B.TECH. CIVIL ENGINEERING SYLLABUS

CREDIT BASED CURRICULUM

CENTRE FOR RURAL TECHNOLOGY

THE GANDHIGRAM RURAL INSTITUTE
(DEEMED TO BE UNIVERSITY)
GANDHIGRAM

(2024 onwards)

THE GANDHIGRAM RURAL INSTITUTE (DEEMED TO BE UNIVERSITY)
CENTRE FOR RURAL TECHNOLOGY

Board of Studies Meeting

Date: 25.06.2024 **Time : 10.00 a.m**
Venue: Seminar Hall, Centre for Rural Technology

PANEL OF MEMBERS

Dr.K.Mahendran Professor & Director Centre for Rural Technology GRI, Gandhigram.	**Chairman**	
Dr.K.Muthukkumaran Professor, Civil Engineering Department, NIT Trichy ; 620 015. Email: kmk@nitt .edu	**Member**	
Dr.D.Brindha Professor , Department of Civil Engineering, Thiyagarajar College of Engineering, Madurai	**Member**	D.
Mrs.B.Sangeethavani Assistant Professor Centre for Rural Technology GRI, Gandhigram.	**Member**	25/6/24
Mr.R.T.Balamurali Assistant Professor Centre for Rural Technology GRI, Gandhigram.	**Member**	25/6/24

MINUTES OF THE MEETING

Dr.K.Mahendran, Professor and Director, Centre for Rural Technology welcomed the members and explained the agenda for the Board of Studies Meeting.

The Board of Studies considered and resolved the following

1. The AICTE's model Curriculum 2024 of B.Tech Civil Engineering and the draft syllabus of I to VIII semesters for B.Tech Civil Engineering was placed before the board ***(Annexure –I).***
2. After careful scrutiny and deliberation, the content of the syllabus was finalized

The meeting ended with the Chairman thanking all the members of Board Studies for their valuable contribution and suggestions.

(Dr.K.Mahendran) **(Dr.K.Muthukkumaran)** **(Dr.D.Brindha)**

(Mrs.B.Sangeethavani) **(Mr.R.T.Balamurali)**

THE GANDHIGRAM RURAL INSTITUTE – (DEEMED TO BE UNIVERSITY)

CENTRE FOR RURAL TECHNOLOGY
4 year Curriculum Structure
Undergraduate Degree in Engineering & Technology
Course: B.Tech Civil Engineering

I. INDUCTION PROGRAM (Mandatory- 3 weeks)

Induction program for students to be offered right at the start of the first year.

- Physical activity
  - Creative Arts
  - Universal Human Values
  - Literary
  - Proficiency Modules
  - Lectures by Eminent People
  - Visits to local Areas
- Familiarization to Dept./Branch & Innovation

II. SEMESTER WISE STRUCTURE OF CURRICULUM

(**L**- Lecture**, T**- Tutorials, **P**- Practicals & **C**- Credits)

CFA	**-**	Continuous Formative Assessment
ESE	-	End Semester Examination
HSMC	-	Humanities & Social Sciences including Management
BSC	-	Basic Science Course
ESC	-	Engineering Science Course
PCC	-	Professional Core Course
PEC	-	Programme Elective Course
MOPEC	**-**	Multidisciplinary Open Elective Course
MNC	-	Mandatory Non-Credit Course

*Note: ***Passing minimum -50% in CFA and ESE***

THE GANDHIGRAM RURAL INSTITUTE- DEEMED TO BE UNIVERSITY
GANDHIGRAM -624302
TEMPLATE FOR OBE ELEMENTS

Name : Dr.K.Mahendran

Designation & Department/ Centre: Professor & Director i/c,
Centre for Rural Technology

Academic Programme offered : B.Tech Civil Engineering

OBE Elements for B.Tech Civil Engineering programme

Programme Educational Objectives (PEO)

PEO 1: Students will gain the ability to identify, analyze, formulate, and solve different challenging of civil engineering problems.

PEO 2: Students will develop professional skills that prepare them for immediate employment or postgraduate study in Civil Engineering disciplines.

PEO 3: Students will develop abilities in the application of the necessary mathematical tools, scientific basics, and fundamental knowledge of civil Engineering.

PEO 4: To produce graduates who are prepared for life-long learning and successful careers as civil engineers.

PEO 5: Students will develop an understanding of the multidisciplinary approach and an ability to relate engineering issues to broader social and human context, in which their engineering contributions will be utilized.

PEO 6: Students will learn to communicate their ideas to be effective in collaboration with other members of civil engineering teams.

Program Outcome (PO)

PO1: Become knowledgeable in the subject of Civil Engineering and apply the principles of the same to the needs of the Employer / Institution /Enterprise/ Society.

PO2: Gain Analytical skills in the field/area of Civil Engineering

PO3: Understand and appreciate professional ethics, community living and Nation Building initiatives

PO4: Graduates of Civil Engineering Programme will be able to design and conduct experiments as well as to analyze and interpret data.

PO5: Graduates of Civil Engineering will be able to use the techniques, skills, and modern civil engineering tools, necessary for engineering practice.

PO6: Graduates of Civil Engineering Programme will be able to incorporate specific contemporary issues into the identification, formulation and solution of a specific Civil Engineering Problems.

PO7: Graduates of Civil Engineering program will be able to work on the basis of broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

PO8: Graduates of Civil Engineering Programme will be able to understand the role of civil engineers and ethical responsibility.

PO9: Graduates of Civil Engineering Programme will be able to function on multidisciplinary teams

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO 1: Apply the knowledge of Civil Engineering in the domain of Civil Engineering

PSO 2: Solve the complex problems in the field of Civil Engineering with an understanding of the societal, legal and cultural impacts of the solution.

PSO3: Plan, analyze, design, prepare cost estimates and execute all kinds of Civil Engineering Projects.

PSO4: Apply modern construction techniques, equipment and management tools so as to complete the project within specified time and funds.

PSO 5: Provide suitable solution to the Civil Engineering Problems.

1. **Definition of Credit**

1 Hr. Lecture (L) per Week	1 Credit
1 Hr. Tutorial (T) per Week	1 Credit
1 Hr. Practical (P) per Week	0.5 Credit
2 Hr. Practical (Lab) Per week	1 Credit

2. **Range of credits:** A range of credits from 164 for a student eligible for a B.Tech Civil Engineering degree. A student will be eligible to get B.Tech Civil Engineering (Honors) or B.Tech Civil Engineering (Minor) if he/she completes an additional18 credits. These could be acquired through offline / SWAYAM (NPTEL) or any other MOOCs.

1. **Structure of Undergraduate Engineering Program:**

S.No.	Category	Breakup of Credits by AICTE	Proposed Credits in GRI
1	Humanities and Social Sciences, including Management courses	06	06
2	Basic Science Courses	24	24
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	20	24
4	Professional Core Courses	58	62
5	Professional Electives in Civil Engineering	26	21
6	Indian Knowledge System	02	02
7	Multidisciplinary Open Electives Courses	12	12
8	Project work, seminar and internship in industry or appropriate work place/ academic and research institutionsin India/abroad	16	13
9	Mandatory Non-Credit Courses	(non-credit)	-
	Total	**164**	**164**

1. **Course Code and Definition**

Course code	Definitions
HSMC	Humanities and Social Sciences including Management course
BSC	Basic Science Course
ESC	Engineering Science Course
PCC	Professional Core Course
PEC	Professional Elective Course
IKS	Indian Knowledge System
MOPEC	Multidisciplinary Open Electives Course
LC	Laboratory course
MNC	Mandatory Non-Credit Course
PR	Project
INT	Internship

Humanities and Social Sciences, including Management courses – 6 credits										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	HSMC	24ENUA1102	English for Technical Writing	2	-	2	3	40	60	100
2.	HSMC	24CEUV1201	Universal Human Values and Professional Ethics	2	1	-	3	40	60	100
			Total	**4**	**1**	**2**	**6**			

Basic Science courses – 24 credits										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	BSC	24PHUB1101	Physics (Introduction to Mechanics)	2	1	-	3	40	60	100
2.	BSC	24MAUB1101	Mathematics I	3	1	-	4	40	60	100
3.	BSC	24PHUB1102	Physics Laboratory (Introduction to Mechanics)	-	-	3	1.5	60	40	100
4.	BSC	24MAUB1202	Mathematics II	3	1	-	4	40	60	100
5.	BSC	24CEUB1203	Chemistry	3	-	-	3	40	60	100
6.	BSC	24CEUB1204	Chemistry Laboratory	-	-	3	1.5	60	40	100
7.	BSC	24CEUC1205	Biology for Engineers	3	-	-	3	40	60	100
8.	BSC	24MAUB2103	Mathematics III	3	1	-	**4**	40	60	100
			Total	**17**	**4**	**6**	**24**			

Engineering Science Courses including workshop, drawing, basics electrical etc: 22 Credits										
S.NO	Category	Course Code	Course Title	Hours per Week			C	Marks		Total
				L	T	P		CFA	ESE	
1	ESC	24CEUC1101	Basic Electrical and Electronics for Civil Engineering Applications	2	1	-	3	40	60	100
2	ESC	24CEUS1101	Python Programming	3	-	-	3	40	60	100
3	ES-LC	24CEUC1102	Basic Electrical and Electronics for Civil Engineering Applications laboratory	-	-	3	1.5	60	40	100
4	ES-LC	24CEUS1102	Python Programming Laboratory	-	-	3	1.5	60	40	100
5	ES-LC	24CEUC1103	Design thinking	-	-	2	1	30	20	50
6	ES-LC	24CEUC1206	Engineering Graphics & Design	1	-	4	3	60	40	100
7	ES-LC	24CEUC1207	Workshop Manufacturing Practices	-	-	4	2	60	40	100
8	ESC	24CEUC2108	Solid Mechanics	3	-	-	3	40	60	100
9	ES-LC	24CEUC2113	Solid Mechanics Laboratory	-	-	3	1.5	60	40	100
10	ESC	24CEUC2215	Materials, Testing & Evaluation	3	-	-	3	40	60	100
11	ES-LC	24CEUC2219	Materials, Testing & Evaluation Laboratory	-	-	3	1.5	60	40	100
			Total	**12**	**1**	**22**	**24**			

Professional Core Courses: 62 Credits										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**Credit**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	PCC	24CEUC2109	Surveying and Geomatics	3	-	-	3	40	60	100
2.	PCC	24CEUC2110	Fluid Mechanics	3	-	-	3	40	60	100
3.	PC-LC	24CEUC2112	Surveying and Geomatics Laboratory	-	-	3	1.5	60	40	100
4.	PC-LC	24CEUC2114	Computer Aided Civil Engineering Drawing	-	-	4	2	60	40	100
5.	PCC	24CEUC2216	Geotechnical Engineering	3	-	-	3	40	60	100
6.	PCC	24CEUC2217	Hydraulic Engineering	3	-	-	3	40	60	100
7.	PCC	24CEUC2218	Concrete Technology	3		-	3	40	60	100
8.	PC-LC	24CEUC2220	Geotechnical Engineering Laboratory	-	-	3	1.5	60	40	100
9.	PC-LC	24CEUC2221	Fluid Mechanics and Hydraulic Engineering Laboratory	-	-	3	1.5	60	40	100
10.	PC-LC	24CEUS2205	Software Skill Development -I	-	-	-	1	30	20	50
11.	PCC	24CEUC3122	Structural Design – I (Design of concrete structures)	3	-	-	3	40	60	100
12.	PCC	24CEUC3123	Environmental Engineering	3	-	-	3	40	60	100
13.	PCC	24CEUC3124	Irrigation Engineering and Hydraulic Structures	3	-	-	3	40	60	100
14.	PCC	24CEUC3125	Transportation Engineering	3	-	-	3	40	60	100
15.	PCC	24CEUC3126	Structural Analysis I	3		-	3	40	60	100
16.	PC-LC	24CEUC3128	Transportation Engineering Laboratory	-	-	3	1.5	60	40	100
17.	PC-LC	24CEUC3129	Environmental Engineering Laboratory	-	-	3	1.5	60	40	100
18.	PC-LC	24CEUS3106	Software Skill Development -II	-	-	-	1	30	20	50
19.	PCC	24CEUC3230	Structural Design – II (Design of Steel structures)	3	-	-	3	40	60	100
20.	PCC	24CEUC3231	Structural Analysis – II	3	1	-	4	40	60	100
21.	PC-LC	24CEUC3233	Structural Design Laboratory	-	-	4	2	60	40	100
22.	PC-LC	24CEUS3207	Software Skill Development -III	-	-	-	1	30	20	50
23.	PCC	24CEUC4134	Construction Engineering and Management	3	-	-	3	40	60	100
24.	PCC	24CEUC4135	Estimation, costing and valuation	3		-	3	40	60	100
25.	PCC	24CEUC4136	Cost-Effective Construction Technologies	3	-	-	3	40	60	100
26.	PC-LC	24CEUC4137	Irrigation and Environmental Engineering Drawing	-	-	3	1.5	60	40	100
Total				**45**	**1**	**26**	**62**			

Professional Elective Courses in Civil Engineering: 21 credits											
S.N	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**Credit**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	PEC	24CEUC32XX	Professional Elective I	3	-	-	3	40	60	100
2.	PEC	24CEUC32XX	Professional Elective II	3	-	-	3	40	60	100
3.	PEC	24CEUC41XX	Professional Elective III	3	-	-	3	40	60	100
4.	PEC	24CEUC41XX	Professional Elective IV	3	-	-	3	40	60	100
5.	PEC	24CEUC42XX	Professional Elective V	3	-	-	3	40	60	100
6.	PEC	24CEUC42XX	Professional Elective VI	3	-	-	3	40	60	100
7.	PEC	24CEUC42XX	Professional Elective VII	3	-	-	3	40	60	100
			Total	**21**	**-**	**-**	**21**			

Note: A Student can choose any one course for each Open Elective offered by other departments of GRI or the courses offered by SWAYAM / NPTEL and other MOOCs platform with prior approval of the Director, Centre for Rural Technology.

Project work, seminar and internship in industry or appropriate work place/academic and research institutions in India / Abroad : 13 Credits										
S.NO	Category	Course Code	Course Title	Hours per Week			Credit	Marks		Total
				L	T	P		CFA	ESE	
1	INT	24CEUS1203	Summer Internship-I	-	-	-	1	30	20	50
2	INT	24CEUS2204	Summer Internship-II	-	-	-	1	30	20	50
3	INT	24CEUS3207	Summer Internship-III	-	-	-	1	30	20	50
4	PR	24CEUC4138	Design Project	-	-	6	4	60	40	100
5	PR	24CEUC4239	Major Project	-	-	12	6	150	50	200
			Total	**-**	**-**	**18**	**13**			

Indian Knowledge System: 2 Credits										
S.NO	Category	Course Code	Course Title	Hours per Week			Credit	Marks		Total
				L	T	P		CFA	ESE	
1.	IKS	24CEUV2102	Indian Knowledge System (xxxxxx)	2	-	-	2	50	-	50
			Total	**2**	**-**	**-**	**2**			

Mandatory Non-credit Courses										
S.NO	Category	Course Code	Course Title	Hours per Week			Credit	Marks		Total
				L	T	P		CFA	ESE	
1.	MNC	24PEUV0003	Hatha Yoga Education	-	-	1	-	50	-	50
2.	MNC	24CEUC1104	Idea Laboratory Workshop	1	-	1	-	50	-	50
3.	MNC	24GTUV1003	Let Us Know Gandhi	2	-	-	-	20	30	50
4.	MNC		NSS/Health and Fitness	-	-	1	-	50	-	50
5.	MNC	24SHSU0001	Shantisena	1	-	-	-	50	-	50
6.	MNC	24EXUE2101	Village Placement Program (VPP)	-	-	-	-	50	-	50
7.	MNC	24CEUV2203	Disability, Accessibility & Universal Design	2	-	-	-	50	-	50
8.	MNC	24CEUV3104	Civil Engineering Societal & Global Impact	2	-	-	-	50	-	50
9.	MNC	24CEUC3232	Disaster Preparedness and Planning	3	-	-	0	40	60	100
10.	MNC	24CEUV4105	Professional Practice Law and Ethics	3	0	0	0	40	60	100
			Total	**14**	**-**	**3**	**-**			

Professional ELECTIVES (24CEUXXEX)

I. Construction Engineering and Management		
1.	24CEUCXXE1	Advanced Construction Techniques
2.	24CEUCXXE2	Sustainable Construction method
3.	24CEUCXXE3	Construction Engineering Materials
4.	24CEUCXXE4	Digitalized Construction laboratory
5.	24CEUCXXE5	Energy Efficient Building
6.	24CEUCXXE6	Form Work Engineering
7.	24CEUCXXE7	Building Construction Practice
II. Transportation Engineering		
1.	24CEUCXXE8	Railways, Airways and waterways
2.	24CEUCXXE9	Intelligent Transport System
3.	24CEUCXXE10	Airport Planning and Design
4.	24CEUCXXE11	Traffic Engineering and Management
5.	24CEUCXXE12	Railway Engineering
6.	24CEUCXXE13	Urban and Regional Planning
7.	24CEUCXXE14	Port and Harbour Engineering
8.	24CEUCXXE15	Pavement Materials
9.	24CEUCXXE16	Transportation Systems Planning
III. Environmental Engineering		
1.	24CEUCXXE17	Environmental Systems
2.	24CEUCXXE18	Transport of Water and Wastewater
3.	24CEUCXXE19	Environmental Laws and Policy
4.	24CEUCXXE20	Physico-Chemical Processes for Water and Wastewater Treatment
5.	24CEUCXXE21	Biological Processes for Contaminant Removal
6.	24CEUCXXE22	Rural Water Supply and Onsite Sanitation Systems
7.	24CEUCXXE23	Water and Air Quality Modelling
8.	24CEUCXXE24	Solid and Hazardous Waste Management
9.	24CEUCXXE25	Air and Noise Pollution Control Engineering
10.	24CEUCXXE26	Environmental Impact Assessment and Life Cycle Analyses
11.	24CEUCXXE27	Climate change adaptation and Mitigation Participatory
12.	24CEUCXXE28	Industrial Waste water Management
13.	24CEUCXXE29	Environment Health and Safety
14.	24CEUCXXE30	Ecological Engineering
IV. Hydraulics, Hydrology & Water Resources Engineering		
1.	24CEUCXXE31	Pipeline Engineering
2.	24CEUCXXE32	Open Channel flow
3.	24CEUCXXE33	River Engineering
4.	24CEUCXXE34	Urban water Resource Management
5.	24CEUCXXE35	Ground water hydrology
6.	24CEUCXXE36	Hydrology & Water Resources Engineering
7.	24CEUCXXE37	Water Resources systems Analysis
8.	24CEUCXXE38	Surface water Hydrology
9.	24CEUCXXE39	Remote sensing and GIS in water Resources
10.	24CEUCXXE40	Watershed conservation & Management

V. Structural Engineering		
1.	24CEUCXXE41	Repair and Rehabilitation of Structures
2.	24CEUCXXE42	Pre stressed concrete
3.	24CEUCXXE43	Smart Materials and smart structures
4.	24CEUCXXE44	Basics of dynamics and Aseismic design
5.	24CEUCXXE45	Design of Masonry Structures
6.	24CEUCXXE46	Analysis and Design of Sub-Structures
7.	24CEUCXXE47	Design of Storage Structures
8.	24CEUCXXE48	Bridge Engineering
9.	24CEUCXXE49	Finite Element analysis
10.	24CEUCXXE50	Industrial Structures
11.	24CEUCXXE51	Safety of Structures
12.	24CEUCXXE52	Reliability analysis of Structures
13.	24CEUCXXE53	Fire Resistance of structures
VI. Geotechnical Engineering		
1.	24CEUCXXE54	Foundation Engineering
2.	24CEUCXXE55	Ground Improvement Techniques
3.	24CEUCXXE56	Earthquake Resistant Design of foundation
4.	24CEUCXXE57	Geo-environmental engineering
5.	24CEUCXXE58	Rock Mechanics and Applications
6.	24CEUCXXE59	Soil Structures Interaction

Annexure – I

EXIT OPTIONS FOR CIVIL ENGINEERING

Level	Semester	Exit Option	Credits	Additional Credits for exit students	List of exit courses
4.5	Sem. I&II	Certificate Programme in Civil Engineering	42	6-8	1. Materials and Civil Engineering (3-0-0 = 3 Credits) 2. Testing of Civil Engineering Materials (0 -0 -4 = 2Credits) 3. Introduction to construction methodology and techniques (3-0-0= 3 Credits) 4. Introduction to construction equipments (3-0-0 = 3Credits) 5. Site Supervision work (0 -0- 4= 2 Credits) 6. Survey Work (0-0-4 = 2 Credits) 7. Surveying and Geomatics (3-0-0=3 credits)
5.0	Sem. III&IV	Diploma in Civil Engineering	44.5	6-8	1. Fundamentals of Structural Design (2-0-0= 2Credits) 2. Transportation Engineering (2-0-4= 3 Credits) 3. Foundation Engineering (2-0-4 = 3 Credits) 4. Sustainable Construction and Lean Construction (3 -0-0 = 3 credits) 5. Prefabricated structures (3-0-0= 3 Credits) 6. Environmental Impact Assessment (3-0-0 = 3Credits) 7. Digital Construction Lab (0-0-4=2credits)
5.5	Sem. V&VI	B.Voc., in Civil Engineering	42	6-8	1. Design of RCC and Steel Structures (3-0-2 = 4credits) 2. Formwork Engineering (3-0-0 = 3 credits) 3. Airports and Harbor (3-0-0 = 3 credits) 4. Construction Management and Safety (3-0-0 = 3Credits) 5. Air and Noise pollution control engineering (3-0-0 =3 credits)
6.0	Sem. VII &VIII	B.Tech in Civil Engineering	35.5	--	-
		B.Tech in Civil Engineering (Minor) or B.Tech in Civil Engineering (Honors)	18	--	(Refer Annexure II & Annexure III)

List of Exit Courses										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**Credit**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ES**	
1.	PCC	24CEUC1X01	Materials and Civil Engineering	3	0	0	3	40	60	100
2.	PC-LC	24CEUC1X02	Testing of Civil Engineering Materials	0	0	4	2	60	40	100
3.	PCC	24CEUC1X03	Introduction to construction methodology and techniques	3	0	0	3	40	60	100
4.	PCC	24CEUC1X04	Introduction to construction equipments	3	0	0	3	40	60	100
5.	PC-LC	24CEUC1X05	Site Supervision work	0	0	4	2	60	40	100
6.	PC-LC	24CEUC1X06	Survey Work	0	0	4	2	60	40	100
7.	PCC	24CEUC1X07	Surveying and Geomatics	3	0	0	3	40	60	100
8.	PCC	24CEUC2X08	Fundamentals of Structural Design	2	0	0	2	40	60	100
9.	PCC	24CEUC2X09	Transportation Engineering	2	0	2	3	40	60	100
10.	PCC	24CEUC2X10	Foundation Engineering	2	0	2	3	40	60	100
11.	PCC	24CEUC2X11	Sustainable Construction and Lean Construction	3	0	0	3	40	60	100
12.	PCC	24CEUC2X12	Prefabricated structures	3	0	0	3	40	60	100
13.	PCC	24CEUC2X13	Environmental Impact Assessment	3	0	0	3	40	60	100
14.	PC-LC	24CEUC2X14	Digital Construction Lab	0	0	4	2	60	40	100
15.	PCC	24CEUC3X15	Design of RCC and Steel Structures	3	0	0	3	40	60	100
16.	PCC	24CEUC3X16	Formwork Engineering	3	0	0	3	40	60	100
17.	PCC	24CEUC3X17	Airports and Harbor	3	0	0	3	40	60	100
18.	PCC	24CEUC3X18	Construction Management and Safety	3	0	0	3	40	60	100
19.	PCC	24CEUC3X19	Air and Noise pollution control engineering	3	0	0	3	40	60	100
			Total	**42**	**0**	**20**	**52**			

Annexure – II

MINOR PROGRAMME

1. Regulations for B. Tech. Civil Engineering (Minor) Degree

a) Minor is an additional credential a student may earn 18 credits worth of additional courses in a discipline other than the major discipline of B.Tech. Civil Engineering Degree.

b) The Centre for Rural Energy and Centre for Geoinformatics offers minors that are most relevant to the B.Tech Civil Engineering degree and will prescribe specific courses necessary for earning a minor.

c) Students with a minimum of 7.00 CGPA without any "F" Grade/backlog are only allowed to register for the Minor program.

d) Students satisfying the eligibility requirements may be permitted to do one minor course with prior approval from the Director/coordinator of the Centre for Rural Technology before the commencement of the III Semester.

e) The number of credits for earning a Minor specialization is 18, with 6 courses prescribed by the Centre.

f) Courses for Minor specialization start from the 3rd Semester, and the student must register for one subject in a minor specialization course each semester.

g) After successfully completing the Minor specialization requirements, the student will be awarded a degree in "*name of the discipline*" with a minor specialization in "name of the minor specialization."

Annexure - III

HONORS PROGRAMME

1. Regulations for B. Tech. Civil Engineering (Honors) Degree

1) The B.Tech Civil Engineering with Honors programme shall be offered from the academic year 2024-2025 onwards. The students pursuing their II year III semester in the current academic year can register for the Honors programme if they fulfill the eligibility criteria.
2) For the B. Tech Civil Engineering with Honors programme, a student must earn an additional 18 credits (over and above the required 164 credits for a B.Tech Civil Engineering degree).
3) The broad guidelines for the courses of the Honors program, their respective credits weightage, and semester-wise break-up of the course are enclosed below.

S. No.	Semester	Course to be chosen from	Mode of Learning	No. of Credits
1	III	PE-1 or PE-2	Offline / SWAYAM / NPTEL or any other MOOCs	3
2	IV	PE-3		3
3	V	PE-4		3
4	VI	PE-5		3
5	VII	PE - 6		3
6	VIII	PE - 7		3
Total Credits				**18**

4) All these 18 credits must be completed within the III semester to the VIII semester only.
5) A student can opt for a B.Tech Civil Engineering degree with Honors; a student should pass all subjects on the first attempt in all the semesters till the results are announced and maintain a CGPA of 7.5 or more.
6) Prior approval of the Director/Coordinator of the Centre for Rural Technology is essential for the enrolment into the Honors programme before the commencement of III semester.

7) After registering for the Honors programme, if a student cannot pass all courses in first attempt and earn the required 18 credits, the student shall not be awarded an Honors degree. However, if the student earns all the required 164 credits of B.Tech Civil Engineering, the student will be awarded only a B.Tech Civil Engineering degree.
8) There is no transfer of credits from courses of the Honors program to regular B.Tech Civil Engineering degree courses & vice versa.
9) These 18 credits are to be earned from the additional courses offered by the Centre for Rural Technology of the Institute or from the SWAYAM / NPTEL or any other MOOC platform.
10) For the courses selected under SWAYAM / NPTEL or any other MOOC platform, the following guidelines may be followed:
    a) Before registration of SWAYAM / NPTEL or any other MOOC courses, formal approval from the Director / Coordinator of the Centre for Rural Technology is essential.
    b) The students will only meet Any expenses incurred for the SWAYAM / NPTEL or any other MOOC courses.
11) The choice to opt/take the Honors programme is purely the students' choice.
12) The student shall be given a choice of withdrawing all the courses registered and/or the credits earned for the Honors programme at any time; in that case, the student will be awarded only a B.Tech Civil Engineering degree on earning the required credits of 164.
13) A student who chooses an Honors programme is not eligible for a Minor programme and vice-versa.
14) After successful completion of the Honors programme, the student will be awarded a degree in " B.Tech Civil Engineering (Honors)"

SEMESTER I (I Year)										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
THEORY										
1.	HSMC	24ENUA1102	English for Technical Writing	2	0	2	3	40	60	100
2.	BSC	24PHUB1101	Physics (Introduction to Mechanics)	2	1	0	3	40	60	100
3.	BSC	24MAUB1101	Mathematics-I	3	1	0	4	40	60	100
4.	ESC	24CEUC1101	Basic Electrical and Electronics for Civil Engineering Applications	2	1	0	3	40	60	100
5.	ESC	24CEUS1101	Python Programming	3	0	0	3	40	60	100
6.	MNC	24PEUV0003	Hatha Yoga Education	0	0	1	0	50	0	50
PRACTICALS										
7.	BS-LC	24PHUB1102	Physics Laboratory (Introduction to Mechanics)	0	0	3	1.5	60	40	100
8.	ES-LC	24CEUC1102	Basic Electrical and Electronics for Civil Engineering Applications Laboratory	0	0	3	1.5	60	40	100
9.	ES-LC	24CEUS1102	Python Programming Laboratory	0	0	3	1.5	60	40	100
10.	ES-LC	24CEUC1103	Design Thinking	0	0	2	1	30	20	50
11.	MNC	24CEUC1104	Idea Laboratory Workshop	1	0	1	-	50	-	50
Total				**13**	**3**	**15**	**21.5**			

SEMESTER II (I YEAR)										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
THEORY										
1.	HSMC	24CEUV1201	Universal Human Values and Professional Ethics	2	1	0	3	40	60	100
2.	BSC	24MAUB1202	Mathematics II -	3	1	0	4	40	60	100
3.	BSC	24CEUB1203	Chemistry	3	0	0	3	40	60	100
4.	BSC	24CEUC1205	Biology for Engineers	3	0	0	3	40	60	100
5.	MNC	24GTUV1003	Let Us Know Gandhi	2	0	0	0	20	30	50
6.	MNC		NSS/Sports &Games	0	0	1	0	50	0	50
PRACTICALS										
7.	BS-LC	24CEUB1204	Chemistry Laboratory	0	0	3	1.5	60	40	100
8.	ES-LC	24CEUC1206	Engineering Graphics and Design	1	0	4	3	60	40	100
9.	ES-LC	24CEUC1207	Workshop Manufacturing Practices	0	0	4	2	60	40	100
10.	INT	24CEUS1203	Summer Internship-I	0	0	-	1	30	20	50
Total				**14**	**2**	**12**	**20.5**			

SEMESTER III(II YEAR)										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours Per Week**			**Credit**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
THEORY										
1.	BSC	24MAUB2103	Mathematics III	3	1	-	4	40	60	100
2.	ESC	24CEUC2108	Solid Mechanics	3	-	-	3	40	60	100
3.	ESC	24CEUC2109	Surveying and Geomatics	3	-	-	3	40	60	100
4.	PCC	24CEUC2110	Fluid Mechanics	3	-	-	3	40	60	100
5.	MOPEC	24CEUC2111	Open Elective -I	3	0	0	3	40	60	100
6.	IKS	24CEUV2102	Indian Knowledge System	2	-	-	2	40	60	100
7.	MNC	24SHSU0001	Shanthi sena	1	0	0	0	50	0	50
PRACTICALS										
8.	ES-LC	24CEUC2112	Surveying and Geomatics laboratory	-	-	3	1.5	60	40	100
9.	PC-LC	24CEUC2113	Solid Mechanics Laboratory	-	-	3	1.5	60	40	100
10.	PC-LC	24CEUC2114	Computer Aided Civil Engineering Drawing	-	-	4	2	60	40	100
11.	MNC	24EXUE2101	Village Placement Programme (VPP)	-	-	-	0	50	-	50
			Total	**18**	**1**	**10**	**23**			
Minor/Honors/Value Added Course (Optional)				**3**	**-**	**-**	**3**			

SEMESTER IV (II YEAR)										
S.NO	Category	Course Code	Course Title	Hours per Week			Credit	Marks		Total
				L	T	P		CFA	ESE	
THEORY										
1.	ESC	24CEUC2215	Material Testing & Evaluation	3	-	-	3	40	60	100
2.	PCC	24CEUC2216	Geotechnical Engineering	3	-	-	3	40	60	100
3.	PCC	24CEUC2217	Hydraulic Engineering	3	-	-	3	40	60	100
4.	PCC	24CEUC2218	Concrete Technology	3	-	-	3	40	60	100
5.	MOPEC	-	Open Elective -II	3	0	0	3	40	60	100
6.	MNC	24CEUV2203	Disability, Accessibility & Universal Design	2	-	-	0	50	-	50
PRACTICALS										
7.	ES-LC	24CEUC2219	Material Testing & Evaluation Laboratory	-	-	3	1.5	60	40	100
8.	PC-LC	24CEUC2220	Geotechnical Engineering Laboratory	-	-	3	1.5	60	40	100
9.	PC-LC	24CEUC2221	Fluid Mechanics and Hydraulic Engineering Laboratory	-	-	3	1.5	60	40	100
10.	INT	24CEUS2204	Summer Internship-II	-	-	-	1	30	20	50
11.	PC-LC	24CEUS2205	Software skill Development-I	-	-	-	1	30	20	50
			Total	**17**	**0**	**9**	**21.5**			
Minors / honors /value added courses (optional)				3	-	-	3	50	-	50

SEMESTER V (III YEAR)										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**Credit**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
THEORY										
1.	PCC	24CEUC3122	Structural Design – I (Design of Concrete Structures)	3	0	0	3	40	60	100
2.	PCC	24CEUC3123	Environmental Engineering	3	0	0	3	40	60	100
3.	PCC	24CEUC3124	Irrigation Engineering and Hydraulic Structures	3	0	0	3	40	60	100
4.	PCC	24CEUC3125	Transportation Engineering	3	0	0	3	40	60	100
5.	PCC	24CEUC3126	Structural Analysis-I	3	0	0	3	40	60	100
6.	MOPEC	24CEUC3127	Open Elective -III	3	0	0	3	40	60	100
7.	MNC	24CEUV3104	Civil Engineering Societal and Global Impact	2	0	0	0	50	-	50
PRACTICALS										
8.	PC-LC	24CEUC3128	Transportation Engineering Laboratory	0	0	3	1.5	60	40	100
9.	PC-LC	24CEUC3129	Environmental Engineering Laboratory	0	0	3	1.5	60	40	100
10.	PC-LC	24CEUS3106	Software Skill Development -II	0	0	0	1	30	20	50
			Total	**20**	**-**	**6**	**22**			
			Minors / honors /value added courses (optional)	**3**	**-**	**-**	**3**			

SEMESTER VI										
S.NO	Category	Course Code	Course Title	Hours Per Week			C	Marks		Total
				L	T	P		CFA	ESE	
THEORY										
1.	PCC	24CEUC3230	Structural Design – II (Design of Steel structures)	3	0	0	3	40	60	100
2.	PCC	24CEUC3231	Structural Analysis – II	3	1	0	4	40	60	100
3.	PEC	24CEUC32XX	Professional Elective – I	3	0	0	3	40	60	100
4.	PEC	24CEUC32XX	Professional Elective – II	3	0	0	3	40	60	100
5.	MOPEC		Open Elective -IV	3	0	0	3	40	60	100
6.	MNC	24CEUC3232	Disaster Preparedness and Planning	3	-	-	0	40	60	100
PRACTICALS										
7.	PC-LC	24CEUC3233	Structural Design Laboratory	0	0	4	2	60	40	100
8.	INT	24CEUS3207	Summer Internship III	0	0	0	1	30	20	50
9.	PC-LC	24CEUS3208.	Software Skill Development -III	0	0	0	1	30	20	50
			Total	**18**	**1**	**4**	**20**			
			Minors / honors /value added courses (optional)	**3**	**-**	**-**	**3**			

SEMESTER VII (IV YEAR)										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
THEORY										
1.	PCC	24CEUC4134	Construction Engineering & Management	3	0	0	3	40	60	100
2.	PCC	24CEUC4135	Estimation, Costing & Valuation	3	0	0	3	40	60	100
3.	PCC	24CEUC4136	Cost-effective construction Technologies	3	0	0	3	40	60	100
4.	PEC	24CEUC41XX	Professional Elective – III	3	0	0	3	40	60	100
5.	PEC	24CEUC41XX	Professional Elective – IV	3	0	0	3	40	60	100
6.	MNC	24CEUV4105	Professional Practice Law and Ethics	3	0	0	0	40	60	100
PRACTICALS										
7.	PC-LC	24CEUC4137	Irrigation and Environmental Engineering Drawing	0	0	3	1.5	60	40	100
8.	PR	24CEUC4138	Design Project	0	0	8	4	60	40	100
			Total	**18**	0	**11**	**20.5**			
			Minors / Honors /value added courses (optional)	**3**	**-**	**-**	**3**			

SEMESTER VIII (IV YEAR)										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**Credit**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	PEC	24CEUC42XX	Professional Elective- V	3	-	-	3	40	60	100
2.	PEC	24CEUC42XX	Professional Elective- VI	3	-	-	3	40	60	100
3.	PEC	24CEUC42XX	Professional Elective- VII	3	-	-	3	40	60	100
4.	PR	24CEUC4239	Major Project	-	-	12	6	150	50	200
			Total	**9**	**0**	**12**	**15**			
			Minors / honors /value added courses (optional)	**3**	**-**	**-**	**3**			

I SEMESTER

Course Title	ENGLISH FOR TECHNICAL WRITING										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24ENUA1102	HSMC	I	3	2	-	2	40	60	-	-	100

Objectives:

- To provide learning environment to practice listening, speaking, reading and writing skills.
- To assist the students to carry on the tasks and activities through guided instructions and materials.
- To effectively integrate English language learning with employability skills and training.
- To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

Unit	Content	No.of Hours
I	Vocabulary Building The concept of Word Formation – Root words from foreign languages and their use in English – Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives – Synonyms, antonyms, and standard abbreviations.	
II	Basic Writing Skills Sentence Structures – Use of phrases and clauses in sentences – Importance of proper punctuation – Creating coherence - Organizing principles of paragraphs in documents – Techniques for writing precisely	
III	Identifying Common Errors in Writing Subject-verb agreement – Noun-pronoun agreement – Misplaced modifiers – Articles – Prepositions – Redundancies – Clichés	
IV	Nature and Style of sensible Writing Describing – Defining – Classifying - Providing examples or evidence - Writing introduction and conclusion	
V	**WritingPractices** Comprehension – Précis Writing – Essay Writing	
	Oral Communication (Practice Sessions in Language Lab) Listening Comprehension – Pronunciation, Intonation, Stress and Rhythm – Common Everyday Situations: Conversations and Dialogues – Communication at Workplace – Interviews – Formal Presentations	

References	Textbook: Kumar, Kulbushan. English for Technical Professionals, 2022. (AICTE Prescribed Textbook) Reference Books: Swan, Michael. Practical English Usage, 1995. Wood, F.T. Remedial English Grammar, 2007. Zinsser, William. On Writing Well, 2001 Lyons & Heasly. Study Writing, 2006. Kumar, Sanjay & Pushpalata. Communication Skills, 2011.	

<table>
<tr><td>Course Title</td><td colspan="12">PHYSICS (INTRODUCTION TO MECHANICS)</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24PHUB1101</td><td>BSC</td><td>I</td><td>3</td><td>2</td><td>1</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Understanding the importance dynamics and Coordinate systems.
K-2: Express the knowledge of Classical Mechanics basics
K-3: Understanding of planet motions
K-4: Introduction of Dimensional motion particles</td></tr>
<tr><td>Course Objectives</td><td colspan="11">This course is designed to address the following:
Introduce the transformation of scalars and vectors.
Understand various Forces and its laws.
Elaborate the Energy equation and energy diagrams.
Understanding of frames of reference</td></tr>
</table>

Unit	**Content**	**No.of Hours**
I	Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical	10
II	Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non- conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler problem; Application: Satellite manoeuvres;	10
III	Non-inertial frames of reference; Rotating coordinate system: Five-term acceleration formula. Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum;	8
IV	Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance.	7

V	Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two- dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed — only need to show that this motion looks two-dimensional but is three-dimensional, and two-dimensional formulation fails.	10
References	**TEXTBOOKS/REFERENCES:** 1. Engineering Mechanics, 2 nd ed. — MK Harbola 2. Introduction to Mechanics — MK Verma 3. An Introduction to Mechanics — D Kleppner & R Kolenkow 4. Principles of Mechanics — JL Synge & BA Griffiths 5. Mechanics — JP Den Hartog 6. Engineering Mechanics - Dynamics, 7th ed. - JL Meriam 7. Mechanical Vibrations — JP Den Hartog 8. Theory of Vibrations with Applications — WT Thomson. End edition 1997	
Course Outcomes	**CO 1:** Understanding the importance of mechanics. **CO 2**: Express the knowledge of electromagnetic waves. **CO 3:** Know the basics of oscillations, optics and lasers. **CO4:** Understanding the importance of quantum physics. **CO 5:** Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	3	1	1	2
CO 2	1	2	1	2	3
CO 3	1	2	2	2	2
CO 4	1	1	1	2	2
CO 5	1	1	1	1	3

<table>
<tr><td>Semester</td><td>I</td><td>Course Code</td><td colspan="2">24CEUB1101</td></tr>
<tr><td>ourse Title</td><td colspan="4">MATHEMATICS- I</td></tr>
<tr><td></td><td colspan="4"></td></tr>
<tr><td>No. of. Credits</td><td>4</td><td>No. of. contact hours per week</td><td colspan="2">4</td></tr>
<tr><td>New Course/
Revised Course</td><td>--</td><td>If revised, Percentage of Revision effected (Minimum 20%)</td><td colspan="2">--</td></tr>
<tr><td>Category</td><td colspan="4">Basic Sciences (B.Tech CE)</td></tr>
<tr><td>Cognitive Levels addressed by the course</td><td colspan="4">• Understanding the concepts of curvature, evolutes and involutes (K-2)
• Knowing the fallouts of Rolle’s Theorem (K-3).
• Evaluate limits of functions (K-5).
• Finding the solutions of gradient and tangent (K-1).
• Gaining the knowledge of integration (K-4).</td></tr>
<tr><td>Course Objective</td><td colspan="4">The Course aims to impart the fundamental concepts of calculus.</td></tr>
<tr><td>Unit</td><td colspan="3">Content</td><td>No. of. Hours</td></tr>
<tr><td>I</td><td colspan="3">Basic Calculus: Curvature, evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties.</td><td>12</td></tr>
<tr><td>II</td><td colspan="3">Single-variable Calculus (Differentiation): Rolle’s Theorem, Mean value theorems and applications; Extreme values of functions; Linearapproximation; Indeterminate forms and L'Hospital's rule.</td><td>13</td></tr>
<tr><td>III</td><td colspan="3">Sequences and series: Limits of sequence of numbers, Calculation of limits, Infinite series; Tests for convergence; Powerseries, Taylor and Maclaurin series; Taylor theorem, convergence of Taylor series.</td><td>13</td></tr>
<tr><td>IV</td><td colspan="3">Multivariable Calculus (Differentiation): Limit, continuity and partial derivatives, directional derivatives, gradient, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers.</td><td>13</td></tr>
<tr><td>V</td><td colspan="3">Multivariable Calculus (Integration): Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity(constant and variable densities); Triple integrals (Cartesian), Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Gradient, curl and divergence, Theorems of Green, Gauss and Stokes.</td><td>13</td></tr>
<tr><td>References</td><td colspan="4">Text Books:
1. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, New Delhi. 2021.
Unit I: Chapters 2, 6 and 11
2. Reena Garg, Mathematics-I (Calculus & Linear Algebra),</td></tr>
</table>

	Khanna Book Publishing Co. New Delhi. 2022 Unit 2: Sections 3.1, 3.2, 3.3, 3.7 & 6.6 Unit 3: Sections 8.1-8.6, 8.8-8.10 Unit 4: Sections 12.1-12.5, 12.7-12.9 Unit 5: Sections 13.1 – 13.7, 14.1 – 14.8
	Reference Books: 1. G.B. Thomas and R.L. Finney, **Calculus and Analytic geometry**, 9th Edition, Pearson, Reprint,2002. 2. Ravish R Singh, **Engineering Mathematics,** MC Graw Hill, New Delhi. 2017. 3. Veerarajan T., **Engineering Mathematics for first year**, Tata McGraw-Hill, New Delhi, 2008. 4. N.P. Bali and Manish Goyal, **A text book of Engineering Mathematics**, Laxmi Publications,Chennai Reprint, 2008. 5. B.S. Grewal, **Higher Engineering Mathematics**, Khanna Publishers, New Delhi . 36th Edition,2010.
Course Outcomes	**CO1**: Understand curvature, evaluate integrals, and apply properties of Beta and Gamma functions. **CO2**: Apply Rolle's Theorem, analyze extreme values, and solve indeterminate forms using L'Hospital's rule. **CO3**: Compute limits, test series convergence, and expand functions into Taylor series. **CO4**: Analyze partial derivatives, gradients, and solve optimization problems using Lagrange multipliers. **CO5**: Compute double and triple integrals, apply change of variables, and utilize vector calculus theorems (Green's, Gauss's, Stokes's).

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	1	3	2	3	3
CO2	1	3	2	3	3
CO3	2	3	2	3	3
CO4	1	3	2	3	3
CO5	2	3	2	3	3

Course Title	BASIC ELECTRICAL AND ELECTRONICS FOR CIVIL ENGINEERING APPLICATIONS										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC1101	ESC	I	3	2	1	-	40	60	-	-	100
Cognitive Level	K-1: To understand the basic law concepts in AC & DC circuits. K-2: To Gain knowledge about the fundamentals of digital electronic system. K-3: To impart basic knowledge of communication engineering										
Course Objectives:	The objective of this Course is to provide the students with an introductory and broad treatment of the field of Electrical & Electronics Engineering to facilitate better understanding of the Devices, Instruments and Sensors used in Civil Engineering applications in subsequent courses.										

Unit	Content	No. of. Hours
I	**Basic Principles of Electricity Resistive Circuits -** Electric current – Electric Potential, Potential difference, voltage and EMF - Ohm's law and its limitations –Resistance– Specific Resistance – Conductance- Conductivity – effects of temperature on resistance-Temperature coefficient of Resistance. Resistances in series, parallel and series-parallel combinations - KCL& KVL. Units of electric Work, Power and Energy – Ratings of different Domestic Appliances - Calculation of Electricity bill of Domestic and commercial Consumers	9
II	**Semiconductor Diodes and Applications** - Semiconductor Diode - Ideal versus Practical, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications;	9
III	**Transistors & Amplifiers** - Bipolar Junction Transistor (BJT) – Construction, Operation, Common Base, Common Emitter and Common Collector Configurations, Distortion, Operating Point, Voltage Divider Bias Configuration; Introduction to nMOS and pMOS.	9
IV	**Operational Amplifiers and Applications -** Introduction to Op-Amp, Block Diagram, Pin Configuration of 741 Op-Amp,	9

	Characteristics of Ideal Op-Amp, Concept of Virtual Ground, Op-Amp Applications – Adder, Subtractor, Voltage Follower and Comparator; Differentiator and Integrator, Square Wave and Triangular Wave Generation.	
V	**Digital Electronics** -Boolean Algebra - Binary, Octal, Hexadecimal Number Systems, Addition, Subtraction using 1's and 2's compliment method, Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs); Functionality of Flip-Flops – SR, JK and D Flip-Flop.	9
Text/Reference Books:	1. B.L.Theraja – Electrical Technology, Vol.-1 – S.Chand & Co. Publications 2. V. K.Mehta - Introduction to Electrical Engineering 3. J.B.Gupta – A course in Electrical Technology 4. David. A. Bell (2003), Laboratory Manual for Electronic Devices and Circuits, Prentice Hall, India. 5. Santiram Kal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India. 6.Thomas L. Floyd and R. P. Jain (2009), Digital Fundamentals by Pearson Education. 7. Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), Basic Electronics – A Text-Lab. Manual, TMH 8. R. T. Paynter (2009), Introductory Electronic Devices & Circuits, Conventional Flow Version, Pearson.	
Course Out Comes	After undergoing this course students will be able to **CO1:** Familiarization with electrical devices and laws **CO2:** Understand construction of diodes and their rectifier applications. **CO3:** Appreciate the construction and working bipolar junction transistors and MOSFETs. **CO4:** Design Op-Amp IC based fundamental applications. **CO5:** Comprehend working of basic elements of digital electronics and circuits.	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	2	1	1	1	2
CO 2	1	2	1	2	1
CO 3	1	1	2	1	1
CO 4	1	1	1	2	2
CO 5	1	1	1	1	1

rse Title	PYTHON PROGRAMMING										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
24CEUS1101	**ESC**	**I**	**3**	**3**	**-**	**-**	**40**	**60**	**-**	**-**	**100**
Cognitive Level	**K-1** Recall the basic definitions and terminologies of computer. **K-2** Summarize the knowledge in programming **K-3** Prepare programs related to their field using Python language										
Course Objectives:	**The Course aims to :** • Introduce the concepts of computer basics and terminologies. • Understand various Data types and control statements in Python. • Elaborate the usage of functions in Python. • Demonstrate the Lists, Tuples & Dictionaries in Python. • Define the concepts of files and modules.										

UNIT	CONTENTS	Lecture Schedule
I	**Introduction to computer and Python programming** Introduction to Computer - Types of computer -Programming languages & History - Fundamentals of computing. Introduction to Python programming - Python Interpreter & Debugging - Applications of Python-Parts of Python programming language-Identifiers – Keywords - Statements and Expressions.	9
II	**Data types, Statements in Python** Data types - int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, operators, precedence of operators-comments-Decision control statements: if-else- if-elif- Looping Statements: for, while-continue and break statements-Illustrative Examples.	9
	Functions and Strings	
III	Functions - Built-in Functions, Function Definition and Call, Importing User-defined Module, Assert Statement, Command Line Arguments - Strings - Basic String Operations, Accessing Characters in String - String slicing and joining - String Methods - Formatting Strings.	9

IV	**Lists, Tuples & Dictionaries** Lists - Creating Lists - Basic List Operations - Indexing and Slicing Lists - Built-In Functions used on Lists - advanced list processing - List Methods - Dictionaries: Creating Dictionary - Dictionary methods - Tuples and sets - Creating Tuples - Basic Tuple Operations -Indexing and Slicing in Tuples - Tuple Methods - Sets, Set Methods.	9
V	**Files, Modules in Python** Files and exception: text files, reading and writing files-format operator; command line arguments, errors and exceptions, handling exceptions.- Modules: Creating modules, import statement - Introduction to Numpy, Pandas and Python for data visualization.	9
Total Conduct Hours		**45**

Text Books:

1. Gowrishankar S and Veena A , Introduction to Python Programming, CRC Press,Taylor & Francis Group, 2019.

References:

1. Paul Deitel and Harvey Deitel, Python for Programmers, Pearson Education, 1st Edition, 2021.
2. VamsiKurama, Python Programming: A Modern Approach, Pearson Education, 2018.
3. G Venkatesh and Madhavan Mukund, Computational Thinking: A Primer for Programmers and Data Scientists, Ist Edition, Notion Press, 2021.

Web Resources

1. https://www.w3schools.com/python/python_reference.asp
2. https://www.python.org/doc/

Course Outcomes	**On successful completion of the course, the students will be able to** **CO1:** Learn the basics of programming languages & Python. **CO2**: Develop the program using Python control flow statements. **CO3**: Decompose a Python program into functions. **CO4**: Working with lists, tuples and dictionaries in Python. **CO5**: Imparted the usage of File handlings & Implementation of modules in Python.

Mapping of COs with PSOs:

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	2	3
CO2	2	2	3	2	3
CO3	3	2	1	3	3
CO4	3	3	3	3	3
CO5	1	3	3	3	3

Course Title	HATHA YOGA EDUCATION										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24PEUV0003	MNC	I	-	-	-	1	50	-	-	-	50

The course is offering by Centre for Physical Education and yoga

Course Title	PHYSICS LABORATORY (INTRODUCTION TO MECHANICS)										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
24PHUB1102	BS-LC	I	1.5	-	-	3	-	-	60	40	100
Cognitive	K-1: Understanding the importance dynamics of rigid bodies . K-2: Express the knowledge of acoustics and ultrasonics										
Course Objectives	This course is designed to address the following: • To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties. • To induce the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.										

