction set and assembler directives – Addressing modes – Assembly language programming-Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications.	9
Unit-3: 80286 MICROPROCESSOR	
Intel 80286 Microprocessor - 80286 Architecture, system connection – Real address mode operation – Protected mode operation	9
Unit-4: 80386 MICROPROCESSOR	
Intel 80386 Microprocessor - 80386 Architecture and system connection – Real operating mode – 386 protected mode operation – segmentation and virtual memory – segment privilege levels and protection – call gates – I/O privilege levels – Interrupts and exception handling – task switching – paging mode – 80386 virtual 86 mode operation.	9
Unit-5: 80486 MICROPROCESSOR	
Advanced Intel Microprocessors - 80486 – Processor model – Reduced Instruction cycle – five stage instruction pipe line – Integrated coprocessor – On board cache – Burst Bus mode.Pentium – super scalar architecture – u-v pipe line – branch prediction logic – cache structure – BIST (built in self test) – Introduction to MMX technology.	9
Self-study :	

Site/Industrial Visits :
Course outcomes: • Student will be able to understand architecture and programming of 8086 microprocessor. • Student will be able to understand interfacing of peripheral devices with 8086 microprocessor. • Student will be able to understand the architecture and programming of 80286, 80386 and 80486 microprocessor.
Textbooks: 1. Ramesh S.Gaonkar, "Microprocessor - Architecture, Programming and Applications with the 8085", Penram International publishing private limited, fifth edition.
Reference Books: 1. A.K. Ray &K.M.Bhurchandi, "Advanced Microprocessors and peripherals- Architectures, Programming and Interfacing", Tata McGraw Hill, 2002 reprint. 2. Barry B. Brey, "The Intel Microprocessors" Pearson Education India., 8th Edition 3. Douglous V. Hall "Microprocessor and Interfacing" Tata McGraw Hill, 2006 revised, 2003.
Online Resources:

Course Name: INTRODUCTION OF ROBOTIC DESIGN					
Course Code : EC636OE2					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**
Course objectives: Robots are slowly and steadily replacing human beings in many fields. The aim of this course is to introduce the students into this area so that they could use the same when they enter the industries.					
Prerequisites:					

Units	**Teaching Hours**
Unit-1 ROBOTIC MANIPULATION	
Robotic manipulation – Automation and Robots –Robot Classification – Applications – Robot Specifications – Notation. Direct Kinematics: The ARM Equation – Dot and Cross products – Coordinate frames – Rotations – Homogeneous coordinates – Link coordinates – The arm equation – A five-axis articulated robot (Rhino XR-3) – A four-axis SCARA Robot (Adept One) – A six-axis articulated Robot (Intelledex 660). Inverse Kinematics: Solving the arm equation – The inverse kinematics problem – General properties of solutions – Tool configuration – Inverse kinematics of a five-axis articulated robot (Rhino XR-3) – Inverse kinematics of a four-axis SCARA robot (Adept one) - Inverse kinematics of a six-axis articulated robot (Intelledex 660) - Inverse kinematics of a three-axis articulated robot – A robotic work cell.	9
Unit-2: DYNAMIC OF ROBOTS	
Workspace analysis and trajectory planning: Workspace analysis – Work envelop of a five-axis articulated robot – Work envelope of a four-axis SCARA robot – Workspace fixtures – The pick-and-place operation – Continuous-path motion – Interpolated motion – Straight-line motion. Differential motion and statics: The tool-configuration Jacobian matrix – Joint-space singularities – Generalized Inverses – Resolved-Motion rate control:n<=6 – Rate control of redundant robots:n>6 – rate control using {1}-inverses – The manipulator Jacobian – Induced joint torques and forces. Manipulator Dynamics: Lagrange's equation – Kinetic and Potential energy – Generalized force – Lagrange -Euler dynamic model – Dynamic model of a two-axis planar articulated robot - Dynamic model of a three-axis SCARA robot – Direct and Inverse dynamics – Recursive Newton-Euler formulation – Dyamic model of a one-axis robot.	9
Unit-3: ROBOT CONTROL	

Robot control: The control problem – State equation – Constant solutions – Linear feedback systems - Single-axis PID control – PD-Gravity control – Computed-Torque control – Variable-Structure control – Impedance control	9
Unit-4: SENSORS AND ACTUATORS	
Actuators - Introduction – Characteristics of actuating systems – Comparison of actuating systems – Hydraulic devices – Pneumatic devices – Electric motors – Microprocessor control of electric motors – Magnetostricitve actuators – Shape-memory type metals – Speed reduction. Sensors – Introduction – Sensor characteristics – Position sensors – Velocity sensors – Acceleration sensors – Force and pressure sensors – Torque sensors – Microswitches – Light and Infrared sensors – Touch and Tactile sensors – Proximity sensors – Range-finders – Sniff sensors – Vision systems – Voice Recognition devices – Voice synthesizers – Remote center compliance device.	9
Unit-5: VISION AND TASK PLANNING	
Robot vision – Image representation – Template matching – Polyhedral objects – Shape analysis – Segmentation – Iterative processing – Perspective Transformations – Structured illumination –Camera calibration. Task planning: Task-level programming – Uncertainty – Configuration space – Gross-Motion planning – Grasp planning – Fine-Motion planning – Simulation of planar motion – A task-planning problem.	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: The course has been so designed to give the students an overall view of the mechanical • tics associated with the same. • Actuators and sensors necessary for the functioning of the robot.	
Text Books: 1. Robert J.Schilling, "Fundamentals of Robotics – Analysis & Control", Prentice Hall of India Pvt. Ltd., 2002. (Chapters 1 to 9 – Unit I, II, III, V) 2. SaeedB.Niku, "Introduction to Robotics – Analysis, Systems, Applications", Prentice Hall of India Pvt. Ltd., 2003. (Chapters 6 & 7 – Unit IV)	
Reference Books:	
Online Resources:	

Course Name: PRINCIPLES OF COMMUNICATION					
Course Code: EC636OE3					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:
To have knowledge about Analog and Digital transmission of both Analog data and Digital Data, Security, modulation and different accessing methods.

Prerequisites:

Units	**Teaching Hours**
Unit-1 AMPLITUDE MODULATION: TRANSMISSION AND RECEPTION	
Principles of amplitude modulation – AM envelope, frequency spectrum and bandwidth, modulation index and percent modulation, AM power distribution, AM modulator circuits – low level AM modulator, medium power AM modulator, AM transmitters – low level transmitters, high level transmitters, Receiver parameters. AM reception: AM receivers – TRF, Superheterodyne receivers, Double Conversion AM receivers.	9
Unit-2: ANGLE MODULATION: TRANSMISSION AND RECEPTION	
Angle Modulation – FM and PM waveforms, phase deviation and modulation index, frequency deviation, phase and frequency modulators and demodulators, frequency spectrum of a angle modulated waves, Bandwidth requirement, Broadcast band FM, Average power FM and PM modulators – Direct FM and PM, Direct FM transmitters, Indirect transmitters, Angle modulation Vs. amplitude modulation.FM receivers: FM demodulators, PLL FM demodulators, FM noise suppression, Frequency Vs. phase Modulation.	9
Unit-3: DIGITAL MODULATION TECHNIQUES	
Introduction, Binary PSK, DPSK, Differentially encoded PSK, QPSK, M-ary PSK, QASK, Binary FSK, MSK, Duobinary encoding – Performance comparison of various systems of Digital Modulation.	9
Unit-4: SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES	
Introduction, Pseudo-noise sequence, DS spread spectrum with coherent binary PSK, Processing gain, FH spread spectrum, multiple access techniques, wireless communications, TDMA and CDMA, wireless communication systems, source coding of speech for wireless communications	9
Unit-5: SATELLITE AND OPTICALCOMMUNICATION	

Satellite Communication Systems-Keplers Law, LEO and GEO Orbits, footprint, Link model-Optical Communication Systems-Elements of Optical Fiber Transmission link, Types, Losses, Sources and Detectors.	9
Self-study :	
Site/Industrial Visits :	

Course outcomes:

- To have understanding about different types of AM Communication systems (Transmitters & Receivers)
- To study in detail the different types of FM transmitters & Receivers and PM Transmitters and Receivers
- To know the spread spectrum modulation techniques and different multiple access methods.
- To learn communication via satellite and optical signal.

Textbooks:

1. Wayne Tomasi, “Electronic Communication Systems: Fundamentals Through Advanced”, Pearson Education, 2001.
2. Simon Haykin, Digital Communications, John Wiley & Sons, 2003.
3. Gerd Keiser, “Optical Fiber Communications” Tata McGraw-Hill Education Private Limited, New Delhi, 4^{th} ed., 2010/5^{th} ed. 2013

Reference Books:

1. Simon Haykin, Communication Systems, John Wiley & Sons, 4th edn.,2001.
2. Taub & Schilling, Principles of Communication Systems, TMH, 2nd edn., 2003.
3. Martin S.Roden, Analog and Digital Communication System, PHI, 3rd edn. 2002.
4. Blake, Electronic Communication Systems, Thomson Delman, 2nd edn., 2002.

Online Resources:

Course Name: BASICS OF VLSI DESIGN					
Course Code: EC636OE4					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: To introduce the technology, design concepts of Very Large Scale Integrated Circuits.

Prerequisites:

Units	Teaching Hours
Unit-1 MOS TRANSISTORS	
Fundamentals of Enhancement Mode MOSFETs, Depletion Mode MOSFETs, CMOS transistor Theory, Long Channel I-V Characteristics, Non-Ideal I-V Effects, DC Transfer Characteristics.	9
Unit-2: CMOS PROCESSING TECHNOLOGY	
Overview of IC industry, CMOS Technologies (Nwell, Pwell, Twin-Tub, SOI, BiCMOS), Layout Design Rules, Stick Diagrams, Euler's Rule for Physical Design.	9
Unit-3: VERILOG HDL	
Basic Concepts: VLSI Design flow, identifiers, gate primitives, value set, ports, gate delays, structural gate level and switch level modeling, Design hierarchies, Behavioral and RTL modeling: Operators, timing controls, Procedural assignments conditional statements, Data flow modeling and RTL. Structural gate level description of combinational and sequential circuits.	9
Unit-4: VLSI CIRCUIT DESIGN	
Precharge-Evaluate logic, Static and Dynamic CMOS logic circuits, Combinational Circuit Design, Sequential Circuit Design, Circuit Design of Latches and Flip-Flops.	9
Unit-5: CMOS CHIP DESIGN	
MOSFETS as switches, Basic logic gates in CMOS, Complex logic gates, Transmission gates: Muxes and latches, CMOS chip design options: Full custom ASICs, Std. Cell based ASICs, Gate Array based ASICs Channeled, Channel less and structured GA, Programmable logic structures; 22V10, Programming of PALs, Programmable Interconnect, Reprogrammable GA: Xilinx programmable GA, ASIC design flow.	9
Self-study:	
Site/Industrial Visits:	

Course outcomes: • To learn the basic CMOS circuits. • To learn the CMOS process technology. • To learn techniques of chip design using programmable devices. • To learn the concepts of designing VLSI subsystems. • To learn the concepts of modeling a digital system using Hardware Description Language.
Textbooks: 1. CMOS VLSI Design : A Circuits and Systems Perspective (English) 3rd Edition Ayan Banerjee , Neil H. E. Weste , David Harris 2. Weste-Eshraghian - Principles of CMOS VLSI Design 3. Verilog HDL:Samir Palnitkar 4. M.J.S.Smith : Application Specific integrated circuits, Pearson Education, 1997.
Reference Books: 1. Puchnell DA &Eshraghian K, Basic VLSI Design , PHI 2. John P. Uyemura , Introduction to VLSr circuits and systems, John Wiley.
Online Resources:

Course Name: ADVANCED DIGITAL SYSTEM DESIGN					
Course Code : EC636OE5					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: To introduce methods to analyze and design synchronous and asynchronous sequential circuits. To introduce variable entered maps and techniques to simplify the Boolean expressions using these maps.

Prerequisites:

Units	**Teaching Hours**
Unit-1 SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN	
Analysis of clocked synchronous sequential circuits**,** Moore / Mealy State diagrams, State Table, **State** Reduction and Assignment, Design of synchronous sequential circuit.	9
Unit-2: ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN	
Analysis of asynchronous sequential circuit, Cycles, Races, Static, Dynamic and Essential Hazards, Primitive Flow Table, State Reductions and State Assignment, Design of asynchronous sequential circuits.	9
Unit-3: VEM AND INTRODUCTION TO MULTI-INPUT SYSTEM CONTROLLER DESIGN	
Variable Entered Maps simplification, System Controllers, Design Phases, Choosing the controller architecture, State Assignment, Next State decoder , Examples of 2s complement system and Pop Vending Machine, Concepts related to the use of conditional outputs.	9
Unit-4: SYSTEM CONTROLLERS USING COMBINATIONAL MSI/LSI CIRCUIT	
Decoders and Multiplexers in system controllers, Indirect Addressed MUX configuration , System controllers using ROM.	9
Unit-5: INTRODUCTION TO VHDL	
Basic VHDL, Constructs, Datatypes, Objects, Sequential Packages and concurrent statements and libraries Attributes, Predefined operators,variables, timing models,examples on Entity declaration,Behavioralspecification,data flow and structural specification.	9
Self-study :	
Site/Industrial Visits:	

Course outcomes:

- Ability to analyze and design sequential digital circuits
- Ability to understand the requirements and specifications of the system required for a given application
- Decide a suitable system controller architecture

Text Books:

1. William I. Fletcher," An Engineering Approach to Digital Design", Prentice Hall India, 2011

Reference Books:

1. Charles Roth Jr "Fundamentals of Logic Design" Thomson Learning 2004
2. Nripendra N Biswas "Logic Design Theory" Prentice Hall of India,2001
3. Arun Kumar Singh, "Foundation of switching theory and logic design", New Age publications, 2008.

Online Resources:

Course Name: BASICS OF DIGITAL SIGNAL PROCESSING					
Course Code : EC636OE6					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: To review signals and systems, study DFT and FFT, discuss the design of IIR & FIR filters and study typical applications of digital signal processing	
Prerequisites:	
Units	**Teaching Hours**
Unit-1 SIGNALS AND SYSTEMS	
Basic elements of digital signal Processing –Concept of frequency in continuous time and discrete time signals –Sampling theorem –Discrete time signals. Discrete time systems –Analysis of Linear time invariant systems –Z transform –Convolution and correlation.	9
Unit-2: FAST FOURIER TRANSFORMS	
Introduction to DFT – Efficient computation of DFT Properties of DFT – FFT algorithms – Radix-2 and Radix-4 FFT algorithms – Decimation in Time – Decimation in Frequency algorithms – Use of FFT algorithms in Linear Filtering and correlation.	9
Unit-3: IIR FILTER DESIGN	
Structure of IIR – System Design of Discrete time IIR filter from continuous time filter – IIR filter design by Impulse Invariance.Bilinear transformation – Approximation derivatives – Design of IIR filter in the Frequency domain.	9
Unit-4: FIR FILTER DESIGN	
Symmetric &Antisymteric FIR filters – Linear phase filter – Windowing technique – Rectangular, Kaiser windows – Frequency sampling techniques – Structure for FIR systems.	9
Unit-5: FINITE WORD LENGTH EFFECTS	
Quantization noise – derivation for quantization noise power – Fixed point and binary floating point number representation – comparison – over flow error – truncation error – co-efficient quantization error - limit cycle oscillation – signal scaling – analytical model of sample and hold operations – Application of DSP – Model of Speech Wave Form – Vocoder.	9
Self-study :	
Site/Industrial Visits :	

Course outcomes: To have an overview of signals and systems. · To study DFT & FFT · To study the design of IIR filters. · To study the design of FIR filters. · To study the effect of finite word lengths & applications of DSP
Textbooks: 1. John G Proakis and Dimtris G Manolakis, "Digital Signal Processing Principles, Algorithms and Application", PHI/Pearson Education, 2000, 3rd Edition.
Reference Books: 1. Alan V Oppenheim, Ronald W Schafer and John R Buck, "Discrete Time Signal Processing", PHI/Pearson Education, 2000, 2nd Edition. 2. JohnyR.Johnson, "Introduction to Digital Signal Processing", Prentice Hall of India/ Pearson Education, 2002. 3. SanjitK.Mitra, "Digital Signal Processing: A Computer – Based Approach", Tata McGraw-Hill, 2001, Second Edition.
Online Resources:

OPEN ELECTIVE

DEPARTMENT OF ELECTRICAL & ELECCTRONICS ENGINEERING

Course Code	Course Name
EE636OE1	Energy Auditing and Management
EE636OE2	Nonconventional Energy Sources
EE636OE3	Introduction of Hybrid Electric Vehicles
EE636OE4	Electrical System Design for Residential and Commercial Buildings
EE636OE5	Smart Grids
EE636OE6	Robotics and Automation
EE636OE7	Power Quality
EE636OE8	Matrix Computations
EE636OE9	Electrical Machines and Drives

Course Name: ENERGY AUDITING AND MANAGEMENT					
Course Code : EE636OE1					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

- To emphasize the energy management on various electrical equipment and metering
- To illustrate the energy management in lighting systems and cogeneration
- To study the concepts behind the economic analysis and load management

Prerequisites:

Units	**Teaching Hours**
Unit-1 ENERGY AUDIT PROCESS	
Basics of Energy – Need for energy management – energy accounting-energy monitoring, targeting and reporting-energy audit process.	9
Unit-2: ENERGY MANAGEMENT IN ELECTRICAL SYSTEMS	
Energy management for electric motors – Transformer and reactors-capacitors and synchronous machines, energy management by cogeneration –forms of cogeneration –feasibility of cogeneration –electrical interconnection	9
Unit-3: ENERGY MANAGEMENT IN LIGHTING SYSTEMS	
Energy management in lighting systems – task and the working space -light sources –ballasts – lighting controls – optimizing lighting energy –power factor and effect ofharmonics, lighting and energy standards	9
Unit-4: METERING	
Metering for energy management – units of measure – utility meters –demand meters –paralleling of current transformers – instrument transformer burdens – multitasking solid state meters, metering location vs requirements, metering techniques and practical examples	9
Unit-5: ECONOMIC ANALYSIS	
Economic analysis – economic models- time value of money - utility rate structures – cost of electricity – loss evaluation, load management –demand control techniques – utility monitoring and control system –HVAC and energy management – economic justification.	9
Self-study :	
Site/Industrial Visits :	

Course outcomes: At the end of this course, the students should be able to:

- Apply energy management schemes in electrical systems
- Perform economic analysis and load management

Textbooks:

1. 'Energy Audit for Professionals' edited by Suresh Kumar Dhungel, G. Krishnakumar, Daya Publishing House, 2013.
2. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, 'Guide to Energy Management', 6th Edition, The Fairmont Press, Inc., 2008.

