B.TECH. CIVIL ENGINEERING SYLLABUS

CREDIT BASED CURRICULUM

CENTRE FOR RURAL TECHNOLOGY

THE GANDHIGRAM RURAL INSTITUTE
(DEEMED TO BE UNIVERSITY)
GANDHIGRAM

(2018 onwards)

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 Courses

ESC - Engineering Science Courses

MC - Mandatory 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, 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.

Distribution of Credits

S.No	Category	Credits As Per AICTE	Allotted Credits in GRI
1	Humanities and Social Sciences including Management courses	12	12
2	Basic Science courses	26	26
3	Engineering science courses including workshop, drawing, basics electrical/mechanical/computer etc..	29	32
4	Professional Core Courses	47	50
5	Professional Elective Courses relevant to chosen specialization/branch	23	23
6	Open Subjects – Electives from other technical and/or emerging subjects	11	11
7	Project work, seminar and internship in industry or appropriate work place/academic and research institutions in India/Abroad	12	12
8	Mandatory courses	-	-
	Total	**160**	**166**

Humanities and Social Sciences including Management courses											
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**HSMC**	**18ENGU01F1**	English	2	-	2	2+1	40+30	60+20	150
2.	**HSMC**	**18ENGU03F2**	Effective Technical Communication	3	-	-	3	40	60	100
3.	**HSMC**	**18BCEU0315**	Civil Engineering – Societal and Global Impacts	2	-	-	2	40	60	100
4.	**HSMC**	**18BCEU0524**	Professional practice, Law and Ethics	2	-	-	2	40	60	100
5.	**HSMC**	**18BCEU0203**	Introduction to Civil Engineering	2	-	-	2	40	60	100
			Total	**11**	**-**	**2**	**12**			

Basic Science courses										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**BSC**	**18BCEU01C1**	Physics	3	1	2	4+1	40+30	60+20	150
2.	**BSC**	**18MATU01C1**	Mathematics I	3	1	-	4	40	60	100
3.	**BSC**	**18CHEU01C1**	Chemistry	3	1	2	4+1	40+30	60+20	150
4.	**BSC**	**18MATU02C2**	Mathematics–II	3	1	-	4	40	60	100
5.	**BSC**	**18MATU03C3**	Engineering Mathematics – III	2	1	-	3	40	60	100
6.	**BSC**	**18BCEU0308**	Biology for Engineers	2	1	-	3	40	60	100
7.	**BSC**	**18BCEU0416**	Life Science	1	-	2	1+1	20+30	30+20	100
			Total	**17**	**6**	**6**	**26**			

Engineering science courses including workshop, drawing, basics electrical/mechanical/computer etc..										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**ESC**	**18BCEU0102**	Engineering Graphics & Design	1	-	4	3	60	40	100
2.	**ESC**	**18BCEU0204**	Basic Electrical Engineering	3	1	2	4+1	40+30	60+20	150
3.	**ESC**	**18BCEU0205**	Workshop Manufacturing Practices	1	-	4	1+2	60	40	100
4.	**ESC**	**18CSAU02B1**	Programming for Problem Solving	3	-	4	3+2	40+60	60+40	200
5.	**ESC**	**18BCEU0206**	Computer Aided Civil Engineering Drawing	1	-	2	2	60	40	100
6.	**ESC**	**18BCEU0204**	Basic Electronics	1	-	2	1+1	20+30	30+20	100
7.	**ESC**	**18BCEU0308**	Engineering Mechanics	3	1	-	4	40	60	100
8.	**ESC**	**18BCEU0312**	Energy Science and Engineering	1	1	-	2	40	60	100
9.	**ESC**	**18BCEU0311**	Mechanical Engineering	2	1	-	3	60	40	100
10.	**ESC**	**18BCEU0423**	Software Skill Development – I (Drafting Software)	-	-	-	1	50		50
11.	**ESC**	**18BCEU0531**	Software Skill Development – II (RS and GIS Software)	-	-	-	1	50		50
12.	**ESC**	**18BCEU0636**	Software Skill Development – III (Structural Analysis & Design Software and Management software)	-	-	-	1	50		50
			Total	**16**	**4**	**18**	**32**			

Professional Core Courses										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**PCC**	**18BCEU0313**	Engineering Geology	1	-	2	1+1	20+30	30+20	100
2.	**PCC**	**18BCEU0530**	Instrumentation and sensor Technologies for Civil Engineering applications	1	1	2	2+1	40+30	60+20	150
3.	**PCC**	**18BCEU0314**	Disaster Preparedness and Planning	1	1	-	2	40	60	100
4.	**PCC**	**18BCEU0417**	Introduction to Solid Mechanics	2	-	3	2+1.5	40+30	60+20	150
5.	**PCC**	**18BCEU0418**	Introduction to Fluid Mechanics	2	-	3	2+1.5	40+30	60+20	150
6.	**PCC**	**18BCEU0419**	Surveying and Geomatics	1	1	3	2+1.5	40+30	60+20	150
7.	**PCC**	**18BCEU0420**	Material Testing and Evaluation	1	1	3	2+1.5	40+30	60+20	150
8.	PCC	**18BCEU0421**	Survey Camp	-	-	-	1	50	-	50
9.	**PCC**	**18BCEU0525**	Geotechnical Engineering	2	-	3	2+1.5	40+30	60+20	150
10.	**PCC**	**18BCEU0526**	Structural Engineering	2	1	-	3	40	60	100
11.	**PCC**	**18BCEU0527**	Hydraulic Engineering	2	-	3	2+1.5	40+30	60+20	150
12.	**PCC**	**18BCEU0528**	Environmental Engineering	2	-	3	2+1.5	40+30	60+20	150
13.	**PCC**	**18BCEU0529**	Transportation Engineering	2	-	3	2+1.5	40+30	60+20	150
14.	**PCC**	**18BCEU0632**	Hydrology and Water Resource Engineering	2	1	-	3	40	60	100
15.	**PCC**	**18BCEU0633**	Engineering Economics, Estimation & Costing	3	1	2	4+1	40+30	60+20	150
16.	**PCC**	**18BCEU0634**	Construction Engineering and Management	2	1	-	3	40	60	100
			Total	**26**	**8**	**30**	**50**			

Professional Elective Courses relevant to chosen specialization/branch										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**PEC-CE**	**18BCEU05EX**	Professional Elective –I	3	-	-	3	40	60	100
2.	**PEC-CE**	**18BCEU06EX**	Professional Elective-II	3	-	-	3	40	60	100
3.	**PEC-CE**	**18BCEU06EX**	Professional Elective –III	3	-	-	3	40	60	100
4.	**PEC-CE**	**18BCEU07EX**	Professional Elective-IV	3	-	-	3	40	60	100
5.	**PEC-CE**	**18bCEU07EX**	Professional Elective –V	3	-	-	3	40	60	100
6.	**PEC-CE**	**18BCEU07EX**	Professional Elective-VI	3	-	-	3	40	60	100
7.	**PEC-CE**	**18BCEU08EX**	Professional Elective-VII	3	-	-	3	40	60	100
8.	**PEC-CE**	**18BCEU08EX**	Professional Elective-VIII	2	-	-	2	40	60	100
			Total	**23**			**23**			

Open Subjects – Electives from other technical and/or emerging subjects										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**OEC**	-	Open Elective- I	3	-	-	3	40	60	100
2.	**OEC**	**-**	Open Elective- II	3	-	-	3	40	60	100
3.	**OEC**	**18BCEU06OX**	Open Elective- III	3	-	-	3	40	60	100
4.	**OEC**	**18BCEU08OX**	Open Elective- IV	2	-	-	2	40	60	100
			Total	**11**			**11**			

Project work, seminar and internship in industry or appropriate work place/academic and research institutions in India/Abroad										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**PROJ**	**18BCEU0422**	Internship-I*	-	-	-	1	50	-	50
2.	**PROJ**	**18BCEU0635**	Internship-II*	-	-	-	1	50	-	50
3.	**PROJ**	**18BCEU0737**	Project-I	-	-	8	4	60	40	100
4.	**PROJ**	**18BCEU0838**	Project-II	-	-	12	6	125	75	200
			Total			**20**	**12**			

Mandatory courses										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**MC**	**18GTPU0001**	Gandhi's Life, Thought and work	2	-	-	-	50	0	50
2.	**MC**	**18YOGU0001**	Yoga Education	-	-	1	-	50	0	50
3.	**MC**	**18BCEU0207**	Summer Internship-I*	-	-	-	-	100	0	100
4.	**MC**	**18NSSU0001/ 18SPOU0001/ 18FATU0001**	NSS/Sports & Games/ Fine Arts	-	-	1	-	50	0	50
5.	**MC**		Village Placement Program (VPP)	-	-	-	-	50	-	50
6.	MC		Indian constitution/Traditional knowledge	2	-	-	-	50	-	50
			Total	**4**		**2**	**-**			

PROFESSIONAL ELECTIVES (18BCEU0XEX)

I. Construction Engineering and Management		
1.	**18BCEU0XE1**	Building Construction Practice
2.	**18BCEU0XE2**	Sustainable Construction Methods
3.	**18BCEU0XE3**	Infrastructure Planning and Management
4.	**18BCEU0XE4**	Repairs and Rehabilitation of Structures
5.	**18BCEU0XE5**	Materials Management
6.	**18BCEU0XE6**	Construction Technology
II. Transportation Engineering		
1.	**18BCEU0XE7**	Intelligent Transport System
2.	**18BCEU0XE8**	Airport Planning and Design
3.	18BCEU0XE9	Traffic Engineering Design and Management
4.	**18BCEU0XE10**	Railway Engineering
5.	**18BCEU0XE11**	Urban and Regional Planning
6.	**18BCEU0XE12**	Port and Harbour Engineering
7.	**18BCEU0XE13**	Pavement Materials
8.	**18BCEU0XE14**	Transportation Systems Planning
III. Environmental Engineering		
1.	**18BCEU0XE15**	Ecological Engineering
2.	**18BCEU0XE16**	Transport of water and Waste Water
3.	**18BCEU0XE17**	Environmental Laws and Policies
4.	**18BCEU0XE18**	Physico-Chemical Processes for Water and Waste Water Treatment
5.	**18BCEU0XE19**	Rural Water Supply and Onsite Sanitation Systems
6.	**18BCEU0XE20**	Air and Noise Pollution and Control
7.	**18BCEU0XE21**	Solid and Hazardous Waste Management
8.	**18BCEU0XE22**	Water and Air Quality Modelling
9.	**18BCEU0XE23**	Environmental Impact Assessment and Life Cycle Analyses
IV. Hydraulics		
1.	**18BCEU0XE24**	Irrigation Engineering
2.	**18BCEU0XE25**	Pipeline Engineering
3.	**18BCEU0XE26**	Open Channel flow
4.	**18BCEU0XE27**	River Engineering
5.	**18BCEU0XE28**	Urban water Resource Management
6.	**18BCEU0XE29**	Ground water hydrology
V. Hydrology & Water Resources Engineering		
1.	**18BCEU0XE30**	Water Resources systems Analysis
2.	**18BCEU0XE31**	Surface water Hydrology
3.	**18BCEU0XE32**	Remote sensing and GIS in water Resources
4.	**18BCEU0XE33**	Watershed conservation & Management
5.	**18BCEU0XE34**	Environmental Hydraulics
VI. Structural Engineering		
1.	**18BCEU0XE35**	Finite Element analysis
2.	**18BCEU0XE36**	Fire Resistance of structures
3.	**18BCEU0XE37**	Safety of Structures
4.	**18BCEU0XE38**	Analysis and Design of Sub-Structures
5.	**18BCEU0XE39**	Industrial Structures
6.	**18BCEU0XE40**	Design of Storage Structures
7.	**18BCEU0XE41**	Structural Analysis by Matrix Method
8.	**18BCEU0XE42**	Structural Analysis-I
9.	**18BCEU0XE43**	Structural Analysis-II
10.	**18BCEU0XE44**	Bridge Engineering
11.	**18BCEU0XE45**	Design of Concrete structures – I
12.	**18BCEU0XE46**	Design of Concrete structures – II