Unit	Content	No.of Hours
I	1. Suggested list of experiments from the following: 2. Coupled oscillators; 3. Experiments on an air-track; 4. Experiment on moment of inertia measurement, 5. Experiments with gyroscope; 6. Resonance phenomena in mechanical oscillators.	**30**
References	**TEXTBOOKS/REFERENCES:** **1.** Engineering Mechanics, 2 nd ed. — MK Harbola 2. Introduction to Mechanics — MK Verma 3. An Introduction to Mechanics — D Kleppner & R Kolenkow 4. Principles of Mechanics — JL Synge & BA Griffiths 5. Mechanics — JP Den Hartog 6. Engineering Mechanics - Dynamics, 7th ed. - JL Meriam 7. Mechanical Vibrations — JP Den Hartog 8. Theory of Vibrations with Applications — WT Thomson	
Course Out Comes	**CO-1:** To determine various moduli of elasticity and also various thermal and optical properties of materials. **CO-2:** To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	2	3	1	1	2
CO 2	1	2	1	2	2
CO 3	1	2	2	2	2
CO 4	1	1	1	2	2
CO 5	1	1	1	1	1

<table>
<tr><td>Course Title</td><td colspan="12">BASIC ELECTRICAL AND ELECTRONIC ENGINEERING LABORATORY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUC1102</td><td>ES-LC</td><td>I</td><td>1.5</td><td>-</td><td>-</td><td>3</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: State the importance dynamics of rigid bodies.
K-2: Express the knowledge of working, maintenance and servicing knowledge of electrical, electronics and domestic instruments
K-3: Understanding the importance of Laser and sensors.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">This course is designed to address the following:
• Provide knowledge for the analysis of basic electrical circuit, electrical appliances, machines with their respective characteristics.
• To induce the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination
• Students will become familiar with the circuit design using semiconductor diodes in Forward and Reverse bias,
• They will also be able to design rectifiers like half-wave, full-wave rectifiers etc. using diodes.
• The ability of circuit design with Bipolar Junction Transistor in CB, CE & CC configurations will be improved.
• The students will acquire the basic engineering technique and ability to design and analyze the circuits of Op-Amp.
• Basic concepts and Circuit design with logic gates will be developed in the students.</td></tr>
</table>

<table>
<tr><td>Unit</td><td>Content</td><td>No.of Hours</td></tr>
<tr><td></td><td>Basic Electricity – Lab
1.Characteristics of Fluorescent, Tungsten and Carbon filament lamps
2.Calibration of Ammeter and Wattmeter
3.Open circuit and short circuit test of a single phase Transformer
4.Starting, Reversing of a D.C shunt motor
5.Test and application of on single phase transformer
6.Familiarization with house wiring practice</td><td>30</td></tr>
</table>

	7.Testing and servicing domestic appliances 8.Construction and testing of series testing board **Basic Electronics – Lab** 1.Familiarization with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, millimeters etc. 2.Familiarization with measuring and testing equipment like CRO, Signal generators etc. 3.Study of I-V characteristics of Junction diodes. 4.Study of I-V characteristics of Zener diodes. 5.Study of Half and Full wave rectifiers with Regulation and Ripple factors. 6.Study of I-V characteristics of BJTs. 7.Familiarization of various functions of OPAMPs. 8.Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs. 9.Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and Differentiators. 10.Study of Logic Gates and realization of Boolean functions using Logic Gates. 11.Innovative Experiment	
Text books	1. V. Mittle & Arvind Mittal, Basic Electrical Engineering, TMH. 2. Ashfaq Hussain, Basic Electrical Engineering, S. Chand Publication 3. Chakrabarti,Nath & Chanda, Basic Electrical Engineering, TMH 4. C.L. Wadhwa, Basic Electrical Engineering, Pearson Education Reference books 5. D. Chattopadhyay, P. C. Rakshit, Electronics Fundamentals and Applications, New Age International 6. Millman & Halkias, Integrated Electronics, Tata McGraw Hill. 7. Boyelstad & Nashelsky: Electronic Devices & Circuit Theory, McGraw Hill, 1976.	

	Sedra & Smith, Microelectronics Engineering
References	1. Kothari & Nagrath, Basic Electrical Engineering, TMH 2. John D. Ryder, Electronic Fundamentals and Applications, PHI 3. J.B.Gupta, Basic Electronics, S.K. Kataria. 4. Malvino: Electronic Principle. Schilling & Belove: Electronics Circuits
Course Out Comes	Upon successful completion of the course, the students will be able to: CO1: To study multimeter and oscilloscope. CO2: To study all network theorems & laws. CO3: To observe waveforms of diode and rectifier. CO4: To study input and output characteristics of a BJT transistor CO5: To study the transfer and drain characteristics of JFET, MOSFET
Program Specific Outcomes (PSOs)	PSO1: Analyze, identify and clearly define a problem for solving user needs by selecting, creating and evaluating an electrical and electronic system through an effective project plan. PSO2: Design, implement and evaluate circuits, components and/or programs using modern techniques, skills and tools of core electrical and electronics engineering to effectively integrate secure solutions into any given environment. PSO3: Develop impactful engineering solutions by using research-based knowledge and research methodsin the fields of electrical machine, power system, electronics and other relevant fields.

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	0	2	0	1
CO 2	1	0	2	1	0
CO 3	1	2	2	1	1
CO 4	1	3	0	1	1

<table>
<tr><td>Course Title</td><td colspan="13">Python Programming Laboratory</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUS1102</td><td>ES-LC</td><td>I</td><td>1.5</td><td>-</td><td>-</td><td>3</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1 To develop higher-order programming skills in core Python.

K-2 To apply the theoretical elements of Python for problem solving

K-3 To provide hands-on training to solve data-intense real-world problems</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims to :
• Introduce the concepts of computer basics and terminologies.
• Understand various Data types and control statements in Python.
• Elaborate the usage of functions in Python.
• Demonstrate the Lists, Tuples & Dictionaries in Python.
• Define the concepts of files and modules.</td></tr>
</table>

<table>
<tr><td colspan="2">PYTHON PROGRAMMING LAB</td></tr>
<tr><td colspan="2">Write a Python Programs for the following:

1. Statements and expressions.
2. Conditionals statements.
3. Lists & Tuples.
4. Sets & Dictionaries.
5. Modules using Functions.
6. String operations.
7. File handling.
8. Exception handling.
9. Standard Libraries (Pandas, Numpy. Matplotlib).
10. Domain-specific applications.</td></tr>
<tr><td>Course Outcomes</td><td>On successful completion of the course, the students will be able to

CO1: Learn the basics of programming languages & Python.
CO2: Develop the program using Python control flow statements.
CO3: Decompose a Python program into functions.
CO4: Working with lists, tuples and dictionaries in Python.
CO5: Imparted the usage of File handlings & Implementation of modules in Python.</td></tr>
</table>

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	2	3
CO2	2	2	3	2	3
CO3	3	2	2	3	3
CO4	3	3	3	3	3
CO5	1	3	3	3	3

Course Title	DESIGN THINKING										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC1103	ES-LC	I	1	-	-	2			30	20	50
Cognitive Level	K1: Identify key concepts and terminologies related to learning, memory, emotions, and Design Thinking. K2: Understand and explain cognitive processes involved in learning and memory, and the importance of empathy and creativity K3: Apply assessment methods to evaluate different learning styles and techniques to enhance memory retention.										
Course Objectives	CO1: Analyze learning and memory processes, including cognitive functions, learning styles, and memory retention strategies. CO2: Apply emotional intelligence and creative thinking techniques to enhance problem-solving and empathy in peer interactions. CO3: Explore and implement Design Thinking principles in engineering and product development. CO4: Develop and test prototypes, applying design and engineering integration for effective product solutions. CO5: Enhance user experience through understanding individual differences and applying user-focused design strategies.										

Unit	Content	No. of Hours
I	**Understanding Learning and Memory** **Understanding the Learning Process:** Overview of how learning occurs, Cognitive processes involved in learning, Kolb’s Learning Styles, Introduction to Kolb's Experiential Learning Theory. A detailed explanation of the four learning styles: Diverging, Assimilating, Converging, and Accommodating Assessing and Interpreting, Methods to assess different learning styles, Interpretation of learning style assessments and their applications in real-life scenarios	

	Understanding the Memory Process: Explanation of how memory works: encoding, storage, and retrieval, Types of memory: sensory, short-term, and long-term memory, Problems in Retention, Common issues that affect memory retention, Factors influencing forgetting and memory decay, Memory Enhancement Techniques: Strategies to improve memory retention, Techniques such as mnemonic devices, visualization, and repetition	10
II	**Emotions and Creative Thinking** **Understanding Emotions:** Experience & Expression, Exploration of the nature of emotions, Theories of emotion and their expression, Assessing Empathy, Definition and importance of empathy, Methods to assess empathy in individuals, Application with Peers, Practical exercises to apply empathy in peer interactions, Group activities to enhance emotional intelligence and empathy, Understanding Creative Thinking Process, Steps and strategies for creative thinking, Techniques to foster creativity **Understanding Problem Solving:** Overview of problem-solving methodologies, Analytical and lateral thinking in problem solving, Testing Creative Problem Solving, Applying creative problem-solving techniques, Case studies and practical exercises	10
III	**Basics and Application of Design Thinking** Definition of Design Thinking: Comprehensive definition and principles of Design Thinking, Need for Design Thinking, Importance of Design Thinking in various fields, Benefits and applications, Objective of Design Thinking, Goals and aims of implementing Design Thinking processes, Concepts & Brainstorming, Stages of Design Thinking Process (with examples), Practical Examples of Customer Challenges, Case studies of real customer issues	8

IV	**Product Design and Prototyping** Process of Engineering Product Design: Steps in the engineering product design process, Integration of design and engineering principles, Design Thinking Approach, Applying Design Thinking to product design, Benefits of using Design Thinking in engineering, Stages of Product Design, Conceptualization, design, development, and testing Examples of Best Product Designs and Functions, Analysis of successful product designs, Key features and functions that make these designs exemplary. Assignment: Engineering Product Design - Practical assignment to design a product using the discussed principles Definition and types of prototypes: Importance of prototyping in the design process, Rapid Prototype Development Process, Steps to quickly develop and iterate prototypes, Testing, Methods and metrics for testing prototypes. Sample Example: Real-world example of a prototype and its testing process Test Group Marketing, Techniques for marketing prototypes to test groups, Gathering and analyzing user feedback	7
V	**Enhancing User Experience and Final Project** **Understanding Individual Differences & Uniqueness**: Exploration of diversity in individual characteristics, Psychological and cultural factors influencing individuality, Group Discussion and Activities, Exercises to promote understanding and appreciation of differences, Collaborative activities to enhance group cohesion, Feedback Loop, Methods to gather and analyze user feedback. **Focus on User Experience:** Prioritizing user needs and experiences in design, Addressing Ergonomic Challenges, Identifying and solving ergonomic issues in product design, User-Focused Design, Strategies for creating user-centric designs **Rapid Prototyping & Testing:** Iterative process of prototyping and testing for rapid improvements, Final Product, Steps to finalize the design and prepare for launch. Final Presentation: Presenting a project on solving a practical engineering problem through innovative product design and creative solutions	10

References	**TEXTBOOKS/REFERENCES:** Text/Reference Books: 1. E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company.	
Course Outcomes	Student will able to • Compare and classify the various learning styles and memory techniques and apply them in their engineering education • Analyze emotional experience and inspect emotional expressions to understand users better while designing innovative products • Develop new ways of creative thinking and learn the innovation cycle of the Design Thinking process for developing innovative products • Propose real-time innovative engineering product designs and choose appropriate frameworks, strategies, and techniques during prototype development • Perceive individual differences and its impact on everyday decisions and further Create a better customer experience	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	1	-	-	1
CO 2	-	2	1	-	1
CO 3	2	3	2	2	3
CO 4	3	3	3	3	3
CO 5	1	2	1	-	1

<table>
<tr><td>Course Title</td><td colspan="11">IDEA LABORATORY WORKSHOP</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUC1104</td><td>MNC</td><td>I</td><td>-</td><td>1</td><td>-</td><td>1</td><td>-</td><td>-</td><td>50</td><td>-</td><td>50</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1: Identify and recall basic concepts, tools, and processes.
K2: Explain concepts and describe processes.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">Develop practical skills in designing, fabricating, and testing electronic circuits using schematic and PCB layouts, machining, 3D scanning, and 3D printing techniques. Gain hands-on experience with laser cutting, welding, and embedded programming to create integrated projects that combine hardware, software, and custom enclosures.</td></tr>
</table>

Unit	**Laboratory Experiment**	**No.of Hours**
	1. Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit. 2. Machining of 3D geometry on soft material such as soft wood or modelling wax. 3. 3D scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer. 4. 2D profile cutting of press fit box/casing in acrylic (3 or 6 mm thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver. 5. 2D profile cutting on plywood /MDF (6-12 mm) for press fit designs. 6. Familiarity and use of welding equipment. 7. Familiarity and use of normal and wood lathe. 8. Embedded programming using Arduino and/or Raspberry Pi. 9. Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure. 10. Mini Project & Documentation	**30**
References	1. AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual), Khanna Book Publishing. 2. All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13: 978-9386173393, Khanna Book Publishing Company, New Delhi. 3. Simplified Q&A - Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Rajiv Chopra, ISBN: 978-9355380821, Khanna Book Publishing Company, New Delhi. 4. 3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi.	

	5. The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325. 6. The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product. Sean Michael Ragan (Author). Weldon Owen; 2017. ISBN-13: 978- 1681881584. 7. Make: Tools: How They Work and How to Use Them. Platt, Charles. Shroff/Maker Media. 2018. ISBN-13: 978-9352137374 8. The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill. Cambridge University Press. ISBN: 9780521809269 9. Practical Electronics for Inventors. 4th edition. Paul Sherz and Simon Monk. McGraw Hill. ISBN-13: 978-1259587542 10. Encyclopedia of Electronic Components (Volume 1, 2 and 3). Charles Platt. Shroff Publishers. ISBN-13: 978-9352131945, 978-9352131952, 978-9352133703 11. Building Scientific Apparatus. 4th edition. John H. Moore, Christopher C. Davis, Michael A. Coplan and Sandra C. Greer. Cambridge University Press. ISBN-13: 978-0521878586 12. Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill. ISBN-13: 978-1259641633 13. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education. ISBN-13 : 978-1260019193. 14. Pro GIT. 2nd edition. Scott Chacon and Ben Straub. A press. ISBN-13 : 978-1484200773 15. Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer. 16. Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010 17. Chapman W.A.J, “Workshop Technology”, Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.	
Course Out Comes	**CO1:** To learn all the skills associated with the tools and inventory related to the IDEA Lab. **CO2:** Learn useful mechanical and electronic fabrication processes. **CO3:** Learn the skills to build a useful, standalone system/ project with enclosures. **CO4:** Learn the necessary skills to create print and electronic documentation for the system/project	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	1	-	2	3	2
CO 2	1	2	2	3	3
CO 3	2	2	3	3	3
CO 4	-	-	2	1	2

II SEMESTER

Course Title	UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUV1201	HSMC	II	3	2	1	-	40	60	-	-	100
Cognitive Level	K1: Identify and recall fundamental concepts of Value Education K2: Explain the principles of harmony in personal relationships, societal values, and the interconnectedness of nature and its impact on the environment. K3: Apply the understanding of holistic harmony to develop ethical and environmentally responsible practices in professional settings.										
Course Objectives	**CO1:** Development of a holistic perspective based on self-exploration about themselves (Human beings), family, society, and nature/existence. **CO2:** Understanding of the harmony in the human being, Family, society and nature/existence **CO3:** Strengthening of self-reflection. **CO4:** Development of commitment and courage to act.										

Unit	Content	No. of Hours
I	Course Introduction - Need, Basic Guidelines, Content and Process for Value Education. Purpose and motivation for the course, recapitulation from Universal Human Values. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance 'and Experiential Validation- as the process for self-exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct Priority Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking	10

II	Understanding Harmony in the Human Being - Harmony in Myself! Understanding human being as a co-existence of the sentient 'I' and the material 'Body 'Understanding the needs of Self ('I') and 'Body' - happiness and physical facility Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct Appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease	10
III	Understanding Harmony in the Family and Society- Harmony in Human Relationship Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship Understanding the meaning of Trust; Difference between intention and Competence Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives	8
IV	Understanding Harmony in the Nature and Existence - Whole existence asCoexistence18. Understanding the harmony in the Nature Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature Understanding Existence as Co-existence of mutually interacting units in all-pervasives pace Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance innature (film "Home" can be used), pollution, depletion of resources and role of technology etc.	7

V	Implications of the above Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c.Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems Strategy for transition from the present state to Universal Human Order: a. Atthe level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations	10
References	**TEXTBOOKS/REFERENCES:** **Text Book** 1. Human Values and Professional Ethics by R Gaur, R Sangal, G P Bagaria,Excel Books,New Delhi, 2010 **REFERENCES:** 1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,1999. 2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004. 3. The Story of Stuff (Book). 4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi 5. Small is Beautiful - E. F Schumacher. 6. Slow is Beautiful - Cecile Andrews 7. Economy of Permanence - J C Kumarappa 8. Bharat Mein Angreji Raj - PanditSunderlal 9. Rediscovering India - by Dharampal 10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi 11. India Wins Freedom - Maulana Abdul Kalam Azad 12. Vivekananda - Romain Rolland (English) 13. Gandhi - Romain Rolland (English)	

Course Outcomes	CO1: Develop a comprehensive understanding of Value Education principles. CO2: Analyze and articulate the concepts of happiness, prosperity, and human aspirations, and their implications for personal and societal fulfillment. CO3: Apply the principles of harmony to relationships, family dynamics, and societal interactions. CO4: Evaluate nature's interconnectedness and human activities' impact on the environment. CO5: Integrate holistic understanding of harmony into professional ethics.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	2	1	-	1
CO 2	1	3	1	-	2
CO 3	1	3	1	-	2
CO 4	1	3	1	-	2
CO 5	1	3	1	-	2

Semester	**II**	Course Code		**24MAUB1202**
Course Title	**MATHEMATICS- II**			
No. of. Credits	**4**	No. of. contact hours per week		**4**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)		--
Category	**Basic Sciences (B.Tech CE)**			
Cognitive Levels addressed by the course	• Kno the concept of matrix theory (K-1) • Apply various methods for solving first order differential equations (K-3) • Evaluate the integrals of complex valued functions (K-5)			
Course Objective	The Course aims to gain basic knowledge about matrices, differential equations and complex functions			
Unit	**Content**		**No. of. Hours**	
I	Matrices: Linear Systems of Equations; Linear Independence; Rank of a Matrix; Determinant, Inverse of a matrix,rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices;Determinants; Eigenvalues and eigenvectors; Orthogonal transformation; Diagonalization of matrices; Cayley-Hamilton Theorem.		13	
II	First order ordinary differential equations: Exact, linear and Bernoulli's equations. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.		13	
III	Ordinary differential equations of higher orders: Second order linear differential equations with variable coefficients: Euler-Cauchy equations, solution by variation of parameters; Power series solutions: Legendre's equations and Legendre polynomials.		13	
IV	Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Mobius transformations and their properties.		13	
V	Complex Variable – Integration**:** Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluationof definite integral involving sine and cosine		12	
References	**Text Book:** 1. Garima Singh, **Mathematics-II**, Khanna Book Publishing Co, New Delhi 2022.			

	Unit 1: Sections 7.3-7.5, 7.7, 7.8, 8.1-8.4 Unit 2: Sections 1.4, 1.5 Unit 3: Sections 2.5, 2.6, 2.10, 5.1, 5.3, 5.4, 5.5 Unit 4: Sections 13.3 – 13.7, 17.1 – 17.3 Unit 5: Sections 14.1 – 14.4, 15.2 – 15.4, 16.1 – 16.4
	Reference Books: 1. Reena Garg, **Advanced Engineering Mathematics**, Khanna Book Publishing Company, New Delhi 2021. 2. Erwin Kreyszig, **Advanced Engineering Mathematics**, 10th Edition, John Wiley & Sons, 2006. 3. Veerarajan T., **Engineering Mathematics for first year**, Tata McGraw-Hill, New Delhi, 2008. 4. B.S. Grewal, **Higher Engineering Mathematics**, 36th Edition, Khanna Publishers, New Delhi. 2010. 5. Ravish R Singh, **Engineering Mathematics**, MC Graw Hill, New Delhi . 2017.
Course Outcomes	**CO1:** Understand linear systems, matrix properties, determinants, eigenvalues, and orthogonal transformations. **CO2:** Solve first-order ordinary differential equations, including exact, linear, and Bernoulli's equations. **CO3:** Solve higher-order ordinary differential equations, such as Euler-Cauchy equations and power series solutions. **CO4:** Apply complex variable differentiation and integration techniques, including Cauchy-Riemann equations and the residue theorem. **CO5:** Utilize contour integrals, Cauchy's integral formulas, series expansions, and analyse analytic functions in complex analysis.

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	1	3	2	3	3
CO2	1	3	2	3	3
CO3	2	3	2	3	3
CO4	1	3	2	3	3
CO5	2	3	2	3	3

Course Title	CHEMISTRY											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUB1203	BSC	II	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces. K-2: Understanding of spectroscopic techniques and applications. K-3: Importance of periodic properties and stereochemistry and understanding of organic reactions.										
Course Objectives	This course is designed to address the following: • To emphasize the importance of atomic and molecular structure • To give an overview of various types of spectroscopic techniques and applications • To stress the importance of corrosion of the use of free energy in chemical equilibria • To make the students understand the need of periodic properties & stereochemistry • To make the students understand the basics of organic reactions and their uses.										

Unit	Content	No. of Hours
I	**Atomic and Molecular Structure** Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic molecules. Pi-molecular orbitals of butadiene and benzene. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties.	10
II	**Spectroscopic techniques and applications** Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence spectroscopy and its applications. Vibrational and rotational spectroscopy of diatomic molecules. Nuclear magnetic resonance spectroscopy and its applications. Surface characterization techniques. **Intermolecular forces and potential energy surfaces** Ionic, dipolar and van Der Walls interactions. Equations of state real gases and critical phenomena.	10
III	**Use of free energy in chemical equilibria** Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid-base, oxidation-reduction and solubility equilibria. Water chemistry, Corrosion.	8

IV	**Periodic properties** Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries.	7
V	**Stereochemistry** Representations of 3-dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transition metal compounds. **Organic reactions and synthesis of a drug molecule** Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.	10
References	**TEXTBOOKS/REFERENCES:** 1. AICTE's Prescribed Textbook: Chemistry – I with Lab Manual, Khanna Book Publishing. 2. Engineering Chemistry, by Manisha Agrawal. 3. University chemistry, by B. H. Mahan 4. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane 5. Fundamentals of Molecular Spectroscopy, by C. N. Banwell 6. Physical Chemistry, by P. W. Atkins 7. Principles of Physical Chemistry, by Puri, Sharma and Pathania, 46^{th} Edition 8. Modern Inorganic Chemistry by R. D. Madan, 3^{rd} Edition 9. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan 10. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	1	1	1	2
CO 2	1	2	1	2	1
CO 3	1	1	2	1	1
CO 4	1	1	1	2	2
CO 5	1	1	1	1	1

Course Title	Biology for Engineers										
Course Code	Category	Sem	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC1205	BSC	II	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1 Knowledge and Comprehension K-2 Application K-3 Analysis, Synthesis and Evaluation										
Course Objectives	The course aims • to enhance the student's knowledge in historical aspects and development of biology • to acquire an overall knowledge on cell biology and biomolecules of life. • to develop knowledge in enzymology and metabolism • to make the students knowledgeable on genetic concepts • to give an overview on various aspects in microbiology										

UNIT	Content	No.of Hours
I	**Unit: I Introduction to Biology** (Source NPTEL course) Concept, history and scope of biology. Hierarchy of life forms at phenomenological level. Three major kingdoms of life and Classification systems in biology and relationships. Classification of life forms based on cellularity- unicellular to multi-cellular organisms; ultrastructure- prokaryotes & eukaryotes; energy and carbon utilization –Autotrophs, hetrotrophs,& lithotrophs; ammonia excretion – aminotelic & uricoteliec; and Habitat- acquatic & terrestrial. Model organisms for the biological studies – *Escherichia coli, Saccharomyces cerevisiae, Drosophila melanogaster,and Arabidopsis thaliana*	10
II	**Unit: II Cell Biology and Biomolecules of Life** Cell as basic unit of life – cell growth, reproduction & cellular differentiation. Molecules of life – DNA & RNA as genetic materials. DNA structure- from single stranded to double helix to nucleosomes. Concept of Genetic code. Universality and degeneracy of genetic code. Proteins-structure and function. Structure and properties of carbohydrates and lipids.	10
III	**Unit: III Enzymology and Cellular metabolism** Enzyme classification - Mechanism of enzyme action - Metabolic concepts –Anabolism & Catabolism - Thermodynamics as applied to biological systems. Exothermic and Endothermic versus endergonic and exergonic reactions. Cellular respiration and energetics - Glycolysis, Krebs Cycle, & ETC.	10

<table>
<tr><td>IV</td><td>Unit: IV Genetics
Mental's laws - Concept of allele, recessiveness and dominance. Concept of segregation and independent assortment. Gene interaction- Epistasis & complementation's - Concept of mapping of phenotype to genes. Genetic disorders in humans. Concept of Meiotic and Mitotic cell divisions.</td><td>08</td></tr>
<tr><td>V</td><td>Unit: V Microbiology
Historical and recent developments in microbiology: Invention of microscopy; Principle and applications of various microscopy: Simple, Compound, Dark field, Phase contrast, Fluorescence and Electron microscopy. Microbial taxonomy & phylogeny and Concepts of species and strains. Microbiological culture techniques - culture media, sterilization and culture methods. concepts of spontaneous generation, biogenesis, germ theory of disease, and fermentation.</td><td>10</td></tr>
<tr><td>References</td><td colspan="2">References
1. Biology: A global approach: Campbell. N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P. K; Bruening, G; Doi, R.H. John Wiley and sons
3. Principles of Biochemistry (V Edition), By Nelson, D.L.; and Cox, M. M. W. H. Freeman and company
4. Jeffery C. Pommerville (2016). Alcamo's Fundamentals of Microbiology (Third Edition). Jones and Bartlett Learning. LLC, Burlington, MA 01803.
5. Wiley, J.M., Sherwood, L.M. and Wodverton, C.J. 2009. Prescott's principle of Microbiology, Mc Graw Hill, New York.
6. Pelczar, Jr., Michael, Chan E. C. S. and Kreig Noel. 2000. Microbiology. 5th Ed. Tata McGraw Hill Book Company</td></tr>
<tr><td>Course Outcomes</td><td colspan="2">After studying the course, the student will be able to:
CO1: Describe how biological observation of 18th century that lead to major discoveries and Covey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine
CO2: Identify DNA as a genetic material in the molecular basis of information transfer.
CO3: Classify enzymes and distinguish between different mechanisms of enzyme action and Apply thermodynamic principles to biological systems.
CO4: Highlight the concepts of recessiveness and dominance during the passage of genetic materials from parent to offspring
CO5: Identify and classify microorganisms.</td></tr>
</table>

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	1	1	1	1	1
CO 2	-	1	1	1	1
CO 3	-	1	1	1	1
CO 4	-	1	1	1	1
CO 5	1	1	1	1	1

Course Title	LET US KNOW GANDHI											
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
24GTUV1003	MNC	II	-	2	-	-	50	-	-	-	50

The course is offering by Dept. of Gandhian Thought and peace Science

Course Title	NSS / SPORTS & GAMES										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
-	MNC	II	-	-	-	1	-	-	50	-	50
The above courses are offering by the concern department											

<table>
<tr><td>Course Title</td><td colspan="11">CHEMISTRY LABORATORY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUB1204</td><td>BS-LC</td><td>II</td><td>1.5</td><td>-</td><td>-</td><td>3</td><td></td><td></td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive</td><td colspan="11">K-1: To develop skill in titrimetric analysis,

K-2: To gain practical knowledge in oil analysis and</td></tr>
<tr><td>Course Objectives</td><td colspan="11">This course is designed to address the following:

• To enhance knowledge in basic principles of titrimetry,
• To develop skill in titrimetric analysis,
• To gain practical knowledge in oil analysis and
• To develop skill in identification of water quality parameters.</td></tr>
</table>

Unit	Content	No.of Hours
I	**List of Experiments:** 1. Determination of total hardness in water 2. Thin Layer Chromatography 3. Determination of chloride content of water 4. Saponification /acid value of an oil 5. Synthesis of a polymer/drug 6. Determination of amount and type of alkalinity in water 7. Determination of the rate constant of a reaction 8. Determination of cell constant and conductance of solutions 9. Potentiometry - determination of redox potentials and emfs 10. Saponification /acid value of an oil	**30**
References	**Text Books &Reference Books:** 1. University chemistry, by B. H. Mahan 2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane 3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell 4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan 5. Physical Chemistry, by P. W. Atkins 6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp	

Course Out Comes	**CO1** The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. **CO2** Estimate rate constants of reactions from concentration of reactants/products as a function of time **CO3** Measure conductance of solutions, redox potentials, chloride content of water, etc **CO4** Synthesize a small drug molecule	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	3	1	1	2
CO 2	1	2	1	2	2
CO 3	1	2	2	2	2
CO 4	1	1	1	2	2

<table>
<tr><td>Course Title</td><td colspan="13">ENGINEERING GRAPHICS & DESIGN</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUC1206</td><td>ES-LC</td><td>II</td><td>3</td><td>1</td><td>-</td><td>4</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Define the visual aspects of engineering design.
K-2: Describe solid modelling.
K-4: Create computer-aided geometric design.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">To make student conversant
• With the construction of geometrical figures
• With the projection of 1D, 2D and 3D elements
• With the sectioning of solids and development of surfaces
• With the Preparation and interpretation of building drawing</td></tr>
</table>

Unit	Content	No.of Hours
I	Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales; Orthographic Projections covering, Principles of Orthographic Projections- Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;	**10**
II	Projections of Regular Solids, covering those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)	**10**
III	Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	**9**

IV	Overview of Computer Graphics covering, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: 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.; Isometric Views of lines, Planes, Simple and compound Solids];Customisation& CAD Drawing 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 and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate inputentry methods to draw straight lines, Applying various ways of drawing circles;	**10**
V	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 (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling; Demonstration of a simple team design project that illustrates Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	**9**

References	Text Books &Reference Books: 1. AICTE's Prescribed Textbook: Engineering Graphics & Design Khanna Book Publishing. 2. Jain, Maheshwari, Gautam (2021), Engineering Graphics & Design, Khanna Book Publishing. 3. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House 4. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics,Pearson Education. 5. Agrawal B. &Agrawal C. M. (2012), Engineering Graphics, TMH Publication 6. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers 7. (Corresponding set of) CAD Software Theory and User Manuals	
Course Out Comes	CO 1 Introduction to engineering design and its place in society CO 2 Exposure to the visual aspects of engineering design CO 3 Exposure to engineering graphics standards CO 4 Exposure to solid modelling CO 5 Exposure to computer-aided geometric design CO 6 Exposure to creating working drawings CO 7 Exposure to engineering communication	

Mapping of Cos with PSOs &POs:

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	3	1	1	2
CO 2	1	2	1	2	2
CO 3	1	2	2	2	2
CO 4	1	1	1	2	2
CO 5	1	1	1	1	1

<table>
<tr><td>Course Title</td><td colspan="11">WORKSHOP MANUFACTURING PRACTICES</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUC1207</td><td>ES-LC</td><td>II</td><td>2</td><td>-</td><td>-</td><td>4</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-3: Apply practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.

K-4: Weld various joints in steel plates using arc welding work</td></tr>
<tr><td>Course</td><td colspan="11">This course is designed to address the following:

• Understanding different manufacturing techniques and their relative advantages/disadvantages with respect to different applications

• The selection of a suitable technique for meeting a specific fabrication need

• Acquire a minimum practical skill with respect to the different manufacturing methods and develop the confidence to design & fabricate small components for</td></tr>
</table>

Unit	**Content**	**No.of Hours**
	Lectures & videos 1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 lectures) 2. CNC machining, Additive manufacturing (1 lecture) 3. Fitting operations & power tools (1 lecture) 4. Carpentry (1 lecture) 5. Plastic moulding, glass cutting (1 lecture) 6. Metal casting (1 lecture) 7. Welding (arc welding & gas welding), brazing (2 lecture) 8. [More hours can be given to Welding for Civil Engineering students as they may have to deal with Steel structures fabrication and erection; 3D Printing is an evolving manufacturing technology and merits some lectures and hands-on training.	5

	Work Shop Practice 1.Machine shop 2. Fitting shop 3. Carpentry 5. Welding shop 6. Casting 7. Smithy 8. Plastic moulding& Glass Cutting	25
References	1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai. 2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002. 3. Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" PearsonEducation, 2008. 4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice HallIndia, 1998. 5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017	
Course Out Comes	**CO 1** : Upon completion of this laboratory course, students will be able to fabricate components with their own hands. **CO 2** : They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes. **CO 3** : By assembling different components, they will be able to produce small devices of their interest. **CO 4** : Weld various joints in steel plates using arc welding work; **CO 5** : Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly common household equipments.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	1	1	1	2
CO 2	1	2	1	2	1
CO 3	1	1	2	1	1
CO 4	1	1	1	2	2
CO 5	1	1	1	1	1

Course Title	SUMMER INTERNSHIP I										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUS1203	INT	II	1	-	-	-	-	-	30	20	50
Cognitive Level	K1: To familiar with field practices K2: To understand the industrial practices										
Course Objectives	• To train the students in field work so as to have a firsthand knowledge of practical problems in carrying out engineering tasks. • To develop skills in facing and solving the field problems.										

Unit	Content	No.of Hours
	The Summer Internship shall carry 100 marks and shall be evaluated through internal assessment only. The students individually undertake training in reputed civil engineering companies for the specified duration. At the end of internship, the candidate shall submit a certificate from the organization where he / she has undergone training and a brief report. EVALUATION PROCEDURE 1. Evaluation of In plant Training Report : 40 marks 2. Viva voce examination : 60 marks	**30 days**
Course Out Comes	• At the end of the course the student will be able to understand • The intricacies of implementation textbook knowledge into practice • The concepts of developments and implementation of new techniques	

III - SEMESTER

Semester	**III**	Course Code	**24CEUB2103**
Course Title	**MATHEMATICS – III**		
No. of. Credits	**4**	No. of. contact hours per week	**4**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	**Basic Sciences - (B.Tech CE)**		
Scope of the Course	Basic Skill		
Cognitive Levels addressed by the course	• Knowing eigenvalues of matrices and related concepts (K-1) • Solving problems using Laplace and Fourier transforms (K-2) • Finding solutions of partial differential equations (K-3) • Applying vector calculus techniques to solve real life problems (K-3)		
Course Objective	The course aims to impart fundamental concepts on matrices, vector calculus, partial differential equations.		

Unit	Content	No. of. Hours
I	Matrices**:** Eigen values Eigen vectors of square matrix, Cayley Hamilton's theorem and function of square matrix, Diagonalization of square matrix, Minimal Polynomial and Minimal Equation of a Matrix.	12
II	Basic concepts of vector calculus**:** Scalar and vector point function, differential operator, gradient, directional derivative, physical meaning of gradient, divergence, curl and Laplacian with their properties; Line Integrals, Surface Integral, Volume integral; Green's theorem, Gauss' theorem and Stoke's theorem (without proof) & its application.	13
III	Fourier Series**:** Definition of Fourier series, Orthogonal and orthonormal functions, Fourier series with arbitrary period, in particular periodic function with period 2, Fourier series of even and odd function, Half range Fourier series.	13
IV	Partial Differential Equation: Second order PDE of mathematical physics (Heat, wave and Laplace equation, one dimensional with standard boundary conditions) Solution by separation of variable method using Fourier series.	13
V	Laplace Transforms and Applications: Introduction, Definition of th Laplace transform, Useful properties of Laplace transform (withou proof): Linearity, Frist shifting theorem, Multiplication and division b t, transforms of derivatives and integrals, Laplace transform of Period function, Inverse Laplace transform using partial fraction ar Convolution theorem (without proof), Application to solve initial ar boundary value problem involving ordinary differential equations wi one dependent and constant coefficient.	13

References	**Text Books:** 1. Ravish R Singh, **Engineering Mathematics**, McGraw Hill, New Delhi. 2017. Unit I: Chapter 1, Sections 1.13 -1.16 Unit 2: Chapter 8, Sections 8.1 - 8.6 Unit 3: Chapter 9, Sections 9.1 – 9.4 2. B.S. Grewal, **Higher Engineering Mathematics**, Khanna Publishers, New Delhi. 44^{th} Edition, 2010. Unit 4: Chapter 18, Sections 18.3 – 18. 5, 18.7 Unit 5: Chapter 21, Sections 21.1 – 21.5, 21.7 – 21.10, 21.12, 21.14
	Reference Books: 1) Kreyszing E, **Advanced Engineering Mathematics**, John Wiley & Sons, Singapore, Int. Student Ed. 1995. 2) Wiley C. R, **Advanced Engineering Mathematics**, McGraw Hill Inc., New York Ed, 1993. 3) Peter V. O'Neil, **Advanced Engineering Mathematics**, Cengage India Edition, 2012.
Course outcomes	On completion of the course students should be able to CO1: Solve problems using matrices. CO2: **Apply vector calculus concepts to find length, surface area and volume.** CO3: **Compute Fourier series of functions.** CO4: **Solve second-order partial differential equations using different methods.** CO5: **Apply Laplace transforms to solve initial and boundary value problems.**

Mapping of COs with Pos

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	1	3	2	3	3
CO2	1	3	2	3	3
CO3	2	3	2	3	3
CO4	1	3	2	3	3
CO5	2	3	2	3	3

Course Title	SOLID MECHANICS											
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUC2108	ESC	III	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Define the basic concepts and definitions of stress strain, shearforce ,bending moment properties of solid sections K-2: Understand the concept of simple Bending and torsion and hoop stress. K-3: solve the problems related to solids stress , shear force, bending moment, simple bending, torsion and hoop stress for thin cylinders										
Course Objectives	1. To develop the theoretical basis about the stress, strain and elastic modulus concepts in various components. 2. To understand the mechanical behavior of materials. 3. To familiarize about finding shear force, bending moment, deflection and slopes in various types of beams with different load conditions 4. To enable students to solve practical problems related to springs and shafts										

Unit	Content	No.of Hours
I	Simple Stresses and Strains- Concept of stress and strain, stress and strain diagrams, Elasticity and plasticity – Types of stresses and strains, Hooke's law– stress – strain diagram for mild steel – Working stress – Factor of safety – Bars of varying section – composite bars-Thermal stresses. Elastic Constants- Lateral strain, Poisson's ratio and volumetric strain –and the relationship between them.	8
II	Bending moment and Shear Force Diagrams- BM and SF diagrams for cantilevers simply supported beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.	9
III	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.	8
IV	Analysis of Truss: Truss – Types- Analysis-methods of joints – methods of sections – graphical method. Deflection of truss: By Williot Mohr's diagram.	6

V	Springs-Types-Analysis of closed-coiled-helical springs. Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.	5
References	1. Strength of Materials R.K.Rajput 2. Strength of Materials R.K.Bansal 3. Strength of Materials R.S.Khurmi 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. 6. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004	
Text book	❖ 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 ❖ Laboratory Manual of Testing Materials - William Kendrick Hall ❖ Mechanics of Materials - Ferdinand P. Beer, E. RusselJhonston Jr., John T. DEwolf– TMH 2002. ❖ Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.	
Course Out Comes	On completion of the course, students should be able to do CO1: Understand the basic principles of stress-strain concepts CO2: calculate the shearforce and bending moments of various types of beams CO3: Understand the principles of simple bending and its theory CO4: Able to find the torsion for cylinders and shaft CO5: Understand the internal pressure of the cylindrical section and its stress	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	2	3	1	1	2
CO 2	3	1	3	1	2
CO 3	1	1	1	1	1
CO 4	1	2	1	1	1
CO 5	1	2	1	1	1

Course Title	SURVEYING AND GEOMATICS										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC2109	ESC	III	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-To recall the basics terms of surveying K2- To understand the concept of advanced modern surveying techniques K3- To understand the concept of photogrammetry and remote sensing K4- To solve the problems in advanced and modern surveying										
Course Objectives	• The main objective of this course to Introduce knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities • Translate the knowledge gained for the implementation of Civil infrastructure facilities • Relate the knowledge on Surveying to the new frontiers of science like curve setting, Electronic Distance Measurement, Global Positioning System, Photogrammetry and Remote Sensing.										

Unit	Content	No.of Hours
I	Introduction to Surveying: Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, 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. Triangulation and Trilateration**:** Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods -triangulation - network- Signals. Baseline - choices - instruments and accessories - extension of base lines - corrections - Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric leveling - Axis single corrections.	11
II	Curves Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves	11
	Modern Field Survey Systems: Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments,	

III	Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.	11
IV	Photogrammetry Surveying : Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereoplotting instruments, mosaics, map substitutes.	10
V	Remote Sensing: Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.	10
References	**Text/Reference Books:** 1. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006. 2. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011 3. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010 4. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002. 5. Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications, 2001. 6. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.	
Course Out Comes	The course will enable the students to: CO1: To know the basics, importance, and methods of Triangulation and Trilateration. CO2: To study the various curves and its applications in surveying CO3: To study the Advance Surveying Instruments like EDM Total Station and GPS. CO4: To Study the Concept of Aerial Photo Interpretation. CO5: To learn the importance and different aspects of remote sensing and digital image processing	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	1	-	1	2
CO 2	2	1	1	2	2
CO 3	2	-	-	3	1
CO 4	1	-	-	3	1
CO 5	1	2	-	3	1

Course Title	FLUID MECHANICS										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CF A	ESE	-	-	
24CEUC2110	PCC	III	3	3	-	-	40	60	-	-	100

Cognitive Level	K-1: Define the basic concepts and definitions of fluid properties K-2: Describe the concept of fluid statics, kinematics and dynamics. K-3: Solve the problems related to Dimensional Analysis.
Course objectives	The Course aims • To introduce the concepts of fluid mechanics useful in Civil Engineering applications. • To provides a first level exposure to the students to fluid statics, kinematics and dynamics. • Measurement of pressure, computations of hydrostatic forceson structural components and the concepts of Buoyancy. • To analyse engineering problems involving fluids – such as those dealing with pipe flow, open channel flow, jets, turbines and pumps, dams and spillways, culverts, river and groundwater flow - with a mechanistic perspective. • To prepare a student to build a good fundamental background useful in the application-intensive courses covering hydraulics, hydraulic machinery and hydrology in later semesters.

Unit	Content	No.of Hours
I	Basic Concepts and Definitions – 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.	**7**
II	Fluid Statics - 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 floatingbodies.	**7**
III	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 -	8

	dimensional continuity equations in Cartesian coordinates.	
IV	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.	7
v	Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π-Theorem.	7
References	**Text Books &Reference Books:** 8. Subramanya K., "Flow in Open channels", Tata McGraw-Hill Publishing Company, 2019. 9. Bansal R.K., "Fluid Mechanics & Hydraulic Machines", Lakshmi publications, 2019. 10. Kumar K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi. 11. Jain A.K., "Fluid Mechanics (including Hydraulic Machines)", Khanna Publishers, 8th edition, 1995. 12. RangaRaju, K.G., "Flow through Open Channels", Tata McGraw-Hill. 13. VenTe Chow, "Open-Channel Hydraulics", McGraw-H: Q Book company, 1996. 14. Ramamirtham S., "Fluid Mechanics, Hydraulics and Fluid Machines", DhanpatRai& Sons, Delhi, 1998. 15. John A. Roberson, "Hydraulic Engineering", Jaico Publishing House, 1998.	
Course Out Comes	On completion of the course, students should be able to do **CO1:** Understand the broad principles of fluid statics, kinematics and dynamics **CO2:** Understand definitions of the basic terms used in fluid mechanics **CO3:** Understand the classifications of fluid flow **CO4:** Be able to apply the continuity, momentum and energy principles **CO5:** Be able to apply dimensional analysis	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	3	1	1	1
CO 2	2	1	2	2	2
CO 3	1	1	2	2	2
CO 4	1	1	1	2	1
CO 5	1	1	1	1	1

<table>
<tr><th colspan="3">Course Title</th><th colspan="11">OPEN ELECTIVE – I</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>24CEUC2111</td><td>MOPEC</td><td>III</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>--</td><td>-</td><td>100</td></tr>
<tr><td colspan="12">The students should undergone the courses which are offered by the Centre for Rural Technology , GRI</td></tr>
</table>

<table>
<tr><td>Course Title</td><th colspan="11">INDIAN KNOWLEDGE SYSTEM</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>24CEUV2102</td><td>IKS</td><td>III</td><td>2</td><td>2</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td colspan="12">The students should undergone the courses which are offered by the Department of ----------</td></tr>
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<table>
<tr><td>Course Title</td><th colspan="11">SHANTI SENA</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>-</td><td>MNC</td><td>III</td><td>-</td><td>1</td><td>-</td><td>-</td><td>50</td><td>-</td><td>-</td><td>-</td><td>50</td></tr>
<tr><td colspan="12">The students should undergone the courses which are offered by the Department of Gandhian thought and Peace Science</td></tr>
</table>

<table>
<tr><td>Course Title</td><td colspan="12">SURVEYING AND GEOMATICS LABORATORY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUC2112</td><td>ES-LC</td><td>III</td><td>1.5</td><td>-</td><td>-</td><td>3</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- recall the basics terms of surveying
K2- Describe the concept of control surveying and adjustments
K3-Demonstrate the concept of modern surveying techniques
K4- Examine the concept of Route surveying, Hydrographic surveying and Field Astronomical surveying.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The main objective of this course to
• Introduce knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities
• Translate the knowledge gained for the implementation of Civil infrastructure facilities
• Relate the knowledge on Surveying to the new frontiers of science like curve setting, Electronic Distance Measurement, Global Positioning System, Route survey, Hydrographic survey and Field Astronomical survey.</td></tr>
<tr><td></td><td colspan="11">List of suggested Exercises.
1. Finding Pace Value of Surveyor using Chaining and Ranging
2. Computation of Included Angle after adjustment of Local Attraction
3. Plain metric Mapping of an Area using Plane Table Surveying (Radiation, Intersection)
4. Fly leveling using dumpy level.
5. Fly leveling using tilting level.
6. Transfer of Bench Mark using Check Levelling.
7. Contour Mapping using Grid Levelling.
8. Study of Theodolite and Angle Observations by Repetition.
9. Observation of Angles by method of Reiteration and Station Adjustment.
10. Establishment of Horizontal Control Points by Traversing.
11. Preparation of Planimetric Map using Stadia Tacheometry.
12. Determination of horizontal distance and height difference between two points by Tangential Tacheometry.
13. Estimation of Sun Rise/ Sun Set time using Sun Observations
14. Determination of Azimuth by Ex-Meridian observation.</td></tr>
<tr><td>Survey Camp</td><td colspan="11">Two weeks Survey Camp will be conducted during summer vacation and students do survey exercises in camp area also prepare detailed report.</td></tr>
</table>

References	**Text/Reference Books:** 1. T.P.Kanetkar and S.V.Kulkarni, Surveying and Levelling, Parts1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008 2. Dr.B.C.Punmia, Ashok K.Jain and Arun K Jain, Surveying Vol.I & II, Lakshmi Publications Pvt Ltd, New Delhi, 2005. 3. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010 Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015. 4. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012. 5. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004 S.K. Roy, Fundamentals of Surveying, Second Edition, Prentice' Hall of India 2004
Course Out Comes	The course will enable the students to: CO1:Introduce the rudiments of various surveying and its principles. CO2: Imparts concepts of Theodolite Surveying and computation of area and volume calculation. CO3: Understand the procedure for establishing horizontal and vertical control and its adjustment procedure. CO4: Introduce the basics of Electronic Surveying and Photogrammetry Surveying CO5: Initiate the knowledge in Route surveying, Hydrographic surveying and Field Astronomical surveying.