Reference Books:

1. Amit K. Tyagi, 'Handbook on Energy Audits and Management', The Energy and Resources Institute, 2006.
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.

Online Resources:

<table>
<tr><td colspan="6">Course Name: NONCONVENTIONAL ENERGY SOURCES</td></tr>
<tr><td colspan="6">Course Code : EE636OE2</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives:
To recognize the need of renewable energy technologies and their role in the current scenario of energy crisis
Distinguish between the sustainable energy sources and fossil energy sources
Describe the principles of renewable energy production from various renewable sources</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 Introduction</td></tr>
<tr><td colspan="5">Conventional energy resources-availability and sustainability issues, Non-conventional sources-advantages over conventional sources-Renewable Energy sources-Advantages and limitations</td><td>9</td></tr>
<tr><td colspan="6">Unit-2:</td></tr>
<tr><td colspan="5">Solar energy – Introduction to solar energy: solar radiation, availability, measurement and estimation.
Solar Thermal systems- Solar collectors(fundamentals only)-Applications -Solar heating system, Air conditioning and Refrigeration system ,Pumping system, solar cooker, Solar Furnace, Solar Greenhouse -Design of solar water heater</td><td>9</td></tr>
<tr><td colspan="6">Unit-3: Solar Photovoltaic Systems</td></tr>
<tr><td colspan="5">Photovoltaic conversion- Solar Cell, module, Panel and Array Solar cell- materials-characteristics- efficiency-Battery back up-Charge controller- MPPT-PV system classification- Design of stand-alone PV system.</td><td>9</td></tr>
<tr><td colspan="6">Unit-4: Wind Power Systems</td></tr>
<tr><td colspan="5">Wind source – wind statistics - energy in the wind –betz criterion-,mechanical components-aerodynamic force-angle of attack-pitch angle-yaw-rotor types, wind driven generators-fixed speed drives-variable speed drives- ––environmental aspects.</td><td>9</td></tr>
<tr><td colspan="6">Unit-5: Ocean, Geothermal and other resources</td></tr>
</table>

OTEC systems-types, wave energy-types, tidal energy-different schemes, Renewable Hydro –Power -Small, Mini and Micro hydro power-Types of turbines and generators Geothermal energy-geothermal resources, limitations and environmental aspects of each type Fuel cells, MHD power generation, Biomass energy	9

Self-study :

Site/Industrial Visits:

Course outcomes: At the end of this course, the students should be able to:

- Demonstrate an understanding of the scientific principles of methodology of Non-conventional energy.
- Acquire working knowledge of different Renewable energy science-related topics

Textbooks:

1. Non Conventional Energy Resources-B.H.Khan
2. G.D.Rai ,Non Conventional Energy Sources, Khanna Publishers,4 th Edition,2009
3. D.P.Kothari, K.C.Singal, RakeshRanjan, *Renewable Energy Sources and Emerging Technologies*, Prentice Hall of India, New Delhi, 2009
4. Mukund R Patel "Wind and solar power systems Design ,Analysis and operation" Taylor and Francis publishers ,2nd edition,2006,ISBN978-0-8493-1570-1

Reference Books:

1. A.K. Mukherjee, NiveditaTakur Photovoltaic Systems –Analysis and Design(PHI-2011)
2. Ahmed Hemami, Wind Turbine Technology, (Cengate Learning,2012,First India Edition)
3. Wind energy Conversion Systems – Freris L.L. (Prentice Hall,1990)
4. Wind Turbine Technology: Fundamental concepts of wind turbine technology Spera D.A. (ASME Press, NY, 1994)

Online Resources:

Course Name: INTRODUCTION TO HYBRID ELECTRIC VEHICLES					
Course Code : EE636OE3					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:
To introduce the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.

Prerequisites:

Units	**Teaching Hours**
Unit-1 HYBRID VEHICLES	
History and importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Basics of vehicle performance, vehicle power sources, transmission characteristics, and mathematical models to describe vehicle performance.	9
Unit-2: HYBRID TRACTION	
Basic concept of hybrid traction, introduction to various hybrid drive-train topologies,power flow control in hybrid drive-train topologies, fuel efficiency analysis. Basic concepts of electric traction, introduction to various electric drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	9
Unit-3: MOTORS AND DRIVES	
Introduction to electric components used in hybrid and electric vehicles, configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.	9
Unit-4: INTEGRATION OF SUBSYSTEMS	
Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems	9
Unit-5: ENERGY MANAGEMENT STRATEGIES	
Introduction to energy management strategies used in hybrid and electric vehicle, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy strategies.	9
Self-study :	

Site/Industrial Visits :

Course outcomes: At the end of this course, the students should be able to:

- Explain the concepts of hybrid and electric drive configuration, types of electric machines that can be used, suitable energy storage devices etc.
- Recognize the application of various drive components and selection of proper component for particular applications.

Textbooks:

1. Bimal K. Bose, 'Power Electronics and Motor drives' , Elsevier, 2011.
2. IqbalHussain, '*Electric and Hybrid Vehicles: Design Fundamentals*', 2nd edition, CRC Pr I Llc, 2010.

Reference Books:

1. Sira -Ramirez, R. Silva Ortigoza, 'Control Design Techniques in Power Electronics Devices', Springer, 2006.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, 'Sliding mode control of switching Power Converters', CRC Press, 2011.
3. Ion Boldea and S.A Nasar, 'Electric drives', CRC Press, 2005.

Online Resources:

Course Name: ELECTRICAL SYSTEM DESIGN FOR RESIDENTIAL AND COMMERCIAL BUILDINGS					
Course Code : EE636OE4					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

- To introduce the fundamentals of estimation and costing of electrical system in residential and commercial buildings.

Prerequisites:

Units	**Teaching Hours**
Unit-1 GENERAL PRINCIPLES OF ESTIMATION	
Introduction to estimation & costing, Electrical Schedule, Catalogues, Market Survey and source selection, Recording of estimates, Determination of required quantity of material, Labor conditions, Determination of cost material and labor, Contingencies, Overhead charges, Profit, Purchase system, Purchase enquiry and selection of appropriate purchase mode, Comparative statement, Purchase orders, Payment of bills, Tender form, General idea about IE rule, Indian Electricity Act and major applicable I.E rules.	9
Unit-2: RESIDENTIAL BUILDING ELECTRIFICATION	
General rules guidelines for wiring of residential installation and positioning of equipment's, Principles of circuit design in lighting and power circuits, Procedures for designing the circuits and deciding the number of circuits, Method of drawing single line diagram, Selection of type of wiring and rating of wires and cables, Load calculations and selection of size of conductor, Selection of rating of main switch, distribution board, protective switchgear ELCB and MCB and wiring accessories, Earthing of residential Installation, Sequence to be followed for preparing estimate, Preparation of detailed estimates and costing of residential installation.	9
Unit-3: ELECTRIFICATION OF COMMERCIAL INSTALLATION	

Concept of commercial installation, Differentiate between electrification of residential and commercial installation, Fundamental considerations for planning of an electrical installation system for commercial building, Design considerations of electrical installation system for commercial building, Load calculation and selection of size of service connection and nature of supply, Deciding the size of the cables, bus bar and bus bar chambers, Mounting arrangements and positioning of switchboards, distribution boards main switch etc., Earthing of the electrical installation, Selection of type wire, wiring system and layout, Sequence to be followed to prepare estimate, Preparation of detailed estimate and costing of commercial installation.	9
Unit-4: SERVICE CONNECTION, INSPECTION AND TESTING OF INSTALLATION	
Concept of service connection, Types of service connection and their features, Method of installation of service connection, Estimates of under ground and overhead service connections, Inspection of internal wiring installations, Inspection of new installations, Testing of installations, Testing of wiring installations, Reason for excess recording of energy consumption by energy meter.	9
Unit-5: ELECTRICAL INSTALLATION FOR POWER CIRCUITS	
Introduction, Important considerations regarding motor installation wiring, Determination of input power, Determination of input current to motors, Determination of rating of cables, determination of rating of fuse, Determination of size of Condit, distribution Board main switch and starter.	9
Self-study :	
Site/Industrial Visits:	
Course outcomes: At the end of this course, the students should be able to: • estimate the electrical design • calculate its costing for both residential and commercial buildings	
Textbooks: 1. J B Gupta, 'A Course in Electrical Installation Estimating & Costing 9th Edition', Kataria& Sons, 2012 2. S. K. Bhattacharya, K. B. Raina, 'Electrical Design Estimating and Costing', 2010	
Reference Books: 1. SL Uppal, GC Garg, 'Electrical Wiring Estimating and Costing', Khanna Publishers Delhi , 2012 2. M. K. Giridharan , *'Electrical Systems Design' 1st Edition*, IK international, 2010	
Online Resources:	

Course Name: SMART GRIDS					
Course Code : EE636OE5					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

- To introduce the concepts of various components of Smart Grid, and their impacts on the energy industry, including renewable integration, PHEV penetration, demand side management, and greenhouse gas (GHG) emissions reductions.
- To discuss the Energy policy modeling and analysis, such as policies on GHG emissions reductions and incentives to green energy investments.

Prerequisites:

Units	**Teaching Hours**
Unit-1 INTRODUCTION TO SMART GRID	
Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid.CDM opportunities in Smart Grid.	9
Unit-2: SMART GRID TECHNOLOGIES: PART 1	
Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.	9
Unit-3: SMART GRID TECHNOLOGIES: PART 2	
Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring &protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).	9
Unit-4: INFORMATION AND COMMUNICATION TECHNOLOGY FOR SMART GRID	
Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid. Broadband over Power line (BPL). IP based protocols.	9
Unit-5: POWER QUALITY MANAGEMENT IN SMART GRID	

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.	9
Self-study :	
Site/Industrial Visits :	

Course outcomes: At the end of this course, the students should be able to:

- Explain the concepts and principles of Smart Grid, technology enabling, and demand participation.
- Know the impacts of renewable resources to the grid and the various issues associated with integrating such resources to the grid.

Textbooks:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press
3. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley
4. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell
5. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010
6. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
7. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press

Reference Books:

1. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011
2. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press
3. MladenKezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert" Substation Automation (Power Electronics and Power Systems)", Springer
4. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication
5. Yang Xiao, "Communication and Networking in Smart Grids", CRC Press.

Online Resources:

<table>
<tr><td colspan="6">Course Name: ROBOTICS AND AUTOMATION</td></tr>
<tr><td colspan="6">Course Code: EE636OE6</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives:
• To understand concepts in kinematics and dynamics of robotic system.
• To introduce control strategies of simple robotic system.
• To study the applications of computer-based control to integrated automation systems.</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 Introduction</td></tr>
<tr><td colspan="5">Robot definitions - Laws of robotics - Robot anatomy - History - Human systems and Robotics - Specifications of Robots - Flexible automation versus Robotic technology - Classification applications</td><td>9</td></tr>
<tr><td colspan="6">Unit-2: Robotic systems</td></tr>
<tr><td colspan="5">Basic structure of a robot – Robot end effectors - Manipulators - Classification of robots – Accuracy - Resolution and repeatability of a robot - Drives and control systems – Mechanical components of robots – Sensors and vision systems - Transducers and sensors - Tactile sensors – Proximity sensors and range sensors - Vision systems - RTOS - PLCs - Power electronics</td><td>9</td></tr>
<tr><td colspan="6">Unit-3: Robot kinematics, dynamics and programming</td></tr>
<tr><td colspan="5">Matrix representation - Forward and reverse kinematics of three degrees of freedom – Robot Arm – Homogeneous transformations – Inverse kinematics of Robot – Robo Arm dynamics - D-H representation of forward kinematic equations of robots - Trajectory planning and avoidance of obstacles - Path planning - Skew motion - Joint integrated motion – Straight line motion - Robot languages- Computer control and Robot programming/software</td><td>9</td></tr>
<tr><td colspan="6">Unit-4: Control system design</td></tr>
<tr><td colspan="5">Open loop and feedback control - General approach to control system design - Symbols and drawings - Schematic layout - Travel step diagram, circuit and control modes - Program control - Sequence control - Cascade method - Karnaugh-Veitch mapping - Microcontrollers - Neural network - Artificial Intelligence - Adaptive Control – Hybrid control</td><td>9</td></tr>
<tr><td colspan="6">Unit-5: Robot applications</td></tr>
</table>

Material handling - Machine loading, Assembly, inspection, processing operations and service robots - Mobile Robots - Robot cell layouts - Robot programming languages	9
Self-study :	
Site/Industrial Visits :	

Course outcomes: At the end of this course, the students should be able to:

- Understand the basic concept of robotics and automation.
- Design requirement of control system for robot.
- Applications of robots in various domains.

Text Books:

1. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 2003.
2. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and sons, 2008.
3. S. R. Deb and S. Deb, 'Robotics Technology and Flexible Automation', Tata McGraw Hill Education Pvt. Ltd, 2010.

Reference Books:

1. Saeed B. Niku, 'Introduction to Robotics', Prentice Hall of India, 2003.
2. Mikell P. Grooveret. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2008.
3. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
4. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics : Control, Sensing, Vision and Intelligence", McGraw Hill, 1987

Online Resources:

<table>
<tr><td colspan="6">Course Name: POWER QUALITY</td></tr>
<tr><td colspan="6">Course Code: EE636OE7</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives:
• To study the production of voltages sags, over voltages and harmonics and methods of control.
• To study various methods of power quality monitoring.</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 INTRODUCTION TO POWER QUALITY</td></tr>
<tr><td colspan="5">Terms and definitions: Overloading, under voltage, sustained interruption; sags and swells; waveform distortion, Total Harmonic Distortion (THD), Computer Business Equipment Manufacturers Associations (CBEMA) curve.</td><td>9</td></tr>
<tr><td colspan="6">Unit-2: VOLTAGE SAGS AND INTERRUPTIONS</td></tr>
<tr><td colspan="5">Sources of sags and interruptions, estimating voltage sag performance, motor starting sags, estimating the sag severity, mitigation of voltage sags, active series compensators, static transfer switches and fast transfer switches.</td><td>9</td></tr>
<tr><td colspan="6">Unit-3: OVERVOLTAGES</td></tr>
<tr><td colspan="5">Sources of over voltages: Capacitor switching, lightning, Ferro resonance; mitigation of voltage swells: Surge arresters, low pass filters, power conditioners – Lightning protection, shielding, line arresters, protection of transformers and cables, computer analysis tools for transients, PSCAD and EMTP.</td><td>9</td></tr>
<tr><td colspan="6">Unit-4: HARMONICS</td></tr>
<tr><td colspan="5">Harmonic distortion: Voltage and current distortion, harmonic indices, harmonic sources from commercial and industrial loads, locating harmonic sources; power system response characteristics, resonance, harmonic distortion evaluation, devices for controlling harmonic distortion, passive filters, active filters, IEEE and IEC standards.</td><td>9</td></tr>
<tr><td colspan="6">Unit-5: POWER QUALITY MONITORING</td></tr>
<tr><td colspan="5">Monitoring considerations: Power line disturbance analyzer, per quality measurement equipment, harmonic / spectrum analyzer, flicker meters, disturbance analyzer, applications of expert system for power quality monitoring.</td><td>9</td></tr>
<tr><td colspan="6">Self-study :</td></tr>
</table>

Site/Industrial Visits :

Course outcomes: At the end of this course, the students should be able to:

- Know the power-quality "events" happening during fault conditions, lightning strikes, and other occurrences that adversely affect the line-voltage and/or current waveforms.
- Use various methods of power quality monitoring when system consists of voltages sags, over voltages and harmonics and methods of control can understood.