13.	**18BCEU0XE47**	Prestressed concrete
14.	**18BCEU0XE48**	Construction Engineering Materials
15.	**18BCEU0XE49**	Masonry Structures
16.	**18BCEU0XE50**	Basics of dynamics and aseismic design
17.	**18BCEU0XE51**	Reliability of Structures
18.	**18BCEU0XE52**	Smart Materials and smart structures
VII. Geotechnical Engineering		
1.	**18BCEU0XE53**	Ground Improvement Techniques
2.	**18BCEU0XE54**	Earthquake Resistant Design of foundation
3.	**18BCEU0XE55**	Foundation Engineering
4.	**18BCEU0XE56**	Geo-environmental engineering
5.	**18BCEU0XE57**	Rock Mechanics and Applications
6.	**18BCEU0XE58**	Soil Structures Interaction

OPEN ELECTIVE COURSES

Open Elective III & IV

S.No	**Course Code**	**OEC**
1.	**18BCEU0XO1**	Architecture
2.	**18BCEU0XO2**	Building Services
3.	**18BCEU0XO3**	Contract law and Regulations
4.	**18BCEU0XO4**	Town and Country planning
5.	**18BCEU0XO5**	Cost Effective Construction Technology

SEMESTER I (I Year) B.Tech Civil Engineering										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**HSMC**	**18ENGU01F1**	English	2	-	2	2+1	40+30	60+20	150
2.	**BSC**	**18BCEU01C1**	Physics	3	1	2	4+1	40+30	60+20	150
3.	**BSC**	**18MATU01C1**	Mathematics I	3	1	-	4	40	60	100
4.	**BSC**	**18CHEU01C1**	Chemistry	3	1	2	4+1	40+30	60+20	150
5.	**MC**	**18GTPU0001**	Gandhi's Life, Thought and work	2	-	-	-	50	-	50
6.	**ESC**	**18BCEU0102**	Engineering Graphics & Design	1	-	4	3	60	40	100
7.	**MC**	**18YOGU0001**	Yoga Education	-	-	1	-	50	-	50
Total				**14**	**3**	**11**	**20**			

SEMESTER II(I Year) B.Tech Civil Engineering										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**BSC**	**18MATU02C2**	Mathematics–II	3	1	-	4	40	60	100
2.	**ESC**	**18BCEU0203**	Introduction to Civil Engineering	2	-	-	2	40	60	100
3.	**ESC**	**18BCEU0204**	Basic Electrical Engineering	3	1	2	4+1	40+30	60+20	150
4.	**ESC**	**18BCEU0205**	Workshop Manufacturing Practices	1	-	4	1+2	60	40	100
5.	**ESC**	**18CSAU02B1**	Programming for Problem Solving	3	-	4	3+2	40+60	60+40	200
6.	**ESC**	**18BCEU0206**	Computer Aided Civil Engineering Drawing	1	-	2	2	60	40	100
7.	**MC**	**18BCEU0207**	Summer Internship-I*	-	-	-	-	100	-	100
8.	**MC**	**18NSSU0001/ 18SPOU0001/ 18FATU0001**	NSS/Sports & Games/ Fine Arts	-	-	1	-	50	-	50
Total				**13**	**2**	**13**	**21**			

SEMESTER III (II Year) B.Tech Civil Engineering										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**Credit**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**BSC**	**18MATU03C3**	Engineering Mathematics – III (Transform & Discrete Mathematics)	2	1	-	3	40	60	100
2.	**BSC**	**18BCEU0308**	Biology for Engineers	2	1	-	3	40	60	100
3.	**ESC**	**18BCEU0309**	Basic Electronics	1	-	2	1+1	20+30	30+20	100
4.	**ESC**	**18BCEU0310**	Engineering Mechanics	3	1	-	4	40	60	100
5.	**ESC**	18BCEU0311	Mechanical Engineering	2	1	-	3	40	60	100
6.	**ESC**	18BCEU0312	Energy Science and Engineering	1	1	-	2	40	60	100
7.	**PCC**	**18BCEU0313**	Engineering Geology	1	-	2	1+1	20+30	30+20	100
8.	PCC	18BCEU0314	Disaster Preparedness and Planning	1	1	-	2	40	60	100
9.	**HSMC**	**18ENGU03F2**	Effective Technical Communication	3	-	-	3	40	60	100
10.	**HSMC**	**18BCEU0315**	Civil Engineering – Societal and Global Impacts	2	-	-	2	40	60	100
11.	**MC**	**18EXNU03VI**	Village Placement Program (VPP)	-	-	-	-	50	-	50
Total				**18**	**6**	**4**	**26**			

SEMESTER IV (II Year) B.Tech Civil Engineering										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**BSC**	18BCEU0416	Life Science	1	-	2	1+1	20+30	30+20	100
2.	**PCC**	**18BCEU0417**	Introduction to Solid Mechanics	2	-	3	2+1.5	40+30	60+20	150
3.	**PCC**	**18BCEU0418**	Introduction to Fluid Mechanics	2	-	3	2+1.5	40+30	60+20	150
4.	**PCC**	**18BCEU0419**	Surveying and Geomatics	1	1	3	2+1.5	40+30	60+20	150
5.	**PCC**	**18BCEU0420**	Material Testing and Evaluation	1	1	3	2+1.5	40+30	60+20	150
6.	**PCC**	**18BCEU0421**	Survey Camp	-	-	-	1	50	-	50
7.	**OEC**	**-**	Open Elective- I	3	-	-	3	40	60	100
8.	**PROJ**	**18BCEU0422**	Internship – I	-	-	-	1	100	-	100
9.	**ESC**	**18BCEU0423**	Software Skill Development-I	-	-	-	1	50	-	50
Total				**10**	**2**	**14**	**22**			

SEMESTER V (III Year)
B.Tech Civil Engineering

S.NO	Category	Course Code	Course Title	Hours per Week			C	Marks		Total
				L	T	P		CFA	ESE	
1.	**HSMC**	**18BCEU0524**	Professional practice, Law and Ethics	2	-	-	2	40	60	100
2.	**PCC**	**18BCEU0525**	Geotechnical Engineering	2	-	3	2+1.5	40+30	60+20	150
3.	**PCC**	**18BCEU0526**	Structural Engineering	2	1	-	3	40	60	100
4.	**PCC**	**18BCEU0527**	Hydraulic Engineering	2	-	3	2+1.5	40+30	60+20	150
5.	**PCC**	**18BCEU0528**	Environmental Engineering	2	-	3	2+1.5	40+30	60+20	150
6.	**PCC**	**18BCEU0529**	Transportation Engineering	2	1		3	40	60	100
7.	**PCC**	**18BCEU0530**	Instrumentation and sensor Technologies for Civil Engineering applications	1	1	2	2+1	40+30	60+20	150
8.	**ESC**	**18BCEU0530**	Software Skill Development-II	-	-	-	1	50	-	50
9.	**MC**	**18PSDU0501**	Constitution of India	2	-	-	-	50	-	50
			Total	**15**	**3**	**11**	**22.5**			

SEMESTER VI (III Year)
B.Tech Civil Engineering

S.NO	Category	Course Code	Course Title	Hours per Week			C	Marks		Total
				L	T	P		CFA	ESE	
1	**PCC**	**18BCEU0632**	Hydrology and Water Resource Engineering	2	1	-	3	40	60	100
2	**PCC**	**18BCEU0633**	Engineering Economics, Estimation & Costing	3	1	3	4+1.5	40+30	60+20	150
3	**PCC**	**18BCEU0634**	Construction Engineering and Management	2	1	-	3	40	60	100
4	**OEC**	-	Open Elective- II	3	-	-	3	40	60	100
5	**OEC**	**18BCEU06OX**	Open Elective- III	3	-	-	3	40	60	100
6	**PEC-CE**	**18BCEU06EX**	Professional Elective –I	3	-	-	3	40	60	100
7	**PEC-CE**	**18BCEU06EX**	Professional Elective-II	3	-	-	3	40	60	100
8	**PROJ**	**18BCEU0635**	Internship – II	-	-	-	1	100	-	100
9	**ESC**	**18BCEU0636**	Software Skill Development-III	-	-	-	1	50	-	50
			Total	**19**	**3**	**3**	**25.5**			

SEMESTER VII (IV Year) B.Tech Civil Engineering										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1	**PEC-CE**	**18BCEU07EX**	Professional Elective- III	3	-	-	3	40	60	100
2	**PEC-CE**	**18BCEU07EX**	Professional Elective- IV	3	-	-	3	40	60	100
3	**PEC-CE**	**18BCEU07EX**	Professional Elective- V	3	-	-	3	40	60	100
4	**PEC-CE**	**18BCEU07EX**	Professional Elective –VI	3	-	-	3	40	60	100
5	**PROJ**	**18BCEU0737**	Project-I	-	-	8	4	60	40	100
			Total	**12**		**8**	**16**			

SEMESTER VIII (IV Year) B.Tech Civil Engineering										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1	**PEC-CE**	**18BCEU08EX**	Professional Elective – VII	3	-	-	3	40	60	100
2	**PEC-CE**	**18BCEU08EX**	Professional Elective- VIII	2	-	-	2	40	60	100
3	**OEC**	**18BCEU08EX**	Open Elective- IV	2	-	-	2	40	60	100
4	**PROJ**	**18BCEU0838**	Project-II	-	-	12	6	125	75	200
			Total	**7**	**-**	**12**	**13**			

I SEMESTER

Course Code & Title	18ENGU01F1 English		
Class	I Year	**Semester**	I
Cognitive Level	KI: Knowing the fundamental aspects of technical English K2: Understanding the linguistic and communicative competence K3: Applying the language skills by giving sufficient practice in the use of the skills in real life contexts		
Course objectives	The Course aims • To enable the students to acquire basic proficiency in English and • To help them to improve their skills in reading, listening, comprehension, writing and speaking.		