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	1	2	1	2
CO 2	2	1	1	2	2
CO 3	2	1	2	3	1
CO 4	1	2	2	3	1
CO 5	1	2	1	3	1

<table>
<tr><td>COURSE TITLE</td><td colspan="12">SOLID MECHANICS LABORATORY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>-</td><td>-</td></tr>
<tr><td>24CEUC2113</td><td>PC-LC</td><td>III</td><td>1.5</td><td>-</td><td>-</td><td>3</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Define the basic concepts and definitions of stress strain, shear force ,bending moment and properties of Materials
K-2: Describe the mechanical properties of materials subjected to simple Bending and torsion and Shear.
K-3: solve the problems related to the field of specialization</td></tr>
<tr><td>Course Objectives</td><td colspan="11">1. To develop the practical knowledge in the stress, strain and elastic modulus concepts of materials.
2. To understand the mechanical behavior of materials.
3. To familiarize about finding tensile strength, modulus of elasticity, compression strength, shear force, bending moment, deflection in various types of materials with different load conditions
4. To enable students to solve practical problems related to material quality</td></tr>
<tr><td>Practical's</td><td colspan="11">List of Experiments:
➢ Tension test
➢ Bending tests on simply supported beam and Cantilever beam.
➢ Compression test on concrete
➢ Impact test
➢ Shear test
➢ Investigation of Hook's law that is the proportional relation between force andstretching in elastic deformation.
➢ Determination of torsion and deflection,
➢ Measurement of forces on supports in statically determinate beam,
➢ Determination of shear forces in beams,
➢ Determination of bending moments in beams,
➢ Measurement of deflections in statically determinate beam,
➢ Measurement of strain in a bar
➢ Bend test steel bar;
➢ Yield/tensile strength of steel bar;</td></tr>
<tr><td>References</td><td colspan="11">1. Strength of Materials R.K.Rajput
2. Strength of Materials R.K.Bansal
3. Strength of Materials R.S.Khurmi
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.
6. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
❖ 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</td></tr>
</table>

	❖ Laboratory Manual of Testing Materials - William Kendrick Hall ❖ Mechanics of Materials - Ferdinand P. Beer, E. RusselJhonston Jr., John T. DEwolf– TMH 2002. ❖ Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.
Course Outcomes	On completion of the course, students should be able to do CO1: Understand the basic principles of stress-strain concepts of materials CO2: calculate the material strengths against tension, compression and shear CO3: Understand the principles of quality of materials CO4: Able to select the suitable materials for the construction CO5: understand the mechanical properties of materials

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	2	3	1	1	2
CO 2	3	1	3	1	2
CO 3	1	1	1	1	1
CO 4	1	2	1	1	1
CO 5	1	2	1	1	1

Course Title	COMPUTER AIDED CIVIL ENGINEERING DRAWING											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC2114	PC-LC		2	-	-	4	-	-	60	40	100

Cognitive Level	K1: To get exposure to national standards relating to technical drawings using Computer Aided Design and Drafting practice K2: Do a detailed study of an engineering artefact K3: Develop drawings for conventional structures using practical norms.
Course Objectives	This course is designed to address the following: • Develop Parametric design and the conventions of formal engineering drawing • Produce and interpret 2D & 3D drawings • Communicate a design idea/concept graphically/ visually • Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3Dsoftware. • Get a Detailed study of an engineering artifact

Unit	Content	No.of Hours
I	**INTRODUCTION:** Introduction to computer aided drawing (Drafting Software), coordinate systems, and reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.	10
II	**Dimensioning and Methods:** Dimensioning, Dimension methods, Unit of Dimensioning, Arrangement of Dimensioning, Symbols and Shapes used for dimensioning, Rules for dimensioning & Exercises, Simple Orthographic Views-Exercises	8
III	**SYMBOLS AND SIGN CONVENTIONS:** Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols;	7
IV	**BUILDING DRAWING:** Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity	10

<table>
<tr><td>V</td><td>List of titles for the Drawing Practice:
1. Buildings with load bearing walls including details of doors and windows.
2. RCC framed structures-Residential
3. Reinforcement drawings for typical slabs, beams, columns and spread footings.
4. Industrial buildings –Steel- roof Trusses</td><td>15</td></tr>
<tr><td>References</td><td>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. Sham Tickoo Swapna D (2009), “AUTOCAD for Engineers and Designers”, Pearson Education,
4. Venugopal (2007), “Engineering Drawing and Graphics + AUTOCAD”, New Age International Pvt. Ltd.,
5. Balagopal and Prabhu (1987), “Building Drawing and Detailing”, Spades publishing KDR building, Calicut,
6. (Corresponding set of) CAD Software Theory and User Manuals.
7. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd New Asian.
8. Sikka, V.B. (2013), A Course in Civil Engineering Drawing, .K.Kataria& Sons</td><td></td></tr>
<tr><td>Course Out Comes</td><td>CO 1: To develop graphical skills for communicating concepts, ideas and designs of engineering products graphically/ visually as well as understand another person’s designs,
CO 2: To get exposure to national standards relating to technical drawings using Computer Aided Design and Drafting practice
CO 3: Develop Parametric design and the conventions of formal engineering drawing
CO 4: Produce and interpret 2D & 3D drawings
CO 5: Examine a design critically and with understanding of CAD The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
CO 6: Do a detailed study of an engineering artefact
CO 7: Develop drawings for conventional structures using practical norms.</td><td></td></tr>
</table>

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	0	2	0	1
CO 2	1	0	2	1	0
CO 3	1	2	2	1	1
CO 4	1	3	0	1	1
CO 5	2	1	1	0	2
CO 6	2	2	1	1	2
CO 7	2	1	2	2	2

<table>
<tr><td>Course Title</td><td colspan="13">VILLAGE PLACEMENT PROGRAMME</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24EXUE2101</td><td>MNC</td><td>III</td><td>-</td><td>-</td><td>-</td><td>-</td><td>50</td><td>-</td><td>-</td><td>-</td><td>50</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1 : Analyse the issues in the village
K2: Asses the various village problem related to Civil Engineering
K3 : Develop the master plan to resolve the village problems.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• Students can be able to understand the reality of people life style and their needs
• Students can be able to develop the plan for Civil Engineering issues</td></tr>
</table>

IV SEMESTER

Course Title		MATERIAL TESTING AND EVALUATION									
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC2215	ESC	IV	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-Remember the various types of Engineering materials used for construction K2- Describe the various properties of Engineering Materials K3-Compute the strength of the Building Materials										
Course Objectives	The Course aims to • Make measurements of behavior of various materials used in Civil Engineering. • Provide physical observations to complement concepts learnt • Introduce experimental procedures and common measurement instruments, equipment, devices. • Exposure to a variety of established material testing procedures and techniques • Different methods of evaluation and inferences drawn from observations										

Unit	Content	No.of Hours
I	**Unit 1:** Introduction to Engineering Materials covering, Cements, M-Sand, Concrete(plain, reinforced and steel fibre/glass fibre-reinforced, light-weight concrete, High Performance Concrete, Polymer Concrete) Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics, 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 of these	11
II	**Unit 2:** Introduction to Material Testing covering, What is the “Material Engineering”?;Mechanical behavior 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;	11
III	**Unit 3**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	11
IV	**Unit 4:** Standard Testing & Evaluation Procedures covering, Laboratory for	10

	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.	
V	**Unit 5: Tutorials** from the above Units covering, understanding i) Tests & testing of bricks, ii) Tests & testing of sand, iii) Tests & testing of concrete, iv) Tests & testing of soils, v) Tests& testing of bitumen & bituminous mixes, vi) Tests & testing of polymers and polymer based materials, vii) Tests & testing of metals & viii) Tests & testing of other special materials, composites and cementitious materials. Explanation of mechanical behavior of these materials.	10
References	1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. Butterworth- Heinemann 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 (2011), Mechanical Testing of Engineering Materials, Cognella 5. E.N. Dowling (1993), Mechanical Behaviour of Materials, Prentice Hall International Edition 6. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards (post 2000) 7. Related papers published in international journals	
Course Out Comes	One should be able to: CO1: Explain the fundamental (engineering related) issues surrounding the use of the following Civil Engineering Materials; concrete, structural steel (and other important structural metals), timber, masonry, ceramics and composites, and polymers. CO2: Explain the production and/or manufacturing methods associated with these materials. CO3: Explain, describe and characterise some of the variability and uncertainty associated with these materials. CO4: Describe and critically analyse the limitations of these materials under various loading circumstances. CO5: Communicate their learned knowledge of these materials.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	3	1	1	1
CO 2	2	1	2	2	2
CO 3	1	1	2	2	2
CO 4	1	1	1	2	1
CO 5	1	1	1	1	1

Course Title	GEOTECHNICAL ENGINEERING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUC2216	PCC	IV	3	3	-	-	40	60	-	-	100

Cognitive Level	K 1 - Recall the formation and types of soil. K 2 – Describe the soil phase relation, properties, consistency of soil and soil classification systems. K 3 - Compute the consolidation time and shear strength of soil.
Course objectives	The Course aims • To explain what Geotechnical Engineering is and how it is important to civil engineering • To explain how three phase system is used in soil and how are soil properties estimated using three phase system • To explain role of water in soil behavior and how soil stresses, permeability and quantity of seepage including flow net are estimated • To determine shear parameters and stress changes in soil due to foundation loads • To estimate the magnitude and time-rate of settlement due to consolidation • To emphasize the importance of soil investigations including destructive and nondestructive methods

Unit	Content	No.of Hours
I	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. Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsion balance method, nuclear method, alcohol method and sensors. Specific gravity by density bottle method, pycnometer method, measuring flask method. Unit weight by water displacement method, submerged weight method, core-cutter method, sand-replacement method. Grain size distribution – sieve analysis – sedimentation analysis	7

II	Unit 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. Identification: field identification of soils, general characteristics of soil in different groups. Soil water-types-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. 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.	8
III	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. Stresses in soils – Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart. Contact pressure under rigid and flexible area, computation of displacements from elastic theory.	7
IV	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. Shear Strength - Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD	7

	tests, pore-pressure measurement, computation of effective shear strength parameters. unconfined compression test, vane shear test	
V	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. problems ,Slope protection measures.	7
References	1. Soil Mechanics by Craig R.F., Chapman & Hall 2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons 3. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ 4. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning 5. Principles of Foundation Engineering, by Braja M. Das, Cengage Learning 6. Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy 7. Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri. 8. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy 9. Soil Mechanics and foundation Engineering by Dr.B.C.Punmia	
Course Outcomes	CO1: Understand the different types of soil, various phase diagrams and derive various phase relationships of the soil; behavior of soils CO2: Determine the permeability of soils, seepage quantities and pore water pressures CO3: Evaluate the stiffness of soil using shear strength parameters CO4: Understand various methods for computation of factor of safety for infinite and finite slopes CO5: Specify a strategy for site investigation to identify the soil deposits and determine the depth and spatial extent within the ground;	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	2	3	2
CO 2	3	3	3	2	3
CO 3	3	3	3	2	3
CO 4	2	3	3	2	3
CO 5	3	2	2	3	2

Course Title	HYDRAULIC ENGINEERING								
Course Code	Category	Sem.	Credits	Hours			Theory		Total
				L	T	P	CFA	ESE	100
24CEUC2217	PCC	IV	3	3	-	-	40	60	
Cognitive Level	K-1: Identify the flow patterns and its properties K-2: Evaluate boundary layer and similitude analysis. K-3: classify the pipe losses and pipe network analysis methods								
Course Objectives	The Course aims • To introduce the various hydraulic engineering problems like open channel flows and hydraulic machines. • students should be able to relate the theory and practice of problems in hydraulic engineering								

Unit	Content	No.of Hours
I	Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates.Stoke's law, Measurement of viscosity.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.	11
II	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. Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problem.	11
III	Introduction to Open Channel Flow-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 "n-	11

	.Most economical section of channel. Computation of Uniform flow, Normal depth.	
IV	Non-Uniform Flow- Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer. 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 by graphical, numerical and analytical approaches. Direct Step method, Graphical Integration method and Direct integration method. 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. Energy dissipation and other uses, surge as a moving hydraulic jump. Positive and negative surges. Dynamics of Fluid Flow- Momentum principle, applications: Force on plates, pipe bends, moments of momentum equation,	10
V	Flow through Pipes: Loss of head through pipes, Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control measures, branching of pipes, three reservoir problem. 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 modeling in water resources engineering.	10
References	1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard BookHouse 2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGrawHill. 3. Open channel Flow, K. Subramanya, Tata McGrawHill. 4. Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill. 5. Burnside, C.D., "*Electromagnetic Distance Measurement*," Beekman Publishers, 1971.	
Course Outcomes	On completion of the course, students should be able to do **CO1:** The students will be able to apply their knowledge of fluid mechanics in addressing problems in open channels. **CO2:** They will possess the skills to solve problems	

	in uniform, gradually and rapidly varied flows in steady state conditions. **CO3:** They will have knowledge in flow through pipes and pipe networks **CO4:** They will have knowledge in hydraulic machineries (pumps and turbines). **CO5 :** The students will be able to solve the fluid dynamics problems	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	3	1	1	2
CO 2	1	2	1	2	2
CO 3	1	2	2	2	2
CO 4	1	1	1	2	2
CO 5	1	1	1	1	1

Course Title	CONCRETE TECHNOLOGY										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC2218	PCC	IV	3	3	-	-	40	60	-	-	100
Cognitive Level	K 1 – Define the properties of ingredients of concrete K 2 –Report the concrete and various applications relative to satisfy the requirement in the construction field K 3 – Design the suitable concrete mix proportions and maintenance of structures.										
Course Objectives	• To study the behaviour of concrete at its fresh and hardened state • Study about the concrete mix design by various methods to reach the target strength. • Study the various types of concretes and concreting methods and their specific applications • Ensure the quality control while testing/sampling and acceptance criteria.										

Unit	Content	No.of Hours
I	**Properties of ingredients:** Properties of coarse and fine aggregates and their influence on concrete, types of cement and their use, Grades of ordinary Portland cement, Portland pozzolana cement, rapid hardening Portland cement, hydrophobic cement, low heat Portland cement and sulphate resisting Portland cement as per relevant I.S. codes. Types of aggregates and their properties. Testing of aggregates as per relevant IS Codes.	8
II	**Properties of different types of concrete:** Concrete for structural work, light weight concrete, high density concrete, biological concrete, workability, durability and strength requirements, effect of w/c ratio on properties of fresh and hardened concrete, acceptability criteria, laboratory testing of fresh and hardened concrete, Fire resistant properties of hardened concrete.	8
III	**Concreting methods:** Process of manufacturing of concrete, transportation, placing, compaction and curing of concrete. Extreme weather concreting, special concreting methods, vacuum dewatering– underwater concrete, special form work., Plum Concrete, Self-Compacting Concrete **Admixtures:** Plasticizers, Retarders, Accelerators and other Admixtures, Test on Admixtures, Chemistry and Compatibility with concrete. GGBS fly Ash, Metakaolin, Silica Fumes, crush sand,	8
IV	**Ready mix concrete:** Requirements of ready-mix concrete, properties of RMC, transit mixer details, Automation, instrumentation and Layout of RMC plant. **Concrete mix design:** Mix Design for compressive strength by I.S.	8

	methods, road note method, British method, ACI Method, Mix design for flexural strength.	
V	**Concrete for repairs and rehabilitation of structures:** High Performance concrete, Polymer Concrete, Fiber Reinforced Concrete, Light weight concrete and its manufacture, Polymer Impregnated Cement Concrete, Polymer Modified cement concrete and Ferro Cement, Special Tests for concrete used for repairs and rehabilitation. **Non-destructive testing of concrete:** Rebound hammer test, Ultrasonic pulse velocity test, Magnetic particle testing, Liquid penetration testing, Visual testing, Laser Testing methods, Leak Testing, Impact echo test, carbonation test, Half-cell potentiometer and corrosion of steel, Core test and relevant provisions of I.S. codes.	8
References	**Text Books** 1. M.L. Gambhir, Concrete Technology, McGraw Hill Book Company, Fifth Edition, 2017. (ISBN- 1259062554, 978-1259062551). 2. M.S. Shetty, Concrete Technology, Theory and Practice, S. Chand Publication, Sixth Edition, 2018. (ISBN-9788121900034,978-8121900034) 3. B.L. Gupta and A. Gupta, Concrete Technology, Jain Book Agency, 2013. (ISBN- 8180140407,978-8180140402). **Recommended Reading** 1. A.R. Santhakumar, Concrete Technology, Oxford University Press, New Delhi, 2018. (ISBN-9780195671537, 978-0195671537). 2. A.M. Neville, Properties of Concrete, Pearson Publication, London, 2012. (ISBN- 978-0273755807, 9780273755807). 3. IS 10262-(2009) Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards,New Delhi, 2009. 4. IS10262 (2009), Mix Design 5. IS269 (2015), Ordinary Portland Cement (33 Grade). 6. IS12269 (2013), Ordinary Portland Cement (53 Grade). 7. IS650 (1991), Specification of Standard Sand. 8. IS383 (1970), Specification for Coarse and Fineaggregate.	
Course Out Comes	CO1: Understand the different types of cements and concretes CO2: Determine the qualities of concrete ingredients CO3: Evaluate the strength and durability parameters of concrete CO4: Understand various methods for computation of strength of concrete materials and concrete CO5: Specify the suitability of the cement and concrete with respect to the strength and grades.	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	2	2	3	2
CO 2	3	3	3	2	3
CO 3	3	3	3	2	3
CO 4	2	3	3	2	3
CO 5	3	2	2	3	2

<table>
<tr><td colspan="2">Course Title</td><td colspan="11">OPEN ELECTIVE – II</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td></td><td>MOPEC</td><td>IV</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>--</td><td>-</td><td>100</td></tr>
<tr><td colspan="12">• The students should undergone the courses which are offered by the other schools/Departments/ Centres of GRI</td></tr>
</table>

Course Title	DISABILITY, ACCESSIBILITY & UNIVERSAL DESIGN										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUV2203	MNC	IV	0	2	-	-	50	-	-	-	50
Cognitive Level	K1: Knowledge of Diversity, Inclusion, and Disability K2: Application of Accessibility Concepts and Guidelines K3: Analysis and Integration of Universal Design Principles										
Course Objectives	Course Objective: 1. To sensitize about the basic concepts of disability, diversity and accessibility in builtenvironments. 2. To introduce the key policy frameworks for legislative and technical perspectives ofaccess. 3. To develop an insight into the understanding of universal design as an approach										

Unit	Content	No.of Hours
I	**Human Diversity and Inclusion:** An Introductory Perspective Understanding concepts of diversity (may please include all vulnerable groups), inclusion, need and significance, impacts **Understanding Disability:** Definitions, Models and Prevalence Theory of disability, Various concepts andmodels, Prevalence	7
II	Disability Types andEnvironmental Needs - I Disability Classification, functional limitations and key coping strategies in the environment For eg. Physical, Movement disabilities, Vision Impairments Disability andEnvironmental Needs - II Hearing, Speech, Cognitive, Learning and other disabilities as per the RPWD Act2016 **Exercises: Role play, user interaction/interviews, observations, and engagement of user**	7

	experts	
III	**Environmental Barriers:** Introduction & Classification Physical, Social, Institutional Barriers in diverse National and International Contexts. Introduction to Harmonized Guidelines, NBC, and other exemplary international codes and guidelines Basics of Accessibility Codes and their review	7
IV	Legislative Policies andPrograms UNCRPD, RPWD Act, 2016, SDGs, and urbandevelopment programs in Indian context other international and national policies **Review Discussions / Presentations on Experiential understanding ofbarriers, legislative rights and technical**	8
V	**Universal Design Theory** Evolution from Barrier Free Environment to Universal Design,Definitions, Associated Myths andConcepts, Terminologies and Perspectives **Universal Design Principles** (International, Indian, UD goals) and theircriteria **Universal Design Case Studies** Built Environment Case Studies from Urban Transportation and other contexts like periurban, rural settings. **Case Study Reviews or a Small Design Exercise on Universal Design reflecting the understanding of Universal Design**	7
References	1. Mismatch: How Inclusion Shapes Design by Kat Holmes 2. The Senses: Design Beyond Vision by Brian Glenney 3. Building for Everyone: Expand Your Market with Design Practices from Google's Product Inclusion Team by Kat Holmes 4. Inclusive Design for a Digital World: Designing with Accessibility in Mind (Design Thinking) by Paul Watson 5. Designing for Everyone: How to Make Your Products Accessible to People with Disabilities by Brian MacDonald	

Course Out Comes	CO1: Demonstrate a comprehensive understanding of diversity, inclusion, and disability concepts CO2: Apply principles of disability and environmental needs and propose effective strategies for improving accessibility. CO3: Critically evaluate and address physical, social, and institutional barriers	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	3	1	-	2
CO 2	2	3	2	2	3
CO 3	1	3	2	-	3

<table>
<tr><td colspan="2">Course Title</td><td colspan="10">MATERIAL TESTING AND EVALUATION LABORATORY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUC2219</td><td>ES-LC</td><td>IV</td><td>1.5</td><td>0</td><td>0</td><td>3</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1-Remember the various types of Engineering materials used for construction
K2- Understand the various properties of Engineering Materials
K3-Compute the strength of the Building Materials</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims to
• Make measurements of behavior of various materials used in Civil Engineering.
• Provide physical observations to complement concepts learnt
• Introduce experimental procedures and common measurement instruments, equipment, devices.
• Exposure to a variety of established material testing procedures and techniques
• Different methods of evaluation and inferences drawn from observations</td></tr>
</table>

Unit	List of Experiment	No.of Hours
	1. Gradation of coarse and fine aggregates 2. Different corresponding tests and need/application of these tests in design and quality control 3. Tensile Strength of materials & concrete composites 4. Compressive strength test on aggregates 5. Tension I - Elastic Behaviour of metals & materials 6. Tension II - Failure of Common Materials 7. Direct Shear - Frictional Behaviour 8. Concrete I - Early Age Properties 9. Concrete II - Compression and Indirect Tension 10. Compression – Directionality 11. Soil Classification 12. Consolidation and Strength Tests 13. Tension III - Heat Treatment 14. Torsion test 15. Hardness tests (Brinnel’s and Rockwell) 16. Tests on closely coiled and open coiled springs 17. Theories of Failure and Corroboration with Experiments 18. Tests on unmodified bitumen and modified binders with polymers 19. Bituminous Mix Design and Tests on bituminous mixes - Marshall method **20.** Concrete Mix Design as per BIS	36

References	1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. Butterworth- Heinemann 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 (2011), Mechanical Testing of Engineering Materials, Cognella 5. E.N. Dowling (1993), Mechanical Behaviour of Materials, Prentice Hall International Edition 6. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards (post 2000) 7. Related papers published in international journals	
Course Outcomes	One should be able to: CO1: Explain the fundamental (engineering related) issues surrounding the use of the following Civil Engineering Materials; concrete, structural steel (and other important structural metals), timber, masonry, ceramics and composites, and polymers. CO2: Explain the production and/or manufacturing methods associated with these materials. CO3: Explain, describe and characterise some of the variability and uncertainty associated with these materials. CO4: Describe and critically analyse the limitations of these materials under various loading circumstances. CO5: Communicate their learned knowledge of these materials.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	3	1	1	1
CO 2	2	1	2	2	2
CO 3	1	1	2	2	2
CO 4	1	1	1	2	1
CO 5	1	1	1	1	1

Course Title	GEOTECHNICAL ENGINEERING LABORATORY											
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC2220	PC-LC	IV	1.5	-	-	3	-	-	60	40	100

Cognitive Level	K 1 –Define the basic definitions and soil phase relation. K 2 – Calculate the engineering properties of soil. K 3 – Analyse and interpret the data for identify the soil.
Course objectives	The Course aims • To explain what Geotechnical Engineering is and how it is important to civil engineering • To explain how three phase system is used in soil and how are soil properties estimated using three phase system • To explain role of water in soil behavior and how soil stresses, permeability and quantity of seepage including flow net are estimated • To determine shear parameters and stress changes in soil due to foundation loads • To estimate the magnitude and time-rate of settlement due to consolidation

Unit	Content	No.of Hours
	Geotechnical Engineering Laboratory 1. Natural moisture content determination using Oven Drying, Pycnometer, Speedy Moisture meter and torsion balance methods. 2. Specific gravity of Soil. 3. Relative density of Sand. 4. Field Density using Core Cutter method. 5. Field Density using Sand replacement method. 6. Field Density using Water displacement method. 7. Grain size distribution by Sieve Analysis. 8. Grain size distribution by Hydrometer Analysis. 9. Consistency limits by Liquid limit 10. Consistency limits by Plastic limit 11. Consistency limits by Shrinkage limit. 12. Permeability test using Constant-head test method. 13. Permeability test using Falling-head method. 14. Compaction test: Standard Proctor test/ Modified Proctor test. 15. Direct Shear Test (Demonstration Only) 16. Consolidation Test. 17. Unconfined Compression Strength Test. 18. Triaxial Test. 19. Vane shear test	**36**

References	1. Soil Mechanics by Craig R.F., Chapman & Hall 2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons 3. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ 4. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning 5. Principles of Foundation Engineering, by Braja M. Das, Cengage Learning 6. Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy 7. Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri. 8. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy 9. Soil Mechanics and foundation Engineering by Dr.B.C.Punmia	
Course Outcomes	CO1: Understand the different types of soil, various phase diagrams and derive various phase relationships of the soil; behavior of soils CO2: Determine the permeability of soils, seepage quantities and pore water pressures CO3: Evaluate the stiffness of soil using shear strength parameters CO4: Understand various methods for computation Moisture content CO5: Specify a strategy to identify the soil properties and to find the suitability of soil for the construction purpose	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	2	3	2
CO 2	3	3	3	2	3
CO 3	3	3	3	2	3
CO 4	2	3	3	2	3
CO 5	3	2	2	3	2

<table>
<tr><td rowspan="2">Course Title</td><td colspan="13">FLUID MECHANICS AND HYDRAULIC ENGINEERING LABORATORY</td></tr>
<tr></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUC2221</td><td>PC-LC</td><td>IV</td><td>1.5</td><td>-</td><td>-</td><td>3</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Determine the co efficient of discharge
K-2: Measure friction factor in pipes
K-3: Determine the performance characteristics of turbines</td></tr>
<tr><td>Course Objectives</td><td colspan="11">1. Calibrate flow measuring devices
2. Determine the force exerted by jet of water on vanes
3. Measure discharge and head losses in pipes
4. Understand the fluid flow pattern</td></tr>
</table>

<table>
<tr><td>Unit</td><td>List of Experiments</td><td>No. of Hours</td></tr>
<tr><td></td><td>1. Verification of Bernoulli’s equation.
2. Determination of C_d for Venturimeter and Orifice meter.
3. Determination of hydraulic coefficients of orifice by Constant head method and variable head method
4. Determination of hydraulic coefficients of Mouth piece by Constant head method and variable head method
5. Determination of hydraulic coefficients of mouth piece by variable head method
6. Determination of C_d for Rectangular notch.
7. Determination of C_d for Triangular notch.
8. Determination of C_d for Venturiflume
9. Determination of C_d for Ogee and Broad crested weir
10. Determination of force exerted by a jet on flat and curved vanes.
11. Determination of efficiency of Pelton wheel turbine
12. Determination of efficiency of Francis turbine
13. Determination of efficiency of Kaplan turbine
14. Determination of efficiency of centrifugal pump
15. Determination of efficiency of Reciprocating pump
16. Determination of Major Loss in Pipes
17. Determination of Minor losses in pipe due to sudden enlargement, sudden contraction and bend.</td><td>36</td></tr>
<tr><td>Text book/ References</td><td>1. Sarbjit Singh , Experiments in Fluid Mechanics - PHI Pvt. Ltd.- New Delhi
2. Mohd. Kaleem Khan, “Fluid Mechanics and Machinery”, Oxford University Press
3. Hydraulics and Fluid Mechanics’ – Dr. P.N. Modi& D r S.M. Seth, Standard Book House New Delhi.2009Edition</td><td></td></tr>
<tr><td>Course Outcomes</td><td>After successfully studying this course, students will:
CO1: Properties of fluids and the use of various instruments for fluid flow measurement.</td><td></td></tr>
</table>

	CO2: Working of hydraulic machines under various conditions of working and their characteristics.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	-	2	3
CO2	2	2	1	2	3
CO3	1	1	-	2	2
CO4	2	3	3	3	3
CO5	2	2	2	1	2

<table>
<tr><th>Course Title</th><th colspan="11">SUMMER INTERNSHIP-II</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>24CEUS2204</td><td>INT</td><td>IV</td><td>1</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>30</td><td>20</td><td>50</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1: apply the knowledge in real issues related to civil engineering
K2 : Analyze the issues of civil engineering field
K3: Develop the plan for civil engineering related sectors</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The main aim is
• To train the students in field work so as to have a firsthand knowledge of practical problems in carrying out engineering tasks.
• To develop skills in facing and solving the field problems.</td></tr>
</table>

OUTCOMES:

- At the end of the course the student will be able to understand
- The intricacies of implementation textbook knowledge into practice
- The concepts of developments and implementation of new techniques

The Summer Internship shall carry 100 marks and shall be evaluated through internal assessment only. The students individually undertake training in reputed civil engineering companies for the specified duration. At the end of internship, the candidate shall submit a certificate from the organization where he / she has undergone training and a brief report.

EVALUATION PROCEDURE

1. Evaluation of In plant Training Report : 40 marks
2. Viva voce examination : 60 marks

<table>
<tr><td>Course Title</td><td colspan="12">SOFTWARE SKILL DEVELOPMENT -II</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUS2205</td><td>PC-LC</td><td>IV</td><td>1</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>30</td><td>20</td><td>50</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1 : Apply the knowledge in the software
K2: Analyze the various software usages and applications
K3: Develop the various models related to civil engineering</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The main of this course is
• The student can acquire knowledge of latest software
• They can able to develop the digital format of the solution related to civil engineering</td></tr>
</table>

V SEMESTER

Course Title	STRUCTURAL DESIGN I (DESIGN OF CONCRETE STRUCTURES)										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC3122	PCC	V	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- Recall the basic properties of material and its inter relationships K2- Explain the design concepts of various super structure elements K3- Analyse the design concepts of various sub structure elements K4- Design the beam, column, staircase, and footing of structures										
Course Objectives	1. To introduce the Role of structural engineer in structural design and the methods of design 2. To understand the limit state concepts and the analysis as per IS 3. To introduce the moment capacity of section and the design of slab as per IS codes 4. To understand the concepts and design of column 5. To know the soil properties and footing design										

Unit	Content	No.of Hours
I	**INTRODUCTION** Role of structural engineer in structural design- Objectives of Structural Design –Plain and Reinforced Concrete - Structural Systems -elements of structures-Purpose of Codes -Basic Code for Design-Properties of Concrete and steel-Loading Standards-Loading combinations - methods of design- Introduction for Working Stress Method, Ultimate Load Method (ULM), Limit States Method (LSM), Code Recommendations for Limit States Design - Permissible Stresses-Factor of Safety.	8
II	**DESIGN OF BEAMS** Limit State Concepts- Assumptions- Characteristic Strength and Load, Partial Safety Factors- Limit state analysis and design of singly reinforced, doubly reinforced, T and L beam -Limit state analysis and design of section for shear and torsion, bond, anchorage and development length. Limit state Design of RC members for combined Bending, Shear and Torsion.	7
III	**DESIGN OF SLABS AND STAIRCASE** Introduction, critical bending moment in slabs, moment capacity of a section and design procedure. Limit state Analysis and Design of one way, Two-way and continuous slabs as per IS codal provisions-introduction about staircase- Types of Staircases – Design of dog-legged Staircase.	7

IV	**DESIGN OF COLUMNS** Introduction, buckling of columns, Types of columns –Axially Loaded columns – Design of short Rectangular, Square and circular columns –Design of Slender columns- Design for Uniaxial and Biaxial bending using Column Curves-design of spiral reinforced concrete column.	7
V	**DESIGN OF FOOTINGS** Introduction, Types of Footings, Concepts of Proportioning of footings and foundations based on soil properties -Soil Pressures for footings- General Design Considerations and Code Requirements, Design of wall footing –Design of Isolated footings with axial and eccentric loading-– Design of Combined Rectangular footing for two columns only.	7
References	**Text Books** 1 Jain and Jaikrishna, Plain and Reinforced Concrete, Vol. I, Nemchand Brothers. (ISBN-8185240086/978-8185240084). 2 V. L. Shah and Karve, Limit State Design - Reinforced Concrete Structures Publications. (ISBN-9788190371711/8190371711). **Reference Books** 1. P. Dayaratnam, Design of Reinforced Concrete Structures, Oxford & IBH. (ISBN-9789386479785/9386479788). 2. P.D. Arthur and V. Ramkrishnan, Ultimate Strength Design for Structural Concrete, Wheeler &Co. Pvt Ltd. (ISBN- 0273403230, 978-0273403234). 3. B.P. Hughes, Limit State Theory for Reinforced Concrete Design, Pitman. (ISBN- 0273010239, 978-0273010234). 4. IS456 (2000), Plain and Reinforced Concrete. 5. IS 875 (1987), Part I- Design Loads (Other than earthquake) for Buildings and Structures (Dead Loads). 6. IS 875 (1987), Part II- Design Loads (Other than earthquake) for Buildings and Structures (Imposed Loads). 7. IS 875 (2015), Part III- Design Loads (Other than earthquake) for Buildings and Structures (Wind Loads). 8. IS 875 (1987), Part IV- Design Loads (Other than earthquake) for Buildings and Structures (Snow Loads).	

	9. SP16, IS456:1978 “Design Aids for Reinforced Concrete to Bureau of Indian Standards, New Delhi, 1999Co., New York, 1972	
Course Outcomes	After learning the course the students should be able to CO1: know the concepts of Working stress method, Ultimate load method and Limit state method. Design philosophy CO2: Understanding principles of limit state design and design of singly and doubly reinforced beams and slab. CO3 :Design slab and staircase. CO4 :Design of flexural members CO5: Analyze and design for shear, torsion bond and Redistribution of moments in continuous reinforced concrete beam ,Design column and footing	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	3	-	2
CO 2	2	2	3	-	2
CO 3	2	1	3	-	2
CO 4	2	1	3	-	2
CO 5	3	2	3	-	3

Course Title	ENVIRONMENTAL ENGINEERING											
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUC3123	PCC	V	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Identify the suitable water and sewage treatment process K-2: Explain the solid waste management systems K-3: Apply the environmental legislations for various pollution control.										
Course Objectives	The Course aims • To introduce the various water quality standards, sources of water and treatment process of water. • To understand the importance of sewage treatment. • To improve their knowledge to control the air and noise pollution. • To know about the Environmental legislations.										

Unit	Content	No. of Hours
I	Water: -Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design. Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes	9
II	Sewage- Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.	9
III	Air - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air	9

	pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations Noise- Basic concept, measurement and various control methods.	
IV	Solid waste management-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods-Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.	9
V	Building Plumbing-Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Pressure reducing valves, Break pressure tanks, Storage tanks, building drainage for high rise buildings, various kinds of fixtures and fittings used. Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.	9
Text book/ References	1. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey. 2. Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008. 3. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw - Hill International Editions, New York 1985. 4. MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi. 5. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi. 6. Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999 7. Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication 8. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.	
Course Outcomes	After successfully studying this course, students will: ➢ Understand the impact of humans on environment and environment on humans ➢ Be able to identify and value the effect of the pollutants on the environment: atmosphere, water and soil.	

	➢ Be able to plan strategies to control, reduce and monitor pollution. ➢ Be able to select the most appropriate technique for the treatment of water, wastewater solid waste and contaminated air. ➢ Be conversant with basic environmental legislation.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	-	2	3
CO2	2	2	1	2	3
CO3	1	1	-	2	2
CO4	2	3	3	3	3
CO5	2	2	2	1	2

<table>
<tr><td rowspan="2">Course Title</td><td colspan="12">IRRIGATION ENGINEERING & HYDRAULIC STRUCTURES</td></tr>
</table>

<table>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUC3124</td><td>PCC</td><td>V</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1: Identify the importance of Irrigation and related components.
K2: Understand the various methods of irrigation and various Irrigation structures
K3: classify the various structures based on necessity.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
1. The student is exposed to different phases in irrigation practices and Planning and management of irrigation
2. Further they will be imparted required knowledge on Irrigation storage and distribution canal system
3. Understand the water management for Irrigation .</td></tr>
</table>

Unit	Content	No.of Hours
I	Introduction- Definition, Necessity, Scope, Benefits and ill effects of irrigation, Types of irrigation schemes, Social and environmental considerations, Irrigation development in India.Water Requirement of Crops- Soil-water-plant relation-field capacity, wilting point, available water, consumptive use, Irrigation requirements – Net irrigation requirement, Field irrigation requirement, Gross Irrigation requirement, Soil moisture extraction pattern, Frequency of irrigation, Principal Indian crops, Gross command area, Culturable command area, Intensity of irrigation	9
II	Irrigation methods: surface and subsurface irrigation, lift irrigation canal irrigation, Duty, Delta and Base period-Irrigation efficiencies-Crops and Seasons-Crop water Requirement-Estimation of Consumptive use of water	9
III	Diversion Works: Different stages of a river and their flow characteristics, Weir and barrages, Various parts of a weir and their functions, Exit gradient, Principles of weir design on permeable formations -Bligh's creep theory and Khosla's theory Storage and Outlet works:Types of earthen dams, Seepage in earth dams, Gravity dams, Forces acting on a gravity dam, Rock-	9

	fill dams, Spillways, Types of spillways, Spillways gates and energy dissipation works.	
IV	Regulating and Cross Drainage Works Canal falls, Cross drainage works, Types of cross drainage works, Canal escapes, Head regulator and Cross regulator, Silt ejector, Flow meters - Parshall flume, Irrigation outlets and types of outlets.	9
V	IRRIGATION WATER MANAGEMENT 8 Modernization techniques – Rehabilitation – Command Area Development - Systems of rice intensification - Water delivery systems - Participatory Irrigation Management – Farmers' organization and turn over – Water users' associations - Economic aspects of irrigation, Water logging-causes, Reclamation, Drainage principles and practice	9
References	1. Dilip Kumar Majumdar, "Irrigation Water Management", Prentice-Hall of India, New Delhi, 2008. 2. Punmia B.C., et. al; Irrigation and water power Engineering, Laxmi Publications, 16th Edition, New Delhi, 2009 3. Garg S. K., "Irrigation Engineering and Hydraulic structures", Khanna Publishers, 23rd Revised Edition, New Delhi, 2009 3. Duggal, K.N. and Soni, J.P., "Elements of Water Resources Engineering", New Age International Publishers, 2005 2. Linsley R.K. and Franzini J.B, "Water Resources Engineering", McGraw-Hill Inc, 2000 4. Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGrawHill Inc., New Delhi, 1997. 69 5. Sharma R.K.. "Irrigation Engineering", S.Chand & Co. 2007. 6. Michael A.M., Irrigation Theory and Practice, 2nd Edition, Vikas Publishing House Pvt. Ltd., Noida, Up, 2008 7. Asawa, G.L., "Irrigation Engineering", NewAge International Publishers, New Delhi, 2000. 8. Basak, N.N, "Irrigation Engineering", Tata McGraw Hill Publishing Co. New Delhi,1999	
Course Out Comes	Students will be able to **CO 1:** Understand Have knowledge and skills on Irrigation and related components. **CO 2**:Understand the methods and management of irrigation. **CO 3:** Gain knowledge on types of Impounding structures **CO 4:**Understand methods of irrigation including canal irrigation. **CO 5:** understand knowledge on water management on optimization of water use	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	1	2	-	-
CO 2	3	2	3	1	2
CO 3	3	3	3	2	2
CO 4	2	3	2	1	1
CO 5	1	1	-	3	2

Course Title	TRANSPORTATION ENGINEERING										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**-**	**-**	
24CEUC3125	PCC	V	3	3	-	-	40	60	-	-	100

Cognitive Level	K1-Recall the survey methods that are used for highway alignment K2-Understand the role of IRC and elements of highway K3-Apply the knowledge of traffic studies for traffic flow and control. K4-Design the elements of highway as per IRC
Course Objectives	The course aims to • carry out surveys involved in planning and highway alignment. • design cross section elements, sight distance, horizontal and vertical alignment. • implement traffic studies, traffic regulations and control, and intersection design. • determine the characteristics of pavement materials. • design flexible and rigid pavements as per IRC.

Unit	Content	No. of Hours
I	Highway development and planning-Classification of roads, road development in India, Current Road projects in India; highway alignment and project preparation. Geometric design of highways-: Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems.	9
II	Design of Access Routes &Walkways (Elements of walkways, Tactile Navigation Systems, BRT Systems, Pedestrian streets and other related aspects), Accessible Streets and Mobility Environments (Street Elements for Accessibility, dimensions and codes material, TGSIs), Inclusive Public Transportation System.	9
III	Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems.	9
IV	Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems.	9
V	Design of pavements- Introduction; flexible pavements, factors affecting design	9

	and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems	
Text book/ References	1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017 2. Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers. 3. Partha Chakraborty, ' Principles of Transportation Engineering, PHI Learning, 4. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley 5. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011. 6. Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.	
Course Outcomes	On completion of the course, the students will be able to: CO-1: Carry out surveys involved in planning and highway alignment. CO-2: design the geometric elements of highways and expressways. CO-3: carry out traffic studies and implement traffic regulation and control measures and intersection design. CO4: characterize pavement materials and design flexible and rigid pavements as per IRC.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	3	2	1
CO2	3	1	3	1	2
CO3	2	3	1	2	3
CO4	1	1	2	2	4
CO5	2	2	3	2	3

Course Title	STRUCTURAL ANALYSIS I										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC3126	PCC	V	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- Understand the different analysis methods K2- Understand the moving loads on structures and influence line diagram K3- Understand the concept of Eddy's theorem and analysis of arches										
Course Objectives	The main objective of this course to • To understand the concept of analysis of indeterminate structures by various classical methods • to study the use of ILD for determinate structure • to learn the concepts of moving loads and its effect on structures • to understand the concept of equivalent UDL and study the reversal of stress under live load										

Unit	Content	No.of Hours
I	**SLOPE DEFLECTION METHOD** Displacement method concept – Slope deflection equations – Fixed end moments – Application to the analysis of statically indeterminate beams with and without settlement of supports and rigid jointed plane frames with and without side sway – Effect of settlement of supports.	9
II	**MOMENT DISTRIBUTION METHOD** Basic concepts – Stiffness, distribution and carry over factors – Application to the analysis of propped cantilever continuous beams, rigid jointed plane frames with and without side sway and box culvert – Effect of settlement of supports.	8
III	**ROLLING LOADS & INFLUENCE LINES** Rolling loads – Description of Influence line (I.L) – I.L for statically determinate beams for reaction, SF & BM due to concentrated and Udl – Effect of rolling loads – Concentrated and uniformly distributed loads – Curves of max. BM & SF diagrams – Load position – Absolute max. BM – Equivalent Udl – I.L. for forces in members of statically determinate parallel chord trusses – Reversal of Stresses under live load. Influence lines – Maxwell Bett's theorem – Muller Brealau's principle and its application to determinate I.L. for propped cantilever, fixed beams, continuous beams and single bay single storey portals.	9
IV	**KANE'S METHOD** Principle – rotation and translation – contribution factors – analysis of continuous frames without joint translation – symmetrical frames and frames with side sway.	7
V	**ARCHES**	7

	Theory of Arches – Eddy's theorem – Analysis of three hinged and two hinged arches – Parabolic & semi – circular – Determination of reaction, Normal thrust, radial shear & BM – I.L. for stress resultants in two hinged & three hinged arches – Load position for maximum values – Rib shortening. .	
References	**Text/Reference Books:** 1. Theory of structures – B.C.Punmia, Ashokkumar Jain & Arunkumar Jain, Laxmi Publications, New Delhi. 2. Structural Analysis – L.S.Negi & R.S.Jangid, Tata McGraw Hill, New Delhi. 3. Basic structural Analysis – C.S.Reddy, Tata McGraw Hill 4. Analysis of structures – V.N.Vazirani & M.M.Ratwani, Khanna Publishers, Delhi. 5. Indeterminate Structures – R.L.Jindal, .Chand & Company, New Delhi. 6. Theory and Analysis of Structures Vol. II – O.P. Jain 7 A.S.Arya, NemChand & Bros., Roorkee, U.P.	
Course Outcomes	On completion of the course, students should be able to do **CO1:** use various classical methods for analysis of indeterminate structures **CO2**:to determine the effect of support settlements for indeterminate structures **CO3**:to apply the concepts of ILD and moving loads on determinate structures **CO4**:to apply the concept of equivalent UDL **CO5**:to determine the reversal of stresses in trusses using ILD	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	3	2	3	3
CO 2	3	2	2	3	3
CO 3	3	3	2	3	3
CO 4	3	2	3	2	3
CO 5	3	2	2	3	3

<table>
<tr><th colspan="2">Course Title</th><th colspan="11">OPEN ELECTIVE – III</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>24CEUC3127</td><td>MOPEC</td><td>V</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>--</td><td>-</td><td>100</td></tr>
<tr><td colspan="12">• The students should undergone the courses which are offered by the Centre for Rural Technology , GRI</td></tr>
</table>

Course Title	CIVIL ENGINEERING SOCIETAL AND GLOBAL IMPACTS										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUV3104	MNC	V	2	2	-	-	50	-	-	-	50
Cognitive Level	**K1 :** State the basic concepts of Global impacts **K2 :** Understand the various Codes and Standards governing Infrastructure development; **K3 :** Apply the Project Management paradigms and Systems.										
Course Objectives	The Course aims • Students can understand the basics of mechanical Engineering and their importance • They can understand the fundamental of thermodynamics and their applications										

Unit	Content	No.of Hours
I	Introduction to Course and Overview; Understanding the past to look into the future: Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis; Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering	6
II	Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind,	6

	Wave, Tidal, Geothermal, Thermal energy); Water provisioning; Telecommunication needs (towers, above-ground and underground cabling); Awareness of various Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring Sustainability;	
III	Environment- Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and non- stationarity; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuring Sustainability.	6
IV	Built environment – Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability	6
V	Civil Engineering Projects – Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution toemployment(projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development;	6
References	1. *Ž iga* Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for and Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht 2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition	

	3. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004. 4. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio. 5. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options 6. http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx	
Course Out Comes	CO1:The impact which Civil Engineering projects have on the Society at large and on the global arena and using resources efficiently and effectively. CO2:The extent of Infrastructure, its requirements for energy and how they are met: past, present and future CO3:The Sustainability of the Environment, including its Aesthetics, CO4:The potentials of Civil Engineering for Employment creation and its Contribution to the GDP CO5:The Built Environment and factors impacting the Quality of Life	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	1	1	1	2
CO 2	2	1	2	1	2
CO 3	2	2	1	2	2
CO 4	3	2	1	2	1
CO 5	2	1	1	2	1

Course Title	TRANSPORTATION ENGINEERING LABORATORY										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P			CFA	ESE	
24CEUC3128	PC-LC	V	1.5	-	-	3	-	-	60	40	100

Cognitive Level	K1-Recall the survey methods that are used for highway alignment. K2-Understand the role of IRC and elements of highway. K3-Apply the knowledge of traffic studies for traffic flow and control. K4-Design the elements of highway as per IRC.
Course Objectives	The course aims to ➢ carry out surveys involved in planning and highway alignment. ➢ design cross section elements, sight distance, horizontal and vertical alignment. ➢ implement traffic studies, traffic regulations and control, and intersection design. ➢ determine the characteristics of pavement materials. ➢ design flexible and rigid pavements as per IRC.

Unit	Content	No. of Hours
I	**Tests on Bitumen** 1) Penetration Test. 2) Ductility Test 3) Softening point test 4) Specific gravity test 5) Viscosity test 6) Flash and fire point test	9
II	**Tests on Road Aggregate** 7) Aggregate crushing value test 8) Los Angeles abrasion test 9) Aggregate impact value test 10) Aggregate shape test (flakiness & elongation) 11) Specific gravity 12) Water Absorption 13) Soundness	9
III	**Experiments on Traffic:** 14) Traffic Volume study (a) at mid-section (b) at intersection 15) Spot speed study 16) Speed and delay study 17) Origin and Destination Study	9
IV	D) **Miscellaneous Tests (Demonstration Only)** 18) Marshal stability test 19) Determination of C.B.R. 20) Benkelman beam test 21) Bitumen extraction test 22) Exposure to Latest Software in the field of Transportation Engineering	9
Text book/ References	• Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017 • Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna	

	Publishers. • Partha Chakraborty, ' Principles of Transportation Engineering, PHI Learning, • Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley • Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011. • Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.	
Course Outcomes	On completion of the course, the students will be able to: • Carry out surveys involved in planning and highway alignment. • Design the geometric elements of highways and expressways. • Carry out traffic studies and implement traffic regulation and control measures and intersection design. • Characterize pavement materials and design flexible and rigid pavements as per IRC.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	3	2	1
CO2	3	1	3	1	2
CO3	2	3	1	2	3
CO4	1	1	2	2	4
CO5	2	2	3	2	3

Course Title	ENVIRONMENTAL ENGINEERING LABORATORY										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC3129	PC-LC	V	1.5	-	-	3	-	-	60	40	100
Cognitive Level	K-1: Identify the suitable water and sewage treatment process K-2:Understand the solid waste management systems K-3:Apply the environmental legislations for various pollution control.										
Course Objectives	The Course aims • To introduce the various water quality standards, sources of water and treatment process of water. • To understand the importance of sewage treatment. • To improve their knowledge to control the air and noise pollution. ➢ • To know about the Environmental legislations.										

Unit	List of Experiments	No. of Hours
	1. Physical Characterization of water: Turbidity, Electrical Conductivity, pH 2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic etc. 3. Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness 4. Optimum coagulant dose 5. Chemical Oxygen Demand (COD) 6. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD) 7. Break point Chlorination 8. Bacteriological quality measurement: MPN, 9. Ambient Air quality monitoring (TSP, RSPM, SOx, NOx) 10. Ambient noise measurement	30
Text book/ References	➢ Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.	

	➢ Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008. ➢ Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw - Hill International Editions, New York 1985. ➢ MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi. ➢ Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi. ➢ Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999 ➢ Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication ➢ Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.	
Course Outcomes	After successfully studying this course, students will: ➢ Understand the impact of humans on environment and environment on humans ➢ Be able to identify and value the effect of the pollutants on the environment: atmosphere, water and soil. ➢ Be able to plan strategies to control, reduce and monitor pollution. ➢ Be able to select the most appropriate technique for the treatment of water, wastewater solid waste and contaminated air. ➢ Be conversant with basic environmental legislation.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	-	2	3
CO2	2	2	1	2	3
CO3	1	1	-	2	2
CO4	2	3	3	3	3
CO5	2	2	2	1	2

Course Title	SOFTWARE SKILL DEVELOPMENT -II										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUS3106	PC-LC	V	1	-	-	-	-	-	30	20	50
Cognitive Level	K1 : Apply the knowledge in the software K2: Analyze the various software usages and applications K3: Develop the various models related to civil engineering										
Course Objectives	The main of this course is • The student can acquire knowledge of latest software • They can able to develop the digital format of the solution related to civil engineering										

VI SEMESTER

Course Title	**STRUCTURAL DESIGN II** **DESIGN OF STEEL STRUCTURES** (Limit State Design as per IS 800-2007)										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
24CEUC3230	PCC	VI	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- recall the basic properties of steel sections and its inter relationships K2-understand the design concepts of various structural elements K3-understand the design concepts of IS800:2007 K4- design the Steel structural elements for industrial structures										
Course Objectives	To study the Sections and properties of steel sections available and design of various building elements (beam, column, foundation, truss, etc.,) by steel sections.										