Text Books:

1. Roger. C Dugan, Mark. F. McGranagham, Surya Santoso, H. Wayne Beaty, 'Electrical Power Systems Quality' McGraw Hill, 2003.

Reference Books:

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994). (For Chapter 1, 2, 3 and 5)
2. M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press, 1999). (For Chapters 1, 2, 3 and 5)
3. J. Arrillaga, N.R. Watson, S. Chen, 'Power System Quality Assessment', (New York: Wiley, 1999). (For Chapters 1, 2, 3, 4 and 5)
4. PSCAD User Manual.

Online Resources:

<table>
<tr><td colspan="6">Course Name: MATRIX COMPUTATIONS</td></tr>
<tr><td colspan="6">Course Code: EE636OE8</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives:
• To introduce the matrix operations and computations involved in solving linear systems.
• To understand the iterative methods and its fast convergence.
• To apply the learning in real time application.</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 Floating point computation</td></tr>
<tr><td colspan="5">Overview of matrix computations - Review of matrices and vectors - Norms - Singular value decompositions - Floating point computations - IEEE floating point arithmetic - Analysis of round off errors - Pitfalls of floating point computations</td><td>9</td></tr>
<tr><td colspan="6">Unit-2: Solution of Linear systems</td></tr>
<tr><td colspan="5">Concept of stability and ill-conditioning - Generic sensitivity analysis - Condition numbers - Backward and forward stability - Solution of linear systems - Triangular and banded systems - Gaussian elimination - Pivoting - Stability of Gaussian elimination - Cholesky factorization</td><td>9</td></tr>
<tr><td colspan="6">Unit-3: Solution of Least Squares of Problem</td></tr>
<tr><td colspan="5">Orthogonal matrices - Rotators and Reflectors - Gram-Schmidt process - QR factorizations - Stability of Householder QR factorization - Solution of Least Squares Problem by QR method - The SVD and the Least Squares Problem - Sensitivity of the Least Squares Problem</td><td>9</td></tr>
<tr><td colspan="6">Unit-4: Eigenvalue Problem and Computation of SVD</td></tr>
<tr><td colspan="5">Eigenvalue problems - Overview of eigenvalue algorithms - Sensitivity analysis of eigenvalue problems - Power, inverse power and Rayleigh quotient iterations - Reduction to Hessenberg and Tridiagonal forms - The QR algorithm with and without shifts - Convergence of the QR algorithm - The implicit QR algorithm with Wilkinson's shift - Reduction to bi-diagonal form - Computing the SVD</td><td>9</td></tr>
<tr><td colspan="6">Unit-5: Iterative Methods for Solution of Linear Systems</td></tr>
<tr><td colspan="5">Overview of iterative methods - Jacobi, Gauss-Seidel and successive over relaxation methods - The generic Krylov process - Implicit restarts, The Arnoldi iteration - The Lanczos iteration - Conjugate gradient method - Preconditioning</td><td>9</td></tr>
</table>

Self-study :
Site/Industrial Visits :
Course outcomes: At the end of this course, the students should be able to: • Know the matrix operations and computations involved in solving linear systems. • Familiar with the algorithm to optimize the multivariable system.
Textbooks: 1. D. S. Watkins, Fundamentals of Matrix Computations, 2nd. ed., Wiley Interscience, 2002.
Reference Books: 1.J. W. Demmel, Applied Numerical Linear Algebra, SIAM, 1997 2.G. H. Golub and C. F. Van Loan, Matrix Computations, 3rd Edition, John Hopkins University Press, 1996 3.L. N. Trefethen and D. Bau III, Numerical Linear Algebra, SIAM, 1997.
Online Resources:

Course Name: ELECTRIC MACHINES AND DRIVES					
Course Code: EE636OE9					
	L	**T**	**P**	**Category**	
Contact Hrs./Week	**3**	**0**	**0**	**CIA Marks**	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	**ESE Marks**	**50**
Credits.	**3**	**0**	**0**	**Exam Hours**	**3**

Course objectives:

- To study the operation of DC and AC Machines.
- To know the fundamentals of power electronic control.
- To understand basic power electronic circuits required to control DC and AC machines.

Prerequisites:

Units	**Teaching Hours**
Unit-1 Introduction to Electrical Machines	
Faraday's laws of Electromagnetic induction, Concept of a generator, Construction of DC machines, working of DC generator and Motor, Relations for generated voltage, Torque. Types of DC motor with characteristics. Construction and working of Induction Motors, Three phase and single phase motors, Torque-slip characteristics, Need for starter and starting methods. Synchronous Motors-Construction and working.	9
Unit-2: Power Electronics Control	
Power Electronic switches, diode, operation of thyristors, rectifier circuits, chopper circuits. Driver circuits for power electronic devices, buck, boost converters.	9
Unit-3: Electrical Drives	
Components of electrical Drives – electric machines, power converter, controllers - dynamics of electric drive - torque equation - equivalent values of drive parameters components of load torques types of load - four quadrant operation of a motor –– steady state stability – load equalization – classes of motor duty- determination of motor rating.	9
Unit-4: DC Motor drives	
DC motor drives – dc motors & their performance (shunt, series, compound, permanent magnet motor, universal motor, dc servomotor) – braking – regenerative, dynamic braking, plugging –Transient analysis of separately excited motor – converter control of dc motors–analysis of chopper controlled dc drives – converter ratings and closed loop control – transfer function of self, separately excited DC motors – linear transfer function model of power converters – sensing and feeds back elements – current and speed loops, P, PI and PID controllers – response comparison – simulation of converter and chopper fed DC drive.	9

Unit-5: AC Machine drives	
Induction motor drives – stator voltage control of induction motor– operation with different types of loads –– stator frequency control – variable frequency operation – V/F control, slip power recovery scheme – torque equation – torque slip characteristics – power factor – methods of improving power factor Synchronous motor drives – speed control of synchronous motors – adjustable frequency operation of synchronous motors.	9
Self-study:	
Site/Industrial Visits:	
Course outcomes: At the end of this course, the students should be able to: • Explain the construction and operation of DC and AC Machines • Apply basic power electronic circuits to control DC and AC machines	
Textbooks: 1. R. Krishnan, Electrical Motor Drives, PHI-2003 2. G.K.Dubey, Power semiconductor controlled drives, Prentice Hall- 1989	
Reference Books: 1. G.K.Dubey, Fundamentals of Electrical Drives, Narosa- 1995 2. S.A. Nasar, Boldea , Electrical Drives, Second Edition, CRC Press – 2006 3. M. A. ElSharkawi , Fundamentals of Electrical Drives , Thomson Learning -2000 4. W. Leohnard, Control of Electric Drives,-Springer- 2001 5. Murphy and Turnbull, Power Electronic Control of AC motors, Pergamon Press 6. VedamSubrahmaniam, Electric Drives, TMH-1994	
Online Resources:	

OPEN ELECTIVE
DEPARTMENT OF MECHANICAL ENGINEERING

Course No	Course Name
ME636OE1	Industrial Robotics
ME636OE2	Engineering Materials
ME636OE3	Basic Automobile Engineering
ME636OE4	Project Management
ME636OE5	Basic Aerospace Engineering
ME636OE6	Computer Application in Design
ME636OE7	CAD/CAM
ME636OE8	Non-Conventional Energy
ME636OE9	Internal Combustion Engines
ME636OE10	Finite Element Analysis

Course Name: INDUSTRIAL ROBOTOICS					
Course Code : ME636OE1					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: To impart knowledge about the engineering aspects of Robots and theirapplications

- To be familiar with the automation and brief history of robot and applications
- To give the student familiarities with the kinematics of robots
- To give knowledge about robot end effectors and their design
- To learn about Robot Programming methods & Languages of robot
- To give knowledge about various Sensors and their applications in robots

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Basic Concepts: Robot anatomy, Manipulators, kinematics: Forward and inverse kinematics, Precision movement, robot specifications and Work volume, Types of Robot drives **Robot Control:** Basic robot motions, Point to point control, continuous path control. Robot control, unit control system concept, servo and non, servo control of robot joints, adaptive and optimal control	9
Unit-2:	

End Effectors: Classification, mechanical, magnetic, vacuum and adhesive gripper, gripper force analysis and design **Sensor Devices:** Types of sensors, contact, position and displacement sensors, Force and torque sensors, Proximity and range sensors, acoustic sensors, Robot vision systems, Sensing and digitizin, Image processing and analysis	9
Unit-3:	
Robot Cell Design: Robot work cell design and control, Safety in Robotics, Robot cell layouts **Robot Interference:** Robots and machine interference, Robot cycle time analysis	9
Unit-4:	
Robot Programming: Robot language classification, programming methods, off and on line programming **Simple Programs:** Lead through method, Teach pendent method, VAL systems and language, simple program	9
Unit-5:	
Industrial Applications: Application of robots, Material handling, Machine loading and unloading, Assembly, Inspection, Welding, Spray painting **Recent Developments in Robotics:** Mobile robot, Microbots, Recent developments, safety considerations	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: At the end of course • Students will be equipped with the automation and brief history of robot and applications • Students will be familiarized with the kinematic motions of robot • Students will have good knowledge about robot end effectors and their design concepts • Students will be equipped with the Programming methods & various Languages of robots • Students will be equipped with the principles of various Sensors and their applications in robots	
Textbooks: 1. Deb .S.R, "Robotics technology and flexible automation", Tata McGraw Hill publishing company limited, New Delhi, 2010 2. Mikell P. Groover, "Industrial Robotics Technology Programming and Applications", McGraw Hill Co., Singapore, 2008	

Reference Books:

1. Klafter.R.D, Chmielewski.T.A and Noggins, “Robot Engineering: An Integrated Approach”, Prentice Hall of India Pvt. Ltd., New Delhi, 2011
2. Fu K.S, Gonzalez.R.C,& Lee, C.S.G, “Robotics control, sensing, vision and intelligence”, McGraw Hill Book Co., Singapore, Digitized 2007
3. Craig.J.J, “Introduction to Robotics mechanics and control”, Addison, Wesley, London, 2008.

Online Resources:

<table>
<tr><td colspan="6">Course Name: ENGINEERING MATERIALS</td></tr>
<tr><td colspan="6">Course Code: ME636OE2</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: The course introduces several advanced concepts and topics in the rapidly evolving field of material science. Students are expected to develop comprehension of the subject and to gain scientific understanding regarding the choice and manipulation of materials for desired engineering applications
The objective of this course is to provide an overview of various engineering materials available and their applications in various fields</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">Electronic Materials: Fermi energy and Fermi, Dirac distribution function, Variation of Fermi level with temperature in intrinsic and extrinsic semiconductors, Hall Effect, Dilute Magnetic Semiconductors (DMS) and their applications
Superconducting and Photonic Materials: Normal and High temperature superconductivity, Applications, Photonic Materials - LED, LCD, Photo conducting materials, Photo detectors, Photonic crystals and applications, Elementary ideas of Non-linear optical materials and their applications</td><td>9</td></tr>
<tr><td colspan="6">Unit-2:</td></tr>
<tr><td colspan="5">Magnetic Materials: Classification of magnetic materials based on spin, Hard and soft magnetic materials, Ferrites, garnets and magneto plumbites, Magnetic bubbles and their applications, Magnetic thin films, Spintronics and devices (Giant magneto resistance, Tunnel magneto resistance and Colossal magneto resistance)
Dielectric Materials: Polarization mechanisms in dielectrics, Frequency and temperature dependence of polarization mechanism, Dielectric loss, Dielectric waveguide and dielectric resonator antenna, Piezoelectric, pyroelectric and ferroelectric materials and their applications</td><td>9</td></tr>
<tr><td colspan="6">Unit-3:</td></tr>
</table>

Modern Engineering Materials: Smart materials, Shape memory alloys, Chromic materials (Thermo, Photo and Electro), Rheological fluids, Metallic glasses, Advanced ceramics, Composites. **Bio-materials:** Classification of bio-materials (based on tissue response), Comparison of properties of some common biomaterials, Metallic implant materials (stainless steel, cobalt, based and titanium, based alloys), Polymeric implant materials (Polyamides, polypropylene, Acrylic resins and Hydrogels), Tissue replacement implants , Soft and hard tissue replacements, Skin implants, Tissue engineering, Biomaterials for organ replacement (Bone substitutes), Biosensor	9
Unit-4:	
Properties of Carbon: Basic concepts of Nanoscience and Nanotechnology, Quantum wire, Quantum well, Quantum dot, fullerenes, Graphene, Carbon nanotubes, Material processing by chemical vapor deposition and physical vapor deposition **Characterization Methods:** Principle of SEM, TEM, AFM, Scanning near, field optical microscopy (SNOM) , Scanning ion, conducting microscopy (SCIM), Potential uses of nanomaterials in electronics, robotics, computers, sensors, sports equipment, mobile electronic devices, vehicles and transportation, Medical applications of nanomaterials	9
Unit-5:	
Diffraction: X-ray diffraction, Neutron diffraction and Electron diffraction **Spectroscopy:** X-ray fluorescence spectroscopy, Fourier transform Infrared spectroscopy (FTIR), Ultraviolet and visible spectroscopy, Thermo-gravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC)	9
Self-study :	
Site/Industrial Visits:	
Course outcomes: At the end of course, the student will be able to • demonstrate basic understanding of advanced materials, their functions and properties for technological applications • brief the significance of materials selection in the design process • explain the principal classes of biomaterials and their functionalities in modern medical science • explain the new concepts of Nano Science and Technology demonstrate the basics of instrumentation, measurement, data acquisition, interpretation and analysis	
Textbooks: 1. Thiruvadigal.J.D, Ponnusamy.S, Sudha.D. andKrishnamohan.M, “Materials Sciences”, Vibrant Publication, Chennai, 2013 2. Rajendran.V, “Materials Science”,Tata McGraw, Hill,New Delhi,2011	

Reference Books: 1.Rolf E. Hummel, “Electronic Properties of Materials”, 4th ed., Springer, New York, 2011 2.Dennis W. Prather, “Photonic Crystals: Theory, Applications, and Fabrication”, John Wiley & Sons, Hoboken, 2009 3.James R. Janesick, “Scientific Charge,Coupled Devices”, Published by SPIE , The International Society for Optical Engineering, Bellingham, Washington, 2001 4.David M. Pozar, “Microwave Engineering”, 3rd ed., John Wiley & Sons, 2005 5.Silver.F and Dillion.C, “Biocompatibility: Interactions of Biological and Implantable Materials”, VCH Publishers, New York, 1989 6.SeverialDumitriu, “Polymeric Biomaterials” Marcel Dekker Inc, CRC Press, Canada 2001 7.Cao.G, “Nanostructures and Nanomaterials: Synthesis, Properties and Applications”, Imperial College Press, 2004 8.Pradeep.T, “A Text Book of Nanoscience and Nanotechnology”, Tata McGraw Hill, New Delhi, 2012 9.Sam Zhang, “Materials Characterization Techniques”, CRC Press, 2008
Online Resources:

Course Name: BASIC AUTOMOBILE ENGINEERING					
Course Code: ME636OE3					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: Automotive engineering is a branch of mechanical engineering that concerns the design, development and manufacture of cars, trucks, motorcycles and other motor vehicles. It also deals with design and test of many subsystems or components that comprise a motorized vehicle
The objective of this course isto impact knowledge to students in various systems of Automobile Engineering and to learn the fundamental principles, construction and auxiliary systems of automotive engines