Unit	Content	No.of Hours
I	**Vocabulary Building** 1.1 The concept of Word Formation 1.2 Root words from foreign languages and their use in English 1.3 Acquaintance with prefixes and suffixes from foreign Languages in English to form derivatives. 1.4 Synonyms, antonyms, and standard abbreviations.	
II	**Basic Writing Skills** 2.1 Sentence Structures 2.2 Use of phrases and clauses in sentences 2.3 Importance of proper punctuation 2.4 Creating coherence	
III	**Identifying Common Errors in Writing** 3.1 Subject-verb agreement 3.2 Noun-pronoun agreement 3.3 Misplaced modifiers 3.4 Articles and Prepositions	

IV	**Nature and Style of sensible Writing** 4.1 Describing 4.2 Defining and Classifying 4.3 Providing examples or evidence 4.4 Writing introduction and conclusion	
V	**Writing Practices** 5.1 Comprehension 5.2 Précis Writing 5.3 Essay Writing **Oral Communication** ***(This unit involves interactive 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	**Text Books & Reference Books:** 1. Practical English Usage. Michael Swan. OUP. 1995. 2. Remedial English Grammar. F.T. Wood. Macmillan.2007 3. On Writing Well. William Zinsser. Harper Resource Book. 2001 4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006. 5. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011. 6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press	
Course Out Comes	On completion of the course, students should be able to do **CO- 1** Proficient in vocabulary building **CO- 2** Create strong sentence structure **CO- 3** Identifying the common errors in writing **CO- 4** Proficient in oral communication by pronunciation, listening comprehension, **CO- 5** The confident conversation by improving their speaking skills.	

Mapping of Cos with PSOs & POs:

CO/PO	PO									PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**
CO1	1	1	0	2	0	0	0	0	0	1	3	0	0	1
CO2	1	0	1	0	0	0	0	0	1	1	0	0	0	0
CO3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO4	0	1	0	0	0	0	0	0	1	0	0	1	0	0
CO5	0	0	0	0	0	0	0	0	1	0	2	0	0	0

Course Code & Title	**18BCEU01C1 Physics**		
Class	I Year	**Semester**	I
Cognitive Level	K-1: Understanding the importance dynamics of rigid bodies . K-2: Express the knowledge of forces K-3: Understanding the importance of engineering mechanics and friction.		
Course objectives	The Course aims • To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering. • To study about the stresses and strains and their action on beams and trusses.		

Unit	Content	No.of Hours
I	**Vector mechanics of particles** 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 coordinates; Potential energy function; F = - Grad V; Conservative and non-conservative forces; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Application: Satellite man oeuvres; No inertial frames of reference; Rotating coordinate system: Five-term acceleration formula — Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum; Harmonic oscillator; Damped harmonic motion; Forced oscillations and resonance;	**10**
II	**Planar rigid body mechanics** Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body	**5**

	motion; Examples; 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.	
III	**Statics:** Free body diagrams with examples on modeling of typical supports and joints; Condition for equilibrium in three- and two-dimensions; Friction: limiting and non-limiting cases; Force displacement relationship; Geometric compatibility for small deformations; Illustrations through simple problems on axially loaded members like trusses.	**5**
IV	**Mechanics of solids :** Concept of stress at a point; Planet stress: transformation of stresses at a point, principal stresses and Mohr's circle; Displacement field; Concept of strain at a point; Plane strain: transformation of strain at a point, principal strains and Mohr's circle; Strain RoseOe; Discussion of experimental results on one-dimensional material behaviour; Concepts of elasticity, plasticity, strain hardening, failure (fracture / yielding); Idealization of one dimensional stress-strain curve; Generalized Hooke's law with and without thermal strains for isotropic materials; Complete equations of elasticity; Force analysis — axial force, shearforce, bending moment and twisting moment diagrams of slender members (without usingsingularity functions);	**10**
V	**Torsion** Torsion of circular shafts and thin-walled tubes (plastic analysis and rectangular shafts not to be discussed); Moment curvature relationship for pure bending of beams with symmetric cross-section; Bending stress; Shear stress; Cases of combined stresses; Concept of strain energy; Yield criteria; Deflection due to bending; Integration of the moment-curvature relationship for simple boundary conditions; Method of superposition(without using singularity functions); Strain energy and complementary	**10** **30**

	strain energy for simple structural elements (i.e. those under axial load, shear force, bending moment and torsion); Castigliano's theorems for deflection analysis and indeterminate problems. **Physics: Mechanics of Solids** **List of Exercise** 1. Young's modulus of the materials of the beam by cantilever depression. 2. Thickness of any thin plates using single optical lever. 3. Determinates of acceleration due to gravity & radius of gyration using compound pendulum. 4. Spring constant 5. Test involving axial compression to obtain the stress – strain curve 6. Test involving axial tension to obtain the stress – strain curve and the strength 7. Test involving torsion to obtain the torque vs. angle of twist and hence the stiffness 8. Test involving flexure to obtain the load deflection curve and hence the stiffness 9. Tests on springs 10. Hardness tests (Brinell, Rokwell and Vicker) 11. Shear test (Single and Double) 12. Impact test (Charpy and Izod) **13.** Verification of Maxwell's law of reciprocal theorem	

References	**Text Books & Reference Books:** 1. Engineering Mechanics, 2nd 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 Gri_ths 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 9. An Introduction to the Mechanics of Solids, 2nd ed. with SI Units — SH Crandall, NCDahl & TJ Lardner 10. Engineering Mechanics: Statics, 7th ed. — JL Meriam Engineering Mechanics of Solids — EP Popov.	
Course Out Comes	On successful completion of this course, the student will be able to CO 1 illustrate the vectorial and scalar representation of forces and moments CO 2 analyze the rigid body in equilibrium CO 3 evaluate the properties of surfaces and solids CO 4 calculate dynamic forces exerted in rigid body CO 5 determine the friction and the effects by the laws of friction CO 6 Understand the concepts of stress and strain, principal stresses and principal planes. CO 7 Determine Shear force and bending moment in beams and understand concept of theory of simple bending. CO 8 Calculate the deflection of beams by different methods and selection of method for determining slope or deflection. CO 9 Apply basic equation of torsion in design of circular shafts and helical springs, .	

Mapping of Cos with PSOs & POs

CO/PO	PO									PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**
CO1	1	1	0	2	0	0	0	0	0	1	1	1	0	1
CO2	1	1	1	0	1	0	0	0	0	1	1	1	0	0
CO3	1	1	0	1	0	1	0	0	0	1	1	1	0	0
CO4	1	1	0	1	0	1	0	0	0	1	1	1	0	0
CO5	1	0	0	1	0	0	0	0	0	1	0	0	0	0
CO6	1	1	0	1	0	1	0	0	0	2	0	1	0	0
CO7	3	1	0	0	1	0	0	0	1	2	0	1	0	0
CO8	3	1	0	0	1	0	0	0	1	2	0	1	0	0
CO9	1	1	0	0	1	0	0	0	1	1	0	1	0	1
CO10	1	1	0	0	1	0	0	0	1	1	0	1	0	1

Course Code & Title	**18MATU01C1 Mathematics-I (Calculus, Multivariable calculus & Linear algebra**		
Class	I Year	**Semester**	I
Cognitive Level	K1- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals. K2- Apply differentiation to solve maxima and minima problems. K3- Evaluate integrals by using the Fundamental Theorem of Calculus.		
Course objectives	The Course aims • To apply advanced matrix knowledge to Engineering problems. • To equip themselves familiar with the functions of several variables. • To familiarize with the applications of differential equations. • To improve their ability in solving geometrical applications of differential calculus problems • To expose to the concept of three dimensional analytical geometry.		

Unit	Content	No.of Hours
I	**Calculus** Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle’s Theorem, Mean value theorems, Taylor’s and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.	**12**
II	**Sequences and series** Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions; Fourier series: Half rangesine and cosine series, Parseval’s theorem.	**10**
III	**Multivariable Calculus (Differentiation)** Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima	**20**

	and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence; Multivariable Calculus (Integration); Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration).	
IV	**Matrices (in case vector spaces is not to be taught)** Algebra of matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.	**22**
V	**Vector spaces** Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank nullity theorem, composition of linear maps, Matrix associated with a linear map.	**10**
References	**Text Books & Reference Books:** 1. T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008. 2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010. 3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010. 4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition,2000 5. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.	

	6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005. 7. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005. Erwin Kreyszig, Advanced Engineering Mathematics, 9^{th} Edition, John Wiley & Sons, 2006.	
Course Out Comes	After completing this course, students should demonstrate competency to: CO 1 Use both the limit definition and rules of differentiation to differentiate functions. CO 2 Apply differentiation to solve maxima and minima problems. CO 3 Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus. CO 4 Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables. CO 5 Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts. CO 6 Determine convergence/divergence of improper integrals and evaluate convergent improper integrals. CO 7 Apply various techniques in solving differential equations.	

Mapping of Cos with PSOs & POs:

CO/PO	PO									PSO				
	1	2	3	4	5	6	7	8	9	1	2	3	4	5
CO1	1	1	0	2	0	0	0	0	0	1	3	0	0	1
CO2	1	1	0	1	0	0	0	0	0	1	2	0	0	1
CO3	1	1	0	1	0	0	0	0	0	1	1	0	0	1
CO4	1	1	0	1	0	0	0	0	0	1	1	0	0	1
CO5	1	1	0	1	0	0	0	0	0	1	1	0	0	1
CO6	1	1	0	1	0	0	0	0	0	1	1	0	0	1
CO7	1	1	0	2	0	0	0	0	0	1	3	0	0	1

Course Code & Title	18CHEU01C1 Chemistry		
Class	I Year	**Semester**	I
Cognitive Level	K-1: Analyse 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		
Course objectives	The Course aims • To emphasize the importance of water and its treatment methods for industrial applications, • To give an overview of various types of fuels including their refining methods, • To stress the importance of corrosion of metals and methods needed to protect the metallic materials, • To make the students understand the need of high polymers and other engineering materials.		