Unit	Content	No.of Hours
I	**INTRODUCTION:** Steel Structures – Types - Advantages and disadvantages of steel structures - Properties of steel - material specifications - Rolled steel sections – Built-up sections - Limit State Design Concepts – Loads on Structures Permissible stresses in tension, compression, bending and shear.	9
II	**BOLTED & WELDED CONNECTIONS** Types of bolts –black bolts–turned and fitted bolts–high strength friction grip bolts – Proof loads – types of bolted connections–design of bolted shear connections– subjected to shear and tension. Welding – welded connection - Types – advantages- defects– butt weld–fillet weld–stresses in welds– design of fillet weld for axial load–design of butt weld–plug and slot weld–eccentrically loaded fillet weld joints–eccentrically loaded butt welded joints.	9
III	**TENSION MEMBER:** Tension members - Types of sections – Net area – Net effective sections for angles and Tee in tension – Design of connections in tension members – Design of Lug Angle - Design of tension splice.	9
IV	**COMPRESSION MEMBERS:** Compression member - Types of compression members – Theory of columns – Basis of current codal provision for compression member design – Slenderness ratio – Design of single section and compound section compression members – Design of lacing and battening – Design of column bases – Gusseted base.	9
V	**BEAMS, ROOF TRUSSES AND INDUSTRIAL STRUCTURES**: Beam – Types - Design of laterally supported and unsupported beams – Built up beams – Beams subjected to biaxial bending – Design of plate girders bolted and welded –stiffeners – Types- Beam Column. Roof trusses – Components - Roof and side coverings – loads on trusses, Design of purlin – gantry girder- components- types- design criteria.	9

Referen ces	**Text Books :** 1. S.K. Duggal, Limit State Design of Steel Structures, Tata McGraw Hill Education Private Limited, 2017. (ISBN: 9789351343493/9351343499). 2. V.L. Shah and V. Gore, Limit State Design of Steel Structures IS:800-2007, Structures Publication, 2012. (ISBN: 8190371754). **Recommended Reading:** 1. S.S. Bhavikatti, Design of Steel Structures, I.K. International Publishing House Limited, 2017.(ISBN: 9789385909559/938590955X). 2. N. Subramanian, Design of Steel Structures, Oxford University Press, 2011. (ISBN: 9780198068815/0198068816). 3. IS 800 (2007), General Construction in Steel- Code of Practice, Ced 7: Structural Engineering and Structural Section, Published by Bureau of Indian Standard Manak Bhavan, New Delhi. 4. IS 875- Part 1 (1987): Dead Loads, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi. 5. IS 875- Part 2 (1987): Imposed Loads, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi. 6. IS 875- Part 3 (2017): Wind Loads, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi. 7. IS 875- Part 4 (1987): Snow Loads, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi. 8. IS 875- Part 5 (1987): Special Loads and Combinations, Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Published by Bureau of Indian Standard Manak Bhavan, New Delhi	

Course Out Comes	After learning the course the students should be able to CO1: know the different types of steel sections and its combinations CO2: Understanding principles of limit state design concepts for design of structural steel elements. CO3 : Understand and design various types of bolted and welded connections CO4 : Design the column, beam, truss, gantry girders etc. CO5: Analyze and design for shear, torsion bond and Redistribution of moments in the steel elements	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	3	-	2
CO 2	2	2	3	-	2
CO 3	2	1	3	-	2
CO 4	2	1	3	-	2
CO 5	3	2	3	-	3

<table>
<tr><td>Course Title</td><td colspan="12">STRUCTURAL ANALYSIS II</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUC3231</td><td>PCC</td><td>VI</td><td>4</td><td>3</td><td>1</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K3 - Analyzing: Break down complex structures, compare methods, and assess structural responses.
K4 - Evaluating: Critically evaluate analysis techniques and assess their appropriateness for given problems.
K5 - Creating: Design and develop new models, systems, or solutions for complex structural challenges</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The main objective of this course to
• To understand the influence line concepts for indeterminate structures
• To understand the methods of analysis of intermediate trusses for external loads
• To know the concept and analysis of cable stayed bridge
• To understand matrix method of analysis
• To understand the concept of finite element method of analysis</td></tr>
</table>

Unit	Content	No.of Hours
I	**SUSPENSION CABLES & BRIDGES, PLASTIC ANALYSIS** Length of cable – Maximum tension – Types of supports – Forces in towers – Suspension bridges with three and two hinged stiffening girders – Influence lines. Plastic Analysis: Statically indeterminate structures – Beams in pure bending – Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism - Static and kinematic methods – Upper and lower bound theorems -Plastic analysis of indeterminate beams and frames.	10
II	**FRAMED STRUCTURES** Analysis of multistory frames for gravity loads and wind loads by approximate methods – Substitute frame for vertical loads – Portal, Cantilever methods & Factor methods for horizontal loads.	10
III	**MATRIX FLEXIBILITY METHOD** Formation of flexibility matrices for elements and structures – Choice of redundant 0 flexibility coefficients – Analysis of propped – cantilever, continuous beams, simple rigid jointed frames with redundancy restricted to two	10
IV	**MATRIX STIFFNESS METHOD** Formation of stiffness matrices for element and structures – Stiffness coefficients – Analysis of propped cantilever, con tenuous beams, and simple rigid jointed frames (with Kinematic indeterminacy restricted to two)	10

V	**FINITE ELEMENT METHOD** Introduction – Discretization of a structure – Displacement functions – Truss element – Beam element - variation formation – Plane stress and plane strain Triangular elements	9
References	**Text/Reference Books:** 1. Theory of structures – B.C.Punmia, Ashok Kumar Jain & Arun Kumar Jain, Lakshmi Publications, New Delhi. 2. Theory and Analysis of Structures Vol.II – O.P. Jain & A.S.Arya, NewChand & Bros, Roorkee, U.P. 3. Elementary matrix analyis of structures – Dr.V.K.Manicka Selvam, Khanna Publishers, New Delhi. 4. Structural Analysis – L.S.Negi & R.S.Jangid, Tata McGraw Hill, New Delhi. 5. Matrix analysis of framed structures – Jr.William Weaver & James M.Gere, CBS 6. Publishers & Distributors, Delhi. 7. Structural Analysis – A Matrix Approach – G..Pandit & S.P.Gupta, Tata McGraw Hil 8. Analysis of indeterminate structures – G.K.Wang, Tata McGraw Hill 9. Structural Analysis I & II – Bhavikatti, Vikas Publishing House P.Ltd. .	
Course Out Comes	On completion of the course, students should be able to CO1: Demonstrate the concepts of qualitative influence line diagram for continuous beams and frames CO2: Apply the methods of indeterminate truss analysis CO3: Analyze cable suspension bridges CO4: Analyze the structures by different matrix methods CO5: Analyze the structures by finite element method	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	3	3	3	2
CO 2	2	2	3	2	3
CO 3	2	3	2	3	3
CO 4	3	2	2	3	3
CO 5	3	3	2	3	3

Course Title	PROFESSIONAL ELECTIVE - I										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC32XX	PEC	VI	3	3	-	-	40	60	-	-	100

The students should undergone the elective courses at civil engineering related sectors which are offered by the Centre for Rural technology , GRI

Course Title	PROFESSIONAL ELECTIVE - I										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC32XX	PEC	VI	3	3	-	-	40	60	-	-	100

The students should undergone the elective courses at civil engineering related sectors which are offered by the Centre for Rural technology , GRI

Course Title	OPEN ELECTIVE – IV										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
	MOPEC	**VI**	**3**	**3**	**-**	**-**	**40**	**60**	**--**	**-**	**100**

- The students should undergone the courses which are offered by the other schools/Departments/ Centres of GRI

Course Title	DISASTER PREPAREDNESS AND PLANNING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUC3232	MNC	VI	0	3	-	-	40	60	-	-	100
Cognitive Level	K1- State the fundamentals of disaster Vulnerability K2-Understand the natural and man-made disasters K3-Interpredit the impact and consequences of various disasters										
Course Objectives	The objectives of the course are ➢ To Understand basic concepts in Disaster Management ➢ To Understand Definitions and Terminologies used in Disaster Management ➢ To Understand Types and Categories of Disasters ➢ To Understand the Challenges posed by Disasters										

Unit	Content	No. of Hours
I	Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks-severity, frequency and details, capacity, impact, prevention, mitigation). Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.	9
II	Disaster Impacts - 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.	6
III	Disaster Risk Reduction (DRR) - 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	9

	stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.	
IV	Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land- use changes, urbanization etc.), sustainable and environmentally friendly recovery; reconstruction and development methods.	6
V	Accessibility in Disaster Contexts and Emergency Services for differently abled publics (Accessibility in context of Disaster Preparedness, Response, Mitigation and reconstruction).	6
Text book/ References	1. http://ndma.gov.in/ (Home page of National Disaster Management Authority) 2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs). 3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall. 4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication. 5. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation 6. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003 7. Inter-Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC	
Course Outcomes	The student will develop competencies in ➢ the application of Disaster Concepts to Management ➢ Analyzing Relationship between Development and Disasters. ➢ Ability to understand Categories of Disasters and ➢ realization of the responsibilities to society	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	2
CO2	2	1	1	1	2
CO3	2	1	1	2	2
CO4	3	2	1	2	3
CO5	3	1	1	1	2

<table>
<tr><td>Course Title</td><td colspan="12">Structural Design Laboratory</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUC3233</td><td>PC-LC</td><td>VI</td><td>2</td><td>-</td><td>-</td><td>4</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Define the basic concepts and definitions of stress strain, shearforce ,bending moment properties of solid sections
K-2: Understand the concept of simple Bending and torsion and hoop stress.
K-3: solve the problems related to solids stress , shear force, bending moment, simple bending, torsion and hoop stress for thin cylinders</td></tr>
<tr><td>Course Objectives</td><td colspan="11">After completion of this course, students will be able to,
1. Analyze and design beam, column, slab, foundation, staircases and cantilever and counterfort retaining walls.
2. Draw detailed structural drawings for slab, beam, column, foundation, staircases and cantilever and counterfort retaining walls</td></tr>
<tr><td>Course Contents</td><td colspan="11">1. Design and drawing of singly reinforced, doubly reinforced rectangular and T-section simply supported and continuous beam.
2. Design and drawing of one way, two way simply supported and continuous slab system.
3. Design and drawing of Dog-legged and open wall type staircases.
4. Design and drawing of columns and foundation.
5. Design and drawing of Retaining wall. (Cantilever and counterfort)</td></tr>
<tr><td>Text Books</td><td colspan="11">1. Jain and Jaikrishna, Plain and Reinforced Concrete, Vol. I, Nemchand Brothers.(ISBN-8185240086/978-8185240084).
2. Shrikhant Vanakudre, Prestressed Concrete (Materials, Analysis and Design), Khanna Publishing House, (ISBN: 9789386173317)
3. V. L. Shah and Karve, Limit State Design - Reinforced Concrete Structures Publications. (ISBN- 9788190371711/8190371711).
4. N. Krishna Raju, Pre-stressed Concrete, Tata McGraw Hill. (ISBN- 9789387886209/9387886204).
Recommended Reading
1. P.Dayaratnam, Design of Reinforced Concrete Structures, Oxford & IBH. (ISBN-9789386479785/9386479788).
2. T.Y. Lin, Design of Prestressed Concrete Structures, John Wiley and Sons Inc., 2010. (ISBN-9788126528035/8126528036).
3. P.D.Arthur and V.Ramkrishnan, Ultimate Strength Design for Structural Concrete, Wheeler & Co. Pvt Ltd. (ISBN- 0273403230/978-0273403234).
4. B.P. Hughes, Limit State Theory for Reinforced Concrete Design, Pitman. (ISBN-0273010239/978-0273010234).</td></tr>
</table>

Course Title	SUMMER INTERNSHIP-III										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUS3207	INT	VI	1	-	-	-	-	-	30	20	50
Cognitive Level	K3: Apply the knowledge in real issues related to civil engineering K4 : Analyze the issues of civil engineering field K5: Develop the plan for civil engineering related sectors										
Course Objectives	The main aim is • To train the students in field work so as to have a firsthand knowledge of practical problems in carrying out engineering tasks. • To develop skills in facing and solving the field problems.										

OUTCOMES:

- At the end of the course the student will be able to understand
- The intricacies of implementation textbook knowledge into practice
- The concepts of developments and implementation of new techniques

The Summer Internship shall carry 50 marks and shall be evaluated through internal assessment only. The students individually undertake training in reputed civil engineering companies for the specified duration. At the end of internship, the candidate shall submit a certificate from the organization where he / she has undergone training and a brief report.

EVALUATION PROCEDURE

1. Evaluation of In plant Training Report : 30 marks

2. Viva voce examination : 20 marks

<table>
<tr><th>Course Title</th><th colspan="12">SOFTWARE SKILL DEVELOPMENT -III</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>24CEUS3208.</td><td>PCC</td><td>VI</td><td>1</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>30</td><td>20</td><td>50</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K3 : Apply the knowledge in the software
K4 : Analyze the various software usages and applications
k5 :Develop the various models related to civil engineering</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The main of this course is
• The student can acquire knowledge of latest software
• They can able to develop the digital format of the solution related to civil engineering</td></tr>
</table>

VII SEMESTER

Course Title	Construction Engineering and Management										
Course Code	Category	Semester	Hours			Credits	Theory		Practical		Total
			L	T	P		CFA	ESE	CFA	ESE	
24CEUC4134	PCC	VII	3	0	0	3	40	60	-	-	100
Cognitive Level	K1-Identify and list out the planning methods for the execution construction projects K2- Understand the concept networks and its preparation for construction projects K3-Apply the knowledge of construction management for plan, control and monitor construction projects with respect to time and cost										
Course Objectives	The Course aims • To study about the construction contract documents. • To impart the idea about planning and scheduling of activities and scheduling software. • To introduce the concepts of resource planning and allocation and control. • To study about the Quality and safety in construction sites.										

Theory		
Unit	**Content**	**No. of Hours**
I	***Basics of* Construction**- Unique features of construction, construction projects- types and features, phases of a project, agencies involved and their methods of execution. ***Construction project planning***- Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation,	9

	computation of float values, critical and semi critical paths, calendaring networks. PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.	
II	***Construction Equipment basics:*** Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities	9
III	***Construction Methods basics:*** Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges. ***Planning and organizing construction site and resources- Site:*** site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling. Common Good Practices in Construction	9
IV	***Project Monitoring & Control***- Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical	9

	quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.	
V	***Contracts Management basics:*** Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods. ***Construction Costs:*** *Make-up of construction costs;* Classification of costs, time- cost trade-off in construction projects, compression and decompression.	9
References	**Text/Reference Books:** 1. Varghese, P.C., "*Building Construction*", Prentice Hall India, 2007. 2. *National Building Code,* Bureau of Indian Standards, New Delhi, 2017. 3. Chudley, R., *Construction Technology*, ELBS Publishers, 2007. 4. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011 5. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006 6. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015 7. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.	
Course Outcomes	**On completion of the course, the students will have:** **CO1**: An idea of how structures are built and projects are developed on the field **CO2:** An understanding of modern construction practices **CO3:** A good idea of basic construction dynamics- various stakeholders, project objectives, processes, resources required and project economics **CO4:** An idea of how to optimise construction projects based on costs **CO5:** An idea how construction projects are administered with respect to contract structures and issues.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	2	3	2
CO 2	3	1	2	3	3
CO 3	2	3	3	2	2
CO 4	2	1	3	3	2
CO 5	3	2	1	2	3

Course Title	ESTIMATION, COSTING AND VALUATION											
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC4135	PCC	VII	3	3	0	0	40	60	-	-	100
Cognitive Level	K1- to understand the concept of estimation of various items of work K2-to understand the detailed specifications for different buildings, roads, bridges, industrial structures K3-to calculate the total quantities and their cost for different structures, K4 to prepare the tender documents, bid preparations, valuation and report preparation										
Course Objectives	The main objective of this course to • To gain the knowledge about to Measure the various items of work as per the Indian Standard Specifications for buildings, road, industrial structures etc • to prepare the tender, and its process, specification and bid preparations, valuation and report preparation										

Unit	Content	No.of Hours
I	**QUANTITY ESTIMATION FOR BUILDINGS.** Philosophy – Purpose – Methods of estimation – Centre line method – Long and short wall method – Types of estimates – Approximate estimates – Detailed estimate – Estimation of quantities for buildings: Load bearing and framed structures – Calculation of quantities of brickwork, RCC, PCC, Plastering, whitewashing, colour washing and painting/varnishing,	10
II	**QUANTITY ESTIMATION FOR ROADS AND OTHER STRUCTURES.** Estimation of quantities for Roads: bituminous and cement concrete roads, Estimation of quantities for other structures: septic tank, soak pit, Sewer line - Manhole, tube well, open well, retaining wall, Culverts, aqueduct, syphon, fall.	10
III	**ESTIMATION FOR QUANTITIES OF MATERIALS, RATE ANALYSIS AND COSTING** Estimation of quantities of materials: Brick work, PCC, RCC, Cement Mortar, white wash, colour wash, Standard Data – Observed Data – Schedule of rates – Market rates – Materials and Labour – Standard Data for Man Hours and Machineries for common civil works – Rate Analysis for all Building works, canals, and Roads – Cost Estimates (additional practice in classroom using Computer software)	10
IV	**SPECIFICATION, REPORT PREPARATION AND TENDERS** Specifications – sources – Preparation of detailed and general specifications. Principles for report preparation – report on estimate of residential building – Culvert – Roads – Water supply and sanitary	9

	installations – Tube wells – Open wells. Tenders – TTT Act – e-tender – Preparation of Tender Notice and Document.	
V	**CONTRACTS AND VALUATION** Contracts: Types of contracts – Drafting of contract documents – Arbitration and legal requirements. Valuation: Necessity – Basics of value engineering – Capitalized value – Depreciation – Escalation – Value of building – Calculation of Standard rent – Mortgage – Lease.	9
	Term Work Assignments may include 1. Deriving an approximate estimate for a multistoried building by approximate methods. 2. Detailed estimate for the following with the required material survey for the same. a) Ground plus three storied RCC Framed structure building with block work walls b) bridge with minimum 2spans c) factory building d) roadwork e) cross drainage work f) Ground plus three storied building with load-bearing walls g) Cost of finishes, MEP works for above 3. Preparation of valuation report in standard Government form. 4. Assignments on rate analysis, specifications and simple estimates. 5. Detailed estimate of minor structure. 6. Report preparation for various works.	
References	**Text/Reference Books:** 1. M Chakravarty, Estimating, Costing Specifications & Valuation 2. Joy P K, Handbook of Construction Management, Macmillan 3. B.S. Patil, Building & Engineering Contracts 4. Relevant Indian Standard Specifications. 5. World Bank Approved Contract Documents. 6. FIDIC Contract Conditions. 7. Acts Related to Minimum Wages, Workmen's Compensation, Contract, andArbitration 8. Typical PWD Rate Analysis documents. 9. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations,2016 10. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBSPublishers, 2016 11. Hand Book of Consolidated Data – 8/2000, Vol.1, TNPWD 12. Tamil Nadu Transparencies in Tenders Act, 2000	

	13. Standard Databook for analysis and rates 14. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996:	
Course Out Comes	CO1: Explain the basic concept of quantity estimation for building, by manual and software packages. CO2: Explain the basic concept of quantity estimation for roads, canals and hydraulic structures by manual and software packages CO3: Acquire the knowledge to calculate quantities of materials required for each work, develop skill to calculate rate analysis and man-hours required for the common civil works by manual and software packages CO4: Develop the specification for the materials used in construction, online and offline tender procedures and tender document preparation. Acquire the knowledge of report preparation. CO5: Acquire the knowledge of construction contracts and contract document preparation. Identify the valuation for building, land and plant and machineries, calculation of rent, mortgage and lease.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	-	2	2	1
CO 2	1	1	2	1	1
CO 3	2	-	3	-	2
CO 4	2	1	3	-	2
CO 5	1	2	2	1	1

Course Title	COST-EFFECTIVE CONSTRUCTION TECHNOLOGIES										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC4136	PCC	VII	3	3	-	-	40	60	-	-	100
Cognitive Level	KI: Define the basic concepts and definitions of mud technology, stone blocks and hollow concrete blocks. K2: Understand the concepts of precast roof , floor and brick panel roofing system K3: understand the manufacturing processing of ferrocement products.										
Course Objectives	The course aim is • To understand the basic concepts of cost effective building materials and technologies.										

Unit	Content	No. of Hours
I	Mud Technology- salient features of SMB – Selection of soil Determination of compressive stress – water retention test – consistency test – cohesion test – observation choice of stabilizer – block making – mould size – Economics of burnt bricks and SMB – suitability of soil for stabilizer – method of construction using mud blocks – water proof coating and plasters – improve earth structures – quality control.	8
II	Pre cast stone clock – Introduction – method of production – types of moulds – selection of materials – casting blocks – physical properties – compressive strength of stone masonry blocks – water absorption – cost economic – hollow concrete blocks introduction – advantages of hollow concrete blocks – masonry precaution – economic method of production – mix ratio curing stocking transportation – compressive strength manufacturing machineries.	8
III	Pre cast roof and floor system: Pre cast reinforced concrete L – pans for roof – interlocution – materials – Element for roof supporting beam method of casting curing erection pre cast RC plank flooring preparation method of pre cast RCC joist moulds cast and curing pre caution during casting and placing Economics funicular shell micro concrete tiles method of manufacturing support beam erection.	8
IV	Pre cast Brick panel roofing system – manufacturing method of Brick panel – suitable joist curved brick panel method of laying roof fly ash bricks manufacturing methods	7
V	Ferrocement – introduction advantages manufacturing process mud mould construction – casting procedure for roof channel curing stocking fabrication and specification of ferrocement doors – manufacturing	6

	method of Ferrocement products – innovation painting installation and maintenance manufacturing methods of small capacity Ferrocement water tanks economics.	
References	1. Reading materials capacity Building for project managers of Building Centre Vol. II (Hudson Manual) 2. CBRI Research publication. 3. Low cost housing in Developing countries G.C. Mathur 4. Low cost housing – A.G. Mathava Rao, SERC.	
Course Out Comes	After studying the course, the student will be able to: CO1: Understand the principles of mud technology and its quality control CO2: understand the properties and manufacturing process of stone blocks and hollow concrete blocks. CO3: Able to understand the precast roof and floor systems. CO4: understand the manufacturing methods of precast brick panel roofing systems CO5: able to understand the manufacturing methods of ferrocement products.	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	2	2	3	2
CO 2	3	1	2	3	3
CO 3	2	3	3	2	2
CO 4	2	1	3	3	2
CO 5	3	2	1	2	3

<table>
<tr><th>Course Title</th><th colspan="12">PROFESSIONAL ELECTIVE - III</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>24CEUC41XX</td><td>PEC</td><td>VII</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td colspan="12">The students should undergone the elective courses at civil engineering related sectors which are offered by the Centre for Rural Technology, GRI</td></tr>
</table>

<table>
<tr><th>Course Title</th><th colspan="12">PROFESSIONAL ELECTIVE - IV</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>24CEUC41XX</td><td>PEC</td><td>VII</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td colspan="12">The students should undergone the elective courses at civil engineering related sectors which are offered by the Centre for Rural technology , GRI</td></tr>
</table>

Course Title	PROFESSIONAL PRACTICE LAW AND ETHICS										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUV4105	MNC	VII	0	3	-	-	40	60	-	-	100
Cognitive Level	K1 - Awareness of different laws related to professional ethics. K2 - Implementation of various laws in different situations K3 - To take fair decisions which satisfy legal rules.										
Course Objectives	1) To familiarize the students with laws related to professional ethics. 2) To understand where and when the laws are used. 3) To provide how these laws have its implications on decisions. 4) To know how business competitors can sue them, 5) To acknowledge the necessity of taking fair decisions.										

NO.	Name of the Topic	No.of Lectures
1	Professional practice - Respective roles of various stakeholders. Government constituted regulatory bodies and standardization organisation(BIS, IRC, IIA/COA, ECI Institution of Engineers India). Role of Local bodies, Developers Consultants, Contractors, Manufacturers, Vendors and Service agencies and respective Acts governing them (RERA, CEAI, Contract Acts and Standards) Professional ethics - Definition of ethics, forms of ethics, code of ethics as defined in the website of institution of engineers(India), Profession, Professionalism, Profession Responsibility, Professional ethics, conflict of interest, Gifts vs Bribery, Environmental breaches - negligence,deficiencies in state -of -the art;Vigil mechanism,Whistleblowing,protected disclosures.	8
2	General principles of contracts management: Indian contract Act 1972 and its amendments. General principles of contract- Types of contract- prime and subcontracts, joint ventures and consortium, complex contract terminology, Tenders, Bids, Proposals, contract conditions, critical / red flag conditions. Variations and changes in contracts - cost escalation, time extension, suspensions and terminations. Delay Analysis, contract documentation, contract notices, wrong practices in contracting, Reverse auction, Public - Private partnerships, International commercial terms.	5
3	Arbitration conciliation and ADR(Alternative Dispute Resolution) system: Arbitration - meaning - scope and types - distinction between laws of 1940 and 1996, UNCTTRAI model law - Arbitration and expert determination, Arbitration Tribunal. Award - Grounds for setting aside an award - Enforcement of foreign awards - New York and Geneva convention Awards, Distinction between conciliation, negotiation, mediation and arbitration, Dispute Resolution Boards, Lok Adalats.	5

4	Engagement of labour and labour and other construction - related laws: Role of labour in Civil Engineering; methods of engaging labour on rolls, labour subcontract, piece rate work, Industrial Disputes Act 1947; Workmen's compensation Act 1923, Building and other construction workers(regulation of employment and conditions of service Act(1996), RERA Act 2017, NBC 2017	5
5	Introduction - meaning of intellectual property, main forms of IP, Copyright, Trade marks, Patents and Designs secrets - Copyright law in India - Patent Act 1970, Patentable inventions with special reference to biotechnology of products.	1
	COURSE OUTCOMES CO1: Develop a procedure for taking fair decision. CO2: Apply laws while taking decisions. CO3: Evaluate the decisions taken. CO4: Identify and eradicate any flaws which occurs in business decisions. CO5: Discuss about Intellectual property rights.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1	2	1
CO 2	2	3	3	2	1
CO 3	3	2	3	2	2
CO 4	2	3	3	3	1
CO 5	2	1	3	2	2

<table>
<tr><td>Course Title</td><td colspan="12">IRRIGATION AND ENVIRONMENTAL ENGINEERING DRAWING</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUC4137</td><td>PC-LC</td><td>VII</td><td>1.5</td><td>-</td><td>-</td><td>3</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K 1 – Understand the basic definitions and Properties of concrete and higway materials.
K 2 – Calculate the engineering properties of Materials.
K 3 – Analyse and interpret the data for identify the suitability of materials.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The students will be able to design and draw the various irrigation and environmental structures</td></tr>
</table>

<table>
<tr><td>Unit</td><td>Content</td><td>No.of Hours</td></tr>
<tr><td></td><td>PART-A IRRIGATION ENGINEERING DESIGN AND DRAWING
1. Tank sluices with Tower Head
2. Surplus weirs
3. Siphon well drop
4. Syphon aqueducts
5. Canal drops
6. Canal regulator
7. Spillway
PART –B ENVIRONMENTAL ENGINEERING DESIGN AND DRAWING
1. Intake towers
2. Clariflocculator
3. Settling tanks
4. Rapid sand filter
5. Screen Chamber and Grit channel
6. Activated sludge process
7. Oxidation ditch
8. Trickling filters
9. Up flow anaerobic sludge blanket reactor
10. Stabilization ponds
11. Septic tanks and disposal arrangements
12. House service connection for water supply and drainage</td><td>36</td></tr>
<tr><td>References</td><td>10. 1.Santosh Kumar Garg, Irrigation Engineering and Hydraulics Structures, Khanna Publications Pvt.Ltd, NewDelhi, 2002.
11. 2. Birde.G.S and Birde.J.S, ―Water supply and sanitary Engineering‖, Dhanpat Rai Publications Pvt.Ltd NewDelhi, 2001.</td><td></td></tr>
</table>

Course Out Comes	CO1: In the first part of the course, students will learn to design and prepare detailed drawings for Irrigation Structures. CO2: In the second part of the course, students will learn to design and draw various Environmental Engineering structures.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	2	3	2
CO 2	3	3	3	2	3
CO 3	3	3	3	2	3
CO 4	2	3	3	2	3
CO 5	3	2	2	3	2

Course Title	DESIGN PROJECT										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC4138	PR	VII	4	-	-	8	-	-	60	40	100
Cognitive Level	K1: Analyze the current issues related to civil engineering K2 : Examine the possibilities of solutions of civil engineering sector K3 : develop or find the solutions for that issues										
Course Objectives	The objective of this course is 1. To impart and improve the design capability of the student.										

- Course conceives purely a design problem in any one of the disciplines of Civil Engineering; e.g., Design of an RC structure, Design of a waste water treatment plant, Design of a foundation system, Design of traffic intersection etc.
- The design problem can be allotted to an individual student
- At the end of the course the students should submit a complete report on the design problem consisting of the data given, the design calculations, specifications if any and complete set of drawings which follow the design.

EVALUATION PROCEDURE

The method of evaluation will be as follows:

1. Internal Marks : 20 marks (Decided by conducting 3 reviews by the guide appointed by the Institution)

2. Evaluation of Project Report : 30 marks (Evaluated by the external examiner) Every student belonging to the same group gets the same mark

3. Viva voce examination : 50 marks (Evaluated by the internal examiner appointed by the HOD with the approval of HOI, external examiner– with equal Weightage)

At the end of course the students will be able to

CO1: Explain design philosophies of structure as a whole

CO2: Design RC and Steel framed structures

CO3: Design Environmental structures

CO4: Design Geotechnical structures

CO5: Design transport related structures and other structures related to Civil engineering

VIII- SEMESTER

Course Title	PROFESSIONAL ELECTIVE - V										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC42XX	PEC	VIII	3	3	-	-	40	60	-	-	100

The students should undergone the elective courses at civil engineering related sectors which are offered by the Centre for Rural technology , GRI

Course Title	PROFESSIONAL ELECTIVE - VI										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC42XX	PEC	VIII	3	3	-	-	40	60	-	-	100

The students should undergone the elective courses at civil engineering related sectors which are offered by the Centre for Rural technology , GRI

Course Title	PROFESSIONAL ELECTIVE - VII										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC42XX	PEC	VIII	3	3	-	-	40	60	-	-	100

The students should undergone the elective courses at civil engineering related sectors which are offered by the Centre for Rural technology , GRI

<table>
<tr><th>Course Title</th><th colspan="12">MAJOR PROJECT</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>24CEUC4239</td><td>PR</td><td>VIII</td><td>6</td><td>-</td><td>-</td><td>12</td><td>-</td><td>-</td><td>150</td><td>50</td><td>200</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1: Analyze the current issues related to civil engineering
K2 : Examine the possibilities of solutions of civil engineering sector
K3 : Develop or find the solutions for that issues</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The objective of this course is to impart creativity by means of new product or design or find solutions for existing problems by working in a group</td></tr>
</table>

CO1: define the necessity of the project

CO2: compare the previous findings

CO3: Execute the work

CO4: Organize the project work with team coordination

CO5: Crate new findings

PROFESSIONAL ELECTIVES

I. CONSTRUCTION ENGINEERING & MANAGEMENT

Course Title	ADVANCED CONSTRUCTION TECHNIQUES										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE1	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- To know the modern construction techniques K2- To know about special structures K3- To study the rehabilitation and strengthening techniques and demolition.										
Course Objectives	The Course aims To study and understand the latest construction techniques applied to engineering construction for sub structure, super structure, special structures, rehabilitation and strengthening techniques and demolition techniques.										

Unit	Content	No.of Hours
I	**SUB STRUCTURE CONSTRUCTION** Box jacking - Pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - Piling techniques - Driving well and caisson - sinking cofferdam - cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Laying operations for built up offshore system - Shoring for deep cutting - Large reservoir construction - well points - Dewatering for underground open excavation.	9
II	**SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS** Vacuum dewatering of concrete flooring – Concrete paving technology – Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – Erection techniques of tall structures, Large span structures – launching techniques for heavy decks – in-situ prestressing in high rise structures, Post tensioning of slab-	9

	aerial transporting – Handling and erecting lightweight components on tall structures.	
III	**CONSTRUCTION OF SPECIAL STRUCTURES** Erection of lattice towers - Rigging of transmission line structures – Construction sequence in cooling towers, Silos, chimney, sky scrapers - Bow string bridges, Cable stayed bridges – Launching and pushing of box decks – Construction of jetties and break water structures – Construction sequence and methods in domes – Support structure for heavy equipment and machinery in heavy industries – Erection of articulated structures and space decks.	9
IV	**REHABILITATION AND STRENGTHENING TECHNIQUES** Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques.	9
V	**DEMOLITION** Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.	9
References	**REFERENCES:** 1. Jerry Irvine, Advanced Construction Techniques, CA Rocketr, 1984 2. Patrick Powers. J., "Construction Dewatering: New Methods and Applications", John Wiley & Sons, 1992. 3. Peter.H.Emmons, “Concrete repair and maintenance illustrated”, Galgotia Publications Pvt. Ltd., 2001.Press, 2008. 4. Robertwade Brown, "Practical foundation engineering hand book", McGraw Hill Publications, 1995. 5. Sankar, S.K. and Saraswati, S., "Construction Technology",	

	Oxford University.	
Course Out Comes	On completion of this course the students will know the modern construction techniques to be used in the construction of buildings and special structures and also rehabilitation and strengthening techniques and demolition.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	1	1	2	3
CO 2	3	2	2	3	2
CO 3	3	3	2	3	3
CO 4	3	3	2	3	3
CO 5	2	3	2	3	3

Course Title	BUILDING CONSTRUCTION PRACTICE										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
24CEUCXXE2	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- Recall standards for materials and its management K2-understand the inventory control techniques K3- apply the knowledge of inventory control in material management										
Course Objectives	The Course aims • To know about the basics and importance of material management and quality control concepts										

Unit	Content	No.of Hours
I	**Importance of Materials Management:**Importance of material management and its role inconstruction industry-scope,objectives and functions, Integrated approach to materials management, Role of materials manager.	9
II	**Codification and procurement:**Classification and Codification of materials of construction.ABC analysis-Procedure andits use, Standardization in materials and their management,Procurement, identification of sources of procurement, vendor analysis. Vendor analysis concept of (MRP) Material requirement planning, planning, purchase procedure, legalaspects.	9
III	**Inventory Management** Inventory Control techniques. EOQ, Advantages and limitation of use of EOQ, Periodic ordering, order point control, safety stock, stock outs,application of AC analysis in inventory control, concept of (JIT)- Just in timemanagement, Indices used for assessment of effectiveness of inventory management.	9
IV	**Stores Management** Receipt and inspection, care and safety in handling, loss on	9

	storage,wastage, Bulk purchasing, site layout and site organization, scheduling of men, materials and equipment.	
V	**Quality Control and use of MMS:** Quality Control – Conventional methods of quality control of Construction materials.Statistical method of quality control, sampling techniques quality control in process.Quality management and its economics.Use of (MMS) – Materials Management Systems in materials planning, procurement, inventory, control, cost control etc.	9
References	**Reference Books** 1. Purchasing and Inventory Control- by K. S. Menon, Wheeler Publication. 2. Materials Management, P.Gopalkrishnan, Prentice Hall 3. Handbook of materials management, P.Gopalkrishnan, Sundershan, Prentice Hall. 4. Inventory Management, L.C.Jhamb, Everest Publ.	
Course Out Comes	Students able to • Apply the knowledge of material management in construction industry • Can purchase the materials with legal procedures • Can manage the time and cost of materials that are to be purchased • Apply the various techniques for material store management • Apply the methods of quality control in quality management	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	2	3	2
CO 2	3	3	1	2	3
CO 3	3	2	1	3	3
CO 4	3	2	2	2	2
CO 5	3	2	1	2	2

Course Title	CONSTRUCTION ENGINEERING MATERIALS											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE3	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	k1-to recall the different types of building materials and its applications K2- to understand the nature, characteristics, performance, and behavior of *civil engineering materials* used in buildings and infrastructure and to evaluate their physical and mechanical properties. K3-application of different materials utilized for construction process										
Course Objectives	The Course aims • To learn the manufacturing process, types, applications and testing procedures for materials used for load bearing purpose • To know about materials that is used for protection and functional purpose. • To impart knowledge about basis of recent paradigms, and new materials										

Unit	Content	No.of Hours
I	**STONES** Classification - Selection - Application of stone in buildings - Requirement and testing of stones - Deterioration and preservation of stone work - Artificial stones.	6
II	**BRICKS AND BUILDING BLOCKS** Manufacture of bricks - classification - Qualities - Test on Bricks - Fire bricks - building blocks types and uses - joist and filter blocks - Curved shell units - Lightweight concrete blocks.	6
III	**MORTAR, CEMENT AND CONCRETE** Classification of mortar - Preparation - Selection of mortar - Tests	6

	for mortars - Manufacture of cement - Types of cement - Characteristics - Aggregates - Basic Characteristics - Types of aggregates - Admixtures - Properties of fresh concrete - Properties of hardened concrete - Slump Test - Vebe test - Flow test - Compacting factor test - Types of Concrete.	
IV	**MATERIALS FOR BUIDINGS SERVICES** Timber - Market forms - Industrial timber - Plywood Veneer - Thermocole - Panels of laminates - Steel - Composition - uses - Market forms - Mechanical treatment - Paints - Vanishes - Distempers.	6
V	**SPECIAL MATERIALS** Glass - Ceramics - Sealants for joints - Sheets for pitched roof coverings - Fibre glass reinforced plastic - Clay products - Refractories - Composite materials - Types - Applications of laminar composites - Fibre textiles - mats and pads for earth reinforcement - Recycling of Industrial waste as building material - Polymers in Civil Engineering.	6
References	**TEXT BOOKS:** 1. Bindra and Arora, “ Building Materials and construction”. Dhanpat Rai and Sons, New Delhi 1994 2. Punmia B.C. “Building Materials and Construction”, Laxmi Publications Pvt. Ltd, 1997 **REFERENCE BOOKS:** 1. Rangwala S.C. “Engineering Materials”, Charotar Publishing House, Anand, India, 1997 2. Surendra Singh, “Building Materials”, Vikas Publishing Company, New Delhi, 1996. 3. Brain Culshaw, “Smart structure and Materials”, Artech House, Borton, London, 1996 4. Deodhar S. V. “Construction Equipment and Job Planning”, Khanna Publishers, New Delhi 2001National Building Code of India, 1983 5. IS 1003 (Part I): Timber, Panelled and Glazed shutters – Specifications, 1991 6. IS 4021: Timber Doors, Windows and Ventilator Frames – Specifications, 199	
Course Outcomes	After learning the course the students should be able to CO1: To identify various building materials and select suitable	

	type of building material for given situation. CO2: Students are able to understand the property , use , advantage and disadvantage of diffent material used in construction. CO3 : To be aware of various traditional building materials and also the emerging materials in the field of Civil Engineering construction CO4:to identify the different timber materials in different types of structures CO5:to identify the some special materials and its applications involved in construction	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	-	-	1	2
CO 2	2	-	-	2	1
CO 3	2	-	-	3	2
CO 4	2	-	-	2	1
CO 5	2	-	-	3	2

Course Title	DIGITALIZED CONSTRUCTION LAB										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE4	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- To understand the importance of latest softwares in a construction industry. K2- To plan a construction project using MS project K3- To analyse the bid management and its effectiveness using bid management software										
Course Objectives	The Course aims • To train the students in field of digitalization of construction. Students can be trained in the latest softwares relevant to construction industry										

Unit	Content	No.of Hours
I	**List of experiments:** To implement the digital knowledge in construction (use relevant software's) 1. Introduction and understanding of Primavera project planner for construction 2. Using Primavera project planner, update the schedule of the project of a construction project. 3. Introduction and understanding of MS Project for a construction project 4. Using MS project, schedule the construction project planning 5. Introduction to BIM in construction projects a. Development of BIM for small construction project 6. Progress the work flows in construction project using BIM 7. Development of bid management for a small firm construction industry using software.	36
Course Out Comes	At the end of the course the student will be able to understand the output of digitalization of construction **CO1:** To understand the importance of latest softwares in a construction industry. **CO2:** To plan a construction project using Primervera	

	CO3: To plan a construction project using MS project **CO4:** To develop a BIM information model **CO5:** To analyse the bid management and its effectiveness using bid management software	

PO/PSO	CO1	CO2	CO3	CO4	CO5	Overall
PO1	2	3	2	2	3	2
PO2	2	3	3	2	2	2
PO3	3	2	2	3	3	3
PO4	2	2	2	3	2	2
PO5	3	3	3	3	3	3
PO6	3	2	3	3	2	3
PO7	2	2	2	3	3	3
PO8	2	2	2	2	3	2
PO9	3	2	3	3	3	3
PO10	2	2	2	2	2	2
PO11	2	3	2	3	3	3
PO12	2	3	2	3	3	3

Course Title	ENERGY EFFICIENT BUILDINGS										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE5	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- To understand the environmental energy supplies on buildings K2-To understand the various aspects of day-lighting and electrical lighting in a building K3- Design a building for climatic zone and apply simulation programs of buildings to perform energy calculations										
Course Objectives	To provide an understanding of the concept of energy consumption in buildings and design an energy efficient building										

Unit	Content	No.of Hours
I	INTRODUCTION Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Greenhouse Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.	9
II	PASSIVE SOLAR HEATING AND COOLING General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain – Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Principles – Case studies – Courtyards – Roof Ponds– Cool Pools – Predicting ventilation in buildings –Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odor removal.	9
III	DAY LIGHTING AND ELECTRICAL LIGHTING Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts –Building Design Strategies – Case Studies – Daylight	9

	apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.	
IV	HEAT CONTROL AND VENTILATION Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed.	9
V	DESIGN FOR CLIMATIC ZONES Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.	9
References	1. Energy Conservation Building Code, cau of Energy Efficiency, New Delhi, 2018. 2. Handbook on Functional Requirements of Buildings Part 1 to 4 SP :41 (S and T) 1995 3. Residential Energy: Cost Savings and Comfort for Existing Buildings by John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013. 4. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc,3rd Edition, 2014 5. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.	
Course Out Comes	On completion of this course, the student is expected to be able to **CO1:** Explain environmental energy supplies on buildings **CO2:** Explain the passive solar heating, cooling system **CO3:** Discuss the various aspects of day-lighting and electrical lighting in a building **CO4:** Predict and design building ventilation and heat control for indoor comfort **CO5:** Design a building for climatic zone and apply simulation programs of buildings to perform energy calculations	

COs-PO's &PSO's MAPPING

PO/PSO		Course Outcome					Overall Correlation Of Cos to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	3	3	3	3	3	3
PO2	Problem analysis	-	-	-	3	3	2
PO3	Design/development of solutions	2	2	2	3	3	3
PO4	Investigation	-	-	-	-	1	2
PO5	Modern Tool Usage	-	-	-	-	2	1
PO6	Individual and Team work	1	-	-	-		1
PO7	Communication	-	-	-	1	1	1
PO8	Engineer and Society	3	3	3	3	3	3
PO9	Ethics	2				2	2
PO10	Environment and Sustainability	3	3	3	3	3	3
PO11	Project Management and Finance	-	-	-	-	-	-
PO12	Life Long Learning	3	-	-	-	-	3

<table>
<tr><td rowspan="1">Course Title</td><td colspan="12">FORM WORK ENGINEERING</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUCXXE6</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- To understand the overall and detailed planning of formwork.
K2- To impart knowledge on formwork materials, accessories, pressures and labour requirement.
K3- To impart the knowledge about different types of form work used for special structures.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
On completion of this course the students will be able to know the detailed planning of formwork, design of forms and erection of form work.</td></tr>
</table>

Unit	Content	No.of Hours
I	**INTRODUCTION TO FORM WORK** Introduction to Formwork and false work, Temporary work systems, Requirements, Construction planning and site constraints, Selection, and Classification (Types) of Formwork, General objectives of formwork building - Planning for safety - Development of a Basic System - Key Areas of cost reduction - Planning examples - Overall Planning - Detailed planning - Overall programme - Detailed programme - Costing - Planning crane arrangements - Site layout plan - Transporting plant - Formwork beams - Scaffold frames - Framed panel formwork.	9
II	**FORMWORK MATERIALS ASSESORIES & PRESSURES** Formwork Materials, Accessories and consumables – Application of tools, Reconstituted wood - Steel – Aluminum Plywood - Types and grades Standard units - Corner units – Pass units, Calculation of labour constants - Formwork hours - Labour Requirement. Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Finish - Sheathing boards working stresses - Repetitive member stress Vertical loads for design of slab forms - Uplift on shores - Laterals loads on slabs and walls.	9
III	**FORMWORK DESIGN** Concepts, Formwork Systems – components, assembly, De-shuttering, safety of work and Design for Tall Structures, Foundation Wall, Column, Slab and Beam formworks. Design of Decks and False works. Effects of various loads. Loading and moment of formwork, IS Code provisions.	9

IV	**FORMWORK FOR SPECIAL STRUCTURES** Formwork for Bridge Structures, Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Nuclear Reactor, Tunnel, Lift Shaft, stairs and Formwork for Precast Concrete. Various climbing system, Table lifting system.	9
V	**CASE STUDIES** Formwork failures: Causes of failures – Inadequate shoring inadequate bracing of members – improper vibration – Premature stripping Errors in design – Case studies – Finish of exposed concrete design deficiencies – Safety factors – Prevention of rotation – Stripping sequence – failure formwork issues in multi - story building construction – vertical and horizontal elements used in the industry.	9
References	**TEXT BOOKS** 1. Peurify R.L and Oberlender G.D , Formwork for Concrete Structures, , McGraw Hill Education India ,2015 2. Jha K N, Formwork for Concrete Structures, Tata McGraw Hill Education, 2012. **REFERENCES:** 1. Austin, C.K., Formwork for Concrete, Cleaver -Hume Press Ltd., London, 1996. 2. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 1996 3. Michael P. Hurst, Construction Press, London and New York, 2003. 4. Christopher Souder , (2014), Temporary Structure Design, Wiley Publications, London. 5. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.	
Course Out Comes	On completion of the course, students should be able to do **CO1:** To understand the overall and detailed planning of formwork. **CO2:** To impart knowledge on formwork materials, accessories, pressures and labour requirement. **CO3:** To develop the conceptual understanding of design, construction and erection of formwork. **CO4:** To impart the knowledge about different types of form work used for special structures. **CO5:** To understand the errors in design and judge the formwork failures through case studies.	

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAMOUTCOMES(PO)							
PO1	Knowledge of Engineering Sciences	2	3	3	2	2	2
PO2	Problem analysis		3	3	3	1	3
PO3	Design/development of solutions		3	3		2	3
PO4	Investigation		2	2		3	2
PO5	Modern Tool Usage			2			1
PO6	Engineer and Society	2					1
PO7	Environment and Sustainability	2	2				2
PO8	Ethics						
PO9	Individual and Team work	3	3	3	2	2	3
PO10	Communication						
PO11	Project Management and Finance	3	2	2	2	3	2
PO12	Life Long Learning	2	2	2	2	2	2
PROGRAMSPECIFICOUTCOMES(PSO)							
PSO1	Knowledge of Civil Engineering discipline	3	3	3	3	3	3
PSO2	Critical analysis of Civil Engineering problems and innovation		3	3			2
PSO3	Conceptualization and evaluation of engineering solutions to Civil Engineering Issues		2	3			2

Course Title	SUSTAINABLE CONSTRUCTION METHODS										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE7	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-Recall the various methods of sub and super structure construction K2-Explain the modular method of construction and methods of steel construction K3- Apply the LEED concept in new construction projects										
Course Objectives	The Course aims • To have idea about foundation construction methods • To get knowledge about methods of steel and modular construction • To understand the strategies used in construction industry.										

Unit	Content	No. of Hours
I	Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls);	9
II	Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures;	9
III	Basic construction methods for steel structures; Basics of construction methods for Bridges; Identification of cutting edge sustainable construction materials, technologies,	9
IV	Project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity.	9
V	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
References	Building Construction by Dr. B. C. Punamia Building Construction by P.C Varghese,Prentice-Hall of India, New Delhi	

	6. Indian Standard Institution, National Building Code of India, ISI, 1984, New Delhi	
Course Out Comes	After completion of this course students should able to **CO1:** To construct foundation for various types of construction **CO2:** Able to build different precast elements **CO3:** To construct the structures with sustainable materials and technologies **CO4:** Able to apply the strategies in construction industries **CO5:** Explain the new construction rating system of LEED	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	2	3	3
CO 2	3	3	2	3	2
CO 3	3	3	2	3	2
CO 4	3	2	2	3	3
CO 5	2	3	2	3	3

II. TRANSPORTATION ENGINEERING

<table>
<tr><td>Course Title</td><td colspan="12">RAILWAYS, AIRWAYS AND WATERWAYS</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUCXXE8</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1: Understand railway element construction and maintenance
K2: Explain planning and design of airport
K3: Knowledge about planning and design of harbour</td></tr>
<tr><td>Course Objectives</td><td colspan="11">• To introduce the students about Railways planning, design, construction and maintenance and planning design principles of airport and harbour</td></tr>
</table>

Unit	Content	No.of Hours
I	**RAILWAY PLANNING AND CONSTRUCTION** Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges - Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods--Geometric design of railway, gradient, super elevation, widening of gauge on curves- Level Crossings.	9
II	**RAILWAY CONSTRUCTION AND MAINTENANCE** Earthwork – Stabilization of track on poor soil - Track drainage – Calculation of Materials required for track laying - Construction and maintenance of tracks – Railway Station and yards and passenger amenities-Signalling	9
III	**AIRPORT PLANNING** Air transport characteristics - airport classification – ICAO - airport planning: Site selection typical Airport Layouts, Case Studies, parking and Circulation Area	9
IV	**AIRPORT DESIGN** Runway Design: Orientation, Wind Rose Diagram, Problems on	9

	basic and Actual Length, Geometric Design – Elements of Taxiway Design – Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings.	
V	**HARBOUR ENGINEERING** Definition of Basic Terms: Harbour, Port, Satellite Port, Docks, Waves and Tides – Planning and Design of Harbours: Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage – Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works – Coastal Regulation Zone, 2011	9
References	1. Saxena Subhash, C.and Satyapal Arora, A Course in Railway Engineering, Dhanapat Rai and Sons, Delhi, 1998 2. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nemachand and Bros, Roorkee, 1994 3. Docks and Harbour engineering by S.B.Bindra 4. K.P., Highways, Railways, Airport and Harbour Engineering, V Scitech Publications (India), Chennai, 2010 5. Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels.,Universities Press (India) Private Limited, Hyderabad, 2015. 6. Mundrey J S, Railway Track Engineering, McGraw Hill Education (India) Private Ltd, New Delhi, 2013	
Course Outcomes	Students who successfully complete this course will be able to: CO1: Understand the methods of route alignment and design elements in Railway Planning and Constructions. CO2: Understand the Construction techniques and Maintenance of Track laying and Railway stations. CO3: Gain an insight on the planning and site selection of Airport Planning and design. CO4: Analyze and design the elements for orientation of runways and passenger facility systems. CO5: Understand the various features in Harbours and Ports, their construction, coastal protection works and coastal Regulations to be adopted.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	3	3	1	1
CO 2	1	3	2	3	1
CO 3	1	2	3	1	2
CO 4	1	1	3	2	2
CO 5	2	1	2	1	2

Course Title	INTELLIGENT TRANSPORTATION SYSTEMS										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE9	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-recall historical background of ITS K2-Understand advanced traffic management systems K3- Apply the knowledge of automated highway systems for ITS programs										
Course Objectives	The Course aims • To expose the recent advancements in Transport Systems										

Unit	Content	No.of Hours
I	Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.	9
II	Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC).	9
III	Vehicle – Road side communication – Vehicle Positioning System; ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS);	9
IV	ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management,	9

	Advanced Vehicle safety systems, Information Management;	
V	Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries	9
References	1. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US,2001 2. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill,1992 3. E.Turban, "Decision Support and Export Systems Management Support Systems", Maxwell Macmillan,1998 4. SitausuS.Mittra, "Decision Support Systems – Tools and Techniques", John Wiley, New York, 1986 5. Cycle W.Halsapple and Andrew B.Winston, "Decision Support Systems – Theory and Application‟, Springer Verlog, New York,1987	
Course Out Comes	On completion of the course the students would have knowledge on CO1: The various Principles and Aspects of Intelligent Transport System. CO2: Manage the traffic with telecommunication systems CO3: Various rural traffic management systems CO4: User needs and services for public transportation CO5: implementation of ITS on developed countries	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	2	2	3
CO 2	3	1	1	2	2
CO 3	3	2	2	2	2
CO 4	3	2	2	2	2
CO 5	3	1	1	1	3

Course Title	AIRPORT PLANNING AND DESIGN										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE10	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-Recall the modes of transports in India K2-Explain the different components of airfield K3-Apply the knowledge of airline economics for pricing										
Course Objectives	The Course aims • Provides a basic understanding on Airport Systems Planning and Operation										

Unit	Content	No.of Hours
I	AIRPORT PLANNING Airport – Accessibility – Transport Connections – Road and Rail, Expansion – Feasibility Studies – Environmental and Social Issues – Forecasting Future Traffic – Airfield Capacity and Delay - Aircraft characteristics – Airport Site Selection	9
II	AIRPORT COMPONENTS Airport Classification, Planning of Airfield Components – Runway, Taxiway, Apron, Hanger, Passenger Terminals	9
III	AIR ROUTE PLANNING AND EVALUATION Demand driven dispatch – Airline Fleet Planning Models – Network Revenue Management – Airport Performance, Slot Issues, Hub Operation, Demand Management, Multi-airport Systems	9
IV	PASSENGER CHOICE, SCHEDULING ANDFLEETASSIGNMENT Load Factor Analysis, Airline Schedule Development, Introduction to PODS	9

	Passenger Choice Models, Decision Window Model, Fleet Assignment	
V	AIRLINE ECONOMICS Pricing – Privitization and Deregulation, Willingness to pay and Competitive Revenue Management	9
References	1. Robert Honjeff and Francis X.Mckelvey, "Planning and Design of Airports", McGraw Hill, New York,1996 2. Richard De Neufille and AmedeoOdoni, "Airport Systems Planning and Design", McGraw Hill, New York,2003 3. Airport Planning and Systems –http://airportssystems.com/Course/index-html 4. S.K.Khanna and M.G.Arora, "Airport Planning and Design", Nem Chand and Bros,1999. 5. Norman.J.Ashford, Sakleh.AMumayiz and Paul.H.Wright, "Airport Engineering Planning Design and Development of 21st Century Airports, John Wiley and sons, New Jersey,2011.	
Course Out Comes	Students would have CO1: Skills on airport planning and design with focus of runway and taxiway CO2: understood the basics of air route Planning CO3: Design of components of airport CO4: Develop the airline development for scheduling CO5: Network revenue Management.	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	2	3	3	3
CO 2	3	2	1	2	2
CO 3	3	2	2	2	3
CO 4	3	2	1	1	2
CO 5	3	3	1	2	2

Course Title	TRAFFIC ENGINEERING DESIGN ANDMANAGEMENT										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE11	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-Recall the physical and physiological characteristics for traffic survey K2-understand the various studies that are involved in traffic volume and capacity K3-apply the knowledge of signals and signs for control of traffic										
Course Objectives	The Course aims • Provides a basic understanding on Traffic Engineering – Planning, Design, Operation and Management										

Unit	Content	No.of Hours
I	TRAFFIC CHARACTERISTICS Physical, Physiological, Psychological, Environmental Characteristics, Traffic Stream Characteristics, Vehicle Characteristics – Static and Dynamic, Urban Road and Road Characteristics Geometric Design – An Overview	9
II	SURVEYS AND STUDIES INTRAFFIC ENGINEERING Conventional and Modern Methods of Traffic Survey and Studies – Volume and Capacity – Headway concepts and applications – Speed and Delay – Origin and Destination, Parking, Accident – Level of Services (LoS)	9
III	DESIGN OFTRANSPORT INFRASTRUCTURE Sight Distance, Design of Cycle Tracks, Pedestrian Facilities, Parking Facilities – On Street, Off Street Multi level Street Lighting	9

IV	INTERSECTION DESIGN Design of Intersection – At grade intersection – Uncontrolled, Channelisation, Rotary, Traffic Signal Control, Signal Co-ordination, Grade Separated Intersection - Types and Design	9
V	TRAFFIC OPERATION ANDMANAGEMENT Traffic Sign, Road Markings, Traffic Control Aids, Street furniture, Road Arboriculture - Traffic Regulation, Cost Effective Management Measures – Traffic Systems Management and Travel Demand Management - Congestion Management, Traffic Calming and Pricing	9
References	1. Kadiyali, L.R., „Traffic Engineering and Transport Planning‟, Khanna Publishers, Delhi,2002 2. Wolfgang S.Homburger et.al., „Fundamentals of Traffic Engineering‟ 15th Edition, Institute of Transportation Studies, University of California, Berkely,2001 3. James L.Pline (Edr) „Traffic Engineering Hand Book‟, Institute of Transportation Engineers, Washington DC, USA,1999 4. Nicholas T.Garber, Lester A Hoel, „Traffic and Highway Engineering‟, Revised Second Edition, ITP, California, USA,1999 5. Thomas Curinan, „An Introduction to Traffic Engineering – A Manual for Data Collection and Analysis‟, Books Cole, UK,2001	
Course Out Comes	Students would be aware of CO1: The characteristics of traffic stream and vehicle CO2: Various survey methods for the calculation of capacity and volume of traffic CO3: Basic Principles and Design of traffic infrastructure CO4: Design of intersections CO5: Management of signals and signs for traffic operation	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1	2	2
CO 2	3	3	1	2	3
CO 3	3	2	2	2	2
CO 4	3	2	3	2	2
CO 5	3	2	2	2	2