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Introduction: Classification of vehicles, options of prime movers, transmission and arrangements **Engine:** Engine classifications, number of strokes, cylinders, types of combustion chambers for petrol and diesel engines, valves, valve arrangements and operating mechanisms, piston, design basis, types, piston rings, firing order, fly wheel	9
Unit-2:	
Fuel Supply Systems: Petrol and diesel engines, fuel pumps, Mechanical and electrical diaphragm pumps, air and fuel filters **Carburetors and Injection System:** carburetors, fuel injection systems for diesel and petrol engines, electronic fuel injection, super chargers, mufflers	9
Unit-3:	
Cooling and Lubrication system for I.C. engines: Necessity, methods of cooling, air cooling, water cooling, components of water-cooling systems, Objective of lubrication, requirements of lubricant, types of lubricant, various systems of engine lubrication **Electrical System:** Ignition system, distributor, electronic ignition, magneto, dynamo, alternator, regulator, starting motor, introduction to various accessories, typical wiring diagram	9
Unit-4:	

Chassis: Introduction of chassis, classification, conventional construction, frameless construction, introduction to vehicle dimensions **Transmission System:** Introduction to single plate clutch, wet and dry type, clutch actuating mechanisms, study of clutch components, fluid fly wheel. Gear box , Theory, four speed and five speed sliding mesh, constant mesh and synchromesh type, selector mechanism, automatic transmission, overdrive, transfer box four wheel drive, torque converter, propeller shaft	9
Unit-5:	
Suspension System: Systems, springs, shock absorbers, axles, front and rear, different methods of floating rear axle, front axle and wheel alignment, types of rims and tyres **Steering System:** Steering mechanisms, types of brakes and brake actuation mechanisms	9
Self-study:	
Site/Industrial Visits:	

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

- describe chassis, body and engine components of automobile
- demonstrate knowledge of transmission, cooling and lubrication systems
- demonstrate knowledge of engine injection and ignition systems
- demonstrate knowledge of steering, brakes and suspension systems
- describe environmental impact of emissions from vehicles and methods for controlling it

Textbooks:

1. "Automobile Engineering", Vol.-1 & 2 by Kripal Singh, Standard publisher distributors
2. "Automotive Mechanics" by Joseph Heitner, East-West student edition

Reference Books:

1. "Automobile Mechanics" by Crouse. W.H. and Angling. D.L
2. "Automobile Electrical System" by Judge, A.W.
3. "Automobile engineering" by K.K.Ramalingam, scitech publications

Online Resources:

Course Name: PROJECT MANAGEMENT					
Course Code: ME636OE4					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: The purpose of this course is to lay the foundation for a solid understanding of project management concepts and principles and to familiarize students with the complexity and challenge of managing public or private projects with tight schedules and limited resources. Students will gain a sound understanding of project management concepts and principles by applying relevant tools and techniques and by making extensive use of case studies and simulation exercises to assimilate that knowledge

The course aims at the following learning targets

- To understand the concepts of project definition, life cycle, and systems approach;
- To develop competency in project scooping, work definition, and work breakdown structure (WBS)
- To handle the complex tasks of time estimation and project scheduling, including PERT and CPM
- To develop competencies in project costing, budgeting, and financial appraisal

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Introduction to Project: Definition of a Project, Sequence of Activities, Unique activities, Complex Activities, Connected Activities, One Goal, Specified Time, Within Budget, According to Specification. Defining a Program, Project parameters: Scope, Quality, Cost, Time, Resources; The scope triangle: Time, Cost, and Resource Availability, Project Classification **Project Management:** Principles of Project Management: Defining, Planning, Executing, Controlling, Closing; Project Management Life Cycle: Phases of Project Management, Levels of Project Management	9
Unit-2:	
Quality Management: Continuous Quality Management Model, Process Quality Management Model; Risk Management, Risk Analysis; Relationship between Project Management and other Methodologies **Project Activities:** Work Breakdown Structure, Uses of WBS, Generating the WBS: Top-Down/ Bottom-Up Approach, WBS for Small Projects, Intermediate WBS for large projects; Criteria to Test for Completeness in the WBS: Measurable Status, Bounded, Deliverable, Cost/Time Estimate, Acceptable Duration Limits, Activity Independence; Approaches to Building the WBS: various approaches, Representing WBS	9

Unit-3:	
Activity Duration, Resource Requirements, & Cost: Duration: Resource Loading versus Activity Duration, Variation in Activity Duration, Methods for Estimating Activity Duration, Estimation Precision; Resources; Estimating Cost, JPP Session to Estimate Activity Duration & Resource Requirements, Determining Resource Requirements **Fundamentals of Project Network Diagram:** Project Network Diagram, Benefits to Network- Based Scheduling, Building the Network Diagram Using the PDM, Analyzing the Initial Project Network Diagram.	9
Unit-4:	
Network Analysis – PERT: Introduction to Project Evaluation and Review Technique, Event, Activity, Dummy, Network rules, Graphical guidelines for network, Common partial situations in network, numbering the events, Cycles; Developing the Network, Planning for network construction, modes of network construction, steps in developing network, hierarchies; Time Estimates in PERT, Uncertainties and use of PERT, Time estimates, Frequency distribution, Mean, Variance & standard deviation, Probability distribution, Beta distribution, Expected time; Time Computations in PERT, Earliest expected time, Formulation for TE, Latest allowable occurrence time, Formulation for TL, Combined tabular computations for TE, TL; Slack, Critical Path, Probability of meeting schedule date. **Network Analysis- CPM:** Introduction to Critical Path Method, Procedure, Networks, Activity time estimate, Earliest event time, Latest allowable occurrence time, Combined tabular computations for TE and TL, Start & Finish times of activity, Float, Critical activities & Critical path. Crashing of project network, Resource leveling and Resource allocation	9
Unit-5:	
Schedules Based on Resource Availability: Resources, Leveling Resources, Acceptability Leveled Schedule, Resource Leveling Strategies, Work Packages: Purpose of a Work Package, Format of a Work Package **Joint Project Planning Session:** Planning the Sessions, Attendees, Facilities, Equipments, Complete Planning Agenda, Deliverables, Project Proposal	9
Self-study:	
Site/Industrial Visits:	

Course outcomes: By the end of the course, students should be able to the following tools and techniques of effective project management: • objective setting and project design • planning, scheduling, and budgeting • progress control and monitoring • risk assessment and management They will also develop a better appreciation for the critical role that human resources skills play in ensuring timely and successful project completion
Textbooks: 3. "Effective Project Management", Robert K. Wysocki, Robert Beck. Jr., and David B. Crane; - John Wiley & Sons 4. "Project Planning and Control with CPM and PERT" Dr. B.C. Punamia&K.K.Khandelwal; - Laxmi Publications, New Delhi
Reference Books: 6. "Project Management" S. Choudhury, - TMH Publishing Co. Ltd, New Delhi 7. "Total Project Management- The Indian Context" P. K. Joy, - Macmillan India Ltd., Delhi 8. "Project Management in Manufacturing and High Technology Operations" AdedejiBodundeBadiru, - John Wiley and Sons 9. "Course in PERT & CPM" R.C.Gupta, - DhanpatRai and Sons, New Delhi 10. "Fundamentals of PERT/ CPM and Project Management" S.K. Bhattacharjee; - Khanna Publishers, New Delhi
Online Resources:

<table>
<tr><td colspan="6">Course Name: BASIC AEROSPACE ENGINEERING</td></tr>
<tr><td colspan="6">Course Code : ME636OE5</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: This first part of the course “Basic Aeronautical Engineering” presents an overall picture of the aeronautics domain. This overview involves a number of different perspectives on the aerospace domain, and shows some basic principles of the most important concepts for flight. Then the basic aerodynamics are covered, followed by flight mechanics
• To familiarize with the basics of aerodynamics
• To familiarize with the basics of aircraft structures, systems & instruments
• To give exposure to the power plants cased in Aircraft</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">Aircraft Configurations: Brief History- airplanes and Helicopters – Components of an airplane and their functions. Different types of flightvehicles, classifications, Basic instruments for flying
Introduction to Principles of Flight: Physical properties and structure of the atmosphere, Temperature, pressure and altituderelationships, Evolution of lift, drag and moment, different types of drag</td><td>9</td></tr>
<tr><td colspan="6">Unit-2:</td></tr>
<tr><td colspan="5">Introduction to Aerodynamics: Aerodynamic forces on aircraft,Basic characteristics of aerofoils, NACA nomenclature, Classification of NACA aerofoils, propagation of sound, Mach number, subsonic, transonic, supersonic, hypersonic flows
Elements of Airplane Performance: Introduction, Equation of motion, Thrust required for level unaccelerated flight, Thrust available and maximum velocity, Power required for level unaccelerated flight, Power available and maximum velocity for reciprocating engine – propeller combination and jet engine, Altitude effect of power available and power required. Rate of climb, gliding flight, Absolute and Ceiling, Time of climb, Range & Endurance for propeller driven and jet air plane</td><td>9</td></tr>
<tr><td colspan="6">Unit-3:</td></tr>
<tr><td colspan="5">Aircraft Structures: General types of construction, Monocoque and Semi-monocoque - construction, Typical wing and fuselage Structures
Landing Gears: Introduction to Landing Gears, Types of Landing Gears</td><td>9</td></tr>
<tr><td colspan="6">Unit-4:</td></tr>
</table>

Aircraft Materials: Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials **Systems and Instruments:** Conventional control, Powered controls, Basic instruments for flying, typical systems for control actuation	9
Unit-5:	
Jet Propulsion: Basic ideas about piston, turboprop and jet engines – comparative merits, Propellers and Jet for thrust production **Rocket Propulsion:** Principle of operation of rocket, types of rocket and typical applications, Exploration into space, Use of multistage rockets	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: At the end of the course, the student will be able to • brief the history of flight • apply basic/constitutive principles of mechanics of fluids – e.g Bernoulli • apply control volume approaches • explain flow regimes (viscous/non-viscous; compressible/incompressible aerodynamics) and to estimate viscous and thermal effects • compute lift/drag of simple configurations • describe reference frames and derive general equations of motion for flight and orbital mechanics • apply equations of motion to determine aircraft performance in steady gliding, horizontal and climbing flight • derive aircraft performance diagram and flight envelope, in relation to aircraft morphology, lift-drag polar and engine performance	
Text Books: 1. Kermode,A.C., 'Flight without Formulae', McGraw Hill,1987 2. Shevell,R.S., Fundamentals of flights, Pearson education 2004	
Reference Books: 1. Anderson.J.D., Introduction to Flight, McGraw Hill,1995 2. McKinley.J.L. and R.D. Bent, Aircraft Power Plants, McGraw Hill1993 3. Pallet.E.H.J. Aircraft Instruments & Principles, Pitman & Co 1933	
Online Resources:	

<table>
<tr><td colspan="6">Course Name: COMPUTER APPLICATIONS IN DESIGN</td></tr>
<tr><td colspan="6">Course Code : ME636OE6</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: This paper gives a basic knowledge of the applications of computer in design as well as it covers some part of applications of computer in manufacturing.
To familiarize with
• The concept of the 2D drawing and its algorithms.
• The concept of 3D modelling and its algorithms.
• The functions behind the software packages used in the laboratories.
• The basic concepts of computer applications in design.
• The background programs behind the design and analysis softwares.
The basic idea of computer to computer communications.</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">Introduction To CAD/CAM/CAE Systems: Overview, Definitions of CAD.CAM and CAE, Integratingthe Design and Manufacturing Processes through a Common Database-A Scenario, Using CAD/ CAM/CAE Systems forProduct Development-A Practical Example.
Components of CAD/CAM/CAE Systems: Hardware Components, Vector-Refresh (Stroke- Refresh) Graphics Devices, Raster Graphics Devices, Hardware Configuration, Software Components, Windows-Based CAD Systems.</td><td>9</td></tr>
<tr><td colspan="6">Unit-2:</td></tr>
<tr><td colspan="5">Basic Concepts ofGraphics Programming: Graphics Libraries, Coordinate Systems, Window and Viewport, Output Primitives-Line, Polygon, Marker Text, Graphics Input, DisplayList, Transformation Matrix, Translation, Rotation, Mapping, Other Transformation Matrices, Hidden- Line and Hidden-Surface Removal, Back-Face Removal Algorithm, Depth-Sorting, or Painter.s, Algorithm, Hidden-Line Removal Algorithm, z-Buffer Method, Rendering, Shading, Ray Tracing, Graphical UserInterface, X Window System.</td><td>9</td></tr>
<tr><td colspan="6">Unit-3:</td></tr>
<tr><td colspan="5">Geometric Modeling Systems: Wireframe ModelingSystems, SurfaceModelingSystems, Solid Modeling Systems, Modeling Functions, DataStructure, EulerOperators, Boolean Operations, Calculation of Volumetric Properties, Non manifold Modeling Systems, Assembly Modeling Capabilities, Basic Functions of Assembly Modeling, Browsingan Assembly, Featuresof Concurrent Design, Use of Assembly models, Simplificationof Assemblies, Web-BasedModeling.</td><td>9</td></tr>
</table>

Unit-4:	
Representation and Manipulation of Curves:Types of Curve Equations, Conic Sections, Circle or Circular Arc, Ellipse or Elliptic Arc, Hyperbola, Parabola, Hermite Curves, Bezier Curve, Differentiation of a Bezier Curve Equation, Evaluation of a Bezier Curve,B-Spline Curve, Evaluation of a B-Spline Curve, Composition of B-Spline Curves, Differentiation of a B-Spline Curve,Nonuniform Rational B-Spline (NURBS) Curve, Evaluation of a NURBS Curve, Differentiation of a NURBS Curve, Interpolation Curves, Interpolation Usinga Hermite Curve, Interpolation Using a B-Spline Curve, Intersection of Curves. **Representation and Manipulation of Surfaces**: Types of Surface Equations, Bilinear Surface, Coon's Patch, Bicubic Patch, Bezier Surface, Evaluation of a Bezier Surface, Differentiation of a Bezier Surface, B-Spline Surface, Evaluation of a B-Spline Surface, Differentiation of a B-Spline Surface, NURBS Surface, Interpolation Surface, Intersection of Surfaces.	9
Unit-5:	
CAD and CAM Integration : Overview of the Discrete Part Production Cycle, Process Planning, Manual Approach, Variant Approach, Generative Approach, Computer-Aided Process Planning Systems, CAM-ICAPP, MIPLANand MultiCAPP, MetCAPP, ICEM-PART, Group Technology, Classification and Coding, Existing Coding Systems, Product Data Management (PDM)Systems. **Standards for Communicating Between Systems**: Exchange Methods of ProductDefinition Data, Initial Graphics Exchange Specification, Drawing Interchange Format, Standard forthe Exchangeof Product Data. **Tutorials:** Computational exercisesinvolving Geometric Modeling of components and their assemblies.	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: • To understand geometric transformation techniques in CAD. • To describe the hidden concepts ofthe 3d modeling software. • To describe the various graphical concepts, used to store thepicture. • To Model engineering components using solid modeling techniques.	
Text Books:	
Reference Books:	
Online Resources:	

<table>
<tr><td colspan="6">Course Name: CAD/CAM</td></tr>
<tr><td colspan="6">Course Code : ME636OE7</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: The course presents the elements of solid modeling, creation of parts of increasing complexity and the assembly of parts to form a final design, along with mechanism simulation
The objectives of the course is to explain
• concepts of modeling in 2D and 3D
• concepts of computer graphics in 2D
• CAD Packages and its features
• theory of analysis</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">Introduction to Design process: CAD, Geometric Modeling, Types, Wireframe, surface and solid modeling. Solid modeling techniques -CSG and B-rep
Operations: Boolean, Extrude, Sweep, Revolve. Mathematical Representation, Line, Circle, Ellipse, Parabola, Cubic Spline, Bezier and B-spline (Basic treatment only)</td><td>9</td></tr>
<tr><td colspan="6">Unit-2:</td></tr>
<tr><td colspan="5">Graphics Concepts (2D and 3D): Coordinate systems, Transformations: translation, scaling, reflection, rotation, Concatenated transformation, Inverse transformation, Clipping, Hidden line removal, Visibility Techniques, Algorithm, Shading , constant, Phong, Gourand& Enhancement, Colouring, color models, Rendering</td><td>9</td></tr>
<tr><td colspan="6">Unit-3:</td></tr>
<tr><td colspan="5">Commercial Solid Modeling Packages: Salient features, Technical comparison, Modules and tools, Brief outline of data exchange standards
Brief Outline of Feature Technology: Classification of features, Design by features, Applications of features, Advantages and limitations</td><td>9</td></tr>
<tr><td colspan="6">Unit-4:</td></tr>
</table>