Unit	Content	No.of Hours
I	**Atomic and molecular structure** Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.	**12**
II	**Spectroscopic techniques and applications** Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering. **Intermolecular forces and potential energy surfaces** Ionic, dipolar and van Der Waals interactions. Equations of	**12**

	state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.	
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. Use of free energy considerations in metallurgy through Ellingham diagrams.	**6**
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, hard soft acids and bases, molecular geometries	**4**
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 transitional 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. **Choice of 1-10 experiments from the following:** 1. Determination of surface tension and viscosity 2. Thin layer chromatography 3. Ion exchange column for removal of hardness of water 4. Determination of chloride content of water 5. Colligative properties using freezing point depression 6. Determination of the rate constant of a reaction 7. Determination of cell constant and conductance of solutions 8. Potentiometry - determination of redox potentials and emfs 9. Synthesis of a polymer/drug	**38**

	10. Saponification/acid value of an oil 11. Chemical analysis of a salt 12. Lattice structures and packing of spheres 13. Models of potential energy surfaces 14. Chemical oscillations- Iodine clock reaction 15. Determination of the partition coefficient of a substance between two immiscible liquids 16. Adsorption of acetic acid by charcoal 17. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.	
References	**Text Books & Reference Books:** o University chemistry, by B. H. Mahan o Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane o Fundamentals of Molecular Spectroscopy, by C. N. Banwell o Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan o Physical Chemistry, by P. W. Atkins o 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	On completion of the course, students should be able to do CO-1 Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces. CO-2 Rationalise bulk properties and processes using thermodynamic considerations. CO-3 Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques CO-4 Rationalise periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity. CO-5 List major chemical reactions that are used in the synthesis of molecules	

Mapping of Cos with PSOs & POs:

CO/PO	PO									PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**
CO1	1	1	0	2	0	1	0	0	0	1	3	0	0	1
CO2	1	1	1	0	0	1	0	0	0	1	0	1	0	1
CO3	1	0	0	1	0	1	0	0	0	1	0	0	0	0
CO4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO5	0	0	0	1	0	2	0	0	0	1	0	0	0	1

Course Code & Title	**18GTPU0001Gandhi's Life, Thought and work**		
Class	I Year	**Semester**	I
CognitiveLevel	K-1: To understand the Gandhian Vision of Society. K-2: To Gain knowledge about Life of Gandhi. K-3: To impart basic knowledge of communication engineering		
Course objectives	The Course aims • To enable students to understand and appreciate the principles and practices of Gandhi and their relevance in the contemporary times. • To develop character and attitude to follow Gandhian values and responsibilities in their personal and social life.		

Unit	Content	No.of Hours
I	Life of Gandhi in brief:Early life in India – London Phase – South African Adventure- Struggle for total freedom in India – Martyrdom	**6**
II	Concepts of Gandhi's Philosophy, Truth and Nonviolence, Ends and Means, Right and Duties, Simply Living and High Thinking	**6**
III	Gandhi's concepts and their applications: Sarvodaya, Satyagraha, SanthiSena Constructive Work	**6**
IV	Gandhian Vision of Society: Self and society-Communal harmony, removal of untouchability and Equality of sexes – Policies: Decentralization of power, GramSwaraj (Panchayatui Raj) and good governance-Economics of Swadeshi, Trusteeship, Bread Labour and Self-employment.	**6**
V	Gandhian Dimension of Education: Basic Education, Adult Education, Pluralism- Multilingualism, Religions and interfaith relations-Health; Diet, Nature Cure, Education on Health, Sanitation and Hygiene.	**6**
References	**Text Books &Reference Books:** 1. M.K. Gandhi: (1983), An Autography of the Story of My Experiments with Truth,Navajivan Publishing House, Ahmedabad. 2. M.K. Gandhi: (1951), Satyagraha in South Africa: Navajivan Publishing House, Ahamadabad. 3. M.K. Gandhi: (1983), ConstrutiveProgramme" Its Meaning and Place. Navajivan Publishing House, Ahamadabad. 4. M.K. Gandhi: (1948) Key to Health, Navajivan Publishing	

	House, Ahamadabad. 5. M.K. Gandhi: (1949), Diet and Diet Reforms, Navajivan Publishing House, Ahamadabad. 6. M.K. Gandhi: Basic Education, Navajivan Publishing House, Ahamadabad. 7. M.K. Gandhi: (2004), Village Industries, Navajivan Publishing House, Ahamadabad. 8. M.K. Gandhi: (1962), Hindi Swaraj, Navajivan Publishing House, Ahamadabad. 9. M.K. Gandhi: (2004), Trusteeship Dreams, Navajivan Publishing House, Ahamadabad. 10. M.K. Gandhi: (2001), India of my Dreams, Navajivan Publishing House, Ahamadabad. 11. M.K. Gandhi: Self Restraint Vs. Self Indulgence, Navajivan Publishing House, Ahamadabad. 12. Arunachalam:Gandhi: (1985), The Peace Maker,GandhiSamarakNidhi, Madurai R.R. Prabhu& UR Rao.The Mind of Mahatma Gandhi, Navajivan Publishing House.	
Course Out Comes	At the end of this course to make the students: **CO- 1** To understand the life of Gandhiji in-depth. **CO- 2** To get introduced to the relevant Gandhian philosophies. **CO- 3** To apply the Gandhian concepts in the relevant context. **CO- 4** To envision the Gandhian socio-economic, political and cultural ideas. **CO- 5** To get educated on Gandhian lines in a multi-dimensional way.	

Mapping of Cos with PSOs &POs:

CO/PO	PO									PSO				
	1	2	3	4	5	6	7	8	9	1	2	3	4	5
CO1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO3	0	0	0	0	0	0	1	0	0	0	1	0	0	0
CO4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Course Code & Title	18BCEU0102Engineering Graphics & Design		
Class	I Year	**Semester**	I
CognitiveLevel	K-1: Drawing orthographic projections of lines and planes and solids. K-2: Drawing development of the surfaces of objects. K-3: Drawing isometric and perspective views of simple solids.		
Course objectives	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		

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,	**10**

	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;	
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. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar 2. Publishing House 3. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, 4. 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:

CO/PO	PO									PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**
CO1	3	1	2	1	3	1	1	2	3	2	1	3	0	1
CO2	3	2	1	2	3	2	1	2	3	3	1	3	1	1
CO3	3	3	2	1	2	1	1	2	2	3	0	3	1	1
CO4	3	2	2	2	3	2	2	1	1	3	1	2	2	1
CO5	2	2	1	2	2	1	1	2	2	2	1	2	2	1
CO6	2	2	1	1	1	1	1	0	2	2	1	2	1	1
CO7	2	1	1	1	2	1	1	2	2	2	1	3	2	2

Course Code & Title	**18YOGU0001Yoga Education**		
Class	I Year	**Semester**	I
CognitiveLevel	K-1: To understand the basics of yoga. K-2: To Gain knowledge about the fundamentals of Asanas Practice. K-3: To impart basic knowledge of Pranayama Practice.		
Course objectives	The Course aims • To gain knowledge about the Yogic Practices		

Unit	Content	No.of Hours
I	**History of Yoga** - Definition of the term Yoga - Comprehensive Nature and Scope of Yoga-Aims and Objectives of Yoga - Yoga as an ideal system of physical culture.	**3**
II	**Schools of Yoga:**Patanjaliyoga – Astangayoga – Tantrayoga – Mantrayoga – Hathayoga – Layayoga - Rajayoga – Jnanayoga – Bhaktiyoga – Karmayoga - Difference between practice of Asanas and Physical Exercise.	**3**
III	**Asanas Practice:** Meditative Asanas: Sukhasana – ArdhaPadmasana – Padmasana –Vajrasana – Standing Asanas: Tadasana –Trikonasana- ParivrttaTrikonasana – Vrikshasana – Sitting Asanas: Baddhakonasana – Janusirasana – Paschimottanasana – Ustrasana – Vakrasana - Gomukhasana - Suryanamaskar.	**3**
IV	**Asanas Practice:** Prone Asanas: Makarasana – Bhujangasana – Shalabhasana – Dhanurasana - Supine Asanas: Pavanamuktasana – Sethubandasana – Navasana –Savasana.	**3**
V	**Pranayama Practice:** Sectional Breathing - Nadisuddhi – Bhramari – Bhastrika - Kapalabhati – Introduction to Bandhas – Mudras – Dharana (Trataka) – Dhyana.	**3**

<table>
<tr><td>References</td><td>Text Books &Reference Books:
1. H R.Nagarathnam&Dr.H R Nagendra (2015) Promotion of positive health swami vivekanandha yoga prakashana, Banglore.
2. Light on Yoga, B.K.S IyengarHarpine Collins Publication, New Delhi, 2000.
3. Sound Health Through Yoga, K.Chandrasekaran, PremKalyan Publications, Sedapatti, 1999.
4. H R.Nagarathnam&Dr.H R Nagendra (2015) Promotion of positive health swami vivekanandha yoga prakashana, Banglore.
5. Swami SatyanandaSaraswati, (2008): Asana Pranayama Mudra, Bandha (IV Revised Edition): Bihar School of Yoga, Munger, India.
6. H R.Nagarathnam&Dr.H R Nagendra (2015) Promotion of positive health swami vivekanandha yoga prakashana, Banglore.
7. Asanas, Swami Kuvalayananda, Kaivalayadhama, Lonavla, 1993.
8. Yoga for All, Maharishi Patanjali, Sahni Publications, 2003.
9. Yoga for Health, Institute of Naturopathy & Yogic Sciences, Bangalore, 2003.
10. Yoga for Health, K.ChandaraShekar, KhelSahitya Kendra, Theni, 2003.
11. Yoga for the Morden Man, M.P.Pandit, Sterling Publishers Private Limited, New Delhi, 1987.
12. Yoga for You, Indira Devi, Jaico Publishing House, Chennai, 2002.</td><td></td></tr>
<tr><td>Course Out Comes</td><td>Students should be able to
CO 1 Evaluate the importance of preparatory exercise.
CO 2 Demonstrate the suryanamaskar and various asanas.
CO 3 Utilize the meditation techniques.
CO 4 Compare mudras and bandhas
CO 5 Assess the difference between the asanas and physical exercises.</td><td></td></tr>
</table>

Mapping of Cos with PSOs & POs:

CO/PO	PO									PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**
CO1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0

II SEMESTER

Course Code & Title	**18MATU02C2 Mathematics–II**		
Class	I Year	**Semester**	II
Cognitive Level	K-1: Apply Laplace transform techniques to solve ordinary differential equations. K-2: Solving partial differential equations first order (linear / non linear) as well as higher order. K-3: Apply Z-Transform techniques to solve difference equation.		
Course objectives	The objective of this course is • To familiarize the prospective engineers with techniques in multivariable integration, Ordinary and partial differential equations and complex variables. • To equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.		