Course Title	RAILWAY ENGINEERING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE12	PEC	-	3	3	-	-	40	60	-	-	100

Cognitive Level	K1- Recall the conventional and modern methods of survey K2- Understand the functions and components of permanent way and rails K3-apply the knowledge of planning, design, construction and maintenance of railway tracks
Course Objectives	The Course aims • This course imparts the student's knowledge of planning, design, construction and maintenance of railway tracks. • The students acquire proficiency in the application of modern techniques such as GIS, GPS and remote sensing in Railway Engineering

Unit	Content	No.of Hours
I	**INTRODUCTION** Role of Indian Railways in National Development – Railway Surveys for Track Alignment – Obligatory points - Conventional and Modern methods (Remote Sensing, GIS & GPS, EDM and other Equipments) - Train Resistances - Rolling Stock - Locomotives, Coaches, Wagons – Train Brakes.	9
II	**RAILWAY PLANNING** Permanent Way, its Components and Functions of each Component: Rails - Types of Rails, Rail Fastenings, Concept of Gauges, Coning of Wheels, Creeps and kinks Sleepers – Functions, Materials, Density Ballasts – Functions, Materials, Ballast less Tracks	9

III	**RAILWAY DESIGN:** Geometric Design of Railway Tracks – Gradients and Grade Compensation, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal and Vertical Curves (Derivations of Formulae and Problems)	9
IV	**RAILWAY OPERATION AND CONTROL** Points and Crossings - Design of Turnouts, Working Principle Signaling, Interlocking and Track Circuiting	9
V	**RAILWAY TRACK CONSTRUCTION, MAINTENANCE**Construction & Maintenance – Conventional, Modern methods and Materials, Track Drainage Track Modernisation– Automated maintenance and upgrading, Technologies, Re-laying of Track, Lay outs of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance, Level Crossings	9
References	1. SaxenaSubhash C and SatyapalArora, A Course in Railway Engineering, DhanpatRai and Sons, Delhi, 1998 2. Rangwala, Railway Engineering, Charotar Publishing House, 1995 3. J.S. Mundrey, “A course in Railway Track Engineering	
Course Out Comes	Students able to CO1: Carry out the survey using modern techniques for railways CO2:Plan the components of permanent ways and railway tracks CO3: Design and construct the railway tracks CO4: Operate and control the tracks and trains CO5: Construct and maintain the track by conventional and modern methods	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1	2	3
CO 2	3	2	3	3	2
CO 3	3	1	3	2	2
CO 4	3	2	1	2	2
CO 5	3	3	1	2	3

<table>
<tr><td>Course Title</td><td colspan="12">URBAN AND REGIONAL PLANNING</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUCXXE13</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: list out and define the concepts of urbanization policies
K-2: understand the planning processes of urban and rural development plans
K-3: Apply the planning laws for development of cities</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• Provides a basic knowledge on Urbanization and it strend.
• Deals with different types of plan, its implementation, regional development and management for sustainable urban growth.</td></tr>
</table>

Unit	**Content**	**No.of Hours**
I	BASIC CONCEPTS POLICIESANDPROGRAMMES Definitions and Concept- Urbanization, Towns, Cities, Metropolis, Megalopolis, Satellite and New towns, CBD, Peri urban areas, Suburban areas, Census Definition, Classification of urban settlements, TOD, National policies, National Urban Transport Policy 2006, National Policy for Urban street vendors 2009- Programme objectives and salient features of Jawaharlal Nehru National Urban Renewal Mission (JNNURM), Urban infrastructure development scheme for small and medium towns (UIDSSMT), Rajiv AwasYojana (RAY)	9
II	PLANNING PROCESS Steps in Planning Process- Plans; levels; objectives, content, and data requirement-regional plan, master plan, detail development plan, city development plan, development control regulation, Zoning Regulation, Layout and Building Regulations.	9
III	SOCIO ECONOMIC ANDSPATIAL PLANNING Economic and social concepts in urban and regional planning and their relevance, Economic principals of zoning, Components of sustainable development, Inclusive development, Compact cities, Quality of life-Form of cities, issues related to inner city fringe areas, and suburban areas, Application of Remote sensing and GIS in Urban and Regional planning.	9

IV	PROJECT FORMULATION AND EVALUATION Constraints for plan implementation – Industrial, Financial and Legal Constraints, Institutional Arrangements for Urban Development – Financing of Urban Developments - Legislation related to Urban Development. Urban infrastructure projects planning, appraisal, formulation, feasibility and preparation of detailed project report, site planning, layout, road network, and service ducts under the road, Environmental impact assessment, and Traffic assessment.	9
V	URBAN GOVERNANCEAND MANAGEMENT Planning laws; Town and Country planning act: Urban Development authorities Act, Constitutional (74^{th} Amendment) Act 1992- Local bodies, Functions, powers and Interfaces	9
References	1. CMDA, Second Master Plan for Chennai, Chennai2008 2. Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi2002 3. George Chadwick, "A Systems view of planning", Pergamon press, Oxford1978 4. Singh V.B, "Revitalised Urban Administration" in India, Kalpaz publication, Delhi2001 5. Edwin S.Mills and Charles M.Becker, "Studies In Urban Development", A World Bank Publication, 1986 6. Thooyavan. K.R, "Human Settlements – A Planning Guide to Beginners. M.A Publications, Chennai2005. 7. Tumlin Jeffrey, "Sustainable Transportation Planning Tools for Creating Vibrant Healthy and Resilient Communities", John Wiley And Sons,2012.	
Course Out Comes	On completion of the course, students should be CO1: To know about the basic concepts of National urban planning. CO2: To understand the steps involved in planning processes CO3: Able to know about the socio-Economic and regional planning CO4: Able to know about the legislation related to urban planning	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1	1	2
CO 2	3	2	1	1	2
CO 3	2	2	3	2	1
CO 4	2	2	1	2	2
CO 5	2	2	3	2	2

Course Title	PORT AND HORBOUR ENGINEERING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE14	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Identify the Location, Traffic estimation, ship characterization. K-2: Understand the design of Harbour K-3: Classify the waterways										
Course Objectives	The Course aims • Students become conversion with definition purpose location materials of coastal structures • Students acquire knowledge on planning and design of harbours										

Unit	Content	No.of Hours
I	Harbour Planning Types of water transportation, water transportation in India, requirements of ports and harbours, classification of harbours, selection of site and planning of harbours, location of harbour, traffic estimation, master plan, ship characteristics	9
II	harbour design, turning basin, harbour entrances, type of docks, its location and number, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations;	9
III	Docks and Repair Facilities: Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, Harbour docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks, pumping plant, floating docks, slipways, locks, size of lock, lock gates, types of gates;	9
IV	Navigational Aids: Requirements of signals, fixed navigation structures, necessity of navigational aids, light houses, beacon lights, floating navigational aids, light ships, buoys, radar; Dredging and Coastal Protection: Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone and beach profile;	9

V	Port facilities: Port development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities. Inland waterways, Inland water transportation in India, classification of waterways, economics of inland waterways transportation, national waterways.	9

References	1. S.P.Bindra A course in Docks and Harbour Engineering DhanpatRai publications New delhi 1993 2. OZA.H.P and Oza.g.H" A course in docks and harbor Enginnering" anandchartor publishing house pvt.Gujarat 2010	
Course Out Comes	On completion of the course, students should be CO1: To know about the Harbour planning CO2: To understand about the various survey involved in harbor planning CO3: To know about the construction of break water CO4: To understand about the Navigational Aids. CO5: To know about the port development and port planning.	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	2	3	3	3
CO 2	3	2	3	3	3
CO 3	3	2	2	2	3
CO 4	3	2	2	2	3
CO 5	3	2	3	2	3

Course Title	PAVEMENT MATERIALS											
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE15	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recall the soil classifications and its characteristics K-2: Understand the preparation, properties and tests for Bitumen K-3: Solve the pavement mix design problems										
Course Objectives	The Course aims • Togivethestudentstohandsonexperienceonthevarioustestingproceduresofpavement materials as per the IRC standards.										

Unit	Content	No.of Hours
I	Soil - Classification, characteristics, compaction, evaluation of soil strength; stabilized pavement materials; Aggregates: requirements, properties and tests on road aggregates for flexible and rigid pavements.	6
II	Bitumen: Origin, preparation, properties and tests, constitution of bituminous road binders; requirements; Criterion for selection of different binders. Bituminous Emulsions and Cutbacks: Preparation, characteristics, uses and tests, Bituminous Mixes:	6
III	Mechanical properties: Resilient modulus, dynamic modulus and fatigue characteristics of bituminous mixes. Bituminous mix design methods and specifications.	6
IV	Weathering and Durability of Bituminous Materials and Mixes. Performance based Bitumen Specifications;	6
V	Super pavement mix design method: design example problems. Cement Concrete for Pavement Construction: Requirements, and design of mix for CC pavement, IRC and IS specifications and	6

	tests, joint filler and sealer materials.	
References	1. Khanna SK Justo CEG and Veeraragavan.A, "Highway Engineering", Nem Chand & Bros, Roorkee, 2010. 2. Brase/Brase "Understandable Statistics 3rd edition",D C Health and Company, Lexington, Massachusetts,Toronko,1987. 3. Jason C.yu, Transportation Engineering: Introduction to Planning, Design and Operations, Elsevier,1992.	
Course Out Comes	On completion of the course, students should be CO1: To know about the soil strength evaluations CO2: To understand the selection of binding materials for pavements CO3: Capable to identify the mechanical properties of bitumen. CO4: To know about the Performance of Bitumen Specifications CO5: Able to design the pavement as per indian standard.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	2	2	2
CO 2	2	2	1	1	2
CO 3	2	2	1	1	2
CO 4	2	2	1	2	2
CO 5	3	3	3	2	3

Course Title	TRANSPORTATION SYSTEMS PLANNING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE16	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-Recall existing transportation systems in India K2-understand the systems of simulation modelling K3-apply the theories for land use transportation models										
Course Objectives	The Course aims To impart knowledge in the rudiments and advancements Transportation Planning and Travel Demand Forecasting										

Unit	Content	No.of Hours
I	TRANSPORTATION SYSTEMSTATUS Status of existing Transportation System – Systems Approach to Transport Planning - Interdependence of the Landuse and Traffic – Stages in Transportation Planning – Transport Systems and Planning Considerations.	9
II	INVENTORIES ANDSIMULATION MODELING Concepts of Zoning – Transportation Surveys – Inventory of Transport and other activities – Travel Forecasting Process – Basics of Systems Simulation Modeling - Application in Travel Forecasting – Critical issues in Travel forecasting.	9
III	FOUR STAGEMODELINGPROCESS Conventional and Four Stage Modeling Process – Trip Generation Models – Trip Distribution Models and Calibration – Methods of Trip Assignment Models –Multi Modal Trip Assignment – Mode Choice and Modal Split Models.	9
IV	ADVANCEDTRAVEL FORECASTING Advanced Travel Demand Forecasting Methods - Activity Based Modeling – Comparison of Conventional and Activity Based Modeling – Integration of Systems Simulation Modeling and Transportation Network Planning for Sustainability.	9
V	LAND USE TRANSPORTMODEL(LUT)	9

	Accessibility Measures and Basic Theories – Lowry Derivatives Model- Garin Model –Approach and Simulation Modeling in LUT Model - Multimodal Transportation Planning.	
References	1. Kadiyali 2. John Khisty C, Kent Lall B, "Transportation Engineering – An Introduction, 3rd Edition, PrenticeHall of India, New Delhi,2002 3. Papacostas C.S., Prevedouros, "Transportation Engineering and Planning, 3rd Edition, Prentice Hall of India, New Delhi,2002 4. John D.Edwards (Edr.), "Transportation Planning Hand Book", 2nd Edition, Institute of Transportation Engineers, Prentice Hall Inc., Washington DC, USA,1999 5. O‟Flaherty C.A, "Transport Planning and Traffic Engineering", Elsevier Publications, New Delhi,1997. 5. Chennai Metropolitan Development authority (CMDA) (2006), Chennai Metropolitan Area – Second Master Plan, Chennai.	
Course Out Comes	Students would be aware of the CO1: Stages in transportation system planning CO2: Simulation models for inventory and transportation systems CO3: Stages of modelling processes CO4: Methods for forecasting travel demand CO5: Planning for multimodal transportation	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	3	2	2
CO 2	3	3	2	1	2
CO 3	3	2	1	1	2
CO 4	3	3	1	2	2
CO 5	3	2	2	2	3

II. ENVIRONMENTAL ENGINEERING

Course Title	ENVIRONMENTAL SYSTEMS										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUCXXE17	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: identify the eco technology which is relevance to the human civilization. K-2: Understand about the system approach and ecological engineering processes. K-3: Apply the eco technology for various waste treatment.										
Course Objectives	Develop conceptual schematics for ecological modeling, models for dissolved oxygen and pathogens, Activated sludge process schemes, linear optimization models, parameter estimation and experimental design.										

Unit	Content	No. of Hours
I	*Introduction to the concepts and applications of environmental systems analysis.* **Ecological System:** Basic concepts in ecology and ecological modeling, population dynamics: birth and death Processes. Single species growth, prey-predator models: Lotka - Volterra, Rosenzweig-macarther, Kolmogorov models. Multi-species modelling - structural analysis and stability of complex Ecosystems.	9
II	*Application of mathematical programming and modeling to the design, planning and management of engineered environmental systems, regional environmental systems, and environmental policy.* **Reactor Modelling:** CSTR, plug-flow, dispersion. A case study of a tubular reactor with axial dispersion, parameter calibration: search algorithms for nonlinear dynamical models, variance of estimated parameters. Application to Monod and Haldane kinetics.	9
III	*Economic analysis, including benefit-cost analysis and management strategies.* **Water Quality Modeling:** Rivers and streams water quality modelling -dispersion and mixing- water quality modelling process- model sensitivity-assessing model performance; models for dissolved oxygen and pathogens- pollutant and nutrient dynamics -dissolved oxygen dynamics -groundwater quality modeling.	9
IV	*Concepts of tradeoff, non- inferior sets, single and multi-objective optimization.* **Microbial Dynamics and Energetics:** Requirements for carbon and nutrient removal. Activated sludge: process schemes: completely Mixed, plug-flow, SBR, nutrient removal. Anaerobic digestion: process dynamics, operational Control of wastewater treatment processes.	9
V	*Practical application to case studies to convey an understanding of the complexity and data collection challenges of actual design practice.* **Computer Based Solutions:** Formulation of linear optimization models. Linear programming. Sensitivity testing and duality. Solution techniques and computer programming; Formulation of linear optimization models. Application of models-simulation, parameter estimation and experimental design.	9
Text book/ References	1. Environmental Systems Philosophy, Analysis and Control" book by Robert John Bennett and Richard J. Chorley, Princeton University press publication,2015 2. "Environmental System Analysis" book by Stefano Marsiliibelli, CRC press publication, 2016 3. "Environmental System Modelling" book by Dr.R.K. Prasad, Standard publishers & Distributors, 2016	

	4. “Introduction to System Analysis Basic Concepts and App” book by Dieter M. Imboden, Stefan D Fenninger, Springer Berlin Heidelberg publications, 14th December 2012 5. “Environmental Pollution Analysis” book by SM. Khopkhar ,2nd Edition, New age international publication, 2020	
Course Outcomes	CO1: Describe ecological modeling, single and multi-species modeling on a brief. CO2:Explain modeling of CSTT and the kinetics of reaction taking place in it. CO3:Analyze and model the river system and also ground water system. CO4:Analyze the wastewater treatment system. CO5:Demonstrate computational techniques for modeling	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	2
CO2	2	2	3	3	2
CO3	3	3	3	3	3
CO4	2	2	3	3	3
CO5	3	3	3	2	2

Course Title	TRANSPORT OF WATER AND WASTEWATER										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUCXXE18	PEC	-	3	3	-	-	40	60	-	-	100

Cognitive Level	K-1 Recall the continuity, energy and momentum principles. K-2 Understand the various pipe materials and their fixtures. K-3 Apply the software tools for network design.
Course Objectives	The Course aims • To educate the students in detailed design concepts related to water transmission mains, water distribution system. • To educate and give analytical skill for solving sewer networks and storm water drain by computer application on design.

Unit	Content	No. of Hours
I	Water Supply Systems: Storage requirements, impounding reservoirs, intake structures, pipe hydraulics.	9
II	Design of distribution systems, distribution and balancing reservoirs, pipe materials, appurtenances, design for external loads, maintenance and operation.	9
III	Sanitary Sewerage Systems: Flow estimation, sewer materials, hydraulics of flow in sewers, sewer lay out, sewer transitions, materials for sewers, appurtenances, manholes, sewer design, conventional and model-based design, sewage pumps and pumping stations, corrosion prevention, operation and maintenance, safety.	9
IV	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.	9
V	Software applications -Use of computer automated tools in water transmission, water distribution and sewer design. LOOP, SEWER, BRANCH, and other tools.	9
Text book/ References	1. Manual on water supply and Treatment. CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1999. 2. Manual on Sewerage and Sewage Development. CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1993. 3. Practical Hydraulics Hand Book, B.A. Hauser. Lewis Publishers, New York, 2011. 4. Water and Wastewater Technology, M.J. Hammer. Regents/Prentice Hall, New Jersey, 2011.	
Course Outcomes	On completion of the course, students should be **CO1** Able to understand the basics of fluid properties **CO2** To Apply the ability gained from theory to the practical design and sizing of water distribution system **CO3** To Apply the ability gained from theory to the practical design and sizing of sewer lines and wastewater treatment system. **CO4** Able to estimate the storm water runoff. **CO5** Able to apply the software tool for network analysis.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	2	2
CO2	3	2	2	3	2
CO3	3	2	2	3	2
CO4	2	2	1	2	1
CO5	3	2	2	3	2

Course Title	ENVIRONMENTAL LAWS AND POLICIES										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUCXXE19	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1 Identify the Precautionary Principle and Polluter Pays Principles for Environmental production. K-2 Understand the Air and Water acts K-3 Apply the Indian forest acts for various environmental issues										
Course Objectives	The Course aims • To gain knowledge on current environmental issues; and methods and practices for solving them through the application of environmental policies and legislation. • Ability to apply the environmental policies and legislative measures on the effective management of environmental problems.										

Unit	Content	No. of Hours
I	Introduction - Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration – Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework(SPCB/CPCB/MoEF)	9
II	Water (P&CP)Act,1974 - Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.	9
III	Air (P&CP)Act,1981- Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.	9
IV	Environment (Protection)Act1986 - Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards	9
V	Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.	9
Text book/ References	1. U.AD. Kesari, Administrative Law University Book Trade Delhi, 1998. 2. Greger I. Megregor, “Environmental law and enforcement”, Lewis Publishers, London. 2004	
Course Outcomes	On completion of the course, students should be **CO1:** able to understand the national environmental policies	

	CO2: able to know about the Air act 1981 **CO3:** able to know about the water act 1981 **CO4:** able to understand the Environmental production Act 1986. **CO5 :** able to understand the Forest Acts.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	2	2	1
CO2	1	1	2	2	2
CO3	2	2	2	2	1
CO4	2	1	2	2	1
CO5	1	1	2	1	1

Course Title	PHYSICO-CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUCXXE20	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1 Recall the characteristics of water and waste water K-2 understand the municipal and Industrial water and waste water treatment plants K-3apply the advanced treatment techniques for water and waste water treatment systems.										
Course Objectives	The Course aims • To educate the students on the principles and process designs of various treatment systems for water and wastewater. • To students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.										

Unit	Content	No. of Hours
I	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**.** Sedimentation, different types of settling, sedimentation tank design.	9
II	Coagulation and flocculation, coagulation processes, stability of colloids, destabilization of colloids, destabilization in water and wastewater treatment, transport of colloidal particles, design aspects.	9
III	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, pre- coat filtration, design aspects.	9
IV	Disinfection: Types of disinfectants, Kinetics of disinfection, chlorination and its theory, Design of Chlorinators. Precipitation: Hardness removal, Iron, Mn, and heavy metal removal;	9
V	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
Text book/ References	1. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw Hill, New Delhi, 2003. 2. Qasim, S.R., Motley, E.M. and Zhu.G. Water works Engineering – Planning, Design and Operation, Prentice Hall, New Delhi, 2002. 3. Lee, C.C. and Shun dar Lin, Handbook of Environmental Engineering Calculations, McGraw Hill, New York, 1999. 4. F.R. Spellman, Hand Book of Water and Wastewater Treatment Plant operations,	

	CRC Press, New York (2009). 5. David Hendricks, Fundamentals of Water Treatment Process, CRC Press New York (2011).	
Course Outcomes	On completion of the course, students should be CO1: able to understand the significations of Physico-chemical treatment systems. CO2: able to know about the water and wastewater treatment principles CO3: able to design the municipal water treatment plant CO4: able to design the industrial water treatment plant CO5: able to design the municipal waste water treatment plants	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	1	1	1
CO2	1	2	2	1	1
CO3	2	2	3	2	3
CO4	2	2	2	2	3
CO5	2	2	3	2	3

Course Title	BIOLOGICAL PROCESSES FOR CONTAMINANT REMOVAL										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUCXXE21	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-Understanding the treatment of biological processes K2- understanding the design of suspended growth treatment plant. K3-to Examine the various digestion processes.										
Course Objectives	Imparting the principles and applications of biological processes in wastewater treatment.										

Unit	Content	No. of Hours
I	Biological treatment processes – objectives – Choice of treatment method – Environmental impact and other considerations in planning the treatment – Cost of Wastewater treatment – Reactors used for the treatment – mass balance analysis – Reactions, Reaction rates – Enzyme reaction. Modeling of ideal flow and non-ideal flow reactors – Reactors in parallel – Reactors in series – Tracer tests – Estimation of dispersion coefficient.	9
II	Role of microorganisms – Microbial growth kinetics – Biological oxidation process – loading -MCRT – F/M ratio – Determination of biokinetic coefficients – Modeling of suspended growth treatment process – Description, Design and operating parameters – Modeling of plug flow reactors – Oxygen requirements-arrangement for transfer of oxygen- Secondary clarifier- design features.	9
III	Aerated lagoons. Oxidation pond – Stabilization ponds – Classification – Application – Process design, flow pattern and analysis of Aerobic ponds – Facultative ponds – Anaerobic ponds – maturation ponds – Construction and performance – MBBR systems.	9
IV	Attached Growth Treatment Process – Substrate Removal in Attached Growth Treatment Process - Trickling Filter – Process – Classification - design based on Popular design equations – NRC, Rankine‟s and Eckenfelder equation – Rotating Biological contactors – Anaerobic attached growth treatment processes – upflow packed Bed – upflow expanded bed – Fluidized bed – Down flow bed. (Only theory).	9
V	Sludge digestion- Sources of sludge- Characteristics- Quantities- Anaerobic digestion- Process- Kinetic relationship- gas production- design considerations. Anaerobic treatment of liquid wastes- Anaerobic sludge blanket process- design considerations. Sludge management facilities, sludge thickening, sludge dewatering (mechanical and gravity) layout.	9
Text book/ References	1. ***"Waste Water Engineering – Treatment and reuse",*** *Metcalf and Eddy, Fourth Edition, McGraw Hill Education, 2017.* 2. "Waste Water Treatment and disposal", Arceivala S. J., Marceldekker publishers, 1981. 3. "Biological process design for Wastewater Treatment", Larry D. Benefield and Clifford W. Randall, Ibis publishers, 1994.	

	4. "Environmental Engineering", Howard S. Peavy, Donald R. Rowe and George Techobanoglous, McGraw Hill Education, 2017. 5. "Wastewater Treatment for Pollution Control and Reuse", Arceivala S. J., Third Edition, McGraw Hill Education, 2017	
Course Outcomes	Upon completion of the course, the students will be able to: CO1: Summarize the background of biological treatment processes. CO2: Model the suspended growth process. CO3: Analyze and design the suspended growth treatment plant and ponds. CO4: Analyze and Design attached growth treatment process facilities. CO5: Examine the various digestion processes.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2
CO2	3	3	2	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	3
CO5	3	3	2	2	2

Course Title	RURAL WATER SUPPLY AND ONSITE SANITATION SYSTEMS										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUCXXE22	PEC	-	3	3	-	-	40	60	-	-	100

Cognitive Level	K-1 Recall the sources of water and pipes and pump selection K-2 understands the water quality standards for rural water supply systems. K-3 Apply the suitable techniques for sewage disposal and reuse.
Course Objectives	The Course aims Understand the importance rural water supply and principles of water supply with their components. • Understand the various onsite sanitation system.

Unit	Content	No. of Hours
I	Development of Water Sources - Sources of water – Surface and ground water sources – Development of deep bore wells; Estimation of yield – Alternate sources of water supply – Rain water harvesting - pumps – Types and selection of pumps for deep bore wells – Construction, operation and maintenance.	9
II	Water Treatment - Quality of water – Standards - conventional water treatment – Technologies for removal of specific contaminants; Iron, Arsenic, Fluoride, T.D.S; Disinfection – Alternate disinfection methods – solar disinfection.	9
III	Sanitation - Basic requirement of sanitation; Decentralized / onsite wastewater management; small bore / settled effluent sewer system – Design and operation.	9
IV	Sewage Treatment - Fundamentals of sewage treatment; Decentralized sewage treatment; Septic tank with depression pit – DEWATS, Intermittent sand filters – Anaerobic filters – Waste stabilization ponds – Design and operation.	9
V	Sewage Disposal and Reuse - Methods of disposal, Land disposal, sewage farms – Artificial recharge of ground water; Recycle and Reuse of sewage – Grey water Harvesting – Salt water intrusion and remediation – Ground water pollution and remediation.	9
Text book/ References	***1.*** CPHEEO Manual on Water Supply and Treatment, Govt. of India (2003). ***2.*** CPHEEO Manual on Sewerage and Sewage Treatment, Govt. of India (1999). ***3.*** Metcalf & Eddy, Wastewater Engg. Treatment and Reuse, Tata McGraw Hill, New Delhi (2003). ***4.*** Todd, D.K. Ground Water Hydrology, John Wiley & Sons, New York (2000). 5. F.R. Spellman, Hand Book of Water and Wastewater Treatment Plant operations CRC Press, New York (2009).	
Course Outcomes	On completion of the course, students should be **CO1:** able to understand the sources of surface and sub-surface sources **CO2:** able to know about the specific contaminant's removal **CO3:** able to develop the on-site sanitation managements	

	CO4: able to design the anaerobic treatment systems **CO5:** able to provide the remedial solution for ground water pollution	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	1	3
CO2	1	1	1	1	2
CO3	2	3	2	2	3
CO4	2	1	1	1	3
CO5	2	1	1	2	3

Course Title	WATER AND AIR QUALITY MODELS										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE23	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1 Identify the water and air quality managements systems K-2 Understand the concepts of water and air quality models K-3 Apply the theoretical concepts of air and water quality model to prepare the real models										
Course Objectives	The Course aims • To acquaint with various water flow models and their kinetics. • To educate about the water parameters modeling and various ground water quality modeling. • Ability to visualize the modeling and behavior of air and water quality systems • To visualize the physical limits on the air and water quality systems through modeling and software systems.										

Unit	Content	No.of Hours
I	Modeling/Concept- Water and air quality management – Role of mathematical models; systems approach – systems and models – kinds of mathematical models – model development and validation effluent and stream standards; ambient air quality standards.	9
II	Surface Water Quality Modeling - Historical development of water quality models; rivers and streams water quality modeling – river hydrology and flow – low flow analysis – dispersion and mixing – flow, depth and velocity – estuaries – estuarine transport, net estuarian flow, estuary dispersion coefficient; Lakes and impoundments – Water quality response to inputs; water quality modeling process – model sensitivity – assessing model performance; Models for dissolved oxygen, pathogens; Streeter – Phelps models.	9
III	Air Quality Modeling - Transport and dispersion of air pollutants – wind velocity, wind speed and turbulence; estimating concentrations from point sources – the Gaussian Equation – determination of dispersion parameters, atmospheric stability; dispersion instrumentation – Atmospheric traces; concentration variation with averaging time; Air pollution modeling and prediction – Plume rise modeling techniques, modeling for non-reactive pollutants, single	9

	source – short term impact, multiple sources and area sources, model performance and utilization, computer models.	
IV	Ground water Quality Modeling **-** Mass transport of solutes, degradation of organic compounds, application of concepts to predict groundwater contaminant movement, seawater intrusion – basic concepts and modeling	9
V	Computer Models **-** Exposure to computer models for surface water quality, groundwater quality and air quality.	9
References	• Steven C.Chapra, Surface WaterQualityModeling,TheMcGraw-HillCompanies,Inc.,NewYork,1997. • Arthur C.Stern Air Pollution (3rdEd.)Volume I –Air Pollutants, their transformation and Transport, 2006. • R.W.Boubel, D.L. Fox, D.B. Turner & A.C. Stern, Fundamentals of Air Pollution Academic Press, New York, 1994. • Ralph A. Wurbs, Water Management Models – A Guide to Software, Prentice Hall. PTR, New Jersey,1995. • Richard W. Boubel, Donald L. Fox, D. Bruce Turner & Arthur C. Stern, “Fundamentals of Air Pollution, Hardcover”,2007. • Deaton and Wine brake, “Dynamic Modeling of Environmental Systems”, Wiley & sons, 2002.	
Course Out Comes	On completion of the course, students should be **CO1:** Ability to visualize the modeling **CO2**: Able to understand the behavior of air and water quality systems **CO3:** To visualize the physical limits on the air and water quality systems through modeling . **CO4:**Ability to validate the findings of modeling on the ground reality under air, water, soil systems. **CO5:**Ability to prepare the computer models for air and water quality.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	2	-	-	2
CO 2	1	2	-	1	2
CO 3	1	2	-	1	2
CO 4	1	2	1	2	2
CO 5	1	2	1	2	2

Course Title	SOLID AND HAZARDOUS WASTE MANAGEMENT										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE24	PEC	-	2	3	-	-	40	60	-	-	100
Cognitive Level	K-1 Identify the Solid and hazardous waste sources and its characteristics K-2 Explain the solid and hazardous waste management systems K-3 Apply the legislations on management of solid and hazardous wastes.										
Course Objectives	The Course aims • To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipment's. • To impart skill for design of solid and hazardous treatment systems. • Ability to design the collection and treatment units for the management of municipal and hazardous waste.										

Unit	Content	No.of Hours
I	Introduction -Solid wastes- definition, types, sources, characteristics, and impact on environmental health. Waste generation rates. Concepts of waste reduction, recycling and reuse.	5
II	Collection, segregation and transport of solid wastes - Handling and segregation of wastes at source. Collection and storage of municipal solid wastes; analysis of Collection systems. Transfer stations - labeling and handling of hazardous wastes. Public participation and the role of NGOs.	5
III	Solid waste management - Solid waste processing technologies. Mechanical and thermal volume reduction. Biological and chemical techniques for energy and other resource recovery: composting. Vermin composting, termigradation, fermentation. Incineration of solid wastes. Disposal in landfills: site selection, design, and operation of sanitary landfills; secure landfills and landfill bioreactors; leachate and landfill gas management; landfill closure and post-closure environmental monitoring; landfill remediation.	5
IV	Hazardous waste management - Hazardous wastes: definition, sources and characteristics: handling, collection, storage and	5

	transport. Hazardous waste treatment technologies. Physical, chemical and thermal treatment of hazardous waste: solidification, chemical fixation and encapsulation, incineration. Hazardous waste landfills: site selection, design and operation. Biomedical, plastic and e-waste: waste categorization, generation, collection, transport, treatment and disposal	
V	Legislation on solid waste handling Elements of integrated waste management: Legislations on management and handling of municipal solid wastes, biomedical wastes, and other hazardous wastes.	5
References	• Handbook of Solid Waste Management, F. Kreith, G. Tchobanoglous, 2009. • CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000. • Pollution Control, Climate Change and Industrial Disasters, Abbasi, T. and Abbasi, S.A. Discovery Publishing House, New Delhi (2010). • Hazardous Waste Management, M. D. LaGrega, P. L Buckingham, J. C. Evans, 2nd edition. McGraw-Hill, 2011.	
Course Out Comes	On completion of the course, students should be **CO:** Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation **CO2:** Define and explain important concepts in the field of solid waste management **CO3:** suggest suitable technical solutions for treatment of municipal and industrial waste **CO4**: Understand the role legislation and policy drivers play in stakeholders' response to the waste a **CO5:** Apply the basic scientific principles for solving practical waste management challenges	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	2	1	1	1
CO 2	1	2	1	1	1
CO 3	2	3	2	2	3
CO 4	1	2	1	1	2
CO 5	2	2	1	2	2

Course Title	AIR AND NOISE POLLUTION CONTROL ENGINEERING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUCXXE25	PEC	-	3	3	-	-	40	60	-	-	100

Cognitive Level	K-1 Identify the various air pollutants, sources and its effects on environment. K-2 Understand the design and performance equations for air pollution control. K-3 Apply annoyance rating schemes for indoor and outdoor noise pollution.
Course Objectives	The Course aims • To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends. • To educate theoretical principles and operational control techniques employed in industrial pollution control engineering.

Unit	Content	No. of Hours
I	Air pollutants, Sources, classification, Combustion Processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects-Smoke, smog and ozone layer disturbance, Greenhouse effect.	9
II	Air sampling and pollution measurement methods, principles and instruments, Ambient air quality and emission standards, Air pollution indices, Air Act, legislation and regulations, control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods.	9
III	Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods like absorption, adsorption, precipitation etc. Biological air pollution control technologies, Indoor air quality.	9
IV	Noise pollution: 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
V	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	9
Text book/ References	1. Introduction to Environmental Engineering and Science, G. M. Masters, Prentice-Hall of India, New Delhi, 2011. 2. Air Pollution Control Engineering, N. de Nevers. McGraw Hill, Singapore, 2011. 3. Environmental Noise Pollution, P. E. Cunniff, McGraw Hill, New York, 1987. 4. Fundamentals of Air pollution, R. W. Boubel, D. L. Fox, and A. C. Stern,	

	Academic Press, NY, 2011.	
Course Outcomes	On completion of the course, students should be **CO1:** Apply sampling techniques **CO2:** Apply modeling techniques **CO3:**Suggest suitable air pollution prevention equipment and techniques for various gaseous and particulate pollutants to Industries. **CO4:** Discuss the emission standards. **CO5:**know about the noise pollution measuring instruments and its standards.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	1	1
CO2	2	2	1	1	1
CO3	2	2	1	1	2
CO4	2	2	1	1	2
CO5	2	2	1	1	2

Course Title	ENVIRONMENTAL IMPACT ASSESSMENT AND LIFE CYCLE ANALYSES										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUCXXE26	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1 Identify the Components and methods For EIA K-2 Understand the Socio-Economic Impact Assessment K-3 Prepare the EIA Report for various sectors										
Course Objectives	The Course aims • To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment • To develop the skill to prepare environmental management plan. • Ability to prepare draft and detailed reports under EIA.										

Unit	Content	No. of Hours
I	Introduction - Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA – Cross sectoral issues and terms of reference in EIA – Public Participation in EIA. EIA process- screening – scoping - setting – analysis – mitigation	9
II	Components and Methods for EIA - Matrices – Networks – Checklists – Connections and combinations of processes - Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological –– Cumulative Impact Assessment – Documentation of EIA findings – planning – organization of information and visual display materials– Report preparation. EIA methods in other countries.	9
III	Socio-Economic Impact Assessment - Definition of social impact assessment. Social impact assessment model and the planning process .Rationale and measurementforSIAvariables.Relationshipbetweensocialimpactsandchangeincommunitya ndinstitutional arrangements. Individual and family level impacts. Communities in transition - neighborhood and community impacts. Selecting, testing and understanding significant social impacts. Mitigation and enhancement in social assessment. Environmental costing of projects.	9
IV	Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment.	9

<table>
<tr><td>V</td><td>Sectoral EIA - EIA related to the following sectors - Infrastructure –construction and housing- Highways - Mining – Industrial - Thermal Power - River valley and Hydroelectric – coastal projects-Nuclear Power Life Cycle Assessment; Resource Balance, Energy Balance & Management Review; Operational Control; Case Studies on EIA</td><td>9</td></tr>
<tr><td>Text book/ References</td><td>1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York.1996
2. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley- Interscience, New Jersey,2003.
3. Petts,J.,HandbookofEnvironmentalImpactAssessment,Vol.,Iand II, Blackwell Science, London, 2009.
4. KolluruRao, Bartell Steven, Pitblado R and Stricoff “Risk Assessment and Management Handbook”, McGraw Hill Inc., New York, 1996.
5. World Bank –Source book on EIA
6. Cutter, S.L.,"EnvironmentalRiskandHazards",Prentice-HallofIndiaPvt.Ltd.,NewDelhi,1999.
7. John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company.</td><td></td></tr>
<tr><td>Course Outcomes</td><td>On completion of the course, students should be
CO1: Able to understand the types and limitations of EIA.
CO2:Able to know about the Components and methods for EIA
CO3:Able to understand the Socio-Economic impact assessments
CO4: A:bility to prepare draft and detailed reports under EIA.
CO5: Ability to compare and validate the impacts on real systems under air, water and soil.</td><td></td></tr>
</table>

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	-	-	2
CO2	2	2	-	-	2
CO3	2	3	-	-	2
CO4	2	2	1	1	2
CO5	2	3	1	1	2

Course Title	CLIMATE CHANGE ADAPTATION AND MITIGATION PARTICIPATORY										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUCXXE27	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-Remembering the basic concepts of climate change. K2- Understanding the changes in patterns of temperature, precipitation and sea level rise and observed effects of climate change. K3-analysing the impacts of climate change.										
Course Objectives	To understand the Earth‟s climate system, changes and their effects on the earth, identifying the impacts, adaptation, mitigation of climate change and for gaining knowledge on clean technology, carbon trading and alternate energy sources.										

Unit	Content	No. of Hours
I	Introduction-Climate in the spotlight - The Earth‟s Climate Machine – Climate Classification- Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies – Cloud Formation and Monsoon Rains – Storms and Hurricanes - The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.	9
II	Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large-Scale Variability –Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol –UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.	9
III	Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios –Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.	9
IV	Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry –Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) – Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.	9
V	Clean Development Mechanism – Carbon Trading - examples of future Clean Technology –Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Biofuels– Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.	9
Text book/ References	1. Impacts of Climate Change and Climate Variability on Hydrological Regimes”, Jan C. Van Dam, Cambridge University Press, 2003.	

	2. IPCC fourth assessment report - The AR4 synthesis report, 2007 3. IPCC fourth assessment report –Working Group I Report, "The physical sciencebasis",2007 4. IPCC fourth assessment report – Working Group III Report" Mitigation of Climate Change", 2007 5. "Climate Change and Water". Technical Paper of the Intergovernmental Panel on Climate Change, Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., IPCC Secretariat, Geneva, 2008.	
Course Outcomes	CO1: Classify the Earths climatic system and factors causing climate change and global warming. CO2: Relate the Changes in patterns of temperature, precipitation and sea level rise and Observed effects of Climate Changes CO3: Illustrate the uncertainty and impact of climate change and risk of reversible changes. CO4: Articulate the strategies for adaptation and mitigation of climatic changes. CO5: Discover clean technologies and alternate energy source for sustainable growth.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2
CO2	3	2	2	2	3
CO3	2	2	2	2	3
CO4	3	2	2	2	2
CO5	3	3	2	3	3

<table>
<tr><th>Course Title</th><th colspan="12">INDUSTRIAL WASTE WATER MANAGEMENT</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>-</th><th>-</th></tr>
<tr><td>24CEUCXXE28</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1-Understanding the wastewater sources and environmental implications of various industrial effluents
K2-apply the remedial measures for disposal of industrial effluents.
K3-design solutions for the treatment and disposal of treated effluents.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">Analysing the disposal effects of industrial waste water with the help the principles of waste minimization techniques, and also imparting knowledge about pollution from major industries and treatment technologies.</td></tr>
</table>

Unit	Content	No. of Hours
I	Sources and types of industrial wastewater- Environmental Impacts-Industrial wastewater monitoring and sampling -characterization and variables - Toxicity and Bioassay tests. Prevention vs Control of Industrial Pollution- Source reduction techniques- effect of Industrial Effluents on Streams, Sewer and Human health.	9
II	Waste minimization - Equalization - Neutralization -Oil separation -Flotation - Precipitation -Heavy metal Removal -Adsorption -Aerobic and anaerobic biological treatment – Sequencing batch reactors -High-Rate reactors - Chemical and wet air oxidation - Ozonation - Photocatalysis – ion exchange-membrane technologies - Nutrient removal.	9
III	Common Effluent Treatment Plants - Advantages - zero polluting industry concept - Reduce, Reuse and Recycle of wastewater-Disposal of effluent on land- characteristics and disposal of sludge – Residual Management.	9
IV	Industrial manufacturing process description, wastewater characteristics, source reduction points and effluent treatment flow sheet for Textiles – Tanneries - Sugar and distilleries – Petroleum refineries – Food processing - Fertilizers-Dairy - Pharmaceutical industry.	9
V	Industrial manufacturing process description, wastewater characteristics, source reduction points and effluent treatment flow sheet for, Pulp and Paper mill - Iron and Steel industries- Meat packing industries and Poultry Plant-Automobile Industry – Industrial Estates.	9
Text book/ References	1. "Microbiology and Chemistry for Environmental Scientists and Engineers", J N Lester, Second edition,2018 2. Chemistry for Environmental Engineering and Science", Clair N. Sawyer, Perry L. Mccarty & Gene F Parkin, McGraw Hill Education, Fifth edition, 2017 3. "Environmental Chemistry", Anil Kumar De, Arnab Kumar De, New Age International publishers, Tenth edition, 2021. 4. "Environmental Science and Engineering", Yugananth P &Kumaravelan R, Scitech Publications, Second edition, 2015. 5. "Manual of Environmental Microbiology", Marylynn V Yates, Fourth edition,	

	2016.	
Course Outcomes	Upon completion of the course, the students will be able to: CO1: Outline the waste water sources and environmental implications of various industrial effluents. CO2: Summarize the various pollution prevention options. CO3: Assess the remedial technologies for disposal of industrial effluents. CO4: Employ the design solutions for the treatment and disposal of treated effluents. CO5: Implement and comprehend the pollution control methods for specific industries.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2
CO2	3	2	3	2	2
CO3	3	3	2	2	2
CO4	3	3	2	3	2
CO5	3	2	3	2	2

<table>
<tr><td>Course Title</td><td colspan="13">ENVIRONMENT HEALTH AND SAFETY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>-</td><td>-</td></tr>
<tr><td>24CEUCXXE29</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- Develop awareness on safety measures in Industries.
K2- Implement safety management as per various standards.
K3- Analyze and execute accident prevention techniques.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">To impart knowledge on occupational health hazards, safety measures at work place, accident prevention, safety management and safety measures in industries.</td></tr>
</table>

Unit	**Content**	**No. of Hours**
I	Occupation, Health and Hazards - Safety Health and Management: Occupational Health Hazards - Ergonomics - Importance of Industrial Safety - Radiation and Industrial Hazards: Types and effects - Vibration - Industrial Hygiene - Different air pollutants in industries and their effects - Electrical, fire and Other Hazards.	9
II	Safety at Workplace - Safe use of Machines and Tools: Safety in use of different types of unit operations - Ergonomics of Machine guarding - working in different workplaces - Operation, Inspection and maintenance - Housekeeping, Industrial lighting, Vibration and Noise.	9
III	Accident Prevention Techniques - Principles of accident prevention - Hazard identification and analysis, Event tree analysis, Hazop studies, Job safety analysis - Theories and Principles of Accident causation - First Aid: Body structure and functions - Fracture and Dislocation, Injuries to various body parts.	9
IV	Safety Management System and Law - Legislative measures in Industrial Safety - Occupational safety, Health and Environment Management, Bureau of Indian Standards on Health and Safety, IS 14489 standards - OSHA, Process safety management (PSM) and its principles - EPA standards	9
V	Plant Layout for Safety - design and location, distance between hazardous units, lighting, colour coding, pilot plant studies, Housekeeping - Accidents Related with Maintenance of Machines - Work Permit System - Significance of Documentation - Case studies involving implementation of health and safety measures in Industries.	9
Text book/ References	1. "Physical Hazards of the Workplace", Barry Spurlock, CRC Press, 2017. 2. "Handbook of Occupational Safety and Health", S. Z. Mansdorf, Wiley Publications,2019 3. Safety, Health, and Environment", NAPTA, 2nd Edition, Pearson Publications, 2019. 4. Occupational Health and Hygiene in Industries", Raja Sekhar Mamillapalli, Visweswara Rao , PharmaMed Press, 1st edition, 2021.	
Course Outcomes	CO1: Identify the occupational health hazards. CO2: Execute various safety measures at workplace. CO3: Analyze and execute accident prevention techniques. CO4: Implement safety management as per various standards. CO5: Develop awareness on safety measures in Industries.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	3
CO2	2	2	2	1	2
CO3	2	3	2	1	2
CO4	1	1	1	2	2
CO5	1	1	1	1	1

Course Title	ECOLOGICAL ENGINEERING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUCXXE30	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: identify the eco technology which is relevance to the human civilization. K-2: Understand about the system approach and Ecological engineering processes. K-3: Apply the eco technology for various waste treatment										
Course Objectives	The Course aims • To know about the environment • To understand about environmental pollution • To apply the knowledge in understanding various environmental issues and problems • To apply the acquired knowledge and skill on the ecological control of air, water and soil systems,										

Unit	Content	No. of Hours
I	Introduction to Ecology and Ecological Engineering - Aim – scope and applications of Ecology, Ecological Engineering and Eco-technology and their relevance to human civilization – Development and evolution of ecosystems – Principles and concepts were pertaining to communities in ecosystem – Energy flow and material cycling in ecosystems – Productivity in ecosystems.	9
II	Systems Approach in Ecological Engineering - Classification of eco-technology – Principles and components of Systems and Modeling – Structural and functional interactions in environmental systems – Human modifications of environmental systems.	9
III	Ecological Engineering Processes - Self-organizing processes – Multiple seeded microcosms – Interface coupling in ecological systems. Concepts of energy – Adapting ecological engineering systems to potentially catastrophic events – Agro ecosystems – Determination of sustainable loading of ecosystems.	9
IV	Eco-technology for Waste Treatment - Principles and operation of soil infiltration systems – wetlands and ponds – source separation systems – aqua cultural systems – detritus based treatment for solid wastes – Applications of ecological engineering marine systems.	9
V	Case studies of integrated ecological engineering systems.	9
Text book/ References	• Mitsch, J.W & Jorgensen, S.E., Ecological Engineering – An Introduction to Ecotechnology, John Wiley & Sons, New York,2009. • Smith, R.L. and Thomas M. Smith (2003), Elements of Ecology (5^{th}ed.). San Francisco: Benjamin Cummings. • White, I.D, Mottershed, D.N and Harrison, S.L., Environmental Systems –	

	An Introductory Text, Chapman Hall, London,2004. • Kangas, P.C. and Kangas, P., Ecological Engineering: Principles and Practice, Lewis Publishers, New York, 2003.	
Course Outcomes	On completion of the course, students should be **CO1** Able to solve environmental problems and issues under ecological engineering. **CO2** Able to visualize the application of control principles on the ecological control of natural and manmade systems. **CO3** Able to understand the Ecological engineering process **CO4** Able to adopt the eco technology for various waste treatment process. **CO5** Able to provide the solution for the various ecological engineering systems.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	2	2
CO2	1	2	1	2	2
CO3	2	2	1	2	1
CO4	2	2	1	2	2
CO5	2	2	3	2	2

IV. HYDRAULIC, HYDROLOGY & WATER RESOURCE

NGINEERING

Course Title	PIPE LINE ENGINEERING										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE31	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	**K1** : recall the various types of water supply systems **K2** : understand the hydraulic principles and network parameters **K3** : Apply the principles in storm water or other water related distribution										
Course Objectives	The Course aims To educate the students in detailed design concepts related to water transmission mains, water distribution system and buried pipes with emphasis on computer application										

Unit	Content	No.of Hours
I	**WATER SUPPLY SYSTEMS** Water requirement – sources of water – water demand – reservoir storage – nodal hydraulic gradient level values - water supply consideration, Types of water supply systems- piping system- distribution network- labeling- network components – Network models – design – optimization in practice	9
II	**HYDRAULIC PRINCIPLES AND NETWORK PARAMETERS** Energy and hydraulic gradient lines – head loss in links – equivalent pipes – series – parallel pipes –path head loss and loop head loss – analysis of water distribution network- static node, dynamic node– network performance – flow analysis - Layout – in situ lining - pipes material – appurtenances – minimization of water losses – leak detection.	9
III	**STORM WATER DISTRIBUTION AND BURIED PIPES** Planning – runoff estimation – rainfall data analysis – storm water drain design Introduction to Buried pipes – external loads	9

	– gravity flow design, pressurized flow- rigid and flexible pipes – installation – trenchless technology	
IV	**RELIABILITY ASSESSMENT AND DESIGN** Uncertainty and reliability – affecting events- assessment – reliability parameters- configurations. Design methodology - strengthening and expansion	9
V	**FLUID TRANSIENTS** Basic equations of unsteady flows through closed conduits. Method of characteristics. Transients caused by centrifugal pumps and hydroelectric power plants.	9
References	**REFERENCES:** 1. Bhave P. R, Optimal design of water distribution networks, Narosa publishing House, New Delhi,2003 2. Bajwa. G. S, Practical handbook on Public Health Engineering, Deep publishers, Shimla 2003 3. Manual on water supply and treatment, CPHEEO, Ministry of Urban Development, GOI, NewDelhi, 1999 4. B.A. Hauser, practical hydraulics Hand Book, Lewis Publishers, New York, 1991 5. Moser A. P, Buried pipe Design, 3rd Edition, American Water Works Association 6. Robert van Bentum and Lan K. Smout, Buried Pipe lines for surface Irrigation, The Water, Engineering and Development Centre, Intermediate Technology Publications,UK,1994 7. Wurbs R.A., and James W.P. Water Resources Engineering. Prentice Hall of India, EasternEconomic Edition. ISBN: 81-203-2151-0, New Delhi, 2007	
Course Out Comes	The students can be **CO1**: understand fundamental of water supply systems. **CO2**: analyze the hydraulic principles and networking parameters. **CO3**: plan for storm water distribution **CO4** : design the pipeline networks and check the reliability. **CO5:** develop water networking system based on characteristics	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	3	2	1	1
CO 2	2	3	2	2	1
CO 3	2	2	3	2	2
CO 4	1	2	1	3	2
CO 5	1	1	2	3	3

Course Title	OPEN CHANNEL FLOW										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE32	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	**K1** :Recall the basics principles of various flow with their concepts **K2** : understand the principles of different types of flow like steady and unsteady flow **K3** : Apply the principles in hydraulic structures for flow of water										
Course Objectives	The Course aims 1. Application of principles of fluid mechanics to the solution of problems encountered in both natural and constructed water systems. 2. Use of model studies and computers in solving a host of problems in hydraulic engineering.										