Steps Involved in FEA: Nodes, Elements and their types, shape function, 2-noded, 3-noded, constraints, forces and nodal displacements, Stiffness matrix, Solution techniques. Simple problems involving stepped bar subject to axial loading and simple structural members with triangular element **FEA in CAD Environment:** Stages of FEA in CAD environment, Preprocessor, Solver and postprocessor	9
Unit-5:	
Implementation of CAD: CAM, CIM, RPT, kinematic analysis, Manufacturability analysis **Simulation and Animation**: Types, Techniques	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: At the end of course, the student will be able to • model the 3–D geometric information of machine components including assemblies, and automatically generate 2–D production drawings • Model complex shapes including freeform curves and surfaces • Create a CAM model and generate the machine codes automatically using the CAM system • integrate the CAD system and CAM system • demonstrate skills to use latest CAD/CAM/CAE software and sophisticated equipment's for analyzing and solving mechanical engineering problems	
Text Books: 1. Ibrahim Zeid, "CAD / CAM, Theory and Practice 2E", Tata Mcgraw, Hill, New Delhi, 2010. 2. Radhakrishnan.P, "CAD / CAM / CIM", New age international, 2008. 3. ChrissMcmahon and Jimmie Browne, "CAD/CAM", AddisionWesly, New York, 2000.	
Reference Books: 1. Chandupatla and Belagundu, "Introduction to Finite Element Methods in Engineering", Prentice Hall of India Private Limited, New Delhi, 2011 2. Newman and Sproull R.F, "Principles of interactive computer graphics", Tata Mcgraw,Hill, New Delhi, 2004. 3. Mikell P. Groover, "CAD/CAM", Prentice Hall of India Private Limited, New Delhi, 2008	
Online Resources:	

<table>
<tr><td colspan="6">Course Name: NON-CONVENTIONAL ENERGY</td></tr>
<tr><td colspan="6">Course Code: ME636OE8</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: The course discusses the use of solar (thermal and photovoltaic), hydro-electric, wind, geothermal, ocean thermal, wave, tidal and geothermal energy, as well as energy from biomass. The use of fuel-cell systems is dealt with. Issues relevant to energy efficiency and energy storage are discussed. The potential of using non-conventional energy technologies as a replacement for conventional technologies are discussed. Strategies for enhancing the future use of non-conventional energy are presented
The purpose of this course is to impart the importance of the most important non-conventional resources, and the technologies for harnessing these energies</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">Introduction: Role and potential of new and renewable sources
Solar Energy: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Solar Energy Storage: Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications, solar heating/ cooling techniques, solar distillation and drying, photovoltaic energy conversion</td><td>9</td></tr>
<tr><td colspan="6">Unit-2:</td></tr>
<tr><td colspan="5">Wind Energy: Sources and potentials, Classification of wind mills, horizontal and vertical axis wind mills, various designs of rotors, site evaluation, wind turbine subsystems, rotors, drive trains, yaw control systems, electrical systems
Biogas: Properties, principles of production, classification, fixed dome, floating type, comparison, site selection, water removing device, environmental effect.</td><td>9</td></tr>
<tr><td colspan="6">Unit-3:</td></tr>
<tr><td colspan="5">Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India
OTEC: Principles, utilization, setting of OTEC plants, thermodynamic cycles</td><td>9</td></tr>
<tr><td colspan="6">Unit-4:</td></tr>
</table>

Tidal and Wave Energy: Potential and conversion techniques, Tidal barrage, modes of operation, generation, flood generation, two way generations **Fuel Cells:** Principle of fuel cells, Faraday's laws, thermodynamic aspects. Performance limiting factors of fuel cells, reactivity, invariance, electrode losses, chemical polarization, concentration polarization, resistance polarization, types of fuel cells, hydrogen, oxygen fuel cells, biochemical cells, regenerative cells	9
Unit-5:	
Direct Energy Conversion: Need for DEC, Carnot cycle, limitations. Principles of DEC. Thermoelectric generators, Seebeck, Peltier and Joule Thompson effects, figure of merit, materials, applications, **MHD Generators:** principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: On learning this course the students will learn about • the various non-conventional energy resources; the use solar energy to produce electricity; ways to utilize wind energy for human usage • the issue of fuel availability and analyse the supply and demand of fuel in the world • the pros and cons of conventional energy sources • identify the different sources of non-conventional and innovative technologies in harnessing energy from these non-conventional sources • scrutinize the advantages and shortcomings of using hydrogen as an energy carrier with application in internal combustion engine and fuel cells	
Text Books: 1. Rai.G.D, "Non,Conventional Energy Sources", Khanna Publishers, 4th edition, New Delhi, 2009 2. Domkundwar.V.M, Domkundwar.A.V, "Solar energy and Non,conventional sources of energy", Dhanpatrai& Co. (P) Ltd, 1st edition, New Delhi, 2010	
Reference Books: 1. Godfrey Boyle, "Renewable energy", 2nd ed, Oxford University Press, 2010 2. Khan.B, "Non,conventional Sources of energy", 2nd edition, New Delhi, Tata McGraw Hill, 2009 3. Tiwari.G.N, Ghosal.M.K, "Fundamentals of renewable energy sources",1st edition, UK, Alpha Science International Ltd, 2007 4. Twidell.J.W and Weir.A.D, "Renewable Energy Resources",1st edition, UK, E.&F.N. Spon Ltd, 2006	
Online Resources:	

<table>
<tr><td colspan="6">Course Name: INTERNAL COMBUSTION ENGINES</td></tr>
<tr><td colspan="6">Course Code : ME636OE9</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: This course is designed to provide detailed information on working and associated topics on internal combustion engines, an important type of heat engine. Combustion chemistry, fuels, combustion and ignition, combustion chamber design, pollution and few modern engine developments are main contents
• To make students familiar with the design and operating characteristics of modern internal combustion engines
• To apply analytical techniques to the engineering problems and performance analysis of internal combustion engines
• To study the thermodynamics, combustion, heat transfer, friction and other factors affecting engine power, efficiency and emissions
• To introduce students to the environmental and fuel economy challenges facing the internal combustion engine
• To introduce students to future internal combustion engine technology and market trends</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">Components of IC Engines: Classification of Internal combustion Engine, Function and operation of Two stroke and Four stroke engines, Comparison of SI and CI and two stroke and four stroke engines, Effects of supercharging and supercharging Types , centrifugal, roots, vane, Types of scavenging process
Performance of IC Engines: Design and Performance data, Efficiency, Specific fuel consumption, IMEP determination, Simple calculations, Performance characteristics, Heat balance calculations, Fuel air cycles and their significance, Comparison of air, standard and fuel air cycles</td><td>9</td></tr>
<tr><td colspan="6">Unit-2:</td></tr>
<tr><td colspan="5">Carburetor, Injection and Ignition systems: Desirable air, fuel ratios for starting, warm up, acceleration, idling and normal operation, Necessity of Carburetors and their function and types, Function and classification of injection systems, Injection pump, governor and nozzle types, Description of construction and function of Electronic injection system and MPFI systems, Energy requirement of ignition system, need, Types, Battery and Magneto ignition types, Ignition timing and engine parameters
Lubrication and Cooling systems: Engine oil properties, lubrication system types, mist, wet sump and dry sump lubrication systems, Types of cooling systems, Direct and Indirect, Coolant and antifreeze solutions</td><td>9</td></tr>
</table>

Unit-3:	
Combustion in SI Engines: Homogeneous and heterogeneous mixture, Combustion in spark ignition engines, Stages of combustion in spark ignition engines, Flame front propagation, Factors influencing flame speed, Rate of pressure rise **Knocking in SI Engines:** Phenomenon of knock in SI engines, Effect of engine variables on knock, Combustion chambers for SI engines, Smooth engine operation, High power output and thermal efficiency, Stratified charge engine	9
Unit-4:	
Combustion in CI engine: Stages of combustion in CI engines, Factors affecting the delay period, compression ratio, engine speed, output, atomization and duration of injection, quality of fuel, intake temperature, intake pressure **Knocking in CI Engines:** Phenomenon of knock in CI engines, Comparison of knock in SI and CI engines, Air motion, Swirl, Squish	9
Unit-5:	
Alternate Fuels: Alcohol, Methanol, Ethanol, Gaseous fuel, Hydrogen, CNG, LPG, Biodiesel, production, advantages & disadvantages **Emission:** Air pollution due to IC engines, Hydrocarbon emission and their reasons, Formation of oxides of nitrogen, CO, Particulates, aldehydes, sulphur, lead and phosphorus emissions, catalytic converter, exhaust gas recirculation, Flame ionization detector, NDIR, smoke types , measuring device, Emission standards	9
Self-study :	
Site/Industrial Visits :	

Course outcomes:

- Differentiate among different internal combustion engine designs
- Recognize and understand reasons for differences among operating characteristics of different engine types and designs
- Given an engine design specification, predict performance and fuel economy trends with good accuracy
- Based on an in-depth analysis of the combustion process, predict concentrations of primary exhaust pollutants
- Exposure to the engineering systems needed to set-up and run engines in controlled laboratory environments
- Develop skills to run engine dynamometer experiments
- Learn to compare and contrast experimental results with theoretical trends, and to attribute observed discrepancies to either measurement error or modeling limitations
- Develop an understanding of real world engine design issues
- Develop an ability to optimize future engine designs for specific sets of constraints (fuel economy, performance, emissions)
- Through the use of both theoretical techniques and experimentation, develop an appreciation for theoretical and practical limits to engine performance and fuel economy

Text Books: 1. Ganesan.V, "Internal Combustion Engines", Tata McGraw,Hill, New Delhi, 2009. 2. Ramalingam.K.K, "Internal Combustion Engines, Theory and practice", SciTech publications India Pvt. Ltd., Chennai, 2010
Reference Books: 1. Thipse.S.S, "Internal Combustion Engines", Jaico Publication House., 2010. 2. Thipse.S.S, "Alternate Fuels", Jaico Publication House., 2010. 3. Mathur.M.L and Sharma.R.P, "A course in Internal Combustion Engines", DhanpatRai& Sons, New Delhi, 2010. 4. Heywood.J.B, "Internal Combustion Engine Fundamentals", McGraw Hill International, New York, 2008. 5. Domkundwar.V.M, "A course inInternal Combustion Engines", DhanpatRai& Sons, 2010.
Online Resources:

Course Name: FINITE ELEMENT ANALYSIS					
Course Code : ME636OE10					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: The course introduces you to theoretical basics and practical application of the finite element method as well as to related numerical modeling techniques. It is designed to enable you to solve practical problems related to solid mechanics, machines and structures

The objectives of the course it to

- understand the basics of Finite Element analysis
- know the application of FEA to static analysis
- understand the application of FEA for Standard truss, beam, plane triangular and quadrilateral elements

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Fundamental Concepts: Introduction, Historical background, Outline of presentation, Stresses and Equilibrium, Boundary conditions, Strain-Displacement relations, Stress-Strain relations, Plane stress, Plane strain problems, Temperature effects, Potential energy and Equilibrium, The Raleigh-Ritz method, Hamilton's principle. Galerkin's method, Saint Venant's principle	9
Unit-2:	
One-dimensional Problems: Introduction, Finite element modeling, coordinates and Shape functions. The potential energy approach, The Galerkin approach, Assembly of the global stiffness matrix, mass matrix and load vector, Treatment of boundary conditions, Quadratic shape functions, Temperature effects **Trusses:** Introduction, Plane trusses, Three-dimensional trusses, Assembly of global stiffness matrix for the Banded and Skyline solutions.	9
Unit-3:	
Two-dimensional Problems Using Constant Strain Triangles: Introduction, Finite element modeling, Constant strain triangle, in plane and Bending, problem modeling and boundary conditions **Axisymmetric Formulation:** Introduction, Axisymmetric formulation, Finite element modeling, Triangular element, Problem modeling and boundary conditions	9
Unit-4:	

Two-dimensional Isoparametric Elements and Numerical Integration: Introduction, The four-node quadrilateral, Numerical integration, Higher order elements **Beams and Frames:** Introduction, Finite element formulation, Load vector, Boundary considerations, Shear force and bending moment, Beams on elastic supports, Plane frame	9
Unit-5:	
Dynamic Considerations: Introduction, formulation, element mass matrices, evaluation of Eigen values and Eigen vectors **Introduction to FEA Packages:** ANSYS, NASTRAN	9
Self-study :	
Site/Industrial Visits :	

Course outcomes: At the end of the course the student will be able to

- describe the Finite Element Analysis (FEA) procedure.
- identify the application and characteristics of FEA elements such as bars, beams, planar elements
- develop the stiffness equation for common FEA elements, and assemble element stiffness equations in to a global equation
- identify and apply suitable boundary conditions to a global structural equation, and reduce it to a solvable form.
- apply existing 3-D computer-aided design (CAD) skills to prepare models for finite element analysis.
- set up and solve 1-D, 2-D, and 3-D structural problems using contemporary finite element software

Textbooks:

1. Hutton.D.V, "Fundamentals of Finite Element Analysis", McGraw Hill, International Edition, 2004
2. Chandrupatla.T.R, Belegundu.A.D, "Introduction to Finite Elements in Engineering", Prentice Hall of India, 2011

Reference Books:

1. Segerlind. L.J, "Applied Finite Element Analysis", John Wiley & Sons, 1984
2. Zienkiewicz. O.C, "Finite Elements and Approximation", Dover International, 2006
3. Cook .R.D, Malkus.D.S, Plesha, M.E., Witt, R.J., "Concepts and Applications of Finite Element Analysis", 4th Ed., John Wiley & Sons, 2001
4. Reddy.J.N, "An Introduction to Finite Element Method", McGraw Hill International Edition, 2006.

OPEN ELECTIVE

DEPARTMENT OF SCIENCES & HUMANITIES

Offered by Department of Science and Humanities

Sl. No.	Course Code	Course Name
1	MA 636OE1	Fundamentals of Boundary Layer Theory
2	MA 636OE2	Non – Linear Programming Problems
3	MA 636OE3	Numerical Solution of Differential Equations
4	MA 636OE4	Mathematical Statistics
5	CH636OE1	Electronic Materials
6	CH636OE2	Catalyst Technology
7	CH636OE3	Environmental Chemistry
8	PH636OE1	Technical ceramics
9	PH636OE2	Advances in materials science and engineering
10	PH636OE3	Nuclear physics

<table>
<tr><td colspan="6" align="center">Course Name: FUNDAMENTALS OF BOUNDARY LAYER THEORY</td></tr>
<tr><td colspan="6" align="center">Course Code : MA636OE1</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td align="right">Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td align="right">CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td align="right">ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td align="right">Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: It provides basic idea of boundary layer theory and mathematical models for laminar flows and turbulent flows based on continuity, momentum and energy equations. Also, it facilitates solution to models with numerical approach.
To develop the skill in research and address to present day problems in fluid mechanics.</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 Viscous Flows , Integral Equations And Solutions For Laminar Flow</td></tr>
<tr><td colspan="5">The importance of viscous phenomena-conditions at a fluid/solid Boundary-Laminar Transport processes- The Boundary layer Concept-Separation and the Kutta Condition-Basic Notions of Turbulent flow-The integral Momentum equation-solution of the Integral Momentum equation (The Pohlhausen Method, The Thwaites-Walz method and Flows with suction or Injection) The Integral energy equation and its solution-The integral species equation and its solution-Relationship of wall friction, Heat transfer, and mass transfer.</td><td>9</td></tr>
<tr><td colspan="6">Unit-2: Differential equations of motion for Laminar flow and Exact and Numerical Solutions for Laminar incompressible flows</td></tr>
<tr><td colspan="5">The continuity equation-The momentum equation (Modeling of the Laminar shear stress, forms of the Momentum equation for Laminar flow) -The energy equation (Modeling of the Laminar heat flux)-The species Continuity equation-Exact solutions for flow over a Flat plate-similar Solutions with pressure Gradient-Numerically Exact solutions (Numerical analysis of the linear, modal equations, An explicit method for the Boundary layer equations, An implicit method for the Boundary layer equations, Transformations and other matters)</td><td>9</td></tr>
<tr><td colspan="6">Unit-3: Compressible Laminar Boundary Layers</td></tr>
<tr><td colspan="5">Introduction-The adiabatic wall temperature-The reference temperature method-The special case of Prandtl number unity-The recovery factor for NonunityPrandtl number-Compressibility Transformations-Exact solutions for Compressible flow over a Flat plate-Numerical solutions of compressible, Laminar Boundary layer Flows</td><td>9</td></tr>
<tr><td colspan="6">Unit-4: Transition To Turbulent Flow</td></tr>
</table>