Unit	Content	No.of Hours
I	Exact linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.Ordinary differential equations of higher orders; Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Besselfunctions of the first kind and their properties.	14
II	Partial Differential Equations – First order, First order partial differential equations, solutions of first order linear and non-linear PDEs.	6
III	Partial Differential Equations – Higher order, Solution to homogenous and non-homogenous linear partial differential equations second and higher order by complimentary function and particular integral method. Flows, vibrations and diffusions, second-order linear equations and their classification, Initialand boundary conditions (with an informal description of well-posed problems), D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation.	5
IV	Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables. Boundary-value problems: Solution of boundary-value problems for various linear PDEs in various geometries	5
V	Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and	8

	their properties; Conformal mappings, Mobius transformations and their properties. 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), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour	
References	**Textbooks** 1. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9^{th} Edition, Wiley India, 2009. 2. S. L. Ross, Differential Equations, 3^{rd} Ed., Wiley India, 1984. 3. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995. 4. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993. 5. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1964. 6. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006. **References:** 1. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4^{th} Ed., Prentice Hall, 1998. 2. Manish Goyal and N.P. Bali, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.	
Course Out Comes	on the completion of this course, student should be able to CO- 1 Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications. CO- 2 Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations. CO- 3 The mathematical tools needed in evaluating multiple integrals and their usage. CO- 4 The effective mathematical tools for the solutions of differential equations that model physical processes. CO- 5 The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.	

Mapping of Cos with PSOs & POs:

CO/PO	PO									PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**
CO1	1	1	0	2	1	0	0	0	0	1	3	0	0	1
CO2	1	2	0	2	2	1	0	0	0	1	2	1	0	1
CO3	0	2	0	3	1	1	0	0	0	0	1	0	1	0
CO4	1	2	0	2	1	2	1	0	0	1	1	3	2	2
CO5	2	3	0	3	2	2	0	0	0	2	2	2	3	1

Course Code & Title	18BCEU0203 **Introduction to Civil Engineering**		
Class	I Year	**Semester**	II
Cognitive Level	K-1: Providing inspiration for doing creative and innovative work K-2: Highlighting possibilities for taking up entrepreneurial activities in this field K-3:Providing a foundation for the student to launch off upon an inspired academic pursuit into this branch of engineering		
Course objectives	This course is designed to address the following: • to give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Civil Engineering • To motivate the student to pursue a career in one of the many areas of Civil Engineering with deep interest and keenness. • To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.		

Unit	Content	No.of Hours
I	1. **Basic Understanding**: What is Civil Engineering/ Infrastructure? Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering, Possible scopes for a career 2. **History of Civil engineering**: Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of Eminent civil engineers 3. **Overview of National Planning for Construction and Infrastructure Development;** Position of construction industry vis-à-vis other industries, five year plan outlays for construction; current budgets for infrastructure works; 4. **Fundamentals of Architecture & Town Planning:** Aesthetics in Civil Engineering, Examples of great architecture, fundamentals of architectural design & town planning; Building Systems (HVAC, Acoustics, Lighting, etc.); LEED ratings; Development of Smart cities	4
II	1. **Fundamentals of Building Materials:** Stones, bricks, mortars, Plain, Reinforced & Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes 2. **Basics of Construction Management & Contracts Management:** Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment;	8

	Automation & Robotics in Construction; Modern Project Management Systems; Advent of Lean Construction; Importance of Contracts Management 3. **Environmental Engineering & Sustainability: Water treatment systems;** Effluent treatment systems; Solid waste management; Sustainability in Construction; 4. **Geotechnical Engineering:** Basics of soil mechanics, rock mechanics and geology; various types of foundations; basics of rock mechanics & tunnelling	
III	1. **Hydraulics, Hydrology &Water Resources Engineering:** Fundamentals of fluid flow, basics of water supply systems; Underground Structures; Underground Structures Multipurpose reservoir projects 2. **Ocean Engineering:** Basics of Wave and Current Systems; Sediment transport systems; Ports & Harbours and other marine structures 3. **Power Plant Structures:** Chimneys, Natural & Induced Draught Colling towers, coal handling systems, ash handling systems; nuclear containment structures; hydro power projects 4. **Structural Engineering:** Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies;	6
IV	1. **Surveying & Geomatics:** Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR; 2. **Traffic &Transportation Engineering:** Investments in transport infrastructure development in India for different modes of transport; Developments and challenges in integrated transport development in India: road, rail, port and harbour and airport sector; PPP in transport sector; Intelligent Transport Systems; Urban Public and Freight Transportation; Road Safety under heterogeneous traffic; Sustainable and resilient pavement materials, design, construction and management; Case studies and examples. 3. **Repairs & Rehabilitation of Structures:** Basics of corrosion phenomena and other structural distress mechanisms; some simple systems of rehabilitation of structures; Non-Destructive testing systems; Use of carbon fibre wrapping and carbon composites in repairs.	3
V	1. **Computational Methods, IT, IoT in Civil Engineering:** Typical software used in Civil Engineering- Finite Element Method, Computational Fluid Dynamics; Computational Geotechnical Methods; highway design (MX), Building Information Modelling; Highlighting typical available software systems (SAP, STAAD, ABAQUS, MATLAB, ETAB, NASTRAN, NISA, MIKE 21, MODFLOW, REVIT, TEKLA, AUTOCAD,…GEOSTUDIO, EDUSHAKE, MSP, PRIMAVERA, ArcGIS, VisSIM, …) 2. **Industrial lectures:** Case studies of large civil engineering projects by industry professionals, covering comprehensive planning to	7

	commissioning; 3. **Basics of Professionalism:** Professional Ethics, Entrepreneurial possibilities in Civil Engineering, Possibilities for creative & innovative working, Technical writing Skills enhancement; Facilities Management; Quality & HSE Systems in Construction	
References	**Text/Reference Books:** 1. Patil, B.S.(1974), Legal Aspects of Building and Engineering Contract 2. The National Building Code, BIS, (2017) 3. RERA Act, (2017) 4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset 5. Chandiramani, Neelima (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai 6. Avtarsingh (2002), Law of Contract, Eastern Book Co. 7. Dutt (1994), Indian Contract Act, Eastern Law House 8. Anson W.R.(1979), Law of Contract, Oxford University Press 9. Kwatra G.K.(2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration 10. Avtarsingh (2005), Law of Arbitration and Conciliation, Eastern Book Co. 11. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co. 12. P. S. Narayan (2000), Intellectual Property Rights, Gogia Law Agency 13. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House 14. Bare text (2005), Right to Information Act 15. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers 16. K.M. Desai(1946), The Industrial Employment (Standing Orders) Act 17. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House 18. Vee, Charles & Skitmore, Martin (2003) Professional Ethics in the Construction Industry, Engineering Construction and Architectural management, Vol.10, Iss. 2, pp 117-127, MCB UP Ltd 19. American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application 20. Ethics in Engineering- M.W.Martin& R.Schinzinger, McGraw-Hill 21. Engineering Ethics, National Institute for Engineering Ethics, USA 22. www.ieindia.org 23. Engineering ethics: concepts and cases – C. E. Harris, M.S. Pritchard, M.J.Rabins 24. Resisting Bureaucratic Corruption: Alacrity Housing Chennai (Teaching Case Study) -S. Ramakrishna Velamuri –CEIBS 25. CONSTRUCTION CONTRACTS,	

	http://www.jnormanstark.com/contract.htm 26. Internet and Business Handbook, Chap 4, CONTRACTS LAW, http://www.laderapress.com/laderapress/contractslaw1.html 27. Contract &Agreements , http://www.tco.ac.ir/law/English/agreements/General/Contract%20Law/C.htm 28. Contracts, http://206.127.69.152/jgretch/crj/211/ch7.ppt 29. Business & Personal Law. Chapter 7. " How Contracts Arise" , ttp://yucaipahigh.com/schristensen/lawweb/lawch7.ppt 30. Types of Contracts, http://cmsu2.cmsu.edu/public/classes/rahm/meiners.con.ppt 31. IV. TYPES OF CONTRACTS AND IMPORTANT PROVISIONS, http://www.worldbank.org/html/opr/consult/guidetxt/types.html 32. Contract Types/Pricing Arrangements Guideline- 1.4.G (11/04/02), http://www.sandia.gov/policy/14g.pdf	
Course Out Comes	**CO- 1** Introduction to what constitutes Civil Engineering **CO- 2** Identifying the various areas available to pursue and specialize within the overall field of Civil Engineering **CO- 3** Highlighting the depth of engagement possible within each of these areas **CO- 4** Exploration of the various possibilities of a career in this field **CO- 5** Understanding the vast interfaces this field has with the society at large **CO- 6** Providing inspiration for doing creative and innovative work **CO- 7** Showcasing the many monuments, heritage structures, nationally important infrastructure, and impressive projects to serve as sources of inspiration **CO- 8** Highlighting possibilities for taking up entrepreneurial activities in this field **CO- 9** Providing a foundation for the student to launch off upon an inspired academic pursuit into this branch of engineering	

Mapping of Cos with PSOs & POs:

CO/PO	PO									PSO				
	1	2	3	4	5	6	7	8	9	1	2	3	4	5
CO1	1	1	0	2	1	2	3	3	3	1	3	0	0	1
CO2	2	0	2	0	1	1	3	3	3	3	2	0	0	2
CO3	3	0	3	0	0	1	1	3	2	2	1	0	1	1
CO4	3	0	0	0	0	1	1	0	2	1	2	0	0	2
CO5	1	0	3	0	1	0	2	3	2	1	3	0	0	1
CO6	2	0	1	0	0	1	0	1	1	1	1	1	0	2
CO7	1	1	2	0	0	0	1	2	0	0	2	0	0	1
CO8	1	0	1	0	0	0	1	1	3	0	1	0	0	1
CO9	1	0	0	0	0	0	0	2	2	1	0	0	0	1

Course Code & Title	18BCEU0204 Basic Electrical Engineering		
Class	I Year	**Semester**	II
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	This course is designed to address the following: • To provide comprehensive idea about AC and D C circuit analysis, working principles and applications of basic machines in electrical engineering. • To provide comprehensive idea about use of basic safety precautions in this field, transformers, working principles and applications of basic machines in electrical engineering.		