Unit	Content	No.of Hours
I	**BASIC PRINCIPLES** Basic concepts of uniform flow - computations. Specific energy and specific force concepts –applications.	9
II	**STEADY VARIED FLOWS IN OPEN CHANNELS** Dynamic equation for spatially varied flows. Flow profile computations. Introduction to HEC-RAS. Spatially varied flows and rapidly varied flows – applications.	9
III	**UNSTEADY FLOWS IN OPEN CHANNELS** Equations of motion. Uniformly progressive wave. Rapidly varied unsteady flow – positive and negative surges. Dam break problem.	9
IV	**SEDIMENT TRANSPORT** Sediment properties – inception of sediment motion – bed forms. Bed load suspended load – Total sediment transport. Design of stable channels and regime channels. Reservoir sedimentation and trap efficiency.	9
V	**FLOW MEASUREMENTS AND HYDRAULIC MODELING** Sharp-Crested weirs, broad-crested weirs, critical depth flumes.	9

	Recent advancement in open channel flow measurements. Physical modeling in hydraulics. Dimensional analysis. Modeling closed flows and free surface flows. Distorted models. Design of physical models.	
References	1. Sturm T.W., "Open Channel Hydraulics" – 2nd edition. Tata-McGraw Hill New Delhi 2011. 2. ISBN:978-1-25-900225-0 3. Wurbs R.A., and James W.P. "Water Resources Engineering". Prentice Hall of India, Eastern 4. Economic Edition. ISBN: 81-203-2151-0, New Delhi, 2007. 5. Subramanya K., "Flow in Open Channels (2nd ed.) Tata McGraw Hill, ISBN 00-746-2446-6, New Delhi 2003. 6. Chaudhry M. H., "Open Channel Flow. Prentice Hall of India, Eastern Economic Edition , . ISBN: 7. 81-203-0863-8,New Delhi. 1994. 8. Chow Ven-te "Open Channel Hydraulics McGraw Hill, New York NY 1959. 9. French, R. H., "Open Channel Hydraulics McGraw Hill, New York NY 1985. 10. Srivastava R. Flow through Open Channels Oxford University Press New Delhi 2008.	
Course Out Comes	The students can be **CO1**: understand fundamental principles of flow of water **CO2**:understand the principles of steady varied flow **CO3**: interpret the unsteady open channel flow. **CO4**:understand the sediment and their characteristics and consequences **CO5**: understand the latest measurement techniques in hydraulics	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	2	2	2	1
CO 2	3	2	1	1	1
CO 3	3	2	2	2	1
CO 4	3	2	1	1	1
CO 5	3	2	2	1	

Course Title	RIVER ENGINEERING										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE33	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	**K1** :Recall the primary function of rivers and Indian River Region. **K2** : understand the principles of river hydraulics based on various types of flow **K3** : Apply the principles in river training works for control of flood.										
Course Objectives	1. To understand theoretical concepts of water and sediment movements in rivers 2. To inculcate the benefits of fluvial system to the society										

Unit	Content	No.of Hours
I	**RIVER FUNCTIONS** Primary function of a river – River uses and measures – Water and Sediment loads of river – Rivers in India, Himalaya and Peninsular.	9
II	**RIVER HYDRAULICS** Physical Properties and Equations – Steady flow in rivers – uniform and non uniform – Turbulence and velocity profiles – resistance coefficients – Boundary conditions and back waters – Transitions – Rating Curve – Unsteady flow in rivers : Propagative of surface waves – Characteristics, flood waves– kinematic and diffusion analogy – velocity of propagation of flood waves – Flood wave –Maximum	9
III	**RIVER MECHANICS** River Equilibrium : Stability of Channel – regime relations – river bend equilibrium – hydraulic geometry of downstream - Bars and meandering - River dynamics – degradation and aggradations of river bed – Confluences and branches – River Data base.	9
IV	**RIVER SURVEYS AND MODEL** Mapping – Stage and Discharge Measurements – Sediments – Bed and suspended load Physical hydraulic Similitude – Rigid and mobile bed – Mathematical – Finite one dimensional – multi – dimensional – Water	9

	Quality and ecological model	
V	**RIVER MANAGEMENT** River training works and river regulation works – Flood plain management – waves and tides inEstuaries - Interlinking of rivers – River Stabilization	9
References	1. Janson PL.Ph., Lvan BendegamJvanden Berg, Mdevries A. Zanen (Editors), Principles of RiverEngineering – The non tidal alluvial rivers – Pitman, 1979. 2. Pierre Y. Julien ., "River Mechanics" ,Cambridge University Press, 2002. 3. K.L Rao , INDIA"s WATER WEALTH – Orient Longman Ltd., 1979.	
Course Outcomes	The students can be **CO1**: understand basics functions of Rivers and Indian rivers **CO2**:understand the principles river hydraulics **CO3**: understand the mechanics of River **CO4**:Apply understand the various surveys and solve the problems **CO5** :understand the river water managing system	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	3	2	3	1
CO 2	3	3	2	2	2
CO 3	3	3	2	2	1
CO 4	2	2	1	1	2
CO 5	2	2	1	2	1

Course Title	URBAN WATER RESOURCES MANAGEMENT										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE34	PEC	-	3	3	-	-	40	60	-	-	100

Cognitive Level	**K1** :Recall the basics principles hydrological cycle and their components **K2** : understand the different types of management models for urban water management. **K3** : Apply the knowledge to develop the Master Plan for Urban water Management
Course Objectives	The Course aims 1. To introduce the concepts of urbanization and its impact on the natural water cycle 2. The student is exposed to the use the urban storm water models for better storm water management. 3. Students also exposed for the preparation of urban storm water master plan and different types of operation and maintenance.

Unit	Content	No.of Hours
I	**URBAN HYDROLOGIC CYCLE** Water in the urban eco-system – Urban Water Resources – Major problems – Urban hydrological cycle – Storm water management objectives and limitations – Storm water policies – Feasibility consideration.	5
II	**URBAN WATER RESOURCES MANAGEMENT MODELS** Types of models – Physically based – conceptual or unit hydrograph based – Urban surface runoff models – Management models for flow rate and volume control rate – Quality models.	5
III	**URBAN STORM WATER MANAGEMENT** Storm water management practices (Structural and Non-structural Management measures) – Detention and retention concepts – Modelling concept – Types of storage – Magnitude of storage – Hydraulic analysis and design guidelines – Flow and storage capacity of urban components – Temple tanks.	5

IV	**MASTER PLANS** Planning and organizational aspects – Inter dependency of planning and implementation of goals and measures – Socio – economics financial aspects – Potential costs and benefit measures – Measures of urban drainage and flood control benefits – Effective urban water user organizations.	5
V	**OPERATION AND MAINTENANCE** General approaches to operations and maintenance – Complexity of operations and need for diagnostic analysis – Operation and maintenance in urban water system – Maintenance Management System – Inventories and conditions assessment – Social awareness and involvement.	5
References	1. Geiger, W.F., Marsalek, F., and Zuidena, F.C., (Ed), manual ondrainage in urbanized areas –Vol.1 and Vol.II, UNESCO, 1987. 2. Hengeveld, H. and C. De Voch.t (Ed)., Role of Water in Urban Ecology, 1982. 3. Martin, P. Wanelista and Yousef, A. Yousef., Storm Water Management, John Wiley and sons,1993. 4. Neil S. Grigg., Urban Water Infrastructure Planning, Management and Operations, John Wiley and Sons, 1986. 5. Overtens D.E. and Meadows M.E., Storm Water Modelling, Academic Press, New York, 1976.	
Course Out Comes	The students can abbe to **CO1:** Understand fundamental principles of flow of water **CO2**: Understand the principles of steady varied flow **CO3:** Interpret the unsteady open channel flow. **CO4**: Understand the sediment and their characteristics and consequences **CO5**: understand the latest measurement techniques in hydraulics	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	2	1
CO 2	3	3	2	1	2
CO 3	1	2	1	1	1
CO 4	3	2	1	1	1
CO 5	1	2	2	1	1

Course Title	GROUND WATER HYDROLOGY											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE35	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	**K1**: Recall the basics principles of ground water flow **K2**: Understand the different surface and sub surface methods of ground water assessment. **K3**: Apply the principles in to interpret the sea water intrusion and ground water Fluctuations										
Course Objectives	The Course aims 1. To enable to the student to understand the basic empirical knowledge of the residence and movement of groundwater, as well as a number of quantitative aspects. 2. At the end of the course, the student should be able to evaluate the aquifer parameters and groundwater resources for different hydro-geological boundary conditions.										

Unit	Content	No.of Hours
I	**Ground water Principles:** Groundwater occurrence – distribution – aquifer – types – Surface investigation - Geophysical- electrical resistivity - Seismic refraction - Gravity and magnetic - Geologic - Air photo interpretation - Dowsing.	9
II	**Subsurface Investigation methods:** Subsurface investigation - test drilling - resistivity logging- potential logging – temperature and caliper logging.	9
III	**Flow Principles:** Steady unidirectional flow - well in a uniform flow - steady flow with uniform recharge -unsteady radial flow to a well - well flow near aquifer boundaries - Multiple well systems -partially penetrating wells - characteristic well losses.	9
IV	**Ground water Fluctuations:** Secular and seasonal variations - Fluctuations due to evapo-transpiration, Meteorological phenomena, tides, external loads and earthquakes - control by	9

	drains and wells. Recharge through sewage pits, shafts and wells.	
V	**Sea water intrusion:** Occurrence of sea water intrusion - Ghypon-Heizberg relation between fresh and saline waters - shape length and structure of the fresh salt water interface - prevention and control of seawater intrusion - role of sea water in ground water - coastal zoning. Sand models - Electrical models - Viscous fluid models - membrane models – numerical analysis methods	9
References	Raghunath H.M., Ground Water Hydrology, New-Age International, 2nd Edition, 1990.	
Course Outcomes	The students can able to **CO1** : understand fundamental principles of ground water **CO2** : understand the sub surface methods of ground water. **CO3:** understand the various flow principles **CO4** : understand reason for ground water Fluctuations **CO5** : understand problems, reason and control techniques of sea water intrusion.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	2	2
CO 2	3	3	2	2	1
CO 3	3	3	2	1	1
CO 4	3	3	2	1	1
CO 5	2	3	1	1	1

Course Title	HYDROLOGY AND WATER RESOURCE ENGINEERING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE36	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	**KI :** Recall the fundamental principles of hydrologic cycle and their components **K2:** Understand the basics principles of various components **K3:** **A**pply the knowledge to field issues and solve the problems										
Course Objectives	The Course aims • Students can understand the basics of hydrology processes and their components . • They can understand the water resources processes and their related structures.										

Unit	Content	No.of Hours
I	Introduction - hydrologic cycle, water-budget equation, history of hydrology, world water balance, applications in engineering, sources of data. Precipitation - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth-area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.	9
II	Abstractions from precipitation - evaporation rocess, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices.	9
III	Runoff - runoff volume, SCS-CN method of estimating runoff volume, flow-duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows.	9
IV	Ground water and well hydrology - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests. Water withdrawals and uses – water for energy	9

	production, water for agriculture, water for hydroelectric generation; flood control. Analysis of surface water supply, Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation.	
V	Distribution systems - canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining. Drainage of irrigated lands: necessity, methods. Dams and spillways - embankment dams: Classification, design considerations,estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams. Spillways: components of spillways, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site.	9
References	**Text/Reference Books:** 1. K Subramanya, Engineering Hydrology, Mc-Graw Hill. 2. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill. 3. K Subramanya, Water Resources Engineering through Objective Questions, Tata Mc-Graw Hill. 4. G L Asawa, Irrigation Engineering, Wiley Eastern 5. L W Mays, Water Resources Engineering, Wiley. 6. J D Zimmerman, Irrigation, John Wiley & Sons 7. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.	
Course Out Comes	At the end of the course, students must be in a position to: **CO1**: Understand the interaction among various processes in the hydrologic cycle **CO2**: Apply the application of fluid mechanics and use of computers in solving a host of problems in hydraulic engineering **CO3**: Study types and classes of hydrologic simulation models and design procedures for safe and effective passage of flood flows for design of hydraulic structures **CO4**: Understand the basic aquifer parameters and estimate groundwater resources for different hydro-geological boundary conditions **CO5**: Understand application of systems concept, advanced optimization techniques to cover the socio-technical aspects in the field of water resources .Apply the principles and applications of remote sensing, GPS and GIS in the context to hydrological extreme flood and drought events in water resources engineering	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1	1	1
CO 2	1	3	1	2	3
CO 3	3	1	2	1	2
CO 4	3	2	1	1	1
CO 5	1	1	2	2	3

Course Title	WATER RESOURCES SYSTEMS ANALYSIS										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE37	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	**K1** :Recall the basics systems analysis concept **K2** : understand the principles of different types of programming **K3** : Apply the principles in model development for water resources										
Course Objectives	The Course aims 1. To introduce the student to the concept of Mathematical approaches for managing the water resources system. 2. To make the students apply an appropriate system approach to optimally operate a water resource system.										

Unit	Content	No.of Hours
I	**SYSTEM APPROACH** Philosophy of modelling – Goals and Objectives – Basics of system analysis concept – scopes and steps in systems engineering.	9
II	**PHYSICAL AND SOCIO - ECONOMIC DATA** Collection, evaluation and processing – project appraisal – public involvement, master Comprehensive and integrated planning of water resources project.	9
III	**LINEAR PROGRAMMING** Operation research - introduction - Problem Formulation-graphical solution- Simplex method – Sensitivity analysis - simple applications	9
IV	**DYNAMIC PROGRAMMING** Optimality criteria Stage coach problem – Bellman"s optimality criteria Problem formulation and Solution - simple applications	9
V	**SIMULATION** Basic principles – Methodology and Philosophy – Model development – input and outputs – Deterministic simulation - simple applications	9

References	**TEXTBOOK:** 1. Vedula, S., and Majumdar, P.P. "Water Resources Systems" – Modeling Techniques and Analysis Tata McGraw Hill, 5th reprint, New Delhi, 2010. **REFERENCES:** 1. Hall Warren, A. and John A. Dracup., "Water Resources System Engineering", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1998 2. Chadurvedi M.C., "Water resource Systems Planning and Management", Tata McGraw Hill inc., New Delhi,1997 3. Taha H.A., "Operation Research", McMillan Publication Co., New York, 1995. 4. Maass A., Husfchimidt M.M., ,Dorfman R., ThomasH A., Marglin S.A and Fair G. M., "Design of Water Resources System", Hardward University Press, Cambridge, Mass.,1995. 5. Goodman Aluvin S., "Principles of Water Resources Planning", Prentice Hall of India, 1984	
Course Out Comes	The students can able be to **CO1**: understand fundamental principles of system principles **CO2**: understand the principles integrated water resource project **CO3**: understand the linear programming **CO4**: understand the dynamic programming for water resources **CO5**:apply the knowledge to develop model for water resource system	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	2	2	1
CO 2	3	1	2	2	1
CO 3	3	1	2	1	1
CO 4	3	2	2	1	2
CO 5	3	2	2	1	3

Course Title	SURFACE WATER HYDROLOGY										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE38	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	**K1** :Recall the basics principles of hydro metrology **K2** : understand the principles of hydrology components **K3** : Apply the principles for real life situations and solve the problems.										
Course Objectives	The Course aims This subject aims at making the students to understand the relevance of various components of hydrologic cycle, which are responsible for spatial and temporal distribution of water availability in any region.										

Unit	Content	No.of Hours
I	**HYDROMETEOROLOGY** Hydrologic cycle – Global water budget – Practical applications – Hydrometeorology – Constituents of atmosphere – Vertical structure of the atmosphere – general circulation – Transitory system – Air mass – Air front – cyclones – Formation of precipitation – Types and forms of precipitation – Climate and Weather – Meteorological Observations.	**9**
II	**PRECIPITATION** Measurement of rainfall – Rain gauges – Radar Measurement of rainfall - Rainfall Hyetograph – Intensity Duration and Frequency analysis – Consistency – Missing data – Rain gauge network – Average depth of rainfall analysis – Spatial analysis using GIS – Annual rainfall of India and Tamilnadu	**8**
III	**ABSTRACTIONS** Water losses - Initial losses – Interception and depression storage – Evaporation – Evaporimeters – Estimation of Evaporation - Evapotranspiration – Field Measurement – Empirical Equations - Infiltration – Infiltrometers – Infiltration Equations - Infiltration Indices.	**8**

IV	**STREAMFLOW MEASUREMENT** Stage and Velocity Measurement – Gauges – Current meter and Doppler flow velocity meter - Discharge measurement – Area Velocity method - Area Slope method – Discharge Measuring Structures - Dilution Technique – Stage Discharge relationship – Selection of a Stream Gauging Site.	**8**
V	**RUNOFF AND WATER CONSERVATION** Concept of catchment – Linear, Areal and Relief Aspects – Detailed study of Runoff process – Factors affecting Runoff – Hydrograph – Unit Hydrograph – Synthetic Hydrograph –Runoff estimation - Strange and SCS methods – Water Conservation – Rain water and Runoff Harvesting in Rural and Urban Areas Reservoir Sedimentation.	**12**
References	**REFERENCES:** 1. Chow V.T., Maidment D.R., Mays L.W., "Applied Hydrology", McGraw Hill Publications, NewYork, 1995. 2. Subramanya K., "Hydrology,Tata McGraw Hill Co., New Delhi, 1994. 3. Patra.K.C, "Hydrology and Water Resources Engineering", Narosa Publications, 2008, 2^{nd}Edition, New Delhi. 4. Jeya Rami Reddy.P, "Hydrology, Laximi Publications, New Delhi, 2004	
Course Out Comes	The students can able to **CO1**: understand fundamental principles of hydrology. **CO2**: understand the principles of hydrology components **CO3**: understand the various measurement techniques **CO4**: understand the stream flow measurement **CO5**: understand the runoff water conservation techniques	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	2	1
CO 2	3	2	2	1	1
CO 3	3	2	2	1	1
CO 4	3	2	2	1	1
CO 5	3	2	2	1	

Course Title	REMOTE SENSING AND GIS IN WATER RESOURCES										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE39	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	**K1** : Recall the importance of Remote sensing and GIS **K2** : Understand the principles of Remote sensing and GIS **K3** : Apply the principles in water resources sector										
Course Objectives	The Course aims To teach the principles and applications of remote sensing, GPS and GIS in the context of water resources. At the end of the course, the student will appreciate the importance of remote sensing and GIS in solving the spatial problems in water resources.										

Unit	Content	No.of Hours
I	**REMOTE SENSING** Physics of remote sensing, electromagnetic radiation (EMR), Interaction of EMR with atmosphere, earth surface, soil, water and vegetation; Remote sensing platforms – Monitoring atmosphere, land and water resources - LANDSAT, SPOT, ERS, IKONOS and others, Indian Space Programme	5
II	**DIGITAL IMAGE PROCESSING** Satellite Data analysis - Visual interpretation – Digital image processing – Image preprocessing – Image enhancement – Image classification – Data Mergin	5
III	**GEOGRAPHIC INFORMATION SYSTEM** Definition – Basic components of GIS – Map projections and co-ordinate system – Spatial data structure: raster, vector – Spatial Relationship – Topology – Geodatabase models: hierarchical, network, relational, object oriented models – Integrated GIS database -common sources of error – Data quality: Macro, Micro and Usage level components - Meta data - Spatial data transfer	5

	standards.	
IV	**SPATIAL ANALYSIS** Thematic mapping – Measurement in GIS: length, perimeter and areas – Query analysis – Reclassification – Buffering - Neighbourhood functions - Map overlay: vector and raster overlay – Interpolation – Network analysis –Digital elevation modelling. Analytical Hierarchy Process, – Object oriented GIS – AM/FM/GIS – Web Based GIS	5
V	**WATER RESOURCES APPLICATIONS** Spatial data sources – 4M GIS approach water resources system – Thematic maps - Rainfall-runoff modelling – Groundwater modeling – Water quality modeling - Flood inundation mapping and Modelling – Drought monitoring – Cropping pattern change analysis –Performance evaluation of irrigation commands. Site selection for artificial recharge - Reservoir sedimentation.	5
References	1. Lillesand, T.M. and Kiefer, R.W., "Remote Sensing and Image Interpretation" 3rd Edition. JohnWiley and Sons, New York. 1993. 2. Burrough P.A. and McDonnell R.A., "Principles of Geographical Information Systems",.OxfordUniversity Press. New York. 1998. 3. Ian Heywood Sarah, Cornelius and Steve Carver "An Introduction to Geographical InformationSystems". Pearson Education. New Delhi, 2002. 4. "Centre for Water Resources", Change in Cropping Pattern in Drought Prone Chittar Sub-basin, Project Report, Anna University, Chennai, 2002. 5. "Centre for Water Resources", Post-Project Evaluation of Irrigation Commands	
Course Out Comes	The students can be **CO1**: Understand fundamental principles of Remote sensing and Introduce the technology and principles of Satellite Imaging **CO2**: Understand the principles of digital image processing and Theoretical explanations on Image processing and information extraction from Satellite Data Products **CO3**: Understand the basic principles of GIS and Functional elucidation of GIS integrating Satellite Data Products into the GIS platform for Decision making	

	CO4: Understand the spatial analysis. **CO5**: Apply the Potential of remote sensing and GIS is solving problems in water resources through case studies.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	2	2	1
CO 2	3	1	2	1	2
CO 3	3	3	3	1	1
CO 4	3	3	2	1	1
CO 5	1	1	1	2	3

Course Title	WATERSHED CONSERVATION AND MANAGEMENT										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE40	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	**K1** :Recall the basics principles of various flow with their concepts **K2** : understand the principles of different types of flow like steady and unsteady flow **K3** : Apply the principles in hydraulic structures for flow of water										
Course Objectives	The Course aims 1. To provide the technical, economical and sociological understanding of a watershed. 2. To provide a comprehensive discourse on the engineering practices of watershed management for realizing the higher benefits of watershed management.										

Unit	Content	No.of Hours
I	**WATERSHED CONCEPTS** Watershed - Need for an Integrated Approach - Influencing Factors: Geology – Soil – Morphological Characteristics - Toposheet - Delineation – Codification – Prioritization of Watershed – Indian Scenario	9
II	**SOIL CONSERVATION MEASURES** Types of Erosion – Water and Wind Erosion: Causes, Factors, Effects and Control – Soil Conservation Measures: Agronomical and Mechanical - Estimation of Soil Loss - Sedimentation	9
III	**WATER HARVESTING AND CONSERVATION** Water Harvesting Techniques – Micro-Catchments - Design of Small Water Harvesting Structures –Farm Ponds – Percolation Tanks – Yield from a Catchment	9
IV	**WATERSHED MANAGEMENT** Project Proposal Formulation - Watershed Development Plan – Entry Point Activities – Estimation – Watershed Economics - Agroforestry – Grassland Management – Wasteland Management – Watershed Approach in Government Programmes –Developing Collaborative	9

	know how – People"s Participation – Evaluation of Watershed Management	
V	**GIS FOR WATERSHED MANAGEMENT** Applications of Remote Sensing and Geographical Information System - Role of Decision Support System – Conceptual Models and Case Studies	9
References	1. Ghanashyam Das, Hydrology and Soil Conservation engineering, Prentice Hall of India PrivateLimited, New Delhi, 2000. 2. Glenn O. Schwab, Soil and Water Conservation Engineering, John Wiley and Sons, 1981. 3. Gurmail Singh, A Manual on Soil and Water Conservation, ICAR Publication, New Delhi, 1982. 4. Suresh, R. Soil and Water Conservation Engineering, Standard Publication, New Delhi, 1982. 5. Vir Singh, Raj , Watershed Planning and Management, Yash Publishing House, Bikaner, 2000. 6. Brooks, K. N., P. F. Ffolliott, H. M. Gregersen and L. F. DeBano. 1997. Hydrology and the Management of Watersheds. Second Edition. Iowa State University Press. Ames, Iowa. 502 pp. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York. 7. Lal, Ruttan. 2000. Integrated Watershed Management in the Global Ecosystem. CRC Press, NewYork. 8. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York. 9. Dhruva Narayana, G. Sastry, V. S. Patnaik, "Watershed Management", CSWCTRI, Dehradun, ICAR Publications, 1997.	
Course Outcomes	The students can be **CO1**: Understand fundamental principles of water shed and morphological characteristics **CO2**: Understand the principles soil conservation **CO3**: Apply decision to methods of rain water harvesting techniques **CO4**: Develop the managing skill for water shed **CO5**: Apply the Potential of remote sensing and GIS is solving problems in water resources through case studies.	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	2	1	1	1
CO 2	3	2	2	2	1
CO 3	3	3	3	1	1
CO 4	3	2	3	3	3
CO 5	1	1	3	3	3

V.STRCTURAL ENGINEERING

<table>
<tr><td>Course Title</td><td colspan="12">REPAIR AND REHABILITATION OF STRUCTURES</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUCXXE41</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- Recall the special types of concrete
K2- Understand the strategies for repair and maintenance of structures
K3- Apply the techniques for the protection of structure</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• To make the students to gain the knowledge on Assess the quality of concrete, and study the durability aspects, causes of deterioration, assessment criteria for damaged structures, repairing of structures and demolition procedures.
• Students must gained knowledge on quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing of structures and demolition procedures.</td></tr>
</table>

Unit	Content	No.of Hours
I	**MAINTENANCE AND REPAIR STRATEGIES :**Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.	9
II	**STRENGTH AND DURABILITY OF CONCRETE :** Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete - Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion - Effects of cover thickness.	9
III	**SPECIAL CONCRETES:** Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes	9
IV	**TECHNIQUES FOR REPAIR AND PROTECTION METHODS:** Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, Cathodic protection.	9

V	**REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES:** Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake – Demolition Techniques - Engineered demolition methods - Case studies.	9
References	**TEXT BOOKS:** 1. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical UK, 1991. 2. Allen R.T. & Edwards S.C, Repair of Concrete Structures, Blakie and Sons, UK, 1987 **REFERENCES:** 1. Shetty M.S., "Concrete Technology - Theory and Practice", S.Chand and Company, 2008. 2. DovKominetzky.M.S., "Design and Construction Failures", Galgotia Publications Pvt. Ltd., 2001 3. Ravishankar.K., Krishnamoorthy.T.S, "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004.96 4. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008. 5. Gambhir.M.L., "Concrete Technology", McGraw Hill, 2013	
Course Out Comes	Students able to **CO1:** Inspect and evaluate various structural damages and can access the cause of deterioration **CO2:** Can assure the qualities of concrete **CO3:** Rectify the damages using different types of special concrete **CO4:** Protect the structures using various techniques **CO5:** Demolish the structure with safe engineering methods	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1	2	2
CO 2	3	1	1	3	2
CO 3	3	3	2	3	2
CO 4	3	2	1	2	3
CO 5	3	2	1	3	3

Course Title	PRE-STRESSED CONCRETE STRUCTURES											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE42	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-to recall the basic design concepts of rc elements and prestress concept K2-to understand the prestress effect and design concepts beam , columns and continuous beams K3-to understand concept of circular pre stressing K4-design calculation of beams ,end block, anchorage, compression member, concrete pipes and composite sections										
Course Objectives	To learn the principles, materials, methods and systems of prestressing and to know the different types of losses and deflection of prestressed members and to learn the design of prestressed concrete beams for flexural, shear and tension and to calculate ultimate flexural strength of beam and to learn the design of anchorage zones, composite beams, analysis and design of continuous beam On completion of the course, the students will be able to design a prestressed concrete beam accounting for losses and to design the anchorage zone for post tensioned members and to design composite members and to design continuous beams										

Unit	Content	No.of Hours
I	**INTRODUCTION TO PRE-STRESSING** General Principles – Classification and type – Materials – Prestressing systems – Loss of prestress – Analysis of section for flexure.	9
II	**DESIGN OF BEAMS**Design of beams: Design of section for flexure – general approach for service load design – Ultimate design for limit state of collapse – Provision of IS code. Design for shear: General theory – Elastic theory – Ultimate limit state – Provision of IS code – Deflection – Beam deflection – Short term and long term deflections – Provision in IS code.	9
III	**ANCHORAGE TENSION & COMPRESSION MEMBERS** Design of Anchorage: Stress distribution in end block – Design of end block – IS code provision. Design of compression and tension	9

	members: Tension member elastic design – Tension member cracking and ultimate strength – Compression members – Design.	
IV	**CONTINUOUS BEAM & CIRCULAR PRE-STRESSING** Design of continuous beams: Advantages of continuity – Effect of prestressing – Analysis of continuous beams – Linear transformation and concordance of cables – Design of continuous beam. Circular prestressing : Method and applications circumferential prestressing – Design of prestress concrete pipes and tanks.	9
V	**COMPOSITE SECTIONS** Composite sections – Types of composite construction flexural analysis – Design of composite section – Shrinkage stresses in composite section.	9
References	**TEXT BOOKS:** 1. Pre-Stressed Concrete, N.Krishna Raju, Tata McGraw Hill, New Delhi. 2. Fundamental of Pre-stressed concrete –N.C.Sinha and S.K.Roy, S.Chand Company Ltd, New Delhi. **REFERENCES:** 1. Design of pre-stressed concrete structures – T.Y.Lin, Asia Publishing House, New Delhi. 2. Modern Pre-stress Concrete – Libby, R.James, Van Nostrand, New York 3. Pre-stress Concrete Structures – P.Dayarathnam, Oxford & IBH Publishers BIS 1343.	
Course Out Comes	After learning the course the students should be able to CO1: Students will understand the general mechanical behavior of ***prestressed concrete***. CO2: Students will be able to analyze and ***design prestressed concrete*** flexural members CO3 :to know design the anchorage and compression member CO4 :to design the continuous beam and pre stress concrete pipes CO5: To design prestressed composite beams	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	3	-	2	2
CO 2	3	3	-	3	2
CO 3	3	2	-	3	2
CO 4	2	2	-	3	2

Course Title	SMART MATERIALS AND SMART STRUCTURE										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE43	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recall the material property testing K-2: Understand the various measuring devices K-3: Apply the knowledge of sensors and actuators for civil engineering materials										
Course Objectives	The Course aims • the fundamentals of smart materials, devices and electronics, in particular those related to the development of smart structures and products; • the skills, knowledge and motivation in the design, analysis and manufacturing of smart structures and products										

Unit	Content	No. of Hours
I	**INTRODUCTION** Introduction to Smart Materials and Structures – Instrumented structures functions and Response – Sensing systems – Self diagnosis – Signal processing consideration – Actuation Systems and effectors.	**9**
II	**MEASURING TECHNIQUES** Strain Measuring Techniques using Electrical strain gauges, Types – Resistance – Capacitance– Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes	**9**
III	**SENSORS** Sensing Technology – Types of Sensors – Physical Measurement using Piezo Electric Strain Measurement – Inductively Read Transducers – The LVOT – Fiber optic Techniques. Chemical and Bio-Chemical sensing in structural Assessment – Absorptive chemical sensors –Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.	**10**
IV	**ACTUATORS** Actuator Techniques – Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Magnetostructure Material – Shape Memory Alloys – Electro rheological Fluids–Electromagnetic actuation – Role of actuators and Actuator Materials	**9**

V	**SIGNAL PROCESSING AND CONTROL SYSTEMS** Data Acquisition and Processing – Signal Processing and Control for Smart Structures – Sensors as Geometrical Processors – Signal Processing – Control System – Linear and Non-Linear.	**8**
References	**1.**Brain Culshaw – Smart Structure and Materials Artech House – Borton. London-1996 1. L. S. Srinath – Experimental Stress Analysis – Tata McGraw-Hill, 1998. 2. J. W. Dally & W. F. Riley – Experimental Stress Analysis – Tata McGraw-Hill, 1998.	
Course Out Comes	Students will have the capacity to CO1: Perform the analysis and design of foundation under earthquake loading by considering the influence of various design parameters that includes the liquefaction of soils due to earthquake. CO2:Describe the provision of IS Codes for Designing of Foundations with earthquake resistant CO3: Explain the shallow and deep foundations with earthquake resistant CO4: Calculate the lateral earth pressures due to earthquake CO5: Evaluate the structural adequacy for foundation with earthquake resistant	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	2	3
CO 2	2	2	2	2	2
CO 3	2	2	1	2	2
CO 4	2	2	1	2	2
CO 5	3	2	3	2	2

Course Title	BASICS OF DYNAMICS AND ASESISMIC DESIGN										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
24CEUCXXE44	PEC	-	3	3	-	-	40	60	-	-	100

Cognitive Level	K1- to recall the concept of vibrations and SDOF,MDOF K2- to understand the causes of earthquake and its elements K3- to understand the design concept of earthquake. K4- design earthquake and its methods as per the codal provision
Course Objectives	The Course aims • The main objective of this course is to introduce to the student the phenomena of earthquakes, the process, measurements and the factors that affect the design of structures in seismic areas. This objective is achieved through imparting rudiments of theory of vibrations necessary to understand and analyse the dynamic forces caused by earthquakes and structures. Further, the student is also taught the codal provisions as well as the aseismic design methodologyandto introduce the concepts of dynamic systems and to study the dynamic response of SDOF and MDOF • On completion of the course, the students will be able to apply the concepts of dynamic systems and to identify, formulate and solve dynamic response of SDOF and MDOF and to analyze continuous systems subjected to different types of dynamic loads and to identify, formulate and solve free and forced vibrations response of structural systems

Unit	Content	No.of Hours
I	**THEORY OF VIBRATIONS** Concept of inertia and damping – Types of Damping – Difference between static forces and dynamic excitation – Degrees of freedom – SDOF idealisation – Equations of motion of SDOF system for mass as well as base excitation – Free vibration of SDOF system – Response to harmonic excitation – Impulse and response to unit impulse – Duhamel integral.	9
II	**MULTIPLE DEGREE OF FREEDOM SYSTEM** Two degree of freedom system – Normal modes of vibration –	9

	Natural frequencies – Mode shapes - Introduction to MDOF systems – Decoupling of equations of motion – Concept of mode superposition (No derivations).	
III	**ELEMENTS OF SEISMOLOGY** Causes of Earthquake – Geological faults – Tectonic plate theory – Elastic rebound – Epicentre – Hypocentre – Primary, shear and Raleigh waves – Seismogram – Magnitude and intensity of earthquakes – Magnitude and Intensity scales – Spectral Acceleration - Information on some disastrous earthquakes.	9
IV	**RESPONSE OF STRUCTURES TO EARTHQUAKE** Response and design spectra – Design earthquake – concept of peak acceleration – Site specific response spectrum – Effect of soil properties and damping – Liquefaction of soils – Importance of ductility – Methods of introducing ductility into RC structures.	9
V	**DESIGN METHODOLOGY** IS 1893, IS 13920 and IS 4326 – Codal provisions – Design as per the codes – Base isolation techniques – Vibration control measures – Important points in mitigating effects of earthquake on structures.	9
References	**TEXT BOOK:** 1. Chopra, A.K., "Dynamics of Structures – Theory and Applications to Earthquake Engineering", Second Edition, Pearson Education, 2003. REFERENCES: 1. Biggs, J.M., "Introduction to Structural Dynamics", McGraw–Hill Book Co., N.Y., 1964 2. Dowrick, D.J., "Earthquake Resistant Design", John Wiley & Sons, London, 1977 3. Paz, M., "Structural Dynamics – Theory & Computation", CSB Publishers & Distributors,Shahdara, Delhi, 1985	
Course Out Comes	On completion of the course, the students will be able to CO1:apply the concepts of dynamic systems CO2: identify, formulate and solve dynamic response of SDOF and MDOF CO3: understand the elements of seismology,magnitude and intensity of earth quake CO4:analysiz the concept of response and design spectrum,ductility in to rc structures CO5:to analyze continuous systems subjected to different types of dynamic loads and to identify, formulate and solve free and forced vibrations response of structural systems as per the codes	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	-	-	3
CO 2	2	2	-	-	3
CO 3	2	-	-	-	2
CO 4	2	2	-	-	3
CO 5	2	1	-	-	2

Course Title	DESIGN MASONRY STRUCTURES											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE45	PEC	-	3	3	-	-	40	60	-	-	100

Cognitive Level	K1- to recall the different types of masonary ,behaviou, properties of masonary units K2- to understand the elstic properties and its strength behaviour of compression shear and flexure. K3-design of load bearing masonary buildings
Course Objectives	Student will be able to 1. Understand masonry materials and its mechanical properties. 2. Analyze the behavior of structural masonry 3. Demonstrate testing, analysis and design methodologies 4. Summarize construction practices, specifications and inspection of masonry buildings

Unit	Content	No.of Hours
I	**Introduction, Masonry units, materials and types:** History of masonry, historical buildings, Masonry arches, domes and vaults: Components, classification and construction procedure.	7
II	**Characteristics of masonry constituents:** Types of masonry units such as stone, bricks, concrete blocks, clay blocks and stabilized mud blocks. Properties of masonry units like strength, modulus of elasticity and water absorption. Masonry mortars – Classification and properties of mortars, selection of mortars.	8
III	**Strength of Masonry in Compression:** Behaviour of Masonry under compression, strength and elastic properties, factors influencing of compressive strength masonry, Effects of slenderness andeccentricity, water absorption, curing, ageing and workmanship on compressive strength Prediction of strength of masonry in Indian context.	9
IV	**Shear and Flexure Behavior of Masonry :** Bond between masonry unit and mortar, test methodsfor determining flexural and shear bond strengths, test procedures for evaluating flexural and shearstrength, factors affecting bond strength, effect of bond	11

	strength on compressive strength, flexureand shear strength of masonry. Concept of Earthquake resistant masonry buildings.	
V	**Design of load bearing masonry buildings:** concept of basic compressive stress, Permissible compressive stress, reduction factors. Increase in permissible stresses for eccentric vertical andlateral loads, permissible tensile and shear stresses, Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels; Wall carrying axial load, eccentric load with different eccentricity ratios, wall with openings, freestanding wall; Design of load bearing masonry for buildings up to 3 to 8storeys using BIS codal provisions.	10
References	**Text/Reference book** 1. Hendry A.W., "Structural masonry"- Palgrave Macmillan Macmillan Education Ltd., 2nd edition, ISBN 10: 0333733096 ISBN 13:9780333733097 2. Robert G Drysdale; Ahmad A Hamid, Masonry structures: Behavior and Design. Boulder, CO : Masonry Society, 2008. 3rd ed, ISBN 1929081332 9781929081332 3. Jagadish K S, Structural Masonry, I K International Publishing House Pvt Ltd, 2015, ISBN – 10: 9384588660, ISBN 13: 978-9384588663. 4. Sven Sahlin, "Structural Masonry"- Prentice Hall Publisher: Prentice Hall, 1971, ISBN-10: 0138539375, ISBN-13: 978-0138539375	
Course Out Comes	After learning the course the students should be able to CO1: To identify various masonary units,materials and its construction process. CO2: Understand the types of masonary and its properties CO3 :Know the principle and understand the behaviour of compression for masonary structures CO4: Understand the behaviour of,shear,flexure for masonary CO5:Evaluate the basic loads of masonary and design load bearing masonary buildings	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	-	-	-	2
CO 2	3	-	-	1	2
CO 3	3	-	-	2	2
CO 4	2	-	1	2	2
CO 5	2	-	2	1	2

Course Title	ANALYSIS & DESIGN OF SUB-STRUCTURES										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE46	PEC	-	3	3	-	-	40	60	-	-	100

Cognitive Level	K-1: Recalling the basic concepts and fundamentals on soil mechanics and its basic terms. K-2:Understand the concept of analysis and design on shallow and deep safety. K-3:Apply the concrete design techniques in the design of shallow and deep foundation K-4: Analyze and design the foundation on expansive soil.
Course Objectives	The Course aims • To learn the principles of subsoil exploration. • To design the sub structures • To evaluate the soil shear parameters. • Able to Design the sub-structure for expansive soils

Unit	Content	No.of Hours
I	**Concepts of Structural safety, Basic Statistics and Probability theory** Principles of safety in design, Basic statistics- Graphical representation and data reduction techniques- Histogram, frequency polygon, Measures of central tendency- grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve Fitting and Correlation, Random events-Sample space and events, Venn diagram and event space,	9
II	**Measures of probability**-interpretation, probability axioms, addition rule, multiplication rule, conditional probability, probability tree diagram, statistical independence, total probability theorem and Baye's theorem., probability density function, Mathematical expectation. Probability Distributions, Discrete distributions- Binomial and poison distributions, Continuous distributions- Normal, Log normal distributions.	9
III	**Probability Distributions for Resistance and Loads** Statistics of Properties of concrete, steel, Statistics of strength of bricks and mortar, Selection of probabilistic model, probabilistic analysis of loads-dead loads, live loads, wind loads.	9
IV	**Reliability Analysis and simulation Techniques** Measures of reliability-factor of safety, safety margin, reliability index,	9

	performance function and limiting state. Reliability Methods-First Order Second Moment Method (FOSM), Point Estimate Method (PEM), and Advanced First Order Second Moment Method (Hasofer- Lind's method).Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample size and accuracy, Generation of random numbers- random numbers with standard uniform distribution, continuous random variables..	
V	**Reliability Based Design** Determination of partial safety factors, safety checking formats – LRFD format, CEB format, processes in reliability based design, IS Code provisions	9
References	**Text/Reference Book** 1. Ranganathan, R. "Structural Reliability Analysis and design"- Jaico publishing house, Mumbai, India – 1999. 2. Ang, A. H. S., and Tang, W. H "Probability concepts in engineering planning and design". Volume –I, John Wiley and sons, Inc, New York. 1984. 3. Ang, A. H. S., and Tang, W. H. "Probability concepts in engineering planning and design"- Volume –II, John Wiley and sons, Inc, New York. 1984. 4. Thoft-christensen, P., and Baker, M., J., "Structural reliability theory and its applications"- Springer-Verlag, Berlin, NewYork. 1982.	
Course Out Comes	At the end of the course the student will CO1: Achieve Knowledge of design and development of problem solving skills. CO2: Understand the principles of subsoil exploration CO3: Design and develop analytical skills. CO4: Identify and evaluate the soil shear strength parameters. CO5: Understand the concepts of Settlement analysis.	

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Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	3	3	3
CO 2	2	2	3	2	3
CO 3	3	3	3	3	3
CO 4	2	2	2	2	3
CO 5	2	3	2	3	3

<table>
<tr><td rowspan="2">Course Title</td><td colspan="12">DESIGN OF STORAGE STRUCUTRES</td></tr>
<tr></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUCXXE47</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Recalling the Fundamentals of concrete design.
K-2: Understand the design concept of bunkers & silos, water tanks
K-3: Applying the design principles used to design the elements.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">• The students will able to Design bunkers and silos, water tanks .n.
• To know about the functions of water storage structures</td></tr>
</table>

Unit	Content	No.of Hours
I	**Design of Bunkers and silos** Introduction, Janssen's theory, Airy's theory. Design of rectangular -Circular bunkers and silos.	9
II	Water tanks – General Introduction, Design requirements according to IS 3370-joints in water tanks.	9
III	Design of water tanks resting on ground Design of circular tanks with flexible base Rigid joints at base.	9
IV	**Design of Underground Water Tanks** Introduction, earth pressure on tank walls, uplift pressure on the floor of the tank, design of rectangular tanks with *L/B > 2*Design of rectangular tanks with L/B < 2	9
V	Design of overhead water tanks -1Design of flat base slab for elevated circular tanks- Circular tank with domed bottom and roof. Design of overhead water tanks -2Design of Intze tank-Design of conical shaped tank.	9
References	**Text/Reference Book** 1. H.J. Shah "Advanced Reinforced Concrete Structures" Vol. – II, Charator Publishers, 6th edition 2012. 2. Bhavikatti S.S. "Advanced RCC Design" New Age International (P) Ltd. Publishers, New Delhi – 2006. 3. B.C. Punmia, Ashok Kumar Jain &Arun Kumar Jain	

	"Comprehensive RCC Designs"– Lakshmi Publication. 4. N. Krishna Raju "Advanced Reinforced Concrete Design" – CBS Publishers & Distributors, New Delhi. – 2008 5. P.C. Varghese "Advanced Reinforced Concrete Design" PHI Pvt. Ltd., New Delhi. - 2007. 6. M.L. Gambhir" Design of Reinforced Concrete Structures" PHI Pvt. Ltd., New Delhi. - 2008. 7. Ashok K. Jain "Reinforced Concrete, Limit State Design" Nemchand& Bros, Roorkee – 2009	
Course Out Comes	Upon successful completion of this course, students will be able to: CO1: Design of Bunkers and silos CO2:Know the design requirements for the design of water tanks CO3: Design the water tank resting on ground. CO4: Design the underground water tank. CO5: Design of overhead water tanks.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	2	3
CO 3	3	3	3	3	3
CO 4	3	3	3	2	3
CO 5	3	3	3	2	3

<table>
<tr><td>Course Title</td><td colspan="12">BRIDGE ENGINEERING</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUCXXE48</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Recalling the fundamentals on site selection and IRC code loading.
K-2: Understand the various theories used for the design of bridge elements.
K-3: Apply the concept concrete and steel design techniques.
K-4: Analyze and design the various bridge elements.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• To develop an understanding of and appreciation for basic concepts in proportioning and design of bridges in terms of aesthetics, geographical location and functionality.
• To help the student develop an intuitive feeling about the sizing of bridge elements, ie. Develop a clear understanding of conceptual design.
• To understand the load flow mechanism and identify loads on bridges.
• To carry out a design of bridge starting from conceptual design, selecting suitable bridge, geometry to sizing of its elements</td></tr>
</table>

Unit	Content	No.of Hours
I	Introduction – Selection of site for bridge – Linear waterway – Free board – Economical span – Scour depth – Components of a bridge – Types of bridges – IRC Loading Classifications – Specifications for a road bridge – Specifications for railway bridge.	9
II	**DESIGN OF RCC BRIDGES.** Design of T beam slab bridges for IRC loading – Design of deck slab, longitudinal and cross girders Design of balanced cantilever bridge – Design of slab, main girder, cantilever and articulation	9
III	**DESIGN OF STEEL BRIDGES** Design of through type steel bridge for railway loading – design	9

	of stringers, cross girder and main girder Design of deck type steel bridge for railway loading – Design of main girder. Design of plate girder Railway Bridge for railway loading	
IV	**DESIGN OF PRESTRESSED CONCRETE BRIDGES** Preliminary sections – Flexural and Tensional parameters – Courban's theory – Design of girder section (I section only) – Check for stresses at various sections – Check for diagonal tension – Forces in anchorage zone.	9
V	**SUBSTRUCTURE AND BEARINGS** Design principles and construction methods of pier, abutment and Caissons Types of bearings – Design of elastomeric bearing – Segmental construction of bridge – TestingAndstrengthening of bridge – Inspection and Maintenance of bridges.	9
References	**TEXT BOOKS:** 1. Victor D.J "Essential of bridge Engineering", Oxford & IBH publishing co. 1980. 2. Krishnaraju N. "Bridge Engineering", CBS Publications, New Delhi. 3. Bindra.S.P., "Principle and practice of Bridge Engineering", DhanpatRai& sons 1979. 4. Ramchandra S. "Design of Steel Structures" Vol I & II, Standard book house, New Delhi, 1978. **REFERENCES:** 1. Ponnusamy "Bridge Engineering", Tata Mcgraw hill Publishing co, 1995 2. Raina "Concrete bridges practice Analysis design and Economics", Tata Mcgraw Hill Publishing co 1995. 3. Jagadesh, T.R &Jeyaram M.A., "Design of bridge structures", Prentice Hall of India Pvt Ltd. 2001 4. Rowe, R.E. "Concrete Bridge Design", John Wiley& Sons, New York, USA, 1962. 5. Phatak, D.R. "Bridge Engineering", SatyaPrakhasam, New Delhi, 1990 **IS Codes:** 1. IRC: 78, "Standard specifications & Code of practice for Road Bridges". Section VII-Foundation and Substructures. 2. IRC: 6-2000, " Standard specifications & Code of practice for Road Bridges". Section II-Loads and Stresses.	

	3. IRC: 21-2000, “Standard specifications& Code of practice for Road Bridges”. Section III-Cement Concrete (Plain and Reinforced). 4. IRC: 83 Part II-1987, “Standard specifications & Code of practice for Road Bridges”. Section: 9 Bearing, Part II – Elastomeric Bearings. 5. IRC: 45-1972, “Recommendations for Estimating the resistance of soil below the maximum scour level in the Design of Well foundations of Bridges. 6. IRC: 78-2000 “Standard specifications & code of practice for Road bridges”.	
Course Out Comes	At the end of the course the student will CO1: Able to develop the clear understanding on conceptual design of bridge elements CO2: Able to identify the IRC class loading on the bridges CO3: Able to design the steel and concrete bridge structure CO4: Able to design the pre-stressed concrete bridge structure CO5: Able to design the foundation and bearings for bridge structure	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	2	2	3
CO 2	3	2	2	2	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3

<table>
<tr><td>Course Title</td><td colspan="11">FINITE ELEMENT ANALYSIS</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUCXXE49</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1-Recall the basic concepts used in structural analysis
K2- understand the displacement functions and energy concepts in finite element analysis
K3-. Analyze trusses, beams and frames by finite element method</td></tr>
<tr><td>Course Objectives</td><td colspan="11">1. To learn the theory and characteristics of finite elements that represent engineering structures.
2. To learn and apply finite element solutions to structural, problem
3. To develop the knowledge and skills needed to effectively evaluate finite element analyses
4. To analyze the various structural elements by finite element method</td></tr>
</table>

Unit	Content	No.of Hours
I	**Introduction** Basic concepts of elasticity, introduction to stiffness method– Element approach for the analyses of beams, trusses and frames, direct stiffness method for the analysis of trusses. Direct stiffness method for the analysis of beam.	9
II	**Introduction to Finite Element Analysis** General description of finite element method, Basic steps involved in FEM, difference between FEM and finite difference method. Discreatisation of structures – Finite elements used for one dimensional, two dimensional and three dimensional problems. Nodes, element aspect ratio, boundary conditions –numbering of nodes, mesh refinement, properties of stiffness matrix. Banded matrix lagrangian and serendipity family of elements.	9

III	**Shape functions** Coordinate systems natural and normalized, convergence criterion, compatibility requirements, geometric invariance shape functions – polynomial displacement functions for one, wo and three dimensional elements, Lagrangian interpolation functions	9
IV	**Finite element formulation using energy concepts** Energy concepts, theorem of minimum potential energy, principle of virtual work, R-R method. Variation method and minimization of energy approach for element formulation.	
V	**Finite Element analysis of structural elements using the direct method** Finite Element Method for the analysis of simply supported beams and trusses.	9
References	Text/Reference Books 1. Rajasekaran. S, **"Finite Element Analysis in Engineering Design**"- Wheeler Publishing, 1988. 2. Chandrupatla TR and Belagonda "**Finite Element Analysis**" Universities Press, 2009. 3. Krishnamoorthy C S, "**Finite Element Analysis**"- Tata McGraw Hill, 2005. 4. Bathe K J. "**Finite Element Procedures in Engineering Analysis**"- Prentice Hall, 1982. 5. Cook R D, Malkan D S & Plesta M.E, "**Concepts and Application of Finite Element Analysis" -** 3rd Edition, John Wiley and Sons Inc., 2007.	
Course Out Comes	Upon successful completion of this course, students will be able to: CO1 Analyze trusses, beams and frames using the stiffness method. CO2 Able to know the one dimensional, two dimensional and three dimensional problems CO3 Describe the basic concepts of finite element analysis, CO4 Able to understand the energy concepts in finite element analysis CO5 Analyze trusses, beams and frames by finite element method	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1	1	2
CO 2	3	2	-	-	3
CO 3	2	1	2	-	2
CO 4	2	1	1	-	1
CO 5	3	1	1	-	2

<table>
<tr><td>Course Title</td><td colspan="12">INDUSTRIAL STRUCTURES</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUCXXE50</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Recalling the classifications of industries and industrial structures and its requirements.
K-2:Understand the functional requirements such lighting, ventilation, fire safety and guidelines for factories.
K-3:Apply the concept concrete and steel design techniques in the design of industrial structures
K-4: Analyze and design the industrial roofs and prefabrication of various elements</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
To study the general requirements of various industrial structures.
To study the functional requirements of the industrial structures
To analyse and design the steel gantry girders.
To analyse and design the concrete and steel storage structures
To understand the basic concepts of prefabrication in the industrial structures</td></tr>
</table>

Unit	Content	No.of Hours
I	**PLANNING** Classification of industries and industrial structures – General requirements of various industries – Planning and layout of buildings and components.	9
II	**FUNCTIONAL REQUIREMENTS** Lighting – Ventilation – Acoustics – Fire safety – Guidelines from factories act.	9
III	**DESIGN OF STEEL STRUCTURES** Industrial roofs – Crane girders – Mills buildings – Bunkers and Silos – Chimney.	9

IV	**DESIGN OF R.C. STRUCTURES** Corbels, Brackets and Nibs – Silos and bunkers –Chimney – Principles of folded plates and shell roofs	9
V	**PREFABRICATION** Principles of prefabrication – Prestressed precast roof trusses – Construction of roof and floor slabs – Wall panels.	9
References	**TEXTBOOKS:** 1. Ramamrutham.S., "Design of Reinforced Concrete Structures", Dhanpat Rai Publishing Company, 2007. 2. Varghese.P.C., " Limit State Design of Reinforced Concrete", Prentice Hall of India Eastern Economy Editions, 2nd Edition, 2003. 3. Bhavikatti.S.S., "Design of Steel Structures", J.K. International Publishing House Pvt.Ltd., 2009. **REFERENCES:** 4. Henn W. "Buildings for Industry", Vol.I and II, London Hill Books, 1995 5. SP32-1986, Handbook on Functional Requirements of Industrial buildings, Bureau of Indian Standards, 1990 6. Structural Engineering Research Centre,Course Notes on Modern Developments in the Design and Construction of Industrial Structures, Madras, 1982 7. Koncz.J., "Manual of Precast Construction", Vol.I and II, Bauverlay GMBH, 1971.	
Course Out Comes	At the end of the course the student will CO1: Design of Steel gantry girders and portal frames CO2: Design Connections for different loading condition CO3: Design of storage structures CO4: Light weight metal structures CO5: Understand the concepts of prefabrication	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	3	2	2
CO 2	3	2	2	2	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3

Course Title	SAFETY OF STRUCTURES											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE51	PEC	-	3	3	-	-	40	60	-	-	100

Cognitive Level	K-1: Recalling the basic concepts and fundamentals on structural safety and reliability analysis and design K-2: Understand the concept of reliability analysis and design on structures safety. K-3: Apply the simulation techniques for reliability analysis for the design of structural safety. K-4: Analyze the structural safety by using Reliability analysis..
Course Objectives	The Course aims • To study the basic concepts and fundamental on structural safety. • To measure of probability by using total probability theorem and Baye's theorem • Able to analyse the structure by various simulation techniques. • Able to Design the structure safety by reliability based design.