Introduction- Hydrodynamic stability Theory - The e^{10} method-A method based on Re_θ -The nature of Transition - Free stream Turbulence – Roughness - Bluff bodies at Low speeds - Density Stratified Flows - Supersonic flows	9
Unit-5: Wall bounded, Incompressible Turbulent flows	
Empirical Information on the mean flow as a basis for analysis-Selected empirical turbulence information - The central problem of the analysis of Turbulent flows - Mean flow turbulent transport formulations - Mean flow integral methods - Mean flow models for the eddy viscosity and the mixing length - Numerical Solution methods for mean flow formulations-Formulations based on turbulent kinetic energy - Formulations based on turbulent kinetic energy and a length scale - Formulations based directly on the Reynolds stress - Direct Turbulence formulations - Boundary and Initial conditions for Higher - order models	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: At the end of the course the students would be capable of writting different boundary conditions of viscous flows, laminar flows and also solving theirs governing equations.	
Text Books: 1. Joseph A. Schetz, "Foundations of Boundary Layer theory for Momentum, Heat, and Mass Transfer", Prentice-Hall, Inc.	
Reference Books: 1. Abramovich G. N., "The theory of Turbulent Jets", MIT Press, Cambridge, Mass 1960 (English edition). 2. Acharya M., "Effects of compressibility on Boundary - Layer Turbulence", AIAA paper 76 - 334 (1976). 3. Anderson E.C. and Lewis C.H., "Laminar or Turbulent Boundary - Layer Flows of perfect Gases or Reacting Gas Mixtures in chemical Equilibrium" NASA CR-1893 (1971).	
Online Resources:	

Course Name: NON LINEAR PROGRAMMING					
Course Code : MA636OE2					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: It provides the platform for extending linear programming skills into nonlinear programming by learning various optimization techniques To develop and apply various optimization techniques to non-linear with emphasis on present day engineering applications.	
Prerequisites:	
Units	**Teaching Hours**
Unit-1 Linear Programming	
Statement and classification of optimization problems overview of optimization techniques standard form of linear programming problems-Definitions and theorems-Simplex method- Big M method – Two -phase -Duality and Dual simplex method.	9
Unit-2: Non – Linear Programming Methods	
The General Non - linear programming problem - Graphical solution method - Quadratic programming - Necessary and sufficient conditions - Equality and inequality constraints – Kuhn - Tucker conditions - Wolfe's Modified Simplex method - Beals method-Separable programming – Piece - Wise Linear approximation of Non - linear functions.	9
Unit-3: Unconstrained optimization techniques	
Interpolation methods - Direct search methods - Indirect methods - Descent methods-Steepest descent, conjugate gradient, Quasi Newton and DFP method.	9
Unit-4: Constrained optimization techniques	
Basic approach in the method of feasible Directions - Zoutendijk's Method of feasible directions - Rosen's Gradient projection method-Generalized Reduced Gradient method- Penalty function method(Interior and Exterior)	9
Unit-5: Dynamic programming	
Introduction –Multistage decision process-Principle of optimality-recurrence relation-Computational procedure-linear programming as a case of Dynamic programming-Continuous programming.	9
Self-study :	

Site/Industrial Visits :
Course outcomes: At the end of this course, the students will be able to: • understand the concept of nonlinear programming with the help of kuhn-tucker conditions. • formulate and solve the problems in different methods. • Also, they are able to analyze the convergence of solution of the given problem.
Textbooks: 1. S. S. Rao, "Optimization Techniques", Wiely Eastern Ltd, New Delhi. 2. Pierre, D.A. "Optimization Theory with Applications", John Wiley & sons, 1969. 3. Fox, R.L., "Optimization method for Engineering Design", Addition Welsey, 1971. 4. Hadely, G., "Linear programming", Addition Welsey, 1962.
Reference Books:
Online Resources:

Course Name: NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS					
Course Code : MA636OE3					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: In this course, the students will be introduced to solve nonlinear differential equations by numerical methods, determine the convergence region and to solve elliptic, parabolic and hyperbolic PDE by finite difference method

Since many physical laws are couched in terms of rate of change of one/two or more independent variables, most of the engineering problems are characterized in the form of either nonlinear ordinary differential equations or partial differential equations. The methods introduced in the solution of ordinary differential equations and partial differential equations will be useful in attempting any engineering problem.

Prerequisites:

Units	**Teaching Hours**
Unit-1 ORDINARY DIFFERENTIAL EQUATIONS	
Multistep (explicit and implicit) methods for initial value problems, Stability and Convergence analysis, Linear and nonlinear boundary value problems, Quasi-linearization, Shooting methods	9
Unit-2: FINITE DIFFERENCE METHODS	
Finite difference approximations for derivatives, boundary value problems with explicit boundary conditions, implicit boundary conditions, error analysis, stability analysis, convergence analysis.	9
Unit-3: PARTIAL DIFFERENTIAL EQUATIONS	
Classification of partial differential equations, finite difference approximations for partial derivatives and finite difference schemes for Parabolic equations, Schmidt's two level, multilevel explicit methods, Crank-Nicolson's two level, multilevel implicit methods.	9
Unit-4: HYPERBOLIC EQUATIONS	
Explicit methods, implicit methods, one space dimension, two space dimensions, ADI methods.	9
Unit-5: ELLIPTIC EQUATIONS	
Laplace equation, Poisson equation, iterative schemes, Dirichlet's problem, Neumann problem, mixed boundary value problem, stability analysis.	9
Self-study :	

Site/Industrial Visits :
Course outcomes: At the end of the course, the student will be able to solve nonlinear differential equations by numerical methods, determine the convergence region for a finite difference method. Also they will be learning to solve elliptic, parabolic and hyperbolic PDE by finite difference method.
Text Books: 1. M.K. Jain, "Numerical Solution of Differential Equations", Wiley Eastern, 1984. 2. G.D. Smith, "Numerical Solution of Partial Differential Equations", Oxford Univ. Press, 2004. 3. M.K.Jain, S.R.K. Iyengar and R.K. Jain, "Computational Methods for Partial Differential Equations", Wiley Eastern, 2005.
Reference Books:
Online Resources:

<table>
<tr><td colspan="6" align="center">Course Name: MATHEMATICAL STATISTICS</td></tr>
<tr><td colspan="6" align="center">Course Code : MA636OE4</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: This paper contains five units which are Review of Probability, Sampling Distributions of Statistics, Basic Concepts of Inferences for Two Samples, Simple and Multiple linear regression and correlation. This paper aims at enabling the students to know various concepts and principles of Probability theory and Statistics. This paper also provides theoretical background for many of the topics in Statistics.
Goals for this course include developing critical thinking skills and the abilities to apply techniques of calculus (i.e. derivatives, integration, infinite series) to assess the probability of an event to interpret the result of a statistical study and to solve mathematical problems with the use of technology. At the end of the course, students should be familiar with the main results of statistical distribution theory and to be able to apply this knowledge to suitable problems in statistics.</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1 Review of Probability</td></tr>
<tr><td colspan="5">The basic goal of statistics, review the theory of probability.
Sample spaces and events, Kolmogorov's axioms, principles of combinatorics including permutations and combinations, conditional probability and independence, Bayes' theorem, random variables, probability mass functions for discrete random variables, probability density functions for continuous random variables, cumulative distribution functions, expected value, mean and variance of a distribution, selected discrete and continuous distributions.</td><td>9</td></tr>
<tr><td colspan="6">Unit-2: Sampling Distributions of Statistics</td></tr>
<tr><td colspan="5">Collecting Data: Types of statistical studies, observational studies, basic sampling designs, Summarizing and Exploring Data.
Sampling Distribution of the Sample Mean, Sampling Distribution of the Sample Variance, Student's t-distribution, Snedecor-Fisher's F-distribution</td><td>9</td></tr>
<tr><td colspan="6">Unit-3: Basic Concepts of Inference</td></tr>
<tr><td colspan="5">Point Estimation, Maximum Likelihood Estimation, Confidence Interval Estimation, Hypothesis Testing, Likelihood Ratio Tests, Inferences on Mean (Large Samples), Inferences on Mean (Small Samples), Inferences on Variance</td><td>9</td></tr>
<tr><td colspan="6">Unit-4: Inferences for Two Samples</td></tr>
</table>

Independent Samples and Matched Pairs Designs, Graphical methods for comparing two samples, Comparing Means of Two Populations, independent samples and matched pairs. Inferences for Proportions and Count Data Inferences on Proportion , Inferences on Comparing Two Proportions	9
Unit-5: Simple and Multiple linear regression and correlation	
The least squares method, The model for simple linear regression, Fitting a line, goodness of fit, Statistical inference with the simple linear regression model, prediction and confidence intervals, Regression diagnostics . Multiple linear regression: The model for multiple linear regression, Goodness of fit, multiple correlation coefficient, Arrays, matrices, and linear algebra for multiple linear regression, Statistical inference for multiple regression, ANOVA tables.	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: At the end of this course, the students will be able to: • understand the inference of the statistical data with the help of available statistics tools and probability concepts. • use different test to analyze samples.	
Text Books: 1. Hogg and Tanis , “Probability and Statistical Inference”, 8th edition, (Prentice Hall, ISBN 0-321-58475-5) 2. George G. Roussas, “A Course in Mathematical Statistics”, Third Edition.	
Reference Books:	
Online Resources:	

Course Name: ELECTRONIC MATERIALS					
Course Code : CH636OE1					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives:

1. Discuss the students to advanced concepts of Electrical Conduction, Modern Theory of Solids and fundamental properties of Semiconductors. Students will learn (1) the principle and operation of basic Semiconductor Devices such as Thermoelectrics, Piezoelectrics, Light Emitting Diodes (LEDs), Solar Cells, and (2) basic Integrated circuit Fabrication processes.
2. It describes student opportunities to learn (1) advanced concepts governing electronic materials properties of inorganic conductors, semiconductors and insulators and (2) how these electronic materials can be combined in wide range of device applications from transistors to energy conversion.
3. To illustrate the current state-of-the-art by reference to journal articles and to examples of actual devices and production processes in use today.

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Elementary Concepts and Electrical Conduction	9
Unit-2: Modern Theory of Solids	
Band theory of solids, Density of states, Boltzmann and Fermi-Dirac statistics, Electron effective mass and Fermi Energy,	9
Unit-3: Semiconductors	
Intrinsic and Extrinsic semiconductors, Degenerate semiconductors, Recombination and minority carrier injection, Schottky Junctions and Ohmic Contacts.	9
Unit-4: Semiconductor Devices	
Basics of a pn junction, Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET), Thermoelectric, Piezoelectric, Light Emitting Diodes (LEDs) and Solar Cells.	9
Unit-5: IC fabrication: brief overview	
Integrated-circuit types, Overview of semiconductor manufacturing and silicon wafer production, Thin films depositions, Diffusion and ion implantation, Oxidation, Plasma processing, Lithography	9
Self-study :	

Site/Industrial Visits :
Course outcomes: • Understanding of conductors and semiconductors and its application • Fabrication of an IC
Text Books: 1. Principles of Electronic Materials and Devices, Third Edition by S.O. Kasap, ISBN: 0-07-295791-3
Reference Books: 1. Electronic Properties of Materials, by Rolf E. Hummel (3^{rd}Edition, Springer, New York, 2000) 2. Microchip Manufacturing, by S.Wolf, ISBN: 0-9616721-8-8 3. Electronic Materials and Devices, David K. Ferry and Jonathan Bird, Academic Press, San Diego, 2001. 4. Advanced Semiconductor Fundamentals (2^{nd} Edition), Robert F. Pierret, Prentice Hall, 2003.
Online Resources:

Course Name: CATALYST TECHNOLOGY					
Course Code : CH636OE2					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**
Course objectives: To discuss the fundamentals of preparation, characterization and application in homogeneous catalysis, heterogeneous catalysis and photocatalysis					
Prerequisites:					

Units	**Teaching Hours**
Unit-1 Fundamentals	
Catalyst - activation energy concept - types of catalysis - comparison of homogeneous & heterogeneous catalysis - enzyme catalysis - green catalysis - nano catalysis - autocatalysis - phase transfer catalysis - promoters - poisons - examples	9
Unit-2: Homogeneous catalysis:	
Noyori asymmetric hydrogenation - metal mediated C-C and C-X coupling reactions - Heck, Stille, Suzuki, Negishi and Sonogashira, Nozaki-Hiyama,Buchwald-Hartwig, Ullmann coupling reactions - directed orthometalation - metal (Rh, Ir) catalyzed C-H activation reactions and their synthetic utility - copper and rhodium based carbene and nitrene complexes - cyclopropanation - Rh catalyzed C-H insertion and aziridination reactions including asymmetric version - introduction to N-heterocyclic carbene metal complexes.	9
Unit-3: Characterization of solid catalysts	
Surface area - structure - surface morphology - porosity - pore volume - diameter - particle size - X-ray diffraction - SEM, TEM, X-ray absorption spectroscopy, XPS and Auger spectroscopy to surface studies - TPD, TPR for acidity and basicity of the catalysts - theories - boundary layer theory - Wolkenstein theory - Balanding's approach.	9
Unit-4: Heterogeneous catalysis	
Adsorption isotherms - surface area - pore size and acid strength measurements - porous solids - catalysis by metals - semiconductors and solid acids - supported metal catalysts - catalyst preparation - deactivation and regeneration - model catalysts - ammonia synthesis - hydrogenation of carbon monoxide - hydrocarbon conversion - selective catalytic reduction - polymerization.	9
Unit-5: Photocatalysis	

Porphyrins - phthalocyanines and semiconductor as photo catalysts in photolysis reactions - generation of hydrogen by photo catalysts - photo catalytic break down of water and harnessing solar energy - photocatalytic degradation of dyes - environmental applications.	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: • Understanding of catalysis and its application and its relation to other disciplines • Design a catalyst in homogeneous, heterogeneous and photocatalysis • Interpretation of characterization required for the structural and textural determination of materials	
Text Books:	
Reference Books: 1. P.H. Emmet, Catalysis (Vol I and II), Reinhold, New York, 1954. 2. M. Schlosser, Organometallics in Synthesis, A manual, John Wiley, New York, 1996. 3. L.S. Hegedus, Transition Metals in the Synthesis of Complex Organic Molecules, University Science, Book, CA, 1999. 4. D.K. Chakrabarty and B. Viswanathan, Heterogeneous Catalysis, New Age, 2008. 5. B. Viswanathan, S. Kannan, R.C. Deka, Catalysts and Surfaces: Characterization Techniques, Narosa, New Delhi, 2010. 6. M. Kaneko, I. Okura, Photocatalysis: Science and Technology, Springer, 2003.	
Online Resources:	

<table>
<tr><td colspan="6">Course Name: ENVIRONMENTAL CHEMISTRY</td></tr>
<tr><td colspan="6">Course Code : CH636OE3</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>45</td><td>0</td><td>0</td><td>ESE Marks</td><td>50</td></tr>
<tr><td>Credits.</td><td>3</td><td>0</td><td>0</td><td>Exam Hours</td><td>3</td></tr>
<tr><td colspan="6">Course objectives: The course mainly describes the fundamentals of environmental pollution, water pollution, classification of industrial waste, water analysis, soil pollution.</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">Introduction: Environmental pollution - structure of atmosphere - biogeological cycles - oxygen nitrogen – carbon – phosphorous – sulphur - biodistribution of elements - air pollutions - reactions in atmosphere - primary pollutants - air quality standards - analysis of CO, nitrogen oxides, sulphur oxides, hydrocarbons and particulate matter - particulate pollution - control methods - vechicular pollution – greenhouse effect and global warming - climatic changes – ozone - photochemical smog - acid rain - sampling - monitoring – control.</td><td>9</td></tr>
<tr><td colspan="6">Unit-2:</td></tr>
<tr><td colspan="5">Hydrosphere: Water pollution - hyrological cycle - chemical composition – sea water composition - water quality criteria for domestic and industrial uses - BIS and WHO standards - ground water pollution - surface water pollution - lake and river water - eutrophication - marine pollution - water pollutants - biodgradeability of detergents – pestisides - endosulfan and related case studies.</td><td>9</td></tr>
<tr><td colspan="6">Unit-3:</td></tr>
<tr><td colspan="5">Classification of industrial waste waters:Principles of water and waste water treatment - aerobic and anaerobic treatment - industrial waste water treatment - heavy metal pollution - hard water - softening - purification of water for drinking purposes - water treatment for industrial use - electrodialysis - reverse osmosis - other purification methods - chemical speciation of elements.</td><td>9</td></tr>
<tr><td colspan="6">Unit-4:</td></tr>
<tr><td colspan="5">Water analysis: Color – odor - conductivity - TDS - pH - acidity - alkalinity - chloride - residual chlorine - hardness - trace metal analysis - elemental analysis - ammonia - nitrite - nitrate - fluoride - sulphide - phosphate - phenols - surfactants - BOD - COD - DO - TOC - nondispersive IR spectroscopy - anode stripping - ICP - AES - Chromatography - ion selective electrodes - neutron activation analysis.</td><td>9</td></tr>
</table>

Unit-5:	
Soil pollution: Soil humus - soil fertility - inorganic and organic components in soil - acid - base and ion exchange reactions in soils - micro and macro nutrients - wastes and pollutants in soil - introduction to geochemistry - solid waste management - treatment and recycling-soil analysis - radioactive pollution - disposal of radioactive waste.	9
Self-study :	
Site/Industrial Visits :	
Course outcomes: • Illustrates the important chemical reactions lead to environmental pollution. • Explains water chemistry and water pollution. • Point out hydrosphere and related terminologies. • Apply the techniques for industrial waste water treatment.	
Textbooks: 1. H. Kaur, Environmental Chemistry, 6thEdn, PragathiPrakashan, Meerut, 2011. 2. K.H.Mancy and W,.J.Weber Jr. Wiley, Analysis of Industrial Waste Water, Interescience, New York, 1971. 3. L.W. Moore and E. A. Moore, Environmental Chemistry, McGraw Hill Publication, New York, 2002. 4. S. M. Khopkar, Environmental Pollution Analysis, New Age International (P) Ltd, 1993. 5. Colid Baird. Environmental Chemistry, W. H. Freemand and Company, 1995.	
Reference Books:	
Online Resources:	

Course Name: TECHNICAL CERAMICS					
Course Code : PH636OE1					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: This course deals with overall aspects of ceramics, different types of ceramics, synthesis, properties and their applications in different aspects of technology frontiers like space, electrical & electronics, industries, medicals, automotive etc. This course will also serve as a prerequisite for post graduate and research**.**

To enhance student's knowledge on theoretical, practical and modern technological applications in the field of Ceramics.