Unit	Content	No.of Hours
I	**DC Circuits (8 hours)** Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.	8
II	**AC Circuits** Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.	8
III	**Transformers** Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.	6
IV	**Electrical Machines** Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor Construction, working, torque-speed characteristic and speed control of separately excited dc motor Construction and working of synchronous generators.	8

V	Power Converters & Electrical Installation DC-DC buck and boost converters, duty ratio control Single-phase and three-phase voltage source inverters; sinusoidal modulation. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup. • Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors. • Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits. • Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power. • Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits. • Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine. • Torque Speed Characteristic of separately excited dc motor. • Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super- synchronous speed. • Synchronous Machine operating as a generator: stand-alone operation with a load. • Control of voltage through field excitation. • Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.	36

References	1. D. P. Kothari and I. J. Nagrath, " Basic Electrical Engineering" , Tata McGraw Hill,2010. 2. D. C. Kulshreshtha, " Basic Electrical Engineering", McGraw Hill, 2009. 3. L. S. Bobrow, " Fundamentals of Electrical Engineering" , Oxford University Press,2011. 4. E. Hughes, " Electrical and Electronics Technology", Pearson, 2010. 5. V. D. Toro, " Electrical Engineering Fundamentals", Prentice Hall India, 1989.	
Course Out Comes	**CO- 1** To understand the basic concepts of magnetic circuits, electro magnetism and electrostatics. **CO- 2** To understand and analyses AC & DC circuits. **CO- 3** To understand the working principle, and applications of DC & AC machines. **CO- 4** Get an exposure to common electrical components and their ratings. **CO- 5** Make electrical connections by wires of appropriate ratings. **CO- 6** Understand the usage of common electrical measuring instruments. **CO- 7** Understand the basic characteristics of transformers and electrical machines. **CO- 8** Get an exposure to the working of power electronic converters	

Mapping of Cos with PSOs & POs:

CO/PO	**PO**									**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**
CO1	1	1	0	3	3	2	1	0	3	1	3	0	0	1
CO2	1	1	0	1	1	1	1	1	1	1	2	3	0	1
CO3	1	1	1	3	1	1	2	0	1	1	2	0	0	1
CO4	1	1	0	1	2	1	1	0	1	1	1	0	0	1
CO5	1	1	0	1	1	1	1	1	1	1	1	0	2	2
CO6	1	1	1	2	2	1	1	2	3	1	1	2	0	1
CO7	1	1	1	2	2	1	1	2	3	1	1	1	0	1
CO8	1	1	1	2	1	1	1	1	2	1	1	0	1	2

Course Code & Title	**18BCEU0205 Workshop Manufacturing Practices**		
Class	I Year	**Semester**	II
Cognitive Level	K-1: practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes. K-2: Weld various joints in steel plates using arc welding work K-3: Machine various simple processes like turning, drilling, tapping in parts		
Course objectives	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 their project work and also to participate in various national and international technical competitions.		

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. Electrical & Electronics (1 lecture) 5. Carpentry (1 lecture) 6. Plastic moulding, glass cutting (1 lecture) 7. Metal casting (1 lecture) 8. Welding (arc welding & gas welding), brazing (1 lecture) 9. [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.	10
	work shop practice 1.Machine shop 2. Fitting shop 3. carpentry 4. Electrical & Electronics	60

	5. Welding shop 6. Casting 7. Smithy 8. Plastic moulding& Glass Cutting	
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** Carry out basic home electrical works and appliances, Measure the electrical quantities **CO- 5** Elaborate on the components, gates, soldering practices.	

Mapping of Cos with PSOs & POs:

CO/PO	PO									PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**
CO1	1	1	0	2	2	2	2	1	1	1	3	0	0	1
CO2	2	2	0	1	2	2	1	1	2	2	1	2	2	0
CO3	1	1	0	2	1	0	1	1	1	2	0	1	2	0
CO4	1	1	0	1	1	1	2	2	3	3	1	1	2	1
CO5	1	0	0	1	1	0	0	0	1	1	1	0	1	0

Course Code & Title	**18CSAU02B1 Programming for Problem Solving**		
Class	I Year	**Semester**	II
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	This course is designed • To learn the basics of computer programming. • To make students to learn basic of C programming language. • To learn the problem solving using C program		

Unit	Content	No.of Hours
I	**Introduction to Programming;** Introduction - Problem Solving Techniques-Algorithm, Flow Chart - Pseudo code, Programming Paradigms - Programming Languages-Types Generations of Programming Languages - Language Translators	9
II	**Structure of C Programs and Control Statements;** C fundamentals: Introduction to C - character set - Keywords and identifiers- constants -Data types –Variables - Operators and expressions – comment - Input and Output functions in C - *Control Statements*: if ….else-switch - while - do…while – for - Break and continue statements - go to statement.	10
III	**Arrays and String;** Array: defining an array – Processing an array - Single dimensional array – Two dimensional Arrays - Multidimensional array-Character array - String: Declaring, Initializing, Printing and reading strings - String manipulation functions.	10
IV	**Function and Structure;** Functions: defining a function -Accessing a function -Passing arguments to a function – Recursion- Structure: Defining, Declaring, initialization - Structures and Functions ,Array of structures.	10
V	**Pointers and File Management;** Pointers: pointer declaration-Chain of Pointer - Passing pointers to a function - File:Defining, Opening and closing of files - Input and output operations - Random Access to files.	9

<table>
<tr><td></td><td>C Program for
1. Simple computational problems using arithmetic expressions
2. Branching: if-then-else, Nested if-else, else-if ladder, switch
3. Loops: Conditional & Unconditional Looping
4. 1D Arrays: searching, sorting and manipulation
5. 2D arrays: Matrix Operations.
6. Character Array
7. Strings: String Manipulation operations
8. Functions-call by value: Simple User-Define functions
9. Problems using arrays and functions: Numerical methods (Root finding, numerical differentiation, numerical integration)
10. Recursive functions
11. Structures: Basics, Structure Array, Structure and Functions
12. Pointers: Pointer Declaration, Pointer to Function
13. File handling: File operations</td><td>60</td></tr>
<tr><td>References</td><td>1. Computer Programming, Ashok N Kamthane, ITL Education Solution Limited, New Delhi,2007.
2. Programming in ANSI C, E.Balagurusamy, 5/e, Tata - McGraw Hill publishing, New Delhi, August 2010.
3. Programming with C, B.S .Gottfried, Schaums outline Series, MCgraw - Hill Publishing Company, 199</td><td></td></tr>
<tr><td>Course Out Comes</td><td>CO- 1 To formulate the algorithms for simple problems
CO- 2 To translate given algorithms to a working and correct program
CO- 3 To be able to correct syntax errors as reported by the compilers
CO- 4 To be able to identify and correct logical errors encountered at run time
CO- 5 To be able to write iterative as well as recursive programs
CO- 6 To be able to represent data in arrays, strings and structures and manipulate them through a program
CO- 7 To be able to declare pointers of different types and use them in defining self- referential structures.
CO- 8 To be able to create, read and write to and from simple text files.</td><td></td></tr>
</table>

Mapping of Cos with PSOs & POs:

CO/PO	PO									PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**
CO1	1	1	0	2	1	1	1	0	2	1	1	0	0	1
CO2	1	1	0	1	1	1	1	0	1	1	3	0	0	1
CO3	0	1	0	1	1	0	0	0	1	1	1	1	0	0
CO4	0	1	0	2	0	0	1	0	0	0	0	0	0	0
CO5	0	0	0	1	2	2	1	0	0	1	1	1	0	1
CO6	1	0	0	2	2	3	1	0	1	1	2	2	0	2
CO7	1	0	0	1	1	0	0	0	0	0	0	2	1	1
CO8	1	0	0	0	1	1	1	1	0	0	0	0	0	0

Course Code & Title	18BCEU0206 Computer Aided Civil Engineering Drawing		
Class	I Year	**Semester**	II
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	The students will be able to a) Develop Parametric design and the conventions of formal engineering drawing b) Produce and interpret 2D & 3D drawings c) Communicate a design idea/concept graphically/ visually d) 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. e) Get a Detailed study of an engineering artifact		

Unit	Content	No.of Hours
I	**INTRODUCTION** to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, coordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.(2)	9
II	**SYMBOLS AND SIGN CONVENTIONS:** Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards (2)	10
III	**MASONRY BONDS**: English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall (1)	10
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 (7)	10

V	PICTORIAL VIEW: Principles of isometrics and perspective drawing. Perspective view of building. Fundamentals of Building Information Modelling (BIM) (3)	9
	List of Drawing Experiments: 1. Buildings with load bearing walls including details of doors and windows. 2. Taking standard drawings of a typical two storeyed building including all MEP, joinery, rebars, finishing and other details and writing out a escriptionof the Facility in about 500 -700 words 3. RCC framed structures 4. Reinforcement drawings for typical slabs, beams, columns and spread footings. 5. Industrial buildings - North light roof structures - Trusses 6. Perspective view of one and two storey buildings	60
References	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,	
Course Out Comes	**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.	

Mapping of Cos with PSOs & POs:

CO/PO	PO									PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**
CO1	1	1	0	2	3	0	0	0	1	1	3	0	0	1
CO2	1	1	1	2	2	0	0	0	1	1	2	2	1	1
CO3	1	0	0	2	2	0	0	0	0	1	0	2	0	1
CO4	1	0	0	2	1	0	0	0	0	1	0	2	1	0
CO5	1	0	0	3	1	1	0	0	0	1	2	2	1	1
CO6	2	0	1	1	1	2	0	0	0	1	3	0	1	1
CO7	1	0	1	2	2	1	0	0	0	2	1	1	0	2

III SEMESTER

<table>
<tr><td>Course Title</td><td colspan="11">Engineering Mathematics – III (Transform & Discrete Mathematics)</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>18MATU03C3</td><td>BSC</td><td>III</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">KI: Knowing the Basic concept of laplace trasform
K2: Understanding the fourier Transform
K3: Applying the Z-transform and difference equations
K4: Evaluating basic operations on sets, functions and patially ordered sets.
K5: analyse the basic properties of graphs</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The course aim is
• The student should able to understand the concept of laplace Transform
• They should understand and solve the problems related to difference Equations</td></tr>
</table>

Unit	Content	No.of Hours
I	**Laplace transform-** properties of Laplace transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by transform, solving ODEs and PDEs by Laplace transform method.	9
II	**Fourier transforms-** Fourier integral theorem, Fourier transform pair- sine and cosine transforms properties Transform of simple functions, Convolution theorem Parseval's identity.	9
III	**Z-Transform and Difference equations**, Z-Transform, elementary properties, inverse Z-Transform, Convolution theorem, Formation of difference equations, Solution of difference equations using Z- Transform.	9
IV	**Sets, relation and functions-** Basic operation on sets, Cartesian products, disjoint union(sum) and power sets. Different types of relations, their compositions and inverse. Different types of function, their compositions and inverses. **Partially ordered sets-**Complete partial ordering, chain, lattice, complete, distributive, modular and complemented lattices. Boolean and pseudo Boolean lattices.	9
V	**Introduction to graphs-**, Graphs and their properties -degree, path, cycle, subgraph, trees.	9

References	**Textbooks/References:** 1. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2010. 2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000. 3. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi,2008. Discrete Mathematics 4. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley &Sons, 2006. 5. Discrete Mathematics- Dr.M.K.Venkataraman, Dr.N.Sridharan, N.Chandra sekaran. 6. Invitation to graph theory- S.Arumugam. 7. Engineering Mathematics-III – P.Kandasamy,K.Thilagavathy,K.Gunavathy.	
Course Out Comes	After studying the course, the student will be able to: CO1: Understand the principles of Laplace Transform and solve the problems CO2: understand the principles of Fourier Transform and solve the problems. CO3: Z-Transform and Difference equations and solve the problems CO4: Understand the principles of Sets, relation and functions and solve the problems CO5: Introduce the graph and other methods	