Unit	Content	No.of Hours
I	**Concepts of Structural safety, Basic Statistics and Probability theory** Principles of safety in design, Basic statistics- Graphical representation and data reduction techniques- Histogram, frequency polygon, Measures of central tendency- grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve Fitting and Correlation, Random events-Sample space and events, Venn diagram and event space,	9
II	**Measures of probability**-interpretation, probability axioms, addition rule, multiplication rule, conditional probability, probability tree diagram, statistical independence, total probability theorem and Baye's theorem., probability density function, Mathematical expectation. Probability Distributions, Discrete distributions- Binomial and poison distributions, Continuous distributions- Normal, Log normal distributions.	9
III	**Probability Distributions for Resistance and Loads** Statistics of Properties of concrete, steel, Statistics of strength of bricks and	9

	mortar, Selection of probabilistic model, probabilistic analysis of loads-dead loads, live loads, wind loads.	
IV	**Reliability Analysis and simulation Techniques** Measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability Methods-First Order Second Moment Method (FOSM), Point Estimate Method (PEM), and Advanced First Order Second Moment Method (Hasofer- Lind's method).Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample size and accuracy, Generation of random numbers- random numbers with standard uniform distribution, continuous random variables..	9
V	**Reliability Based Design** Determination of partial safety factors, safety checking formats – LRFD format, CEB format, processes in reliability based design, IS Code provisions	9
References	**Text/Reference Book** 1. Ranganathan, R. "Structural Reliability Analysis and design"- Jaico publishing house, Mumbai, India – 1999. 2. Ang, A. H. S., and Tang, W. H "Probability concepts in engineering planning and design". Volume –I, John Wiley and sons, Inc, New York. 1984. 3. Ang, A. H. S., and Tang, W. H. "Probability concepts in engineering planning and design"- Volume –II, John Wiley and sons, Inc, New York. 1984. 4. Thoft-christensen, P., and Baker, M., J., "Structural reliability theory and its applications"- Springer-Verlag, Berlin, NewYork. 1982.	
Course Out Comes	At the end of the course the student will CO1: analyse structures using force method CO2: analyse structures using displacement method CO3: analyse curved beams in plan CO4: analyse structures using plastic theory	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	2	2	2	3
CO 2	3	2	3	2	2
CO 3	3	2	3	3	3
CO 4	3	2	3	3	2
CO 5	3	2	3	3	2

Course Title	RELIABILITY ANALYSIS OF STRUCTURES											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE52	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recalling the fundamentals on reliability and probability concepts. K-2:Understand the concept of probability. K-3:Apply the concept probability mass function, dnsity function.										
Course Objectives	The Course aims • To learn principles ofreliability. • To implement the Probability Concepts for the Reliability Analysis • To evaluate different methods of reliability analysis.										

Unit	Content	No.of Hours
I	**Preliminary Data Analysis:** Graphical representation-Histogram, frequency polygon, Measures of central tendency-grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve fitting and Correlation: Fitting a straight line, curve of the form$\boldsymbol{y} = \boldsymbol{ab^x}$, and parabola, Coefficient of correlation.	
II	**Probability Concepts**: Random events-Sample space and events, Venn diagram and event space, Measuresof probability-interpretation, probability axioms,addition rule, multiplication rule, conditionalprobability, probability tree diagram, statisticalindependence, total probability theorem and Baye'stheorem	
III	**Random variables**: Probability mass function, probability density function, Mathematical expectation, Chebyshev's theorem. Probability distributions: Discrete distributions-Binomial and poison distributions, Continuous distributions-Normal, Lognormal distributions.	
IV	**Reliability Analysis:** Measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability Methods-First Order Second Moment Method (FOSM), Point Estimate Method (PEM), and Advanced First	

	Order Second Moment Method (Hasofer-Lind’s method)	
V	**System reliability**: Influence of correlation coefficient, redundant and non-redundant systems series, parallel and combined systems, Uncertainty in reliability assessments- Confidence limits, Bayesian revision of reliability. Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample size and accuracy, Generation of random numbers-random numbers with standard uniform distribution, continuous random variables, discrete random variables.	
References	1. Ranganathan, R. (1999). “Structural Reliability Analysis and design”- Jaico publishing house, Mumbai, India. 2. Ang, A. H. S., and Tang, W. H. (1984). “Probability concepts in engineering planning and design”- Volume –I, John Wiley and sons, Inc, New York. 3. Ang, A. H. S., and Tang, W. H. (1984). “Probability concepts in engineering planning and design”-Volume –II, John Wiley and sons, Inc, New York. 4. Milton, E. Harr (1987). “Reliability based design in civil engineering”- McGraw Hill book Co. 5. Nathabdndu, T., Kottegoda, and Renzo Rosso (1998). Statistics, “Probability and reliability for Civil and Environmental Engineers”- McGraw Hill international edition, Singapore. 6. AchintyaHaldar and SankaranMahadevan (2000). “Probability, Reliability and Statistical methods in Engineering design”- John Wiley and Sons. Inc. 7. Thoft-christensen, P., and Baker, M., J., (1982), “Structural reliability theoryand its applications”- Springer-Verlag, Berlin, NewYork. 8. Thoft-christensen, P., and Murotsu, Y. (1986). “Application of structural systems reliability theory”- Springer-Verlag, Berlin, NewYork	
Course Out Comes	At the end of the course the student will • Achieve Knowledge of design and development of problem solving skills. • Understand the principles of reliability. • Design and develop analytical skills. • Summarize the Probability distributions • Understands the concept of System reliability.	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	2	2	2	3
CO 2	2	2	2	2	2
CO 3	2	3	3	2	2
CO 4	2	2	2	2	3
CO 5	2	3	2	3	3

Course Title	FIRE RESISTANCE OF STRUCTURES										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE53	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-Identify the types of building and its requirements K2- understand the different methods of fire resistance in different types of structures K3-. Calculation of fire resistance of steel columns and provision of opening the fire walls as per the standards										
Course Objectives	1. To develop the knowledge about the fire protection process in different engineering structures. 2. To solve the problems of fire resistance in the different type of structures 3. To develop the knowledge about the fire openings provision as per the Indian standards										

Unit	Content	No.of Hours
I	**Classification of Buildings and Types of Production Processes** Types of construction and classification of buildings, Main building elements, Requirements of buildings, Combustibility and fire resistance I.	9
II	**Calculation of Required Fire Resistance Limit of Building Structures** Initial condition for calculating fire resistance of structures, Duration of fire, Temperature of fire, Main points on the method of investigating temperature regimes of fires, Results of experimental investigations on fires, Simulation of temperature regimes of fires, Determination of fire in residential and public buildings, Determination of fire duration of fire in industrial buildings and warehouses: Standardization of fire resistance of structures.	9
III	**Methods of Testing Structures for Fire Resistance** Problems of testing for fire resistance, Set-up for testing fire resistance,	9

	Temperature regime of the tests, Test pieces of structures, Conditions of loading and supporting of structures	
IV	**Fire Resistance of Reinforced Concrete Structures** Main aspects of the calculations for fire resistance, Thermo technical part of the calculation Boundary conditions, Calculation of temperature in plane structures (one- dimensional temperature field), Calculation of temperature in bar type structures (Two- dimensional temperature field), Calculation of depth at which a given temperature is reached, Effect of moisture in concrete on the heating of structures, Thermo physical properties of concrete at high temperatures ,Statics part of calculations, Change in the strength of reinforcement steel with increase of temperature, Change in the strength of concrete in compression with increase in temperature, 9Coefficients of thermal expansion of reinforcement bars and concrete, Axially loaded columns, Statically determinate elements subjected to bending stresses	9
V	**Fire Resistance of Steel Columns** General, Cross sections of steel columns and other design data, Methods of protecting steel columns from heat, Limiting state of steel columns on heating, Heat insulating capacity of protection and fire resistance limit``s of columns, Calculation of fire resistance of steel columns, The effect of the form of the cross-section of steel columns and filling of space between the column shafts and the protection, on the fire resistance of steel columns, Different stages of thermal deformation of column bars with different types of fire protection **Protection of Openings of Fire Walls** 1. Fire doors-Door specifications in the building standards and regulations 2. Noncombustible doors, Low combustible doors, Doors made of glass-fiber reinforced plastic Glass fittings for openings- Specifications of building standards	9

References	**Text Book** 1.Andrew H. Buchanan, **“Structural Design for Fire Safety”** John Wiley & Sons. Ltd – 2001. **Reference Books** 1. U.S Bendev Etal, “**Fire Resistance of Buildings**”- Amerind Publishing Co. Pvt. Ltd 2. Andrew H. Buchman “**Structural design for fire safety, comprehensive overview of the fire resistance of building structures”-,** John Wiley and sons., 2001. 3.John A. Purkiss **“Fire Safety Engineering Design of structures**”-, Butterworth Heinemann, 2009.	
Course Out Comes	Upon successful completion of this course, students will be able to: CO 1: Interpret the intentions of code requirements for fire safety. CO2:Understand the concepts of fire severity and fire resistance, and CO3: Design steel, concrete or timber structures to resist fire exposure CO4: calculate the fire resistance of different reinforced concrete structures CO5:calculate the thermal deformation of column bars with different types of fire protection	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	2	3	4	5
CO 2	2	-	-	-	1
CO 3	2	-	-	1	1
CO 4	2	2	2	1	2
CO 5	1	1	-	-	1

VI. GEOTECHNICAL ENGINEERING

Course Title	FOUNDATION ENGINEERING											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE54	PEC	-	3	3	-	-	40	60	-	-	100

Cognitive Level	K-1: Recall the soil sampling by boring, types of foundations and retaining walls K-2: Describe the shallow foundations and Deep foundations and types K-3: Apply the learned knowledge in designing of various foundations
Course Objectives	The Course aims • To study the various methods of soil investigation, load bearing capacity of soil and the suitable types of foundation. • Familiarize the students with a basic understanding of the essential steps involved in a geotechnical site investigation. Introduce the principal types of foundations and the factors governing the choice of the most suitable type of foundation for a given solution and familiarize the students with the procedures used for: a) bearing capacity estimation, b) load carrying capacity of pile, c) determining earth pressure and stability of structures.

Unit	Content	No.of Hours
I	**SITE INVESTIGATION & SELECTION OF FOUNDATION** Scope and Objectives – Methods of exploration - boring – water boring and rotary drilling – Depth of boring – Spacing of bore hole – Sampling – Disturbed and undisturbed sampling – sampling techniques – Split spoon sampler, Thin tube sampler, Stationary piston sampler – Bore log report – Penetration tests (SPT and SCPT) – Types of foundations -selection of foundation based on soil condition.	7
II	**SHALLOW FOUNDATION** Introduction – Location and depth of foundation – codal provisions – bearing capacity of shallow foundation on homogeneous deposits – Terzaghi's formula and BIS formula – factors affecting bearing capacity – problems – Bearing capacity from insitu tests (SPT,SCPT and PLT) – Allowable bearing pressure, Settlement – Components of settlement – determination of settlement of foundations on granular and clay deposits-equal settlement - differential settlement – allowable settlements	8

	– Codal provision – Methods of minimizing settlement.	
III	**FOOTINGS AND RAFTS** Types of foundation – Contact pressure distribution below footings & raft – Isolated and combined footings – types – proportioning – mat foundation- types – uses – proportioning – floating foundation	7
IV	**PILES** Types of piles and their function - Factors influencing the selection of pile – Load Carrying capacity of single pile in granular and cohesive soil – Static formula – dynamic formulae (Engineering news and Hiley's) – capacity from insitu tests (SPT & SCPT) – Negative skin friction – uplift capacity – Group capacity by different methods (Feld's rule, converse Labarra formula and block failure criterion) – Settlement of pile groups –Interpretation of pile load test – Forces on pile caps – under reamed piles – capacity under compression and uplift.	7
V	**RETAINING WALLS** Plastic equilibrium in soils – active and passive states – Rankine's cohesionless and cohesive soil – Coloumbo's wedge theory – condition for critical failure plane – Earth pressure on retaining walls of simple configurations – Graphical methods (Rebhann and Culmann) – pressure on the wall due to line load Stability of retaining walls.	7
References	**TEXT BOOKS:** 1. Punmia, B.C, "Soil Mechanics and foundations"' Laximi publication pvt.Ltd., New Delhi1, 2005. 2. Gopal Ranjan and Rao, A.S.R. "Basic and Applied Soil Mechanics", Wiley Eastern Ltd., New Delhi (India), 2003. **REFRENCE BOOKS:** 1. Varghese P.C.,"Foundation Engineering", PHI Learning Private Limited, New Delhi, 2005. 2. Das, B.M. "Principles of Foundation Engineering (Fifth Edition), Thomson Books/COLE, 2003 3. Murty, V.N.S. ``Soil Mechanics and Foundation Engineering", UBS Publishers Distribution Lts., New Delhi,1999. 4. Swamisaran, "Analysis and Design of Structures – Limit state Design:, Oxford IBH Publishing Co-Pvt. Ltd., New Delhi, 1998.	
Course Out Comes	After completion of the course the students should be **CO1:** Able to understand the various sampling techniques **CO2:** Know about the various insitu tests used to find the bearing capacity of the soil. **CO3:** Ability to select the suitable footings for the soil conditions. **CO4:** know about the piles and pile groups under various loading conditions **CO5:** able to design the various retaining walls as per Indian standard.	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	2	1	1	1	2
CO 2	2	1	1	1	2
CO 3	3	2	2	2	3
CO 4	2	2	3	2	3
CO 5	3	3	3	3	3

Course Title	GROUND IMPROVEMENT TECHNIQUES											
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE55	PEC	-	3	3	-	-	40	60	-	-	100

Cognitive Level	K-1: Remember the concepts of Ground water lowering, soil compaction and soil stabilization K-2: Understand the stone column and soil nailing K-3: Apply the principles of earth reinforcing and Grouting
Course Objectives	The Course aims studentswillbeexposedtovariousproblemsassociatedwithsoildepositsandmethodsto evaluate them. The different techniques will be taught to them to improve the characteristics of difficult soils as well as design techniques required to implement various ground improvement methods.

Unit	Content	No.of Hours
I	**DEWATERING** Introduction–Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage–Ground Water lowering by well points, deep wells, vacuum and electro- osmotic methods. Stabilization by thermal and freezing techniques-Applications.	**5**
II	**COMPACTIONAND SAND DRAINS** In-situ compaction of granular and cohesive soils, Shallow and Deep compaction methods–Sand piles–Concept, design, factors influencing compaction. Blasting and dynamic consolidation– Preloading with sand drains, fabric drains, wick drains etc.–Theories of sand drain–design and relative merits of various methods–Case studies.	**5**
III	**STONE COLUMN, LIMEPILESAND SOIL NAILING** Stone column, lime piles –Functions–Methods of installation–design, estimation of load carrying capacity and settlement. Root piles and soil nailing–methods of installation–Design and Applications-Soil lique faction mitigation methods- case studies.	**5**

IV	**EARTH REINFORCEMENT** Earth reinforcement – Principles and basic mechanism of reinforced earth, simple design: Synthetic and natural fiber based Geo textiles and their applications. Filtration, drainage, separation, erosion control–case studies.	**5**
V	**GROUTING** Grouting–Typesofgrout–Suspensionandsolutiongrouts–Basicrequirementsofgrout. Grouting equipment–injection methods– jet grouting– grout monitoring–Electro–Chemical stabilization–Stabilization with cement, lime- Stabilization of expansive clays–case studies.	**5**
Reference s	1. Pappala,A.J.,Huang,J.,Han,J.,andHoyos,L.R.,"GroundImprovementandGeosynthetics; Geo technical special publication No.207, Geo Institute,ASCE, 2010 2. Cox,B.R.,andGrifithsS.C.,"PracticalRecommendationforEvaluationandmitigationofSoil 3. Liquefaction" in Arkansas, (Project Report),2010. 4. Day,R.W.,"FoundationEngineeringHandbook,McGraw –Hill Companies, Inc. 2006. 5. Rowe,R.K.,"GeotechnicalandGeoenvironmentalEngineeringHandbook,KluwerAcademic Publishers,2001. 6. Das,B.M., "Principles of FoundationEngineering, Fourth Edition, PWSPublishing,1999. 7. Moseley,M.P., "GroundTreatment,Blackie Academic andProfessionals, 1998. 8. Koerner, R.M., "Designingwith Geosynthetics, Third Edition,PrenticeHall 1997. 9. Hehn,R.W.,"Practical Guide toGroutingofUndergroundStructures, ASCE,1996. 10. Jewell,R.A., "Soil ReinforcementwithGeotextiles,CIRIA, London, 1996. 11. Koerner,R.M.andWelsh,J.P.,"ConstructionandGeotechnicalEngineeringusingSynthetic 12. Fabrics,JohnWiley,1990. 13. Jones, J.E.P., "EarthReinforcement andSoil Structure", Butterworths,1985.	
Course Out Comes	**CO1**: An understanding about types of ground improvement techniques and soil distribution in India **CO2:** Understanding about various methods of dewatering of soil and Compaction of soil **CO3:** Knowledge about types of chemical stabilization and their construction method **CO4:** Understanding about Ground Anchors, Rock Bolts and Soil Nailing **CO5:** Knowledge about various types of grouts and their applications	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	2	2	2
CO 3	3	2	1	3	3
CO 4	3	3	3	3	2
CO 5	3	3	2	2	2

<table>
<tr><td>Course Title</td><td colspan="12">EARTHQUAKE RESISTANTDESIGNOF FOUNDATIONS</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUCXXE56</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Recall the basics of earthquake and its effects
K-2: Understand the design parameters of earthquake resistant foundations as per Indian codes
K-3: Apply the soil behaviour in earthquake for designing earthquake resistant foundations and structures</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
Focus is mainly on identifying the different kinds of loading induced on the foundation due to earthquake and soil - foundation interaction analysis with reference to various design parameters that including liquefaction of soil due to earthquake.</td></tr>
</table>

Unit	Content	No.of Hours
I	**BASIC DESIGN PARAMETERS** Dynamic properties of soils and its evaluation, strength and deformation characteristics of soils under earthquake loading, liquefaction hazard evaluations and remedial measures, geotechnical failure of foundations during earthquake, provision of IS 1893 and IS 13920	**9**
II	**SHALLOW FOUNDATION** Design requirements – bearing capacity theory under earthquake loading – bearing capacity analysis for liquefied soil – bearing capacity analysis for cohesive and cohesionless soils - seismic settlement of foundation.	**9**
III	**DEEP FOUNDATION** Earthquake loading – inertial and kinematic loading - performance of piles during earthquake loading – theories of pile failure in liquefiable soils – failure based on bending mechanism/buckling instability – methods of analysis – force based or limit equilibrium method – p-y method – pile settlement - guidelines for designing of piles under kinematic loading due to liquefaction – seismic design of well/cassion foundations.	**10**

<table>
<tr><td>IV</td><td>SEISMIC DESIGN OF RETAINING WALL

Introduction – Seismic passive lateral earth pressure, behaviour of retaining wall during earthquakes, modification of Coulomb's Theory, Modified Culmann's Theory, displacement analysis, Indian standard code of practice.</td><td>9</td></tr>
<tr><td></td><td>STRUCTURAL DESIGN OF FOUNDATION

Introduction – loads acting on foundations during earthquake – fundamental failure mechanisms of foundations – essential criteria for design of foundations in liquefiable soils – structural design of foundations subjected to earthquake loading.</td><td>8</td></tr>
<tr><td>References</td><td>1. Design of foundation in seismic areas: Principles and some applications by Bhattacharya S. (eds), Published by NICEE [National Centre for Earthquake Engineering (India)]. ISBN: 81-904190-1-3, 2007.
2. Geotechnical Earthquake Engineering by Day R. W., handbook, McGraw – Hill, New York,2002.
3. Design of Pile Foundations in Liquefiable Soils by Gopal Madabhushi, Jonathan Knappett andStuart Haigh, Imperial College Press, London WC2H 9HE, 2010.
4. Basic geotechnical earthquake engineering by Kamalesh Kumar, New Age International Publishers, New Delhi, 2008.
5. Soil Mechanics in Engineering Practice by Terzaghi and Peck, R. B, John Wiley & Sons, NewYork, 1967.
6. Pile foundation analysis and design by Poulos H.G. and Davis E.H., John Wiley and Sons,1980.
7. Soil dynamics by Prakash, S., McGraw Hill, New York, 1981.
8. Geotechnical Earthquake Engineering by Steven L. Kramer, Prentice Hall, New Delhi, 1996.
9. Foundation design and construction by Tomilinson M.J., Longman Scientific & Technical, England, 1986.</td><td></td></tr>
<tr><td>Course Out Comes</td><td>Students will have the capacity to

1. Perform the analysis and design of foundation under earthquake loading by considering the influence of various design parameters that includes the liquefaction of soils due to earthquake.
2. Describe the provision of IS Codes for Designing of Foundations with earthquake resistant
3. Explain the shallow and deep foundations with earthquake resistant
4. Calculate the lateral earth pressures due to earthquake
5. Evaluate the structural adequacy for foundation with earthquake resistant</td><td></td></tr>
</table>

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	1	2	2
CO 2	1	2	1	2	2
CO 3	2	2	1	2	1
CO 4	2	2	1	2	2
CO 5	2	2	3	2	2

<table>
<tr><td>Course Title</td><td colspan="12">GEOENVIRONMENTAL ENGINEERING</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUCXXE57</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Identify the soil contaminants and its classifications
K-2: Understand the various remedial methods for contaminant removal.
K-3: Apply the suitable method for contaminant removal</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
The student acquires the knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques thereby protecting environment.</td></tr>
</table>

Unit	Content	No.of Hours
I	**SOIL – WASTE INTERACTION** Role of Geo environmental Engineering – sources, generation and classification of wastes – causes and consequences of soil pollution – case studies in soil failure -factors influencing soil-pollutant interaction – modification of index, chemical and engineering properties – physical and physio-chemical mechanisms – Environmental laws and regulations.	**8**
II	**CONTAMINANT TRANSPORT AND SITE CHARACTERISATION** Transport of contaminant in subsurface – advection, diffusion, dispersion – chemical process – biological process, sorption, desorption, precipitation, dissolution, oxidation, complexation, ion exchange, volatization, biodegradation – characterization of contaminated sites – soil and rock data – hydrological and chemical data – analysis and evaluation – risk assessment – case studies	**9**
III	**WASTE CONTAINMENT AND REMEDIATION OF CONTAMINATED SITES** Insitu containment – vertical and horizontal barrier – surface cover – ground water pumping system on subsurface drain – soil remediation – soil vapour extraction, soil waste stabilization, solidification of soils, electroinetic remediation, soil heating, verification, bio remediation, phyto remediation – ground water	**9**

	remediation – pump and treat , Insitu flushing, permeable reacting barrier, Insitu air sparging - case studies.	
IV	**LANDFILLS AND SURFACE IMPOUNDMENTS** Source and characteristics of waste - site selection for landfills – components of landfills – liner system – soil, geomembrane, geosynthetic clay, geocomposite liner system – leachate collection – final cover design – monitoring landfill.	**9**
V	**STABILISATION OF WASTE** Evaluation of waste materials – flyash, municipal sludge, plastics, scrap tire, blast furnace slag, construction waste, wood waste and their physical, chemical and biological characteristics – potential reuse – utilization of waste and soil stabilization – case studies.	**10**
References	**REFERENCES:** 1. Daniel B.E, Geotechnical Practice for waste disposal, Chapman & Hall, London, 1993. 2. Hari D. Sharma and Krishna R.Reddy, Geo-Environmental Engineering – John Wiley and Sons, INC, USA, 2004. 3. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995. 4. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989. 5. Proceedings of the International symposium of Environmental Geotechnology (Vol.I and II), Environmental Publishing Company, 1986 and 1989. 6. Ott, W.R., Environmental Indices, Theory and Practice, Ann Arbor, 1978. 7. Fried, J.J., Ground Water Pollution, Elsevier, 1975. 8. ASTM Special Tech. Publication 874, Hydraulic Barrier in Soil and Rock, 1985. 9. Lagrega, M.d., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.	

Course Out Comes	CO1: To understand the soil failure due the contaminants CO2 To assess the contamination in the soil and to select suitable remediation methods based on contamination. CO3: To prepare the suitable disposal system for particular waste. CO4: To utilize the treated soil for land filling CO5: To utilize the waste materials for soil stabilization	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	2	1	1	2
CO 2	1	2	1	2	2
CO 3	2	2	1	2	1
CO 4	2	2	2	2	2
CO 5	2	2	3	2	2

Course Title	ROCK MECHANICS AND APPLICATIONS										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUCXXE58	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recall the types of Rocks and its properties K-2: Understand the In-situ stresses and bearing capacity of rocks K-3: Apply the Rock reinforcement method for Rock jointing.										
Course Objectives	The Course aims Students are expected to classify, understand stares-strain characteristics, failure criteria, and influence of insitu stress in the stability of various structures and various technique to improve the insitu strength of rocks.										

Unit	Content	No.of Hours
I	**CLASSIFICATION OF ROCKS** Types of Rocks - Index properties and classification of rock masses, competent and incompetent rock - value of RMR and ratings in field estimations.	**9**
II	**STRENGTH CRITERIA OF ROCKS** Behaviour of rock under hydrostatic compression and deviatric loading - Modes of rock failure - planes of weakness and joint characteristics - joint testing, Mohr - Coulomb failure criterion and tension cut-off. Hoek and Brown Strength criteria for rocks with discontinuity sets.	**9**
III	**INSITU STRESSES IN ROCKS** Insitu stresses and their measurements, Hydraulic fracturing, flat jack, over coring and under coring methods - stress around underground excavations – Design aspects of openings in rocks - case studies.	**10**
IV	**SLOPE STABILITY AND BEARING CAPACITY OF ROCKS** Rock slopes - role of discontinuities in slop failure, slope analysis and factor of safety - remedial measures for critical slopes – Bearing capacity of foundations on rocks – case studies	**9**

V	**ROCK REINFORCEMENT** Reinforcement of fractured and joined rocks - shotcreting, bolting, anchoring, installation methods - case studies.	**8**
References	**REFERENCES:** 1. Goodman, R.E., Introduction to rock mechanics, John Willey and Sons, 1989. 2. Hudson, A. and Harrison, P., Engineering Rock mechanics – An introduction to the principles, Pergamon publications, 1997. 3. Hoek, E and Bray, J., Rock slope Engineering, Institute of Mining and Metallurgy, U.K. 1981. 4. Hoek, E and Brown, E.T., Underground Excavations in Rock, Institute of Mining and Metallurgy, U.K. 1981. 5. Obvert, L. and Duvall, W., Rock Mechanics and the Design of structures in Rock, John Wiley, 1967. 6. Bazant, Z.P., Mechanics of Geomaterials Rocks, Concrete and Soil, John Wiley and Sons, Chichester, 1985. 7. Wittke, W., Rock Mechanics. Theory and Applications with case Histories, Springerverlag, Berlin, 1990. 8. Waltham, T, Foundations of Engineering Geology, Second Edition, Spon Press, Taylor & Francis Group, London and New York, 2002. 9. T. Ramamurthy, Editor, Engineering in Rocks for Slopes Foundations and Tunnels, PHI Learning Pvt. Ltd., 2007	
Course Out Comes	CO1 To understand about the types of rocks and its properties CO2 To know about the strength behavior of rocks CO3 Able to understand the In-situ stresses in Rocks CO4 To Know about the slope stability and bearing capacity of rocks CO5 To understand the concepts of Rock reinforcements.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	1	1	1	2
CO 2	2	1	1	1	2
CO 3	2	1	1	1	2
CO 4	2	2	1	2	2
CO 5	2	1	1	1	2

Course Title	SOIL STRUCTURE INTERACTION											
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
24CEUCXXE59	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recall the soil and foundation engineering definitions and derivations K-2: understand the different Infinite and finite beams on elastic foundations K-3: predict the deflection for laterally loaded piles										
Course Objectives	The Course aims • Focus is on idealization of soil response to closely represent continuum behavior and interaction analysis between the soil-structure with reference to relative stiffness of beams, slabs and piles under different loading conditions.										

Unit	Content	No.of Hours
I	**SOIL RESPONSE MODELS OF INTERACTION ANALYSIS** Introduction to soil – Foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, soil-foundation interaction analysis, soil response models, Elastic continuum, Winkler, Two parameter elastic models, Elastic – plastic behavior, Time dependent behavior.	**9**
II	**INFINITE AND FINITE BEAMS ON ELASTIC FOUNDATIONS** Infinite beam, General solution of the elastic line – concentrated and distributed loads on beams – Idealization of semi-infinite and finite beams. Classification of finite beams, different end conditions and loads – solutions by general method, finite difference and application packages.	**9**
III	**PLATE ON ELASTIC MEDIUM** Infinite plate, elastic continuum, Winkler, Two parameters, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, simple solution, ACI method, Numerical analysis of finite plates, Analysis of highway and airfield pavements – Application packages.	**9**

IV	**ANALYSIS OF PILE AND PILE GROUPS** Elastic analysis of single pile – Methods of analysis for settlement of pile – Solutions for settlement and load distribution in pile – Pile tip load – settlement of pile groups – Analysis – Interaction between piles – end bearing and floating piles – Effect of pile cap – Piled raft – Application packages.	**9**
V	**LATERALLY LOADED PILE** Load - deflection prediction for laterally loaded piles, subgrade reaction and elastic analysis, Interaction analysis, pile raft system, solutions through influence charts and Application packages.	**9**
References	**REFERENCE** 1. Salgado,R., "The Engineering of Foundations", Tata McGraw Hill Education Private Limited, New Delhi, 2011. 2. Murthy, V.N.S., "Advanced Foundation Engineering", CBS Publishers, New Delhi, 2007. 3. Saran, S, "Analysis and Design of Substructures", Taylor & Francis Publishers, 2006 4. McCarthy, D.F. "Essentials of Soil Mechanics and Foundations", Basic Geotechnics, Sixth 5. Edition, Prenticce Hall, 2002. 6. Hemsley, J.A, "Elastic Analysis of Raft Foundations", Thomas Telford, 1998. 7. ACI 336, "Suggested Analysis and Design Procedures for Combined Footings and Mats", American Concrete Institute, Dehit, 1988. 8. Scott, R.F. "Foundation Analysis", Prentice Hall, 1981. 9. Poulos, H.G., and Davis, E.H., "Pile Foundation Analysis and Design", John Wiley, 1980. 10. Selvadurai, A.P.S., "Elastic Analysis of Soil Foundation Interaction", Elsevier 1979. 11. Kurien, N.P., "Design of Foundation Systems: Principles and Practices Narosa Publishing 12. House, New Delhi, 1999.	
Course Out Comes	At the end of this course students will have the capacity CO1: To Solve the Foundation interaction problems. CO2: To Provide the solutions of the elastic lines for infinite and finite beams with different Ends and loading conditions CO3: To analyses the highway and airfield pavements. CO4: To analyses the pile and pile groups. CO5: to predict the deflection for latterly loaded piles.	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	3	3	2	3
CO 2	3	3	3	2	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3

COURSES FOR EXIT OPTION
I & II SEMESTER

Course Title	Materials and Civil Engineering										
Course Code	Category	Semester	Hours			Credits	Theory		Practical		Total
			L	T	P		CFA	ESE	CFA	ESE	
24CEUC1X01	PCC	I/ II	3	-	-	3	40	60	-	-	100

Cognitive Level	K1- To recall the different types of building materials and its applications K2- To understand the nature, characteristics, performance, and behavior of civil engineering materials used in buildings and infrastructure and to evaluate their physical and mechanical properties. K3- application of different materials utilized for construction process
Course Objectives	The Course aims To learn the manufacturing process, types, applications and testing procedures for materials used for load bearing purpose To know about materials that is used for protection and functional purpose. To impart knowledge about basis of recent paradigms, and new materials

Theory		
Unit	**Content**	**No. of Hours**
I	**STONES** Classification - Selection - Application of stone in buildings - Requirement and testing of stones - Deterioration and preservation of stone work - Artificial stones.	9
II	**BRICKS AND BUILDING BLOCKS** Manufacture of bricks - classification - Qualities - Test on Bricks - Fire bricks - building blocks types and uses - joist and filter blocks - Curved shell units - Lightweight concrete blocks.	9
III	**MORTAR, CEMENT AND CONCRETE** Classification of mortar - Preparation - Selection of mortar - Tests for mortars - Manufacture of cement - Types of cement - Characteristics - Aggregates - Basic Characteristics - Types of aggregates - Admixtures - Properties of fresh concrete - Properties of hardened concrete - Slump Test - Vebe test - Flow test - Compacting factor test - Types of Concrete.	9
IV	**MATERIALS FOR BUIDINGS SERVICES** Timber - Market forms - Industrial timber - Plywood Veneer - Thermocole - Panels of laminates - Steel - Composition - uses - Market forms - Mechanical treatment - Paints - Vanishes - Distempers.	9

V	**SPECIAL MATERIALS** Glass - Ceramics - Sealants for joints - Sheets for pitched roof coverings - Fibre glass reinforced plastic - Clay products - Refractories - Composite materials - Types - Applications of laminar composites - Fibre textiles - mats and pads for earth reinforcement - Recycling of Industrial waste as building material - Polymers in Civil Engineering.	9
References	**Text/Reference Books:** 1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.), R. Butterworth- Heinemann 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 materialsused for Civil Engineering applications 4. Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella 5. E.N. Dowling (1993), Mechanical Behaviour of Materials,Prentice Hall International Edition 6. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards (post 2000)	
Course Out Comes	One should be able to: CO1: Explain the fundamental (engineering related) issues surrounding the use of the following Civil Engineering Materials; concrete, structural steel (and other important structural metals), timber, masonry, ceramics and composites, and polymers. CO2: Explain the production and/or manufacturing methods associated with these materials. CO3: Explain, describe and characterise some of the variability and uncertainty associated with these materials. CO4: Describe and critically analyse the limitations of these materials under various loading circumstances. CO5: Communicate their learned knowledge of these materials.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	3	1	1	1
CO 2	2	1	2	2	2
CO 3	1	1	2	2	2
CO 4	1	1	1	2	1
CO 5	1	1	1	1	1

Course Title	TESTING OF CIVIL ENGINEERING MATERIALS										
Course Code	Category	Semester	Hours			Credits	Theory		Practical		Total
			L	T	P		CFA	ESE	CFA	ESE	
24CEUC1X02	PC-LC	I /II	0	0	4	2	-	-	60	40	100
Cognitive Level	K1-Remember the various types of Engineering materials used for construction K2- Understand the various properties of Engineering Materials K3-Compute the strength of the Building Materials										
Course Objectives	The Course aims to • Make measurements of behavior of various materials used in Civil Engineering. • Provide physical observations to complement concepts learnt • Introduce experimental procedures and common measurement instruments, equipment, devices. • Exposure to a variety of established material testing procedures and techniques • • Different methods of evaluation and inferences drawn from observations										

	Content	No. of Hours
	List of Experiments: 1. Gradation of coarse and fine aggregates 2. Different corresponding tests and need/application of these tests in design and quality control 3. Tensile Strength of materials & concrete composites 4. Compressive strength test on aggregates 5. Tension I - Elastic Behaviour of metals & materials 6. Tension II - Failure of Common Materials 7. Direct Shear - Frictional Behaviour 8. Concrete I - Early Age Properties 9. Concrete II - Compression and Indirect Tension 10. Compression – Directionality 11. Soil Classification 12. Consolidation and Strength Tests 13. Tension III - Heat Treatment 14. Torsion test 15. Hardness tests (Brinnel's and Rockwell) 16. Tests on closely coiled and open coiled springs 17. Theories of Failure and Corroboration with Experiments 18. Tests on unmodified bitumen and modified binders with polymers 19. Bituminous Mix Design and Tests on bituminous mixes - Marshall method	**30**

	20. Concrete Mix Design as per BIS	
References	**Text/Reference Books:** 1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.), R. Butterworth- Heinemann 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 materialsused for Civil Engineering applications 4. Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella 5. E.N. Dowling (1993), Mechanical Behaviour of Materials,Prentice Hall International Edition 6. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards (post 2000)	
Course Out Comes	One should be able to: CO1: Explain the fundamental (engineering related) issues surrounding the use of the following Civil Engineering Materials; concrete, structural steel (and other important structural metals), timber, masonry, ceramics and composites, and polymers. CO2: Explain the production and/or manufacturing methods associated with these materials. CO3: Explain, describe and characterise some of the variability and uncertainty associated with these materials. CO4: Describe and critically analyse the limitations of these materials under various loading circumstances. CO5: Communicate their learned knowledge of these materials.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	3	1	1	1
CO 2	2	1	2	2	2
CO 3	1	1	2	2	2
CO 4	1	1	1	2	1
CO 5	1	1	1	1	1

<table>
<tr><td>Course Title</td><td colspan="12">INTRODUCTION TO CONSTRUCTION METHODOLOGY AND TECHNIQUES</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUC1X03</td><td>PCC</td><td>I /II</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- To explain the modern construction techniques used in the sub structure construction
K2- To demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings.
K3- Knowledge on Various strengthening and repair methods for different cases</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• The main objective of this course is to make the student aware of the various construction techniques for different types of construction activities.
• To study and understand the latest construction techniques applied to engineering construction for sub structure, super structure, special structures, rehabilitation and strengthening techniques and demolition techniques.</td></tr>
</table>

Unit	Content	No.of Hours
I	**SUB STRUCTURE CONSTRUCTION** Construction Methodology - Box jacking - Pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - Piling techniques - Driving well and caisson - sinking cofferdam - cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Laying operations for built up offshore system - Shoring for deep cutting - Large reservoir construction - well points - Dewatering for underground open excavation.	9
II	**SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS** Vacuum dewatering of concrete flooring – Concrete paving technology – Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – Erection techniques of tall structures, Large span structures – launching techniques for heavy decks – in-situ prestressing in high rise structures, Post tensioning of slab- aerial transporting – Handling and erecting lightweight components on	9

	tall structures.	
III	**CONSTRUCTION OF SPECIAL STRUCTURES** Erection of lattice towers - Rigging of transmission line structures – Construction sequence in cooling towers, Silos, chimney, sky scrapers - Bow string bridges, Cable stayed bridges – Launching and pushing of box decks – Construction of jetties and break water structures – Construction sequence and methods in domes – Support structure for heavy equipment and machinery in heavy industries – Erection of articulated structures and space decks.	9
IV	**REHABILITATION AND STRENGTHENING TECHNIQUES** Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques.	9
V	**DEMOLITION** Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.	9
References	**REFERENCES:** 1. Jerry Irvine, Advanced Construction Techniques, CA Rocket, 1984 2. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992. 3. Peter H.Emmons, “Concrete repair and maintenance illustrated”, Galgotia Publications Pvt. Ltd., 2001.Press, 2008. 4. Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995. 5. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University, New Delhi, 2008.	

Course Out Comes	**CO1:** Understand the modern construction techniques used in the sub structure construction. **CO2:** Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings **CO3:** Understand the concepts used in the construction of special structures **CO4:** Knowledge on Various strengthening and repair methods for different cases. **CO5:** Identify the suitable demolition technique for demolishing a building.	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	3	1	3	2
CO 2	3	3	1	3	2
CO 3	3	3	1	3	2
CO 4	3	3	1	3	2
CO 5	3	3	1	3	2

Course Title	INTRODUCTION TO CONSTRUCTION EQUIPMENT'S											
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
24CEUC1X04	PCC	I /II	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- To explain basics of equipment and selection of equipment K2- To gain knowledge on fundamentals of earth work operations, earth moving operations and types of earth work equipment. K3- To describe handling of various equipments										
Course Objectives	The Course aims • The main objective of this course is to make the student aware of the various construction techniques and equipments needed for different types of construction activities. • To expose the students in the field of construction equipment and machineries so as to gain knowledge in carrying out engineering tasks.										

Unit	Content	No.of Hours
I	**CONSTRUCTION EQUIPMENTS** Identification - Planning of equipment - Selection of equipment - Equipment management in projects - Maintenance management - Equipment cost - Operating cost - Cost control of equipment - Depreciation analysis - Replacement analysis - Safety management.	9
II	**EQUIPMENT FOR EARTHWORK** Fundamentals of earthwork operations - Earth moving operations - Types of earthwork equipment - Tractors, motor graders, scrapers, front end waders - Dozer, excavators, rippers, loaders, trucks and hauling equipment, compacting equipment, finishing equipment - Case studies on earthwork equipment.	9
III	**OTHER CONSTRUCTION EQUIPMENT** Equipment for dredging, trenching, drag line and clamshells, tunneling - Jacking equipment - Equipment for drilling and blasting - Pile driving equipment - Erection equipment - Crane, mobile crane - Types of pumps used in construction - Equipment for dewatering, grouting and demolition.	9

IV	**ASPHALT AND CONCRETE PLANTS** Aggregate production - Different crushers - Feeders - Screening equipment - Handling equipment - Batching and mixing equipment - Ready mix concrete equipment, concrete pumping equipment - Asphalt plant - Asphalt pavers - Asphalt compacting equipment.	9
V	**MATERIALS HANDLING EQUIPMENT** Forklifts and related equipment - Portable material bins - Material handling conveyors - Material handling cranes - Industrial trucks - Aerial transporting equipment.	9
References	**TEXT BOOKS:** 1. Peurifoy, R.L., Schexnayder, C., Schmitt, R.L. and Aviad Shapira., Construction Planning, Equipment and Methods, 9th Edn. McGraw Hill, Singapore, 2018. 2. Granberg G.,Popescu M Construction Equipment and Management for Engineers Estimators and Owners, Taylor and Francis Publishers, New York, 2006. **REFERENCES:** 1. Deodhar, S.V. Construction Equipment and Job Planning, 4th Edn. Khanna Publishers, New Delhi, 2020. 2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, 2018. 3. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 2008. 4. Dr. Mahesh Varma., Construction Equipment and its Planning and Application, Metro-politan Book Company, New Delhi., 2003.	
Course Out Comes	**CO1:** Develop knowledge on planning of equipment and selection of equipment **CO2:** Explain the knowledge on fundamentals of earth work operations, earth moving operations and types of earth work equipment **CO3:** Develop the knowledge on special construction equipment **CO4:** Apply the knowledge on asphalt and concrete plants **CO5:** Apply the knowledge and select the proper materials handling equipment	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	1	3	2
CO 2	3	3	1	3	2
CO 3	3	3	1	3	2
CO 4	3	3	1	3	2
CO 5	3	3	1	3	2

<table>
<tr><td>Course Title</td><td colspan="13">SITE SUPERVISION WORK</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEUC1X05</td><td>PC-LC</td><td>I/II</td><td>2</td><td>-</td><td>-</td><td>4</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- Recall the basic stages of building construction.
K2-understand the concepts of various superstructure elements
K3-understand the concepts of various sub-structure elements
K4- understand the bar bending, concreting and quality controlling.</td></tr>
<tr><td>Course Objectives</td><td colspan="11"></td></tr>
</table>

<table>
<tr><td>Unit</td><td>Content</td><td>No.of Hours</td></tr>
<tr><td>Course Content</td><td>1. Foundation including marking, earthwork excavation
2. Basement work, including PCC, footing, plinth beam, sand filling and flooring
3. Brick work in basement and superstructure
4. Concreting in Lintel and sunshade
5. Beams-types, reinforcement details
6. Roofing work, types, reinforcement details,
7. Staircase
8. Parapet wall
9. Concrete work – mix ratio, methods of quantity of materials measuring at field &curing methods
10. Form work & Bar bending
11. Plastering, whitewashing, Colour washing
12. Floor finishing and other finishing work
13. Material purchasing and testing
14. Miscellaneous work</td><td></td></tr>
<tr><td>References</td><td>Text Books

1. Jain and Jaikrishna, Plain and Reinforced Concrete, Vol. I, Nemchand Brothers.(ISBN-8185240086/978-8185240084).
2. V.L. Shah and Karve, Limit State Design - Reinforced Concrete Structures Publications. (ISBN-</td><td></td></tr>
</table>

	9788190371711/ 8190371711). 3.K. Raju, Pre-stressed Concrete, Tata McGraw Hill.(ISBN- 9789387886209/9387886204). **Recommended Reading** 1. P.Dayaratnam, Design of Reinforced Concrete Structures, Oxford & IBH. (ISBN-9789386479785/9386479788). 2. T.Y. Lin, Design of Prestressed Concrete Structures, John Wiley and Sons Inc., 2010. (ISBN-9788126528035/8126528036). 3. P.D.Arthur and V.Ramkrishnan, Ultimate Strength Design for Structural Concrete, Wheeler&Co. Pvt Ltd. (ISBN-0273403230/978-0273403234). 4. B.P. Hughes, Limit State Theory for Reinforced Concrete Design, Pitman. (ISBN-0273010239/978-0273010234).	
Course Out Comes	After completion of this course, students will be able to, CO1: Identify the building elements and construction stages. CO2: Familiarize in quality construction CO3: Familiarize in selection and purchase of Materials and Labours.	

Course Title	SURVEY WORK										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC1X06	PC-LC	I/II	2	-	-	4	-	-	60	40	100
Cognitive Level	k1-to recall the basics terms of surveying K2- to understand the concept of control surveying and adjustmets K3-to understand the concept of modern surveying techniques K4-to understand the concept of Route surveying, Hydrographic surveying and Field Astronomical surveying.										
Course Objectives	The main objective of this course to • Introduce knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities • Translate the knowledge gained for the implementation of Civil infrastructure facilities • Relate the knowledge on Surveying to the new frontiers of science like curve setting, Electronic Distance Measurement, Global Positioning System, Route survey, Hydrographic survey and Field Astronomical survey.										

List of suggested Exercises.

1. Finding Pace Value of Surveyor using Chaining and Ranging
2. Computation of Included Angle after adjustment of Local Attraction
3. Plain metric Mapping of an Area using Plane Table Surveying (Radiation, Intersection)
4. Fly leveling using dumpy level.
5. Fly leveling using tilting level.
6. Transfer of Bench Mark using Check Levelling.
7. Contour Mapping using Grid Levelling.
8. Study of Theodolite and Angle Observations by Repetition.
9. Observation of Angles by method of Reiteration and Station Adjustment.
10. Establishment of Horizontal Control Points by Traversing.
11. Preparation of Planimetric Map using Stadia Tacheometry.
12. Determination of horizontal distance and height difference between two points by Tangential Tacheometry.
13. Estimation of Sun Rise/ Sun Set time using Sun Observations
14. Determination of Azimuth by Ex-Meridian observation.

References	Text/Reference Books: 1. T.P.Kanetkar and S.V.Kulkarni, Surveying and Levelling, Parts1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008 2. Dr.B.C.Punmia, Ashok K.Jain and Arun K Jain, Surveying Vol.I & II, Lakshmi Publications Pvt Ltd, New Delhi, 2005. 3.Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010 4.Arora, K.R., Surveying, Vol-I, II and III, Standard Book House,	

	2015. 5.R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012. 6.. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004 7.. S.K. Roy, Fundamentals of Surveying, Second Edition, Prentice‘ Hall of India 2004	
Course Out Comes	The course will enable the students to: CO1:Introduce the rudiments of various surveying and its principles. CO2: Imparts concepts of Theodolite Surveying and computation of area and volume calculation. CO3: Understand the procedure for establishing horizontal and vertical control and its adjustment procedure. CO4: Introduce the basics of Electronic Surveying and Photogrammetry Surveying CO5: Initiate the knowledge in Route surveying, Hydrographic surveying and Field Astronomical surveying.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	1	2	1	2
CO 2	2	1	1	2	2
CO 3	2	1	2	3	1
CO 4	1	2	2	3	1
CO 5	1	2	1	3	1

Course Title	SURVEYING AND GEOMATICS										
Course Code	Category	Sem	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC1X07	PCC	I/II	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-to recall the basics terms of surveying K2- to understand the concept of advanced modern surveying techniques K3-to understand the concept of photogrammetry and remote sensing K4-to solve the problems in advanced and modern surveying										
Course Objectives	• The main objective of this course to • Introduce knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities • Translate the knowledge gained for the implementation of Civil infrastructure facilities • Relate the knowledge on Surveying to the new frontiers of science like curve setting, Electronic Distance Measurement, Global Positioning System, Photogrammetry and Remote Sensing.										