- To introduce fundamentals of technical ceramics for engineering applications.

Prerequisites:

Units	**Teaching Hours**
Unit-1 Introduction to Technical Ceramics	
Introduction and classification of Technical Ceramics, Brief review of Griffith theory of fracture, toughness, statistical nature of strength.	9
Unit-2: Alumina and Zirconia Ceramics	
Alumina and alumina ceramics Crystal structure, phases, types of alumina, properties and its relation to microstructure, importance and application. Zirconia Ceramics Crystal structure and polymorphic modifications, Transformation Toughening; different system in zirconia.	9
Unit-3: Composites and Abrasives	
Composites: strengthening and toughening mechanisms, composite fabrication. Composites of some oxides and nonoxides. Classification of non-oxide ceramics, silicon carbide, silicon nitride Sialon, Tungsten Carbide, Boron Carbide, Boron Nitride, Carbon and Graphite, phase diagrams, processing, sintering and properties. Abrasives; natural and synthetic; properties, applications in Aerospace, Automotive, Household Applications, Electronics, Industrial Equipment, Medical, Power Generation & Distribution, Security and Defence.	9
Unit-4: Semiconductor, electronic and ionic conductors	
Semiconductor, electronic, ionic conductors and fast ion conductors; defects in fluoride type and perovskite oxides; conduction process and transference number; electronic conduction in oxides; semiconductor - metal transition; Ionic conduction in oxides; fast –ion conductors; resistors and varistors; ceramic capacitors.	9
Unit-5: Ceramic in Electronic Packaging	

Ceramic in Electronic Packaging; Piezoelectric materials, properties and its Industrial applications; electro-optic ceramics; Super conductivity: basic principles; materials; synthesis and Industrial applications; Magnetic Ceramics: Introduction; magnetic Materials: soft and hard; synthesis; characterization and applications.	9
Self-study :	
Site/Industrial Visits:	
Course outcomes: At the end of the course, the students would be exposed to fundamental knowledge and the various applications of technical ceramics in advanced engineering fields.	
Textbooks: 1. W. E. Lee and W. M. Rainforth, Ceramic Microstructures: Property Control by Processing, Springer, 1994. 2. J. B. Wachtman Jr., Structural Ceramics, Treatise on Materials Science & Technology Vo l- 29, Academic Press, New York, 1989 3. J. Moulson and J. M. Herbert, Electroceramics: Materials, Properties and Applications, 2nd Edition, John Wiley & Sons Ltd, 2003. 4. Mechanical Properties of Ceramics, JOHN B. WACHTMAN, W. ROGER CANNON, M. JOHN MATTHEWSON, 2nd Edition, John Wiley & Sons Inc, 2009.	
Reference Books: 1. E. Dorre and H. Hubner, Alumina: Processing, Properties and Applications, Springer-Verlag, Berlin Heidelberg, 1984. 2. R. C. Buchanan, Ceramic Materials for Electronics: Processing, properties and applications, Marcel Dekker, 1986.	
Online Resources:	

Course Name: ADVANCES IN MATERIALS SCIENCE AND ENGINEERING					
Course Code : PH636OE2					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: This course deals with overall aspects of the advancements in the field of material sciences and engineering and their applications in different aspects of technology frontiers like space, electrical & electronics, industries, medicals, automotive, defense etc. This course will also serve as a prerequisite for postgraduate and research**.**

- To develop the student's knowledge on practical and modern technological applications in the field of material sciences and engineering.
- To introduce fundamentals of advanced materials for engineering applications.

Prerequisites:

Units	**Teaching Hours**
Unit-1 Introduction to Advanced Materials	
Introduction: Various classes of advanced materials. ; Ultra light Materials and Metallic Foams: Material Definition and Processing, Characterization of cellular metals, Material properties and applications.	9
Unit-2: Bio Materials	
Bio-Materials: Various types of biomaterials, Biopolymer, Bioceramics, Nanostructured bio-materials, Classes of materials used in medicine, Application of materials in medicine and dentistry, Various materials and coatings for implants.	9
Unit-3: Composite Materials	
Composite Materials: Material definition and classifications, Advanced polymer composite, Ceramic composite, Metal matrix composite, Nanocomposite, Applications. ; Coatings, surface modification and high temperature materials.	9
Unit-4: Semiconductors and Shape memory alloys	
Semiconductors: Electronic structure, Macroscopic properties, applications. ; Smart materials: Piezoelectric materials, Shape memory alloys, Magnetic shape memory, Thin film shape memory alloys for MEMS application; Super alloys: Types of super alloys, Properties and applications.	9
Unit-5: Structural Ceramics	
Structural Ceramics: Crystalline and amorphous ceramics, Bonding in ceramics, Properties, Applications.	9
Self-study :	

Site/Industrial Visits :
Course outcomes: At the end of the course, the students would be exposed to fundamental knowledge and the various applications of advanced materials in engineering fields.
Textbooks: 1. Jr. W. D. Callister, Materials Science and Engineering, An Introduction, 5th Edition, John Wiley & Sons, Inc., New York, 1999, with CD-ROM. 2. R E Smallman, A.H.W. Ngan, Physical Metallurgy and Advanced Materials, Seventh Edition, Butterworth-Heinemann, 2007, ISBN: 0750669063. 3. Edited by B.D. Ratner, A.S. Hoffman, F.J. Sckoen, and J.E.L Emons,Biomaterials Science, An Introduction to Materials in Medicine, Academic Press, Second edition, 2004.
Reference Books: 1.Edited by H.P. Degischer& B. Kriszt, Handbook of Cellular metals, Production, processing, Application, Wiley - VCH, 2002. 2.Edited by J. R. Davis, Handbook of Materials for Medical Devices, ASM international, 2003. 3.L.J. Gibson, and M.F. Ashby, Cellular Solids, Structure and Properties, 2nd Edition, Cambridge University Press, 1999. 4.Ashby, M. F. Evans, A. Fleck, N. A. Gibson, L. J. Hutchinson, J. W. & Wadley, H. N. G. Metal Foams: A Design Guide, Butterworth-Heinmann, Massachusetts; 2000. 5.Disegi, Kennedy, and Pilliar, Cobalt-Base Alloys for Biomedical Applications,ASTM-STP1365. 6.J.F. Shackelford, Advanced Ceramics, Vol.1- Bioceramics, Gordon and Breach Science Publishers, 1999. 7.M. Ohring, Materials Science of Thin Films, 2ndEdition, Academic Press, 2002. 8.C.T. Herakovich, Mechanics of Fibrous Composites, John Wiley & Sons, Inc., New York, 1998. 9.M.P. Grover, Fundamentals of Modern Manufacturing, Materials, Processing, and Systems, 2ndedition, John Wiley & Sons, Inc. 10.S.Suresh, A. Mortensen and A. Needleman, Fundamentals of metal matrix composites, Butterworth Heinemann, 1993. **11.**Henkel and Pense, Structure and properties of engineering materials, fifth edition, McGraw Hill, 2002.
Online Resources:

Course Name: NUCLEAR PHYSICS					
Course Code : PH636OE3					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**45**	**0**	**0**	ESE Marks	**50**
Credits.	**3**	**0**	**0**	Exam Hours	**3**

Course objectives: This course deals with fundamental aspects of Nuclear Physics like nuclear properties, salient features of nuclear forces, nuclear decay modes, nuclear models and nuclear applications in fission and fusion reactions. This course will also serve as prerequisite for post graduation and research.

- To enhance student's knowledge on theoretical, practical and technological applications in the field of Nuclear Physics.
- To introduce basic tools for the students to further continue their exploration in Nuclear Science.

Prerequisites:

Units	**Teaching Hours**
Unit-1 Nuclear properties	
Nuclear radius-determination by mirror nuclei, nuclear density, Nuclear moments—spin, magnetic dipole moment. Determination of nuclear magnetic moment.	9
Unit-2: The Nuclear force	
Salient features of nuclear forces, spin dependence, charge independence, exchange character, repulsive core, Mass defect, binding energy, Meson theoryof nuclear forces- Yukawa's theory.	9
Unit-3: Nuclear decay modes	
Beta decay: Beta ray spectrum, neutrino hypothesis, mass of the neutrino from beta ray spectral shape, Fermi's theory of beta decay, Curie plot, forbidden transitions. Methods of excitation of nuclei. Nuclear isomerism. Mossbauer effect.	9
Unit-4: Nuclear models	
Liquid drop model: Semi-empirical mass formula, stability of nuclei against beta decay, Shell model: Evidence for magic numbers, prediction of energy levels in an infinite square well potential, spin-orbit interaction.	9
Unit-5: Applications-Nuclear power	
Natural Radioactivity, Radioactive decay, half life, induced radioactivity, Nuclear fission, fission chain reaction, self sustaining reaction, uncontrolled Reaction, Nuclear reactors, different types of reactors and reactors in India. Nuclear waste management. Nuclear fusion, Nuclear energy—applications and disadvantages.	9

Self-study :
Site/Industrial Visits :
Course outcomes: At the end of the course, the students would be exposed to fundamental aspects of Nuclear physics and various applications and drawbacks of nuclear fission and fusion reactions.
Text Books: 1. Theoretical Nuclear Physics by J M Blatt and V F Weisskopf, Dover Publications 2. Nuclear Theory by R G Sachs, Addison-Wesley 3. K. S. Krane, Introductory nuclear physics, Wiley, New York, 1955.
Reference Books: 1. Wong S.S.M., Introductory nuclear physics, Prentice Hall of India, Delhi, 1998. 2. Atomic and Nuclear Physics, S N. Ghoshal: Vol. II., 2000. 3. Nuclear Physics, R. R. Roy and B. P. Nigam: Wiley-Eastern Ltd. 1983. 4. S. S. Kapoor and V. Ramamoorthy, Nuclear radiation detectors, Wiley Eastern, Bangalore, 2007.
Online Resources:

ELECTIVE-III

Sl. No.	Course Code	Course Name	Hours			Marks	Credits			Total Credits
			L	T	P		L	T	P	
1	HU736OE 1	German Language	3	0	0	50	2	0	0	2
2	HU736OE 2	Media Studies for Engineering	3	0	0	50	2	0	0	2
3	HU736OE 3	Technical writing and editing	3	0	0	50	2	0	0	2
4	HU736OE 4	Piano GRADE	3	0	0	50	2	0	0	2
5	HU736OE 5	Western Music Theory GRADE	3	0	0	50	2	0	0	2
6	HU736OE 6	French Language	3	0	0	50	2	0	0	2
7	HU736OE 7	Applied Theatre	3	0	0	50	2	0	0	2

<table>
<tr><td colspan="7">Course Name: GERMAN LANGUAGE</td></tr>
<tr><td colspan="7">Course Code : HU736OE1</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td colspan="2">Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td colspan="2">CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>30</td><td>0</td><td>0</td><td colspan="2">ESE Marks</td><td>-</td></tr>
<tr><td>Credits.</td><td>2</td><td>0</td><td>0</td><td colspan="2">Exam Hours</td><td>-</td></tr>
<tr><td colspan="7">Course objectives: The Basic Course in German aims is to provide students a good knowledge of the language, enabling them to read, write and speak German, whereby the emphasis is laid on speech. At the end of the first course, the students are in the position to communicate in a basic manner. An example of their skills would be:
• Ordering food in a restaurant
• Expressing their likes and dislikes
• Going shopping
• Booking a room in a hotel
• Or even making complaints where necessary.
Course structure:
A. German Language (speaking, reading, writing, grammar and test)
B. Life in Germany (shopping, restaurant, doctor, government, bank, post)
C. The German Way (introduction, doing business, conversation, meetings, dining)
D. Germany (Culture, Climate)</td></tr>
<tr><td colspan="7">Prerequisites:</td></tr>
<tr><td colspan="6">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="7">Unit-1</td></tr>
<tr><td colspan="6">Welcome: Introduction to the Language, Spelling and Pronunciation (The alphabets and numbers) Greetings, ordering, requesting, saying thank you, Grammar – the article “the”, conjugation of verbs</td><td>9</td></tr>
<tr><td colspan="7">Unit-2:</td></tr>
<tr><td colspan="6">Shopping
Grammar – adjectives, endings before nouns</td><td>9</td></tr>
<tr><td colspan="7">Unit-3:</td></tr>
<tr><td colspan="6">Addresses, Occupations, Studies
Grammar - ‘to be’, the definite/indefinite articles</td><td>9</td></tr>
<tr><td colspan="7">Unit-4:</td></tr>
<tr><td colspan="6">Leisure Time, Sports, Hobbies
Grammar – position of a verb in a main clause</td><td>9</td></tr>
</table>

Unit-5:	
At a Restaurant, Food and Drink Grammar – the personal pronoun in the Nominative andAccusative	9
Self-study :	
Site/Industrial Visits :	
Course outcomes:	
Textbooks:	
Reference Books: 1. Sprachkurs Deutsch 1 (VerlagDiesterweg)	
Online Resources:	

Course Name: MEDIA STUDIES FOR ENGINEERING					
Course Code : HU736OE2					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**30**	**0**	**0**	ESE Marks	**-**
Credits.	**2**	**0**	**0**	Exam Hours	**-**
Course objectives: To be able to familiarise with the content generation for print media; also to develop diverse in audio and video and digital based designing and printing with the use of softwares.					
Prerequisites:					

Units	**Teaching Hours**
Unit-1	
Concept of News Introduction, fundamental principles Definitions of News- News values-Changing trends-Types of News-Structure of News stories- Lead- Body- Conclusion.Writing news stories and features. Content for photography History of photograph Early history of photography Basics Theory ● Introduction to Digital Photography ● Formats of Photography Megapixels **(practicals)** ● Understanding your Camera ● Focal Length and Magnification - X factor ● Advantages & Disadvantages of Digital Photography Portfolio Design & Submission	9

Unit-2:	
Understanding Audio and Video Production Radio programmes- scripting the content, recording it and editing. ● Introduction to Radio Broadcasting, Principles of Script Writing, Types of programmes: Production, Talks, Interviews, Discussions, Drama, Features, News, Special Audience Programmes, Sports ● Handling of simple equipments for recording sound, Usage and awareness of softwares for audio editing, Techniques in audio editing. **Practical:** Write script for - Talk show, TV News, News feature, Drama	9
Unit-3:	
Television production- writing the script, shooting the programmes and editing it. ● Introduction to TV as a mass medium, Advantages And Disadvantages of Television, Various Types of Television Programmes, Scripting for TV News, Order of news presentation, sources of news gathering. ● Usage of simple equipments for video recording, Editing techniques **Practical**: News production, Documentary making, Ad making	9
Unit-4:	
Newsletter/Newspaper/Magazine Layout for Newsletter, Layout for Newspaper, Layout for Magazine, Softwares: Quarkxpress, Anatomy of Newsletter, newspaper and magazine (to explain what goes where),The basics Tools, Menu commands, and Dialog boxes, Measurement palette, Document layout palette, Library palette	9
Unit-5:	