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	BIOLOGY (Biology for Engineers)										
Course Code	Category	Sem	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0308	BSC	III	3	2	1	-	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 enzymolog 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) Biological observations of 18th century that lead to major discoveries of Robert Brown, and Julius Mayor. Darwinian evolution & molecular perspective; 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 and Protein as genetic materials. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of Genetic code. Universality and degeneracy of genetic code. Proteins-structure and function. Hierarch in protein structure. Primary, secondary, Tertiary and quaternary structures. Proteins as enzymes, transporters, receptors and structural elements. Structure and properties of carbohydrates and lipids.	10
III	**Unit: III Enzymology and Cellular metabolism** Enzyme classification - Mechanism of enzyme action - Enzyme kinetic parameters. Concepts of K_{eq} and its reaction to standard free energy. Spontaneity. ATP as an energy currency. Metabolic concepts –	10

	Anabolism & Catabolism - Thermodynamics as applied to biological systems. Exothermic and Endothermic versus endergonic and exergonic reactions. Cellular respiration and energetics - Glycolysis, Krebs Cycle, & ETC.	
IV	**Unit: IV Genetics** Mental's laws - Concept of allele, recessiveness and dominance. concept of segregation and independent assortment. Gene interaction- Epistasis & complementations - Concept of mapping of phenotype to genes. Genetic disorders in humans. Concept and principle mechanism of Meiotic and Mitotic cell divisions.	08
V	**Unit: V Microbiology** Historical and recent developments in microbiology: Invention of microscopy; concepts of spontaneous generation, biogenesis, germ theory of disease, and fermentation. 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. Identification of bacteria as per Bergey's manual of determinative Bacteriology	10
References	**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	
Course Outcomes	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.	

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

<table>
<tr><td>Course Title</td><td colspan="11">BASIC ELECTRONICS</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Categor y</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>18BCEU0309</td><td>ESC</td><td>III</td><td>2.5</td><td>1</td><td>-</td><td>3</td><td>20</td><td>30</td><td>30</td><td>20</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1 State the Diodes and applications covering
K2 Understand the characteristics of Transistor
K3 Apply the Amplifiers in various configurations</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
The objective of this Course is to provide the students with an introductory and broad treatment of the field of Electronics Engineering to facilitate better understanding of the devices, instruments and sensors used in Civil Engineering applications. Lab should be taken concurrently. This course emphasizes more on the laboratory/practical use of the knowledge gained from the course lectures.</td></tr>
</table>

Unit	Content	No.of Hours
I	***Diodes and Applications*** **covering,** Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, 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; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications;	12
II	***Transistor Characteristics*** **covering**, Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration	12
III	**Field Effect Transistor (FET) –** Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOScircuits;	12
IV	***Transistor Amplifiers and Oscillators*** **covering**, Classification, Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series and Voltage Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift, Wien Bridge, High Frequency LC and Non-Sinusoidal type Oscillators;	12
V	***Operational Amplifiers and Applications*** **covering**, Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of	12

	741 Op-Amp, Characteristics of Ideal OpAmp, Concept of Virtual Ground;	
PRACTICALS	Laboratory Sessions covering, Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT and DIP), Bread Boards and Printed Circuit Boards (PCBs); Identification, Specifications, Testing of Active Devices – Diodes, BJTs, JFETs, MOSFETs, Power Transistors, SCRs and LEDs;	
	Study and Operation of Digital Multi Meter, Function / Signal Generator, Regulated Power Supply (RPS), Cathode Ray Oscilloscopes; Amplitude, Phase and Frequency of Sinusoidal Signals using Lissajous Patterns on CRO; (CRO);	
	Experimental Verification of PN Junction Diode Characteristics in A) Forward Bias B) Reverse Bias, Zener Diode Characteristics and Zener Diode as Voltage Regulator, Input and Output Characteristics of BJT in Common Emitter (CE) Configuration, Drain and Transfer Characteristics of JFET in Common Source (CS) Configuration;	
	Study of Half Wave and Full Wave Rectification, Regulation with Filters, Gain and Bandwidth of BJT Common Emitter (CE) Amplifier, Gain and Bandwidth of JFET Common Source (CS) Amplifier, Gain and Bandwidth of BJT Current Series and Voltage Series Feedback Amplifiers, Oscillation Frequency of BJT based RC Phase Shift, Hartley and Colpitts Oscillators; Op-Amp Applications – Adder, Subtractor, Voltage Follower and Comparator; Op-Amp Applications – Differentiator and Integrator, Square Wave and Triangular Wave Generation, Applications of 555 Timer – Astable and MonostableMultivibrators;	
	Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs); Truth Tables and Functionality of Flip-Flops – SR, JK and D Flip-Flop ICs; Serial-In-Serial-Out and Serial-In-Parallel-Out Shift operations using 4-bit/8-bit Shift Register ICs; Functionality of Up-Down / Decade Counter ICs; (15 Sessions)	
References	1. David. A. Bell (2003), *Laboratory Manual for Electronic Devices and Circuits*, Prentice Hall,India 2. SantiramKal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall,India 3. Thomas L. Floyd and R. P. Jain (2009), *Digital Fundamentals* by Pearson Education, 4. Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), *Basic Electronics – A Text-Lab. Manual*, TMH 5. R. T. Paynter (2009), *Introductory Electronic Devices & Circuits, Conventional Flow Version*, Pearson	

Course Out Comes	CO 1 : state the Diodes and their application covering CO 2 : understand the concept of **Transistor Characteristics covering**, CO 3 : understand the characterisitces of Field Effect Transistor (FET) – CO 4 : Understand the Transistor Amplifiers and Oscillators covering, CO 5 : Apply the Amplifiers concept in various applications to analyze the functions	

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	ENGINEERING MECHANICS											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0310	ESC	III	4	3	1	-	40	60	-	-	100
Cognitive Level	K-1: Identify system of forces acting on the bodies, static and dynamic conditions. K-2: understand the concepts of equilibrium in three dimensions, method of section and joints. K-3: compute the various forces and angles in various parts of wall crane, roof trusses, pipes etc.,										
Course Objectives	The Course aims • To provide an introductory treatment of Engineering Mechanics to all the students of engineering, • To provide a working knowledge of statics with emphasis on force equilibrium and free body diagrams. • To Provide an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and • To provide an understanding of the mechanical behaviour of materials under various load conditions.										

Unit	Content	No.of Hours
I	Introduction to Engineering Mechanics covering, Force SystemsBasic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminancy. Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;	12
II	Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;	12
III	Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles,Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.	12
IV	Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of	12

	freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium. Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.Impulse-momentum (linear, angular); Impact (Direct and oblique). Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;	
V	Mechanical Vibrations covering, Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of freevibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums; Tutorialsfrom the above Units covering, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack	12
References	1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall 2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill 3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press. 4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press 5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education, 6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education 7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics 8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications 9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co. 10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications	

Course Out Comes	On completion of the course, students should be able to **CO1**Use scalar and vector analytical techniques for analyzing forces in statically determinate structures **CO2**Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems **CO3**Understand basic dynamics concepts – force, momentum, work and energy; **CO4**Understand and be able to apply other basic dynamics concepts - the Work-Energy principle, Impulse-Momentum principle and the coefficient ofrestitution; **CO5**Attain an introduction to basic machine parts such as pulleys and mass-spring systems.	

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

<table>
<tr><td>Course Title</td><td colspan="13">MECHANICAL 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>18BCEU0311</td><td>ESC</td><td>III</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">K1 : State the basic concepts of mechanical engineering
K2 : Understand the principles of thermodynamics and properties of pure substance
K3 : Relate the Ideal and real gases with thermodynamics</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• Students can understand the basics of mechanical Engineering and their importance
• They can understand the fundamental of thermodynamics and their applications</td></tr>
</table>

Unit	**Content**	**No.of Hours**
I	**Basic Concepts-** Basic concepts - concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasistatic process, work, modes of work. Zeroth law of thermodynamics, concept of temperature and heat. Concept of ideal and real gases. First Law of Thermodynamics- Concepts of Internal Energy, Specific Heat Capacities, Enthalpy. Energy Balance for Closed and Open Systems, Energy Balance for Steady-Flow Systems. Steady-Flow Engineering Devices. Energy Balance for Unsteady- Flow	9
II	**Second Law of Thermodynamics-** Thermal energy reservoirs, heat engines energy conversion, Kelvin's and Clausius statements of second law, the Carnot cycle, the Carnot Theorem, the thermodynamic temperature scale, the Carnot heat engine, efficiency, the Carnot refrigerator and heat pump, COP. Clausius inequality, concept of entropy, principle of increase of entropy – availability, the increase of entropy principle, perpetual-motion machines, reversible and irreversible processes, Entropy change of pure substances, isentropic processes, property diagrams involving entropy, entropy change of liquids and solids, the entropy change of ideal gases, reversible steady-flow work, minimizing the compressor work, isentropic efficiencies of steady-flow devices, and entropy balance. Energy a measure of work potential, including work potential of energy, reversible work and irreversibility, second-law efficiency, energy change of a system, energy transfer by heat, work, and mass, the decrease of energy principle and energy destruction, energy balance: closed systems and control volumes energy balance.	9

III	**Properties Of Pure Substance-** Properties of pure substances. Thermodynamic properties of pure substances in solid, liquid and vapour phases. Phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces. Thermodynamic properties of steam. Calculations of work done and heat transfer in non- flow and flow processes.Power Cycles- Vapour and combined power cycles, including the Carnot vapor cycle, Rankine cycle: the ideal cycle for vapor power, the ideal reheat and regenerative and the second-law analysis of vapour power cycles. Gas power cycles, including basic considerations in the analysis of power cycles, the Carnot cycle and its value in engineering, an overview of reciprocating engines, air standard assumptions, gasoline engine Otto cycle diesel engine cycle, gas-turbine Brayton cycle, and the second-law analysis of gas power cycles.	9
IV	**Ideal and Real Gases and Thermodynamic Relations-** Gas mixtures – properties ideal and real gases. Equation of state, Avogadro's Law, Vander Waal's equation of state, Compressibility factor, compressibility chart. Dalton's lawof partial pressure.Exact differentials, T-D relations, Maxwell's relations. Clausius Clapeyron equations, Joule – Thomson coefficient.	9
V	**Psychrometry and psychrometric charts** property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling.Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables. Refrigeration cycles, including refrigerators and heat pumps, the ideal reversed Carnot vapour-compression refrigeration cycle, actual vapor-compression refrigeration cycles, heat pump systems, gas refrigeration cycles, and absorption refrigeration systems.	9
References	1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, NewDelhi. 2. Cengel, Thermodynamics – AnEngineeringApproach *Tata McGraw Hill,New* Delhi. 3. Sonntag, R. E., Borgnakke, C., &Wylen, G. J. V. Fundamentals of thermodynamics: Wiley. 4. Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. Fundamentals of Engineering . Thermodynamics: John Wiley & Sons. 5. Jones, J. B., & Dugan, R. E. Engineering thermodynamics: PrenticeHall. 6. Potter, M. C., & Somerton, C. W. Schaum's Outline of Thermodynamics for Engineers, McGraw-Hill. **7.**	

Course Out Comes	CO 1 : understand the concepts of basic mechanical engineering and their components CO 2 : understand the principles of second law of thermodynamics CO 3 : understand the properties of pure substance and their analysis CO 4 : Relate the thermodynamics principles with ideal and real gases CO 5 : Analysis the Psychrometry and psychrometric charts	

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	ENERGY SCIENCE AND ENGINEERING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0311	ESC	III	3	2	1	-	40	60	-	-	100

Cognitive Level	K1 : Recall the scientific principles and environmental and climate issue related energy K2 : Understand the energy resources and various energy systems K3 : Apply the energy principles in various civil engineering projects like green building, building materials etc
Course Objectives	The course aim is The students can understand energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application. The class will explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternatives, renewable energy sources such as solar, biomass (conversions), wind power, waves and tidal, geothermal, ocean thermal, hydro and nuclear. Energy conservation methods will be emphasized from Civil Engineering perspective. The knowledge acquired lays a good foundation for design of various civil engineering systems/ projects dealing with these energy generation paradigms in an efficient manner.