Unit	Content	No.of Hours
I	Introduction to Surveying: Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, 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. Triangulation and Trilateration**:** Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods -triangulation - network- Signals. Baseline - choices - instruments and accessories - extension of base lines - corrections - Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric leveling - Axis single corrections.	11
II	Curves Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves	11
III	Modern Field Survey Systems: Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories – Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.	11
IV	Photogrammetry Surveying : Introduction, Basic concepts,	10

	perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereo plotting instruments, mosaics, map substitutes.	
V	Remote Sensing: Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.	10
References	**Text/Reference Books:** 7. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006. 8. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011 9. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010 10. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002. 11. Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications, 2001. 12. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.	
Course Out Comes	The course will enable the students to: CO1: To know the basics, importance, and methods of Triangulation and Trilateration. CO2: To study the various curves and its applications in surveying CO3: To study the Advance Surveying Instruments like EDM Total Station and GPS. CO4: To Study the Concept of Aerial Photo Interpretation. CO5: To learn the importance and different aspects of remote sensing and digital image processing	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	2	1	-	1	2
CO 2	2	1	1	2	2
CO 3	2	-	-	3	1
CO 4	1	-	-	3	1
CO 5	1	2	-	3	1

COURSES FOR EXIT OPTION III & IV SEMESTER

Course Title	Fundamentals of structural Design										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC2X08	PCC	III/IV	2	2	-	-	40	60	-	-	100
Cognitive Level	K1- recall the basic properties of material and its inter relationships K2-understand the design concepts of various super structure elements K3-understand the design concepts of various sub structure elements K4- design the beam, column, staircase, and footing of structures										
Course Objectives	1. To introduce the Role of structural engineer in structural design and the methods of design 2. To understand the limit state concepts and the analysis as per IS 3. To introduce the moment capacity of section and the design of slab as per IS codes 4. To understand the concepts and design of column 5. To know the soil properties and footing design										

Unit	Content	No.of Hours
I	**INTRODUCTION** Role of structural engineer in structural design- Objectives of Structural Design –Plain and Reinforced Concrete - Structural Systems -elements of structures-Purpose of Codes -Basic Code for Design-Properties of Concrete and steel-Loading Standards-Loading combinations - methods of design- Introduction for Working Stress Method, Ultimate Load Method (ULM), Limit States Method (LSM), Code Recommendations for Limit States Design - Permissible stresses-Factor of Safety.	6
II	**DESIGN OF BEAMS** Limit State Concepts- Assumptions- Characteristic Strength and Load, Partial Safety Factors- Limit state analysis and design of singly reinforced, doubly reinforced, T and L beam -Limit state analysis and design of section for shear and torsion, bond, anchorage and development length. Limit state Design of RC members for combined Bending, Shear and Torsion.	6
III	**DESIGN OF SLABS AND STAIRCASE**	6

	Introduction, critical bending moment in slabs, moment capacity of a section and design procedure. Limit state Analysis and Design of one way, Two-way and continuous slabs as per IS codal provision.	
IV	**DESIGN OF COLUMNS** Introduction, buckling of columns, Types of columns –Axially Loaded columns – Design of short Rectangular, Square and circular columns –Design of Slender columns- Design for Uniaxial and Biaxial bending using Column Curves-design of spiral reinforced concrete column.	6
V	**DESIGN OF STAIRCASE** Introduction about staircase- Types of Staircases – Design of dog-legged Staircase.	6
References	**Text Books** 1. Punmia.B.C and Jain, A.K., Comprehensive RCC Designs, Lakshmi Publications (P) Ltd., New Delhi, Ninth Edition, 2002 2. Ashok K. Jain, 'Reinforced Concrete Limit State Design', 4th Edition Nem Chand & Bros, Roorkee, 1993 3. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Pvt. Ltd., New Delhi, 2002. 4. Gambhir. M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006. 5. Subramanian,N.,"Design of Reinforced Concrete Structures",Oxford University Press, New Delhi, 2013. 6. Krishnaraju.N " Design of Reinforced Concrete Structurres ", CBS Publishers & Distributors Pvt. Ltd., New Delhi. 7. Ramachandra, "Limit state Design of Concrete Structures" Standard Book House, New Delhi **Reference Books** 1. Shah V.L and Karve SR, Advanced Reinforced Concrete Design, Structures	

	Publications, Pune, 2002. 2. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2002. 3. Nilson H., A.H., George Winter,G., ‘Design of Concrete Structures’, McGraw Hill Book Bandyopadhyay. J.N., "Design of Concrete Structures"., Prentice Hall of India Pvt. Ltd., New Delhi, 2008. 4.IS456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi, 2000 5.. SP16, IS456:1978 “Design Aids for Reinforced Concrete to Bureau of Indian Standards, New Delhi, 1999Co., New York, 1972	
Course Out Comes	After learning the course the students should be able to CO1: know the concepts of Working stress method, Ultimate load method and Limit state method. Design philosophy CO2: Understanding principles of limit state design and design of singly and doubly reinforced beams and slab. CO3 :Design slab and staircase. CO4 :Design of flexural members CO5: Analyze and design for shear, torsion bond and Redistribution of moments in continuous reinforced concrete beam ,Design column and footing	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	2	3	-	2
CO 2	2	2	3	-	2
CO 3	2	1	3	-	2
CO 4	2	1	3	-	2
CO 5	3	2	3	-	3

Course Title	TRANSPORTATION ENGINEERING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUC2X09	PCC	III/IV	3	2	-	4	40	60	-	-	100
Cognitive Level	K1-Recall the survey methods that are used for highway alignment K2-Understand the role of IRC and elements of highway K3-Apply the knowledge of traffic studies for flow and control of traffic K4-Design the elements of highway as per IRC										
Course Objectives	The Course aims to • carry out surveys involved in planning and highway alignment. • design cross section elements, sight distance, horizontal and vertical alignment. • implement traffic studies, traffic regulations and control, and intersection design. • determine the characteristics of pavement materials, design flexible and rigid pavements as per IRC.										

Unit	Content	No. of Hours
I	Highway development and planning-Classification of roads, road development in India, Current Road projects in India; highway alignment and project preparation.	9
II	Geometric design of highways-: Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, derivation and problems.	9
III	Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements.	9
IV	Design of pavements- Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems.	9
V	Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems	9
Laboratory Experiments	I. Tests on Bitumen 1) Penetration Test. 2) Ductility Test 3) Softening point test 4) Specific gravity test 5) Viscosity test 6) Flash and fire point test. II. Tests on Road Aggregate 7) Aggregate crushing value test 8) Los Angeles abrasion test 9) Aggregate impact value test 10) Aggregate shape test (flakiness & elongation) 11) Specific gravity 12) Water Absorption 13) Soundness III. Experiments on Traffic: 14) Traffic Volume study (a) at mid-section (b) at intersection 15) Spot speed study 16) Speed and	24

	delay study 17) Origin and Destination Study. IV. Miscellaneous Tests (Demonstration Only) 18) Marshal stability test 19) Determination of C.B.R. 20) Benkelman beam test 21) Bitumen extraction test 22) Exposure to Latest Software in the field of Transportation Engineering.	
Text book/ References	1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017 2. Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers. 3. Partha Chakraborty, ' Principles Of Transportation Engineering, PHI Learning, 4. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley 5. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011. 6. Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.	
Course Outcomes	On completion of the course, the students will be able to: **CO1**: carry out surveys involved in planning and highway alignment **CO2:** design the geometric elements of highways and expressways **CO3:** carry out traffic studies and implement traffic regulation and control measures and intersection design. **CO4:** characterize pavement materials and; **CO5:** design flexible and rigid pavements as per IRC.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	3	2	1
CO2	3	1	3	1	2
CO3	2	3	1	2	3
CO4	1	1	2	2	2
CO5	2	2	3	2	3

Course Title	FOUNDATION ENGINEERING											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC2X10	PCC	III/IV	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recall the soil sampling by boring, types of foundations and retaining walls K-2: Describe the shallow foundations and Deep foundations and types K-3: Apply the learned knowledge in designing of various foundations										
Course Objectives	The Course aims • To study the various methods of soil investigation, load bearing capacity of soil and the suitable types of foundation. • Familiarize the students with a basic understanding of the essential steps involved in a geotechnical site investigation. Introduce the principal types of foundations and the factors governing the choice of the most suitable type of foundation for a given solution and familiarize the students with the procedures used for: a) bearing capacity estimation, b) load carrying capacity of pile, c) determining earth pressure and stability of structures.										

Unit	Content	No.of Hours
I	**SITE INVESTIGATION & SELECTION OF FOUNDATION** Scope and Objectives – Methods of exploration - boring – water boring and rotary drilling – Depth of boring – Spacing of bore hole – Sampling – Disturbed and undisturbed sampling – sampling techniques – Split spoon sampler, Thin tube sampler, Stationary piston sampler – Bore log report – Penetration tests (SPT and SCPT) – Types of foundations -selection of foundation based on soil condition.	7
II	**SHALLOW FOUNDATION** Introduction – Location and depth of foundation – codal provisions – bearing capacity of shallow foundation on homogeneous deposits – Terzaghi's formula and BIS formula – factors affecting bearing capacity – problems – Bearing capacity from insitu tests (SPT,SCPT and PLT) – Allowable bearing pressure, Settlement – Components of settlement – determination of settlement of foundations on granular and clay deposits-equal settlement - differential settlement – allowable settlements – Codal provision – Methods of minimizing settlement.	8
III	**FOOTINGS AND RAFTS** Types of foundation – Contact pressure distribution below footings & raft – Isolated and combined footings – types – proportioning – mat foundation- types – uses –proportioning – floating foundation	7
IV	**PILES** Types of piles and their function - Factors influencing the	7

	selection of pile – Load Carrying capacity of single pile in granular and cohesive soil – Static formula – dynamic formulae (Engineering news and Hiley's) – capacity from insitu tests (SPT & SCPT) – Negative skin friction – uplift capacity – Group capacity by different methods (Feld's rule, converse Labarra formula and block failure criterion) – Settlement of pile groups –Interpretation of pile load test – Forces on pile caps – under reamed piles – capacity under compression and uplift.	
V	**RETAINING WALLS** Plastic equilibrium in soils – active and passive states – Rankine's cohesionless and cohesive soil – Coloumbo's wedge theory – condition for critical failure plane – Earth pressure on retaining walls of simple configurations – Graphical methods (Rebhann and Culmann) – pressure on the wall due to line load Stability of retaining walls.	7
References	**TEXT BOOKS:** 3. Punmia, B.C, "Soil Mechanics and foundations"' Laximi publication pvt.Ltd., New Delhi1, 2005. 4. Gopal Ranjan and Rao, A.S.R. "Basic and Applied Soil Mechanics", Wiley Eastern Ltd., New Delhi (India), 2003. **REFRENCE BOOKS:** 5. Varghese P.C.,"Foundation Engineering", PHI Learning Private Limited, New Delhi, 2005. 6. Das, B.M. "Principles of Foundation Engineering (Fifth Edition), Thomson Books/COLE, 2003 7. Murty, V.N.S. ``Soil Mechanics and Foundation Engineering", UBS Publishers Distribution Lts., New Delhi,1999. 8. Swamisaran, "Analysis and Design of Structures – Limit state Design:, Oxford IBH Publishing Co-Pvt. Ltd., New Delhi, 1998.	
Course Out Comes	After completion of the course the students should be **CO1:** Able to understand the various sampling techniques **CO2:** Know about the various insitu tests used to find the bearing capacity of the soil. **CO3:** Ability to select the suitable footings for the soil conditions. **CO4:** know about the piles and pile groups under various loading conditions **CO5:** able to design the various retaining walls as per Indian standard.	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	2	1	1	1	2
CO 2	2	1	1	1	2
CO 3	3	2	2	2	3
CO 4	2	2	3	2	3
CO 5	3	3	3	3	3

Course Title	SUSTAINABLE CONSTRUCTION AND LEAN CONSTRUCTION											
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC2X11	PCC	III/IV	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- To get knowledge on various sustainable materials used in construction. K2- To Describe the features of LEED, TERI and GRIHA ratings of buildings. K3- To achieve sustainability in construction projects with lean tools & techniques.										
Course Objectives	The Course aims To impart knowledge about sustainable construction and to understand the concepts of sustainable materials, energy calculations, green buildings and environmental effects.										

Unit	Content	No.of Hours
I	**INTRODUCTION & MATERIALS USED IN SUSTAINABLE CONSTRUCTION** Introduction and definition of Sustainability - Carbon cycle - role of construction material: concrete and steel, etc. - CO_2 contribution from cement and other construction materials - Recycled and manufactured aggregate - Role of QC and durability - Life cycle and sustainability.	9
II	**ENERGY CALCULATIONS** Components of embodied energy - calculation of embodied energy for construction materials - Energy concept and primary energy - Embodied energy via-a-vis operational energy in conditioned building - Life Cycle energy use.	9
III	**GREEN BUILDINGS** Control of energy use in building – National Building Code (NBC), ECBC code, codes in neighboring tropical countries - OTTV concepts and calculations – Features of LEED and TERI – Griha ratings - Role of insulation and thermal properties of construction materials - influence of moisture content and modeling -Performance ratings of green buildings - Zero energy building	9

IV	**CORE CONCEPTS IN LEAN** Introduction to the Course; Lean Overview; Need for Productivity Measurement and improvement; Productivity Measurement System (PMS).	9
V	**LEAN CONSTRUCTION TOOLS AND TECHNIQUES** Sampling/ Work Sampling; Survey/ Foreman delay survey; Value Stream/ Process Mapping– 5S , Collaborative Planning System (CPS)/ Last Planner™ System (LPS) – Big Room Approach, IT/BIM and Lean, How to Start Practicing Lean Tools in Project Site.	9
References	**REFERENCES:** 1. Charles J Kibert, Sustainable Construction: Green Building Design & Delivery, 4th Edition, Wiley Publishers 2016. 2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016. 3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011. 4. Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2002. 5. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005.	
Course Out Comes	**CO1:** Describe the various sustainable materials used in construction. **CO2:** Explain the method of estimating the amount of energy required for building. **CO3:** Describe the features of LEED, TERI and GRIHA ratings of buildings. **CO4:** Explain the core concepts of lean construction tools and techniques and their importance in achieving better productivity. **CO5:** lean tools & techniques to achieve sustainability in construction projects	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	3	3	1	3	2
CO 2	3	3	1	3	2
CO 3	3	3	1	3	2
CO 4	3	3	1	3	2
CO 5	3	3	1	3	2

Course Title	PREFABRICATED STRUCTURES										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC2X12	PCC	III/IV	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- To get knowledge on various sustainable materials used in construction. K2- To Describe the features of LEED, TERI and GRIHA ratings of buildings. K3- To achieve sustainability in construction projects with lean tools & techniques.										
Course Objectives	To impart knowledge to students on modular construction, industrialised construction and design of prefabricated elements and construction methods.										

Unit	Content	No. of Hours
I	INTRODUCTION - Need for prefabrication – Principles of prefabrication – Modular coordination – Standarization – Materials – Systems – Production – Transportation – Erection.	9
II	PREFABRICATED COMPONENTS - Behaviour and types of structural components – Large panel systems – roof and floor slabs – Walls panels – Beams – Columns – Shear walls	9
III	DESIGN PRINCIPLES - Design philosophy- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation – Demountable precast concrete systems.	9
IV	JOINTS AND CONNECTIONS IN STRUCTURAL MEMBERS - Types of Joints – based on action of forces – compression joints – shear joints – tension joints – based on function – construction, contraction, expansion. Design of expansion joints – Dimensions and detailing – Types of sealants – Types of structural connections – Beam to Column – Column to Column – Beam to Beam – Column to foundation.	9
V	DESIGN FOR ABNORMAL LOADS - Progressive collapse – Codal provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., – Importance of avoidance of progressive collapse.	9
Text book/ References	TEXT BOOKS: 1. Bruggeling A.S. G and Huyghe G.F. “Prefabrication with Concrete”, A.A. Balkema Publishers,USA,1991. 2. Lewitt,M. ” Precast Concrete- Materials, Manufacture, Properties	

	And Usage", Applied Science Publishers , London And New Jersey, 1982. 3. Bachmann, H. and Steinle, A. "Precast Concrete Structures", Ernst & Sohn, Berlin, 2011. REFERENCES: 1. Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH, 1976. 2. "Handbook on Precast Concrete Buildings", Indian Concrete Institute, 2016. 3. "Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009.	
Course Outcomes		

Course Title	ENVIRONMENTAL IMPACT ASSESSMENT										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUC2X13	PCC	III/IV	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1 Identify the Components and methods for EIA K-2 Understand the Socio-Economic Impact Assessment K-3 Prepare the EIA Report for various sectors										
Course Objectives	The Course aims • To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment • To develop the skill to prepare environmental management plan. • Ability to prepare draft and detailed reports under EIA.										

Unit	Content	No. of Hours
I	Introduction - Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA – Cross sectoral issues and terms of reference in EIA – Public Participation in EIA. EIA process- screening – scoping - setting – analysis – mitigation.	9
II	Components and Methods for EIA - Matrices – Networks – Checklists – Connections and combinations of processes - Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological –– Cumulative Impact Assessment – Documentation of EIA findings – planning – organization of information and visual display materials–– Report preparation. EIA methods in other countries.	9
III	Socio-Economic Impact Assessment - Definition of social impact assessment. Social impact assessment model and the planning process .Rationale and measurementforSIAvariables.Relationshipbetweensocialimpactsandchangeincommunityandinstitutional arrangements. Individual and family level impacts. Communities in transition - neighborhood and community impacts. Selecting, testing and understanding significant social impacts. Mitigation and enhancement in social assessment. Environmental costing of projects.	9
IV	Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment.	9
V	Sectoral EIA - EIA related to the following sectors - Infrastructure –construction and housing- Highways - Mining –	9

	Industrial - Thermal Power - River valley and Hydroelectric – coastal projects-Nuclear Power	
Text book/ References	1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York.1996 2. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey,2003. 3. Petts,J.,Handbook of Environmental Impact Assessment, Vol.,I and II, Blackwell Science, London, 2009. 4. KolluruRao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996. 5. World Bank –Source book on EIA 6. Cutter, S.L.,"EnvironmentalRiskandHazards",Prentice-HallofIndiaPvt.Ltd.,NewDelhi,1999. 7. John G. Rau and David C. Wooten (Ed), *Environmental Impact Analysis Handbook*, McGraw Hill Book Company.	
Course Outcomes	On completion of the course, students should be **CO1:** Able to understand the types and limitations of EIA. **CO2:**Able to know about the Components and methods for EIA **CO3:**Able to understand the Socio-Economic impact assessments **CO4:** A:bility to prepare draft and detailed reports under EIA. **CO5:** Ability to compare and validate the impacts on real systems under air, water and soil.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	-	-	2
CO2	2	2	-	-	2
CO3	2	3	-	-	2
CO4	2	2	1	1	2
CO5	2	3	1	1	2

Course Title	DIGITAL CONSTRUCTION LAB										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC2X14	PC-LC	III/IV	3	0	0	4	-	-	60	40	100
Cognitive Level	K1- To understand the importance of latest softwares in a construction industry. K2- To plan a construction project using MS project K3- To analyse the bid management and its effectiveness using bid management software										
Course Objectives	The Course aims • To train the students in field of digitalization of construction. Students can be trained in the latest softwares relevant to construction industry										

Unit	Content	No.of Hours
	List of experiments: To implement the digital knowledge in construction (use relevant software's) 1. Introduction and understanding of Primavera project planner for construction 2. Using Primavera project planner, update the schedule of the project of a construction project. 3. Introduction and understanding of MS Project for a construction project 4. Using MS project, schedule the construction project planning 5. Introduction to BIM in construction projects a. Development of BIM for small construction project 6. Progress the work flows in construction project using BIM 7. Development of bid management for a small firm construction	90

	industry using software.	
Course Out Comes	At the end of the course the student will be able to understand the output of digitalization of construction **CO1** To understand the importance of latest softwares in a construction industry. **CO2** To plan a construction project using Primervera **CO3** To plan a construction project using MS project **CO4** To develope a BIM information model **CO5** To analyse the bid management and its effectiveness using bid management software	

PO/PSO	CO1	CO2	CO3	CO4	CO5	Overall
PO1	2	3	2	2	3	2
PO2	2	3	3	2	2	2
PO3	3	2	2	3	3	3
PO4	2	2	2	3	2	2
PO5	3	3	3	3	3	3

COURSES FOR EXIT OPTION
V & VI SEMESTER

Course Title	DESIGN OF RCC AND STEEL STRUCTURES										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC3X15	PCC	V/VI	4	3	-	2	40	60	30	20	150
Cognitive Level	K1- recall the basic properties of the material and its interrelationships K2-understand the design concepts of various superstructure elements K3- design the structural elements of the beam, column, and footing K4-recall the basic properties of steel sections and their inter-relationships K5-understand the design concepts of various structural elements										
Course Objectives	• To introduce the Role of structural engineer in structural design and the methods of design • To understand the limit state concepts and the analysis as per IS • To introduce the moment capacity of the section and the design of the slab as per IS codes • To study the Sections and properties of steel sections available • To design bolted and welding connections										

Unit	Content	No.of Hours
I	**INTRODUCTION FOR RCC STRUCTURES** Role of structural engineer in structural design- Objectives of Structural Design –Plain and Reinforced Concrete - Structural Systems -elements of structures-Purpose of Codes -Basic Code for Design-Properties of Concrete and steel-Loading Standards-Loading combinations - methods of design- Introduction for Working Stress Method, Ultimate Load Method (ULM), Limit States Method (LSM), Code Recommendations for Limit States Design - Permissible Stresses-Factor of Safety.	8
II	**DESIGN OF BEAMS & SLABS** Limit State Concepts- Assumptions- Characteristic Strength and Load, Partial Safety Factors- Limit state analysis and design of singly reinforced, doubly reinforced, Limit state Analysis and Design of one-way, Two-way, and continuous slabs as per IS codal provisions	7

III	**DESIGN OF COLUMNS & FOOTINGS** Columns-Introduction, buckling of columns, Types of columns – Axially Loaded columns – Design of short Rectangular, Square and circular columns –Design for Uniaxial bending. Footing-Introduction, Types of Footings, Concepts of Proportioning of footings and foundations based on soil properties -Soil Pressures for footings- General Design Considerations and Code Requirements, Design of wall footing –Design of Isolated footings with axial loading	7
IV	**INTRODUCTION FOR STEEL STRUCTURES**: Types - Advantages and disadvantages of steel structures - Properties of steel - material specifications - Rolled steel sections – Built-up sections - Limit State Design Concepts – Loads on Structures Permissible stresses in tension, compression, bending and shear.	7
V	**BOLTED & WELDED CONNECTIONS** Types of bolts –black bolts–turned and fitted bolts–high strength friction grip bolts – Proof loads – types of bolted connections–design of bolted shear connections– subjected to shear and tension. Welding – welded connection - Types – advantages- defects– butt weld–fillet weld–stresses in welds–design of fillet weld for axial load–design of butt weld–plug and slot weld–eccentrically loaded fillet weld joints–eccentrically loaded butt welded joints.	7
References	**Text Books** 3 Jain and Jaikrishna, Plain and Reinforced Concrete, Vol. I, Nemchand Brothers. (ISBN- 8185240086/978-8185240084). 4 V. L. Shah and Karve, Limit State Design - Reinforced Concrete Structures Publications. (ISBN-9788190371711/8190371711). **Reference Books** 1. P. Dayaratnam, Design of Reinforced Concrete Structures, Oxford & IBH. (ISBN-9789386479785/9386479788). 2. P.D. Arthur and V. Ramkrishnan, Ultimate Strength Design for Structural Concrete, Wheeler&Co. Pvt Ltd. (ISBN- 0273403230, 978-0273403234). 3. B.P. Hughes, Limit State Theory for Reinforced Concrete Design, Pitman. (ISBN- 0273010239, 978-	

	0273010234). 4. IS456 (2000), Plain and Reinforced Concrete. 5. IS 875 (1987), Part I- Design Loads (Other than earthquake) for Buildings and Structures (DeadLoads). 6. IS 875 (1987), Part II- Design Loads (Other than earthquake) for Buildings and Structures (Imposed Loads). 7. IS 875 (2015), Part III- Design Loads (Other than earthquake) for Buildings and Structures (Wind Loads). 8. IS 875 (1987), Part IV- Design Loads (Other than earthquake) for Buildings and Structures (Snow Loads). 9. SP16, IS456:1978 "Design Aids for Reinforced Concrete to Bureau of Indian Standards, New Delhi, 1999Co., New York, 1972	
Course Out Comes	After learning the course the students should be able to CO1: know the concepts of Working stress method, Ultimate load method and Limit state method. Design philosophy CO2: Understanding principles of limit state design and design of singly and doubly reinforced beams and slab. CO3 :Design Column and footing. CO4 : identify the types of steel sections CO5: design the bolted and welded connections	

Course Title	FORMWORK ENGINEERING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC3X16	PCC	V/VI	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- To understand the overall and detailed planning of formwork. K2- To impart knowledge on formwork materials, accessories, pressures and labour requirement. K3- To impart the knowledge about different types of form work used for special structures.										
Course Objectives	The Course aims On completion of this course the students will be able to know the detailed planning of formwork, design of forms and erection of form work.										

Unit	Content	No.of Hours
I	**INTRODUCTION TO FORM WORK** Introduction to Formwork and false work, Temporary work systems, Requirements, Construction planning and site constraints, Selection, and Classification (Types) of Formwork, General objectives of formwork building - Planning for safety - Development of a Basic System - Key Areas of cost reduction - Planning examples - Overall Planning - Detailed planning - Overall programme - Detailed programme - Costing - Planning crane arrangements - Site layout plan - Transporting plant - Formwork beams - Scaffold frames - Framed panel formwork.	9
II	**FORMWORK MATERIALS ASSESORIES & PRESSURES** Formwork Materials, Accessories and consumables – Application of tools, Reconstituted wood - Steel – Aluminum Plywood - Types and grades Standard units - Corner units – Pass units, Calculation of labour constants - Formwork hours - Labour Requirement. Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Finish - Sheathing boards working stresses - Repetitive member stress Vertical loads for design of slab forms - Uplift on shores - Laterals loads on slabs and walls.	9
III	**FORMWORK DESIGN** Concepts, Formwork Systems – components, assembly, De-shuttering, safety of work and Design for Tall Structures, Foundation Wall, Column, Slab	9

	and Beam formworks. Design of Decks and False works. Effects of various loads. Loading and moment of formwork, IS Code provisions.	
IV	**FORMWORK FOR SPECIAL STRUCTURES** Formwork for Bridge Structures, Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Nuclear Reactor, Tunnel, Lift Shaft, stairs and Formwork for Precast Concrete. Various climbing system, Table lifting system.	9
V	**CASE STUDIES** Formwork failures: Causes of failures – Inadequate shoring inadequate bracing of members – improper vibration – Premature stripping Errors in design – Case studies – Finish of exposed concrete design deficiencies – Safety factors – Prevention of rotation – Stripping sequence – failure formwork issues in multi - story building construction – vertical and horizontal elements used in the industry.	9
References	**TEXT BOOKS** 1. Peurify R.L and Oberlender G.D , Formwork for Concrete Structures, , McGraw Hill Education India ,2015 2. Jha K N, Formwork for Concrete Structures, Tata McGraw Hill Education, 2012. **REFERENCES:** 1. Austin, C.K., Formwork for Concrete, Cleaver -Hume Press Ltd., London, 1996. 2. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 1996 3. Michael P. Hurst, Construction Press, London and New York, 2003. 4. Christopher Souder , (2014), Temporary Structure Design, Wiley Publications, London. 5. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.	
Course Out Comes	On completion of the course, students should be able to do **CO1** To understand the overall and detailed planning of formwork. **CO2** To impart knowledge on formwork materials, accessories, pressures and	

	labour requirement. **CO3** To develop the conceptual understanding of design, construction and erection of formwork. **CO4** To impart the knowledge about different types of form work used for special structures. **CO5** To understand the errors in design and judge the formwork failures through case studies.	

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PROGRAMOUTCOMES(PO)							
PO1	Knowledge of Engineering Sciences	2	3	3	2	2	2
PO2	Problem analysis		3	3	3	1	3
PO3	Design/ development of solutions		3	3		2	3
PO4	Investigation		2	2		3	2
PO5	Modern Tool Usage			2			1
PO6	Engineer and Society	2					1
PO7	Environment and Sustainability	2	2				2
PO8	Ethics						
PO9	Individual and Team work	3	3	3	2	2	3
PO10	Communication						
PO11	Project Management and Finance	3	2	2	2	3	2
PO12	Life Long Learning	2	2	2	2	2	2
PROGRAMSPECIFICOUTCOMES(PSO)							
PSO1	Knowledge of Civil Engineering discipline	3	3	3	3	3	3
PSO2	Critical analysis of Civil Engineering problems and innovation		3	3			2
PSO3	Conceptualization and evaluation of engineering solutions to Civil Engineering Issues		2	3			2

Course Title	AIRPORTS AND HARBOUR										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUC3X17	PCC	V/VI	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-Recall the modes of transports in India K2-explain the different components of airfield K3-Identify the Location, Traffic estimation, ship characterization. K-4 Understand the design of Harbour K-5 Classify the waterways										
Course Objectives	The Course aims • Provides a basic understanding on Airport Systems Planning and Operation. • Students become conversion with definition purpose location materials of coastal structures. • Students acquire knowledge on planning and design of harbour										

Unit	Content	No. of Hours
I	Aircraft characteristics; Aircraft performance characteristics: Airport planning and air travel demand forecasting: Airport Site Selection;	9
II	Geometric Design of the Airfield: Determination of Runway Capacity and Delay - Taxiway and Gate Capacity - Holding Aprons - Terminal Aprons – Airport drainage - Function of Airport Passenger and Cargo Terminal - Design of Air Freight Terminals - Airport access - Airport Landside planning - Capacity;	9
III	Air Traffic Management: Navigational aids: ground-based systems, satellite-based systems – Air traffic control and surveillance facilities – Airfield lighting - air traffic management.	9
IV	Harbour Planning: Types of water transportation, water transportation in India, requirements of ports and harbours, classification of harbours, selection of site and planning of harbours, location of harbour, traffic estimation, master plan, ship characteristics, harbour design, turning basin, harbour entrances, type of docks, its location and number, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations;	9
V	; Docks and Repair Facilities: Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, Harbour docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks, pumping plant, floating docks, slipways, locks, size of lock, lock gates, types of gates; Navigational Aids: Requirements of signals, fixed navigation structures, necessity of navigational aids, light houses, beacon lights, floating navigational aids, light ships, buoys, radar;	9
Text book/ References	• Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nemachand and Bros, Roorkee, 1994 • Docks and Harbour engineering by S.B.Bindra • K.P., Highways, Railways, Airport and Harbour Engineering, V	

	Scitech Publications (India), Chennai, 2010 • Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels., Universities Press (India) Private Limited, Hyderabad, 2015.	
Course Outcomes	Students would have **CO1:** Skills on airport planning and design with focus of runway and taxiway **CO2:** understood the basics of air route Planning and Design of components of airport. **CO3:** Develop the airline development for scheduling. **CO4:** To know about the Harbour planning and understanding about the various survey involved in harbor planning **CO5:** To know about the construction of break water, understand about the Navigational Aids.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3
CO2	3	2	1	2	2
CO3	3	2	2	2	3
CO4	3	2	1	1	2
CO5	3	3	1	2	2

Course Title	CONSTRUCTION MANAGEMENT AND SAFETY										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEUC3X18	PCC	V/VI	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- To Perform formulations of projects K2- To Develop the knowledge on accidents and their causes . K3- To Plan, assess, analyze and manage the construction project sites.										
Course Objectives	The Course aims • To expose the students in the field of construction equipment and machineries so as to gain knowledge in carrying out engineering tasks. • To study and understand the formulation, costing of construction projects, scheduling and various safety concepts and its requirements applied to construction projects.										

Unit	Content	No.of Hours
I	**GENERAL OVERVIEW AND PROJECT ORGANIZATION** Introduction - Interdisciplinary nature of modern construction projects – execution of project – evaluation of bits – resource management.	9
II	**ESTIMATION OF PROJECT COST & ECONOMICS** Estimating quantities – description of items – estimation of project cost – running account bills – decision making in construction projects – depreciation of construction equipment – case study.	9
III	**PLANNING AND SCHEDULING** Introduction – project scheduling – uncertainties in duration of activities using PERT – Project monitoring and control system – resource levelling and allocation – crashing of network.	9
IV	**SAFETY DURING CONSTRUCTION** Basic terminology in safety - types of injuries - safety pyramid - Accident patterns - Planning for safety budget, safety culture -	9

	Introduction to OSHA regulations - Site safety programs - Job hazard analysis, accident investigation & accident indices-violation, penalty.	
V	**SAFE OPERATING PROCEDURES** Safety during alteration, demolition works – Earthwork, steel construction, temporary structures, masonry & concrete construction, cutting & welding - Construction equipment, materials handling disposal & hand tools - Other hazards – fire, confined spaces, electrical safety.	9
	LAB Ex 1 Introduction to various construction management software Ex 2 Planning and creating new project Ex 3 Scheduling and constraints using PRIMAVERA Ex 4 Project cost management using PRIMAVERA Ex 5 Construction project safety management using BIM	
References	**REFERENCES:** 1. Barcus, S.W. and Wilkinson.J.W., Hand Book of Management Consulting Services, McGraw Hill, New York, 1986. 2. Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd., 1992 3. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth- Heinemann, USA , 2017. 4. Patrick X.W. Zou ,Riza YosiaSunindijo, Strategic Safety Management in Construction and Engineering John Wiley & Sons, Ltd 2015.	
Course Out Comes	**CO1:** Perform formulations of projects **CO2:** Analyze project costing. **CO3:** Identify and estimate the activity in the construction. **CO4:** Develop the knowledge on accidents and their causes. **CO5:** Plan, assess, analyze and manage the construction project sites	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	1	3	2
CO 2	3	3	1	3	2
CO 3	3	3	1	3	2
CO 4	3	3	1	3	2
CO 5	3	3	1	3	2

Course Title	AIR AND NOISE POLLUTION CONTROL ENGINEERING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
24CEUC3X19	PCC	V/VI	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1 Identify the various air pollutants, sources and its effects on environment. K-2 Understand the design and performance equations for air pollution control. K-3 Apply annoyance rating schemes for indoor and outdoor noise pollution.										
Course Objectives	The Course aims • To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends. • To educate theoretical principles and operational control techniques employed in industrial pollution control engineering.										

Unit	Content	No. of Hours
I	Air pollutants, Sources, classification, Combustion Processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects-Smoke, smog and ozone layer disturbance, Greenhouse effect.	9
II	Air sampling and pollution measurement methods, principles and instruments, Ambient air quality and emission standards, Air pollution indices, Air Act, legislation and regulations, control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods.	9
III	Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods like absorption, adsorption, precipitation etc. Biological air pollution control technologies, Indoor air quality.	9
IV	Noise pollution: 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
V	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	9
Text book/ References	5. Introduction to Environmental Engineering and Science, G. M. Masters, Prentice-Hall of India, New Delhi, 2011. 6. Air Pollution Control Engineering, N. de Nevers. McGraw Hill, Singapore, 2011. 7. Environmental Noise Pollution, P. E. Cunniff, McGraw Hill, New York, 1987. 8. Fundamentals of Air pollution, R. W. Boubel, D. L. Fox, and A. C. Stern, Academic Press, NY, 2011.	
Course Outcomes	On completion of the course, students should be **CO1:** Apply sampling techniques **CO2:** Apply modeling techniques **CO3:**Suggest suitable air pollution prevention equipment and techniques	

	for various gaseous and particulate pollutants to Industries. **CO4:** Discuss the emission standards. **CO5:**know about the noise pollution measuring instruments and its standards.	

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	1	1
CO2	2	2	1	1	1
CO3	2	2	1	1	2
CO4	2	2	1	1	2
CO5	2	2	1	1	2

VALUE ADDED COURSES

S.No	Semester	Course Code & Course title
Odd Semester		
1	I	**24CEU11VA1 /** Building Materials and construction
2	III	**24CEU23VA3 /** Environmental impact Assessment
3	V	**24CEU35VA5 /** Water supply and Sanitation system
Even Semester		
4	II	**24CEU12VA2 /** Solid Waste Management
5	IV	**24CEU24VA4 /** Watershed conservation & Management
6	VI	**24CEU36VA6 /** Cost Effective Construction Technology

Course Title	BUILDING MATERIALS AND CONSTRUCTION											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEU11VA1	-	-	2	2	-	-	50	-	-	-	50

Cognitive Level	K1- to recall the different types of building materials and its applications K2- to understand the nature, characteristics, performance, and behaviour of *civil engineering materials* used in buildings and infrastructure and to evaluate their physical and mechanical properties. K3- application of different materials utilized for construction process
Course Objectives	The Course aims • Identification of construction materials required for the assigned work. • Provide procedural knowledge of the simple testing methods of cement and concrete. • Provide knowledge on foundations and its types • List the requirements of stairs and provide knowledge on building by laws.

Unit	Content	No.of Hours
I	**STONES, BRICKS AND AGGREGATES** Properties and classification of building stones, stone quarrying, precautions in blasting, dressing of stone, composition of good brick earth, various methods of manufacture of bricks, Fine & Coarse aggregate: Natural and manufactured; Importance of size, shape and texture.	5
II	**CEMENT AND ADMIXTURES** Various types of cement and their properties; Various field and laboratory tests for cement; Various ingredients of cement concrete and their importance, various tests for concrete; Field and tests admixtures, mineral and chemical admixture.	5
III	**BUILDING COMPONENTS** Brick masonry construction: Principles of construction, types of bonds, introduction to reinforced brick work, lintels and arches; Stone masonry: Types of stone masonry & method of its construction, lintels and arches; Finishing: Pointing, Plastering, Paintings, varnishing; General Principles: Flooring and its types, Roofing and its types, Damp proof course (DPC).	5
IV	**FOUNDATIONS** Functions of foundations, Shallow foundations – spread, combined, strap and mat footings, deep foundation – pile foundation	5
V	**STAIRS AND BUILDING PLANNING** Stairs: Definitions, technical terms and types of stairs, requirements of good stairs; Geometrical design of RCC doglegged and open-well stairs; Principles of building planning, classification building, planning and building by laws.	5

<table>
<tr><td>References</td><td>TEXT BOOKS:
1. S. K. Duggal, “Building Materials”, New Age International Publishers.
2. Sushil Kumar “Building Materials and construction”, Standard Publishers, 20th edition, reprint, 2015.
3. Dr.B. C. Punmia, Ashok kumar Jain, Arun Kumar Jain, “Building Construction”, Laxmi Publications (P) ltd., New Delhi.
4. Rangawala S. C. “Engineering Materials‖”, Charter Publishing House, Anand, India
REFERENCE BOOKS:
1. PC Varghese, “Building Construction”, PHI.
2. R. Chuddy, “Construction Technology”,Vol 1&2, Longman UK.
3. Subhash Chander, “Basic Civil Engineering”, Jain Brothers.</td><td></td></tr>
<tr><td>Course Out Comes</td><td>After learning the course the students should be able to
CO1: Predict, Understand and identify the building materials and select suitable type of building material for given situation.
CO2: Students can explore the importance of cement, mineral and chemical admixtures, and requirements of the concrete in construction.
CO3: To be aware of various building components and its construction procedures.
CO4: Students can explain the foundations and uses of different types of foundations.
CO5: Students can understand the requirements and different types of stairs and Principle of building planning and by laws and standards of building material Components and orientation of the building</td><td></td></tr>
</table>

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	-	-	1	2
CO 2	2	-	-	2	1
CO 3	2	-	-	3	2
CO 4	2	-	-	2	1
CO 5	2	-	-	3	2

<table>
<tr><td>Course Title</td><td colspan="11">SOLID WASTE MANAGEMENT</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEU12VA2</td><td>-</td><td>-</td><td>2</td><td>2</td><td>-</td><td>-</td><td>50</td><td>-</td><td>-</td><td>-</td><td>50</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1 Identify the Solid and hazardous waste sources and its characteristics
K-2 Explain the solid and hazardous waste management systems
K-3 Apply the legislations on management of solid and hazardous wastes.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">• To make the students conversant with different aspects of the types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste
• The students completing the course will have an understanding of the nature and characteristics of municipal solid wastes and the regulatory requirements regarding municipal solid waste management and ability to plan waste minimization and design storage, collection, transport, processing and disposal of municipal solid waste</td></tr>
</table>

Unit	Content	No.of Hours
I	**SOURCES AND TYPES** Sources and types of solid wastes-waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes-Public health and environmental effects. Elements of solid waste management –Social and Financial aspects – integrated management-Public awareness; Role of NGO‟s.	10
II	**ON-SITE STORAGE AND PROCESSING** On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and economic aspects of open storage – waste segregation and storage – case studies under Indian conditions – source reduction of waste – Reduction, Reuse and Recycling.	9
II	**COLLECTION AND TRANSFER** Methods of Residential and commercial waste collection – Collection vehicles – Manpower– Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems- solving.	10
IV	**OFF-SITE PROCESSING** Objectives of waste processing – Physical Processing techniques and Equipments; Resource recovery from solid waste composting and biomethanation; Thermal processing options – case studies under Indian conditions.	9

V	**DISPOSAL** Land disposal of solid waste; Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor– Dumpsite Rehabilitation.	10
References	1. Tchobanoglous, G., Theisen, H. M., and Eliassen, R. "Solid. Wastes: Engineering Principles and Management Issues". McGraw Hill, New York, 1993. 2. Vesilind, P.A. and Rimer, A.E., "Unit Operations in Resource Recovery Engineering", Prentice Hall, Inc., 1981 3. Paul T Willams, "Waste Treatment and Disposal", John Wiley and Sons, 2000 4. Government of India, "Manual on Municipal Solid Waste Management", CPHEEO, Ministry of Urban Development, New Delhi, 2000. 5. Bhide A.D. and Sundaresan, B.B. "Solid Waste Management Collection", Processing and Disposal, 2001 6. Manser A.G.R. and Keeling A.A.," Practical Handbook of Processing and Recycling of Municipal solid Wastes", Lewis Publishers, CRC Press, 1996 7. George Tchobanoglous and Frank Kreith"Handbook of Solidwaste Management", McGraw Hill, New York, 2002	
Course Out Comes	On completion of the course, students should be **CO:** Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation **CO2:** Define and explain important concepts in the field of solid waste management **CO3:** suggest suitable technical solutions for treatment of municipal and industrial waste **CO4**: Understand the role legislation and policy drivers play in stakeholders' response to the waste a **CO5:** Apply the basic scientific principles for solving practical waste management challenges	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	1	2	1	1	1
CO 2	1	2	1	1	1
CO 3	2	3	2	2	3
CO 4	1	2	1	1	2
CO 5	2	2	1	2	2

<table>
<tr><td>Course Title</td><td colspan="11">ENVIRONMENTAL IMPACT ASSESSMENT</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEU23VA3</td><td>-</td><td>-</td><td>2</td><td>2</td><td>-</td><td>-</td><td>50</td><td>-</td><td>-</td><td>-</td><td>50</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1 Identify the Components and methods For EIA
K-2 Understand the Socio-Economic Impact Assessment
K-3 Prepare the EIA Report for various sectors</td></tr>
<tr><td>Course Objectives</td><td colspan="11">• To impart knowledge on Environmental management and Environmental Impact Assessment.
• The broad education necessary to understand the impact of engineering solutions in global, economic, environmental and social context.</td></tr>
</table>

Unit	Content	No.of Hours
I	**INTRODUCTION** Impact of development projects – Sustainable development- Need for Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) – EIA capability and limitations – Legal provisions on EIA-Stages of EIA, Types of EIA	
II	**METHODOLOGIES** Methods of EIA – Check lists – Matrices – Networks – Cost-benefit analysis – Analysis of alternatives	
III	**PREDICTION AND ASSESSMENT** Assessment of Impact on land, water, air, social & cultural activities and on flora & fauna- Mathematical models- Public participation	
IV	**ENVIRONMENTAL MANAGEMENT PLAN** Plan for mitigation of adverse impact on environment – Options for mitigation of impact on water, air, land and on flora & fauna - Addressing the issues related to the Project Affected People. Post project monitoring	
V	**CASE STUDIES** EIA for infrastructure projects – Dams – Highways – Multi-storey Buildings – Water Supply and Drainage Projects – Waste water treatment plants, STP.	

References	1. Canter, R.L., “Environmental Impact Assessment”, McGraw Hill Inc., New Delhi, 1996. 2. Shukla, S.K. and Srivastava, P.R., “Concepts in Environmental Impact Analysis”, Common Wealth Publishers, New Delhi, 1992. 3. John G. Rau and David C Hooten “Environmental Impact Analysis Handbook”, McGraw Hill Book Company, 1990. 4. “Environmental Assessment Source book”, Vol. I, II & III. The World Bank, Washington, D.C., 1991. 5. Judith Petts, “Handbook of Environmental Impact Assessment Vol. I & II”, Blackwell Science, 1999.	
Course Out Comes	CO1: To know about the basics and importance of Environmental Impact Assessment CO2: To study about the Environmental Impact Statement and methods of EIA. CO3: To know about the Environmental Management and Prediction Methods CO4: To study about the Environmental Management Plan CO5: To understand the impact of Engineering solutions in environmental and social context.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	2	-	-	2
CO 2	2	2	-	-	2
CO 3	2	3	-	-	2
CO 4	2	2	1	1	2
CO 5	2	3	1	1	2

Course Title	WATERSHED CONSERVATION AND MANAGEMENT											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEU24VA4	**-**	**-**	**2**	**2**	**-**	**-**	**50**	**-**	**-**	**-**	**50**
Cognitive Level	**K1** :Recall the basics principles of various flow with their concepts **K2** : understand the principles of different types of flow like steady and unsteady flow **K3** : Apply the principles in hydraulic structures for flow of water										
Course Objectives	The Course aims 3. To provide the technical, economical and sociological understanding of a watershed. 4. To provide a comprehensive discourse on the engineering practices of watershed management for realizing the higher benefits of watershed management.										

Unit	Content	No.of Hours
I	**WATERSHED CONCEPTS** Watershed - Need for an Integrated Approach - Influencing Factors: Geology – Soil – Morphological Characteristics - Toposheet - Delineation – Codification – Prioritization of Watershed – Indian Scenario	9
II	**SOIL CONSERVATION MEASURES** Types of Erosion – Water and Wind Erosion: Causes, Factors, Effects and Control – Soil Conservation Measures: Agronomical and Mechanical - Estimation of Soil Loss – Sedimentation.	9
III	**WATER HARVESTING AND CONSERVATION** Water Harvesting Techniques – Micro-Catchments - Design of Small Water Harvesting Structures –Farm Ponds – Percolation Tanks – Yield from a Catchment	9
IV	**WATERSHED MANAGEMENT** Project Proposal Formulation - Watershed Development Plan – Entry Point Activities – Estimation – Watershed Economics - Agroforestry – Grassland Management – Wasteland Management – Watershed Approach in Government Programmes –Developing Collaborative know how – People"s Participation – Evaluation of Watershed Management	9
V	**GIS FOR WATERSHED MANAGEMENT** Applications of Remote Sensing and Geographical Information System - Role of Decision Support System – Conceptual Models and Case Studies	9

References	10. Ghanashyam Das, Hydrology and Soil Conservation engineering, Prentice Hall of India PrivateLimited, New Delhi, 2000. 11. Glenn O. Schwab, Soil and Water Conservation Engineering, John Wiley and Sons, 1981. 12. Gurmail Singh, A Manual on Soil and Water Conservation, ICAR Publication, New Delhi, 1982. 13. Suresh, R. Soil and Water Conservation Engineering, Standard Publication, New Delhi, 1982. 14. Vir Singh, Raj , Watershed Planning and Management, Yash Publishing House, Bikaner, 2000. 15. Brooks, K. N., P. F. Ffolliott, H. M. Gregersen and L. F. DeBano. 1997. Hydrology and the Management of Watersheds. Second Edition. Iowa State University Press. Ames, Iowa. 502 pp. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York. 16. Lal, Ruttan. 2000. Integrated Watershed Management in the Global Ecosystem. CRC Press, NewYork. 17. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York. 18. Dhruva Narayana, G. Sastry, V. S. Patnaik, "Watershed Management", CSWCTRI, Dehradun, ICAR Publications, 1997.	
Course Out Comes	The students can be **CO1**: understand fundamental principles of water shed and morphological characteristics **CO2**: understand the principles soil conservation **CO3**: Apply decision to methods of rain water harvesting techniques **CO4**: develop the managing skill for water shed **CO5**: Apply the Potential of remote sensing and GIS is solving problems in water resources through case studies.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1	1	1
CO 2	3	2	2	2	1
CO 3	3	3	3	1	1
CO 4	3	2	3	3	3
CO 5	1	1	3	3	3

<table>
<tr><td rowspan="1">Course Title</td><td colspan="12">WATER SUPPLY AND SANITATION SYSTEM</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Sem.</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>24CEU35VA5</td><td>-</td><td>-</td><td>2</td><td>2</td><td>-</td><td>-</td><td>50</td><td>-</td><td>-</td><td>-</td><td>50</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1 Recall the sources of water and pipes and pump selection
K-2 understands the water quality standards for rural water supply systems.
K-3 Apply the suitable techniques for sewage disposal and reuse.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• Understand the importance rural water supply and principles of water supply with their components
• Understand the various onsite sanitation system.</td></tr>
</table>

Unit	**Content**	**No.of Hours**
I	Development of Water Sources - Sources of water – Surface and ground water sources – Development of deep bore wells; Estimation of yield – Alternate sources of water supply – Rain water harvesting	9
II	Water Treatment - Quality of water – Standards - conventional water treatment – Technologies for removal of specific contaminants; Iron, Arsenic, Fluoride, T.D.S; Disinfection – Alternate disinfection methods – solar disinfection.	9
III	Sanitation - Basic requirement of sanitation; Decentralized / onsite wastewater management; small bore / settled effluent sewer system.	9
IV	Sewage Treatment - Fundamentals of sewage treatment; Decentralized sewage treatment; Septic tank with depression pit – DEWATS, Intermittent sand filters – Anaerobic filters – Waste stabilization ponds.	9
V	Sewage Disposal and Reuse - Methods of disposal, Land disposal, sewage farms – Artificial recharge of ground water; Recycle and Reuse of sewage – Grey water Harvesting .	9
References	*6.* CPHEEO Manual on Water Supply and Treatment, Govt. of India (2003). *7.* CPHEEO Manual on Sewerage and Sewage Treatment, Govt. of India (1999). *8.* Metcalf & Eddy, Wastewater Engg. Treatment and Reuse, Tata McGraw Hill, New Delhi (2003). *9.* Todd, D.K. Ground Water Hydrology, John Wiley & Sons, New York (2000). 10. F.R. Spellman, Hand Book of Water and Wastewater Treatment Plant operations CRC Press, New York (2009).	
Course Out Comes	On completion of the course, students should be **CO1:** able to understand the sources of surface and sub-surface sources **CO2:** able to know about the specific contaminants removal	

	CO3: able to develop the on-site sanitation managements **CO4:** able to Design the anaerobic treatment systems **CO5:** able to provide the remedial solution for sewage disposal	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1	1	3
CO 2	1	1	1	1	2
CO 3	2	3	2	2	3
CO 4	2	1	1	1	3
CO 5	2	1	1	2	3

Course Title	COST EFFECTIVE CONSTRUCTION TECHNOLOGY										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
24CEU36VA6	-	-	2	2	-	-	50	-	-	-	50

Cognitive Level	KI: Define the basic concepts and definitions of mud technology, stone blocks and hollow concrete blocks. K2: Understand the concepts of precast roof , floor and brick panel roofing system K3: understand the manufacturing processing of ferrocement products.
Course Objectives	The course aim is • To understand the basic concepts of cost effective building materials and technologies.

Unit	Content	No.of Hours
I	Mud Technology- salient features of SMB – Selection of soil Determination of compressive stress – water retention test – consistency test – cohesion test – observation choice of stabilizer – block making – mould size – Economics of burnt bricks and SMB – suitability of soil for stabilizer – method of construction using mud blocks – water proof coating and plasters – improve earth structures – quality control.	
II	Pre cast stone clock – Introduction – method of production – types of moulds – selection of materials – casting blocks – physical properties – compressive strength of stone masonry blocks – water absorption – cost economic – hollow concrete blocks introduction – advantages of hollow concrete blocks – masonry precaution – economic method of production – mix ratio curing stocking transportation – compressive strength manufacturing machineries.	
III	Pre cast roof and floor system: Pre cast reinforced concrete L – pans for roof – interlocution – materials – Element for roof supporting beam method of casting curing erection pre cast RC plank flooring preparation method of pre cast RCC joist moulds cast and curing pre caution during casting and placing Economics funicular shell micro concrete tiles method of manufacturing support beam erection.	
IV	Pre cast Brick panel roofing system – manufacturing method of Brick panel – suitable joist curved brick panel method of laying roof fly ash bricks manufacturing methods	
V	Ferrocement – introduction advantages manufacturing process mud mould construction – casting procedure for roof channel curing stocking fabrication and specification of ferrocement doors – manufacturing method of Ferrocement products – innovation painting installation and maintenance manufacturing methods of small capacity Ferrocement water tanks economics.	

References	5. Reading materials capacity Building for project managers of Building Centre Vol. II (Hudson Manual) 6. CBRI Research publication. 7. Low cost housing in Developing countries G.C.Mathur 8. Low cost housing – A.G. Mathava Rao, SERC.	
Course Out Comes	After studying the course, the student will be able to: CO1: Understand the principles of mud technology and its quality control CO2: understand the properties and manufacturing process of stone blocks and hollow concrete blocks. CO3: Able to understand the precast roof and floor systems. CO4: understand the manufacturing methods of precast brick panel roofing systems CO5: able to understand the manufacturing methods of ferrocement products.	

Course outcome	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	1	1	1	2
CO 2	2	1	2	1	2
CO 3	2	2	1	2	2
CO 4	3	2	1	2	1
CO 5	2	1	1	2	1