Working with documents.: Customize default settings and preferences, Create, modify, and arrange document pages Master pages (Automatic page numbers), Copy items and pages between documents **Working with text:** Create, edit, and import text from other programs Tabs and indents, Style Sheets, Search-and-replace text, character attributes, and fonts **Working with pictures:** Import artwork created in other programs, Modify the frame and background of a picture box, Change the pictureís scale, skew, and rotation How to precisely control the placement and look of type,Leadingmethods,Initial caps and drop caps,Tracking and kerning, Baseline shiftIntegrate various page elements,text boxes, picture boxes, and lines,Text inset, Vertical alignment,Stacking order of objects, Ruler guides, Reshaping boxes, Repeating and aligning items, Grouping, Rotating,Labeling Library palette entries, Runarounds,Anchoring boxes to text and anchoring rules to text,Linking text boxes The print dialog box.The Color palette,Painting frames, backgrounds, text, and imported pictures	9
Self-study :	
Site/Industrial Visits:	
Course outcomes:	
Textbooks:	
Reference Books:	
Online Resources:	

Course Name: TECHNICAL WRITING AND EDITING					
Course Code: HU736OE3					
	L	**T**	**P**	Category	
Contact Hrs./Week	**2**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**30**	**0**	**0**	ESE Marks	**-**
Credits.	**2**	**0**	**0**	Exam Hours	**-**

Course objectives:

- Gather , interpret ,and document information logically, efficiently and coherently
- develop business writing ability; design and use tables, graphs and technical illustrations

Write several specific kinds of documents that recur in technical and scientific communications

Prerequisites:

Units	**Teaching Hours**
Unit-1 Basics of Technical Writing	
Nature and scope of technical writing; Differences between technical writing and other forms of writing; Qualifications of technical writers and editors; Glossary of technical writing and applications.	9
Unit-2: Products of technical writing	
end products of technical writing – technical reports, projects, proposals, project abstracts, project documents and manuals-technical, installation and end-user; Creating a technical document; Professionals involved- project manager/editor, writers, graphic artists; Liasoning with product engineers/scientists and clients	9
Unit-3: Technical writing team	
Technical writing- a team work; Roles and transportation of technical document editors, writers and managers; Documents, testing and revision, Clients approval; Document formats- hard and soft versions	9
Unit-4: Technical Writing principles	
Principles of technical writing; Styles in technical writing; Clarity: Precision, coherence and logical sequence in writing: The writing process-aim of writing, knowing the writing assignment, its clients and end users, Gathering fats/data: Planning the document's content and organization: Document design: Writing the draft; Draft revision, use of graphic/illustrations	9
Unit-5: Editing technical documents	
The technical editing process-review of the document aim, content and its organization; Editing for accuracy of technical details, language style and usage: Editing tables, graphs/illustrations, copy fitting, design and layout of documents: Online editing.	9

Self-study:
Site/Industrial Visits:
Course outcomes:
Textbooks:
Reference Books: 1. Gerald J. Alred, "Hand book of Technical Writing", tenth edition. 2. Mike Markel, "Practical strategies for Technical Communication". 3. Philip C Kolin, "Successful Writing at work".
Online Resources:

<table>
<tr><td colspan="6">Course Name: Piano Grade</td></tr>
<tr><td colspan="6">Course Code : HU736OE4, HU73G4</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td>Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td>CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>30</td><td>0</td><td>0</td><td>ESE Marks</td><td>-</td></tr>
<tr><td>Credits.</td><td>2</td><td>0</td><td>0</td><td>Exam Hours</td><td>-</td></tr>
<tr><td colspan="6">Course objectives:</td></tr>
<tr><td colspan="6">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td>Teaching Hours</td></tr>
<tr><td colspan="6">Unit-1</td></tr>
<tr><td colspan="5">SCALES AND BROKEN CHORDS*: see also p. 8
Scales
C, G, D, F majors hands separately 2 octaves
A, D minors (L.H. may, at candidate’s choice, be
(naturalor harmonic or melodic at played descending and ascending)
candidate’s choice)
Contrary-motion scale
C major hands beginning on the key-note (unison) 1 octave
Broken chords
C, G, F majors hands separately, as pattern below:
A, D minors</td><td>9</td></tr>
<tr><td colspan="6">Unit-2:</td></tr>
<tr><td colspan="5">THREE PIECES: one chosen by the candidate from each of the three Lists, A, B and C:
LIST A
1 ClementiArietta: Lesson 5 from Op. 42
2 Haydn Minuet in G: No. 2 from 12 Minuets, Hob. IX:3Piano Exam Pieces 2015 & 2016, Grade 1 (ABRSM)
3 Trad. English The Lincolnshire Poacher, arr. Davies
4 Blow Hornpipe. Keynotes, Grades 1–2 (Faber)
5 L. Mozart Menuett in G. No. 4 from L. Mozart Notebook for Nannerl(Schott ED 9006)
6 NeefeAllegretto in C. No. 2 from ClavierstückefürAnfänger (Piano Pieces for Beginners) (Schott ED 2572)</td><td>9</td></tr>
<tr><td colspan="6">Unit-3:</td></tr>
</table>

LIST B 1 **Gurlitt**Das Schaukelpferd (The Rocking Horse): from Technik und Melodie, Op. 228, Vol. 1 Piano Exam Pieces 2015 & 2016, 2 **Knut Nystedt**Løvet faller (Falling Leaves): from Barnebilder Grade 1 (ABRSM) 3 **Trad. Catalan** El cant delsocells (The Song of the Birds), arr. Marshall ¸ÓÏ˛ 4 **Gedike**Heiteres Lied (Cheerful Song): No. 31 from 60 Easy Piano Pieces for Beginners, Op. 36, Vol. 2 (Peters EP 4702b) 5 **Lajos Papp** Waltz: No. 5 from 22 Little Piano Pieces (EditioMusica Budapest Z.13216) 6 **Ponchielli** Dance of the Hours (from La Gioconda), arr. Bullard.Pianoworks: A Night at the Theatre (OUP)	9
Unit-4:	
LIST C 1 **Stephen Clarke** The Giant's Coming 2 **Stephen Duro**Calypso Joe: No. 9 from Finger Jogging Boogie Piano Exam Pieces 2015 & 2016, Grade 1 3 **Eben**Na krmítku (Bird at the Feeding Box): No. 19 from Svˇetmalých¸˝˛ (ABRSM) 4 **Bartók**Children at Play: No. 1 from For Children, Vol. 1 (Boosey& Hawkes) 5 **Ornstein** My, what a din the cuckoos are making! Keynotes, Grades 1–2 (Faber) 6 **Kevin Wooding** The House on the Hill. Spooky Piano Time (OUP)	9
Unit-5:	

<table>
<tr><td>SIGHT-READING*: a four-bar piece in 44 or 34 , or a six-bar piece in 24 , in C, G or F majors, A or D minors, with each hand playing separately note values, articulations and occasional accidentals (within minor keys only) may be encountered. See also p. 9.
* Published by ABRSM (Scale requirements, Specimen Sight-Reading Tests, Specimen Aural Tests)

Aural Tests
A To clap the pulse of a piece played by the examiner, and to identify whether it is in two time or three time. The examiner will start playing the passage, and the candidate should join in as soon as possible, clapping in time and giving a louder clap on the strong beats. The examiner will then ask whether the music is in two time or three time. The candidate is not required to state the time signature.
B To sing as ‘echoes’ three phrases played by the examiner.The phrases will be two bars long, in a major key, and within the range of tonic–mediant. First the examiner will play the key-chord and the starting note (the tonic) and then count in two bars. After the examiner has played each phrase, the candidate should sing back the echo without a pause, keeping in time.
C To identify where a change in pitch occurs during a phrase played by the examiner.The phrase will be two bars long, in a major key, and the change will affect only one of the notes. First the examiner will play the key-chord and the tonic and then count in two bars. The examiner will play the phrase twice, making the change in the second playing, after which the candidate should state whether the change was near the beginning or near the end. If necessary, the examiner will play both versions of the phrase again (although this will affect the assessment).
D To answer questions about two features of a piece played by the examiner. Before playing, the examiner will tell the candidate which two features the questions will be about. The first will be: dynamics (loud/quiet, or sudden/gradual changes); the second will be articulation (smooth/detached).</td><td>9</td></tr>
<tr><td colspan="2">Self-study:</td></tr>
<tr><td colspan="2">Site/Industrial Visits:</td></tr>
<tr><td colspan="2">Course outcomes:</td></tr>
<tr><td colspan="2">Textbooks:</td></tr>
<tr><td colspan="2">Reference Books:
1. Piano Pieces Grade 1 ABRSM
2. Scales and Arpegios Grade 1 ABRSM
3. Sight Reading Grade 1 ABRSM
4. Aural Tests Grade 1 ABRSM</td></tr>
<tr><td colspan="2">Online Resources:</td></tr>
</table>

<table>
<tr><td colspan="7" align="center">Course Name: WESTERN MUSIC THEORY GRADE</td></tr>
<tr><td colspan="7" align="center">Course Code: HU736OE5, HU73G5</td></tr>
<tr><td></td><td>L</td><td>T</td><td>P</td><td colspan="2" align="right">Category</td><td></td></tr>
<tr><td>Contact Hrs./Week</td><td>3</td><td>0</td><td>0</td><td colspan="2" align="right">CIA Marks</td><td>50</td></tr>
<tr><td>Contact Hrs./Sem.</td><td>30</td><td>0</td><td>0</td><td colspan="2" align="right">ESE Marks</td><td>-</td></tr>
<tr><td>Credits.</td><td>2</td><td>0</td><td>0</td><td colspan="2" align="right">Exam Hours</td><td>-</td></tr>
<tr><td colspan="7">Course objectives:</td></tr>
<tr><td colspan="7">Prerequisites:</td></tr>
<tr><td colspan="5">Units</td><td colspan="2">Teaching Hours</td></tr>
<tr><td colspan="7">Unit-1</td></tr>
<tr><td colspan="5">1 Note values of semibreve, minim, crotchet, quaver and semiquaver, and their equivalent rests
(candidates may use the terms ‘whole note’, ‘half note’, etc.). Tied notes. Single-dotted notes and
rests.
2 Simple time signatures of $\frac{2}{4}$ $\frac{3}{4}$ $\frac{4}{4}$,</td><td colspan="2">9</td></tr>
<tr><td colspan="7">Unit-2:</td></tr>
<tr><td colspan="5">bar-lines and the grouping of the notes listed above within these times. Composition of a two-bar rhythm in answer to a given rhythm starting on the first beat of a bar.</td><td colspan="2">9</td></tr>
<tr><td colspan="7">Unit-3:</td></tr>
<tr><td colspan="5">The stave. Treble (G) and bass (F) clefs. Names of notes on the stave, including middle C in both clefs. Sharp, flat and natural signs, and their cancellation.</td><td colspan="2">9</td></tr>
<tr><td colspan="7">Unit-4:</td></tr>
<tr><td colspan="5">Construction of the major scale, including the position of the tones and semitones. Scales and key</td><td colspan="2">9</td></tr>
<tr><td colspan="7">Unit-5:</td></tr>
<tr><td colspan="5">signatures of the major keys of C, G, D and F in both clefs, with their tonic triads (root position),
degrees (number only), and intervals above the tonic (by number only).
5 Some frequently used terms and signs concerning tempo, dynamics, performance directions and articulation marks. Simple questions will be asked about a melody written in either treble or bass clef.</td><td colspan="2">9</td></tr>
<tr><td colspan="7">Self-study :</td></tr>
<tr><td colspan="7">Site/Industrial Visits :</td></tr>
</table>

Course outcomes:
Text Books:
Reference Books: 1. PianoTheory ABRSM
Online Resources:

Course Name: FRENCH LANGUAGE					
Course Code: HU736OE6					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**30**	**0**	**0**	ESE Marks	**-**
Credits.	**2**	**0**	**0**	Exam Hours	**-**

Course objectives: The Basic Course in French is designed to introduce the basics of the language to beginners and to develop their knowledge as well as their communicative skills so as to be able to respond in simple everyday contexts.
Tempo I consists of units with each unit presenting a dialogue and giving the know-how, grammatical and lexical notions as well as activities required for communication. In addition, Tempo includes documents which initiate the learners to the French culture and which acclimatize them to the authentic use of the French language through the exploitation of written and iconographic documents.

Prerequisites:

Units	**Teaching Hours**
Unit-1	
First contacts – the most frequent names in France Know how – Introducing oneself / getting acquainted with someone / asking questions, answering questions / identifying someone Grammar- Verbs 'to be', 'to live', 'to have', to call oneself'/the apostrophe / gender / plural / days of the week Written – Acquiring the codes of writing	9
Unit-2:	
First exchanges – illustrated map of France Know how – Speaking about oneself /asking someone about himself Grammar- Possessive adjectives / the mark of the plural / numbers / negation / indicators of time Written – Understanding and editing short written texts	9
Unit-3:	
First friends – What do you know of France? Know how – Establishing a relation with someone / you (informal & formal), greeting someone / asking for information / expressing tastes and opinions Grammar- Possessive / interrogative / time / present and past tenses / negation / responses Written – Characterizing	9
Unit-4:	

My country – France is like that! Know how – Giving general information about a place / situating a place geographically / presenting a place Grammar- Prepositions before countries / to go to / to come from / to present something / definite / indefinite articles / we / how to write numbers / demonstrative adjectives / revision of the past tense	9
Unit-5:	
Written – describing a place My city – the different cities of France Know how – Giving an itinerary / getting an itinerary Grammar-expressions indicating the location of a place / identifying the presence of a vowel or a consonant at the beginning of a word / ordinal numbers / negation Written – Taking notes My travels – Know how – Giving specific information about a place / having a positive or negative judgment about a place / reporting an event Grammar- It is + noun / It is +adjective / which / indicators of place / time / past tense / imperfect tense Written – Understanding a descriptive text	9
Self-study :	
Site/Industrial Visits :	
Course outcomes:	
Text Books:	
Reference Books: 1. Bérard Evelyne, Yves Canier et Christian Lavenne. *Tempo I – Méthode de Français*. Paris : Didier, 1996	
Online Resources:	

Course Name: APPLIED THEATRE					
Course Code : HU736OE7					
	L	**T**	**P**	Category	
Contact Hrs./Week	**3**	**0**	**0**	CIA Marks	**50**
Contact Hrs./Sem.	**30**	**0**	**0**	ESE Marks	**-**
Credits.	**2**	**0**	**0**	Exam Hours	**-**

Course objectives: The changing scenario of the media has re-defined the term "theatre". From being a medium of self-indulgence and creative expression, the key phrase in today's evolved atmosphere is "application". Applied Theatre is emerging as an evolved tool of expression across various sectors ranging from education to corporate learning.
Applied Theatre is unique to each environment. Knowledge, skill and logistics of the environment frame the parameters of an effective Applied Theatre experience. The aim of introducing this Unit is to give participants a first-hand experience of the skills, marketing tools and application patterns in the context of emerging markets.

To make students experience the basic skills of theatre

- Create and implement steps to market the created production.
- Application of skills in the niche market
- Showcase performance across venues

Prerequisites:

Units	**Teaching Hours**
Unit-1	
Applied Theatre: Skills - Identifying a theme, creating a script, social audit of the script, casting, stage management, blocking and direction	9
Unit-2:	
Use of Body-Mind-Voice in Theatre, Stage positions and composition, movement, basic understanding of lights, sound, scripting, costumes, sets and props, direction, characterization, creating thematic presentations.	9
Unit-3:	
Applied Theatre: Marketing - Identifying markets and market needs, clients, creating marketing tools, budgeting, marketing shows across venues, identifying sponsors and revenue streams, publicity through print, radio, TV, Web and new media.	9
Unit-4:	
Applied Theatre: Implementation - Tailor-made sessions for client needs, understanding environment dynamics, creating conducive environments, feedback mechanisms, closure written and visual documents, project report.	9
Unit-5: Practical Component	

Showcase presentations for an invited audience and create a scalable version of the production	9
Self-study :	
Site/Industrial Visits :	
Course outcomes:	
Textbooks:	
Reference Books: 1. Applied Theatre: Bewilderment And Beyond - James Thompson 2. The Applied Theatre Reader – Tim Prentki , Sheila Preston 3. Interactive and Improvisational Drama: Varieties of Applied Theatre and performance – Adam Blatner 4. The Actor's ways and means – Michael Redgrave\ 5. An Actor Prepares – Constantin Stanislavsky 6. Improv – Keith Johnstone 7. Theatre on the edge: New Visions, New Voices – Mel Gussow	
Online Resources:	