Unit	Content	No.of Hours
I	*Introduction to Energy Science:* Scientific principles and historical interpretation to *place ener*gy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment	9
II	*Energy Sources:* Overview of energy systems, sources, transformations, efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiencybatteries)	9
III	*Energy & Environment:* Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and research policy	9
IV	*Civil Engineering Projects connected with the Energy Sources:* Coal mining technologies, Oil exploration offshore platforms,	9

	Underground and under-sea oil pipelines, solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydro power stations above-ground and underground along with associated dams, tunnels, penstocks, etc.; Nuclear reactor containment buildings and associated buildings, design and construction constraints and testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposal systems	
V	*Engineering for Energy conservation:* Concept of Green Building and Green Architecture; Green building concepts (Green building encompasses everything from the choice of building materials to where a building is located, how it is designed and operated); *LEED ratings;* Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption	9
References	1. *Rao,S. and Parulekar,R.B., Energy Technology - "Non-Conventional, Renewable and Conventional", Khanna Publishers, Delhi, 1995.* 2. *Rai, G.D., "Non-Conventional Sources of Energy", Khanna Publishers, Delhi 1995.* 3. *Venugopal,K. "Basic Mechanical Engineering" New Age International Private Ltd., New* 4. *Delhi 1991.* 5. *Gulp,A.G., "Principles of Energy Conversion" McGraw Hill Book Company, 1994.* 6. *T.D.Eastop & D.R.Croft, "Energy Efficiency for Engineers and Technologists" Longmen 1990*	
Course Out Comes	*The students can able to* **CO1 :** understand the scientific Principles and historical interpretation in the context of pressing societal, environmental and climate issues and Introduction to energy systems and resources **CO2 :** Understand the various energy resources and energy systems **CO3 :** understand the various Energy Technologies and sustainable Development **CO 4 :** Apply the Energy sources in civil engineering Projects **CO 5 :** Identify the energy related enterprises and industries and apply the concept on green building for sustainbility	

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	ENGINEERING GEOLOGY										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0311	ESC	III	2	1	-	2	20	30	30	20	100
Cognitive Level	K1- Identify the rock forming minerals K2-Understand the role of geology in civil engineering K3-Apply the knowledge of structural feature of rocks in Civil construction										
Course Objectives	At the end of this course the student shall be able to understand about geological formations, classification and morphology of rocks, and the importance of the study of geology for civil engineers with regard to founding structures like dams, bridges, buildings, etc.										

Unit	Content	No.of Hours
I	**GENERAL GEOLOGY:** Geology in Civil Engineering – Branches of Geology – Earth Structures and Composition – Elementary Knowledge on Continental Drift and Plate Technologies. Earth Processes – Weathering – Geological Work of Rivers, Wind and Sea and their Engineering Importance – Earthquake Belts in India. Groundwater – Mode of Occurrence – Prospecting – Importance in Civil Engineering.	9
II	**MINERALOGY:** Elementary Knowledge on Symmetry Elements of Important Crystallographic Systems – Physical Properties of Minerals – Study of the Following Rock Forming Minerals – Quartz Group, Feldpar Group, Pyroxene Group, Amphibole Group and Mica Group. Fundamentals of Process of Formation of Ore Minerals – Identification of Minerals - Coal and Petroleum – Their Origin and Occurrence in India-	9
III	**PETROLOGY**: Classification of Rocks – Distinction between Igneous, Sedimentary and Metamorphic Rocks. Description of Structures, Textures and Mode of Occurrence, Engineering Properties, Distribution and uses of following rocks. Igneous Rocks – Granite, Syenite, Diorite, Gabbro, Pegmatite, Dolerite and Basalt; Sedimentary Rocks - Sandstone, Limestone, Shale, Laterite, Conglomerate and Breccia; Metamorphic Rocks - Quartizite, Marble, Slate, Phyllite, Gniess, Charnockite and Schist – Identification of Rocks.	9
IV	**STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD:** Attitude of Beds – Outcrops – Introduction to Geological Maps – Study of Structures – Folds: Parts, classification of folds, Causes of folding. Faults: Parts, classification of fold, Causes of folding. Joints: Classification and Occurrence and origin of joints – Importance of structures on Engineering Construction. Seismic and Electrical Methods for Civil Engineering Investigations.	9

V	**GEOLOGICAL INVESTIGATIONS IN CIVIL ENGINEERING:** Geological Conditions necessary for Construction of Reservoirs and Dams, Tunnels, Buildings, Road Cuttings - Important building stones - Improvement of sites. Causes and Preventions of Land Slides –. Sea Erosion and Coastal Protection structures.	9
References	1. 1. Parbin Singh. "Engineering and General Geology", S.K. Kataria & Sons, Katson Publishing House Ludhiana, 8th Edition, reprint 2011-12. 2. Chenna Kesavulu N. "Textbook of Engineering Geology", Macmillan India Ltd., 2009 3. Venkat Reddy D. "Engineering Geology", Vikas Publishers, 2010 ISBN-978-81259-9032 4. Krynine and Judd. "Engineering Geology and Geotechniques", CBS Publisher,2005 5. Tyrrell "Principles of Petrology", B.I. Publications, Bombay 1989 6. Billings P Marland. "Structural Geology", 3rd Edition , PHI Learning, 2008 7. Varghese P. C "Engineering Geology for Civil Engineers", PHI Learning Private Ltd, M-97, Connaught Circus, New Delhi -2012	
Course Out Comes	CO1:describe the importance of geology in Civil engineering CO2:Assess the role of structural features and rocks in civil construction CO3:Describe the different types of minerals and rocks CO4: Predict the natural disasters to prevent failure of civil projects CO5: Describe the investigating techniques for site selection	

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

Course Title	Disaster preparedness and planning										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0314	PCC	III	2	1	1	-	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 i) To Understand basic concepts in Disaster Management ii) To Understand Definitions and Terminologies used in Disaster Management iii) To Understand Types and Categories of Disasters iv). 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). .	6
II	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.	6
III	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
IV	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	6

	responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.	
V	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 environmental friendly recovery; reconstruction and development methods.	6
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 Out Comes	CO1: The application of Disaster Concepts to Management CO2: Analyzing Relationship between Development and Disasters. CO3: Ability to understand Categories of Disasters and CO4: Realization of the responsibilities to society CO5: To understand Impacts of Disasters Key Skills	

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

Course Title	EFFECTIVE TECHNICAL COMMUNICATION										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18ENGU03F2	HSMC	III	3	3	-	-	40	60	-	-	100
Cognitive Level	**K1 :** Recall the fundamentals of communication **K2 :** understand the technical communication procedure **K3 :** Apply the communication skill in various situations										
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	Basics of Communication Barriers to communication	6
II	Communication and Language skills Communicating in a global language	6
III	Resumes and cover letters Group Discussions	6
IV	Business Communication Intercultural Communication	6
V	Profession Communication Interviews	6
References	Krishnaswamy, Dhariwal and Krishnaswamy, Mastering communication skill and soft skill, Blomsburry , 2015	
Course Out Comes	After completion of the Course students should able to CO1: Understand the basics of communications CO2: Understand Communication and Language skills CO3: Understand to prepare resume and cover letter CO4: Understand business Communication CO5: Understand Profession Communication Interviews	

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

<table>
<tr><td>Course Title</td><td colspan="11">CIVIL ENGINEERING SOCIETAL AND GLOBAL IMPACTS</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>18BCEU0315</td><td>HSMC</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>Cognitive Level</td><td colspan="11">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.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• Students can understand the basics of mechanical Engineering and their importance
• They can understand the fundamental of thermodynamics and their applications</td></tr>
</table>

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, 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	6

	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

<table>
<tr><td>Course Title</td><td colspan="12">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>18EXNU03VI</td><td>MC</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">K3 : Analyse the issues in the village
K4: Asses the various village problem related to Civil Engineering
K5 : 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>

SEMESTER - IV

<table>
<tr><td rowspan="2">Course Title</td><td colspan="12">LIFE SCIENCE</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>18BCEU0416</td><td>BSC</td><td>IV</td><td>1+1</td><td>1</td><td>-</td><td>2</td><td>20</td><td>30</td><td>30</td><td>20</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1 Knowledge and Comprehension
K-2 Application
K-3 Analysis, Synthesis and Evaluation</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The course aims
• to enhance the student’s knowledge on biodiversity and its conservation
• to acquire an overall knowledge on ecosystem and population ecology
• to develop knowledge on environmental pollution and management
• to make the students knowledgeable on molecular techniques and biotechnology
• to give practical exposure on various biological techniques</td></tr>
</table>

UNIT	Content	No.of Hours
I	**Unit I : Biodiversity** Plant System - basic concepts of plant growth, nutrition, photosynthesis respiration and nitrogen fixation. Animal System- elementary study of digestive-respiratory-circulatory-excretory systems and their functions. Microbial System: history - types of microbes - economic importance and control of microbes. Biodiversity conservation strategies -*In-situ and Ex-situ.*	5
II	**Unit II: Ecosystem** Components and types- Terrestrial- Forest and grassland- Aquatic- Freshwater and marine – Food chain, food web and Ecological Pyramids- Biogeochemical cycles- Oxygen, Carbon, nitrogen, sulphur and phosphorus- Population Ecology.	5
III	**Unit III: Environmental Pollution and management** Types- Air, water, soil and radiation- Sources and control- Environmental Impact Assessment (EIA)- Steps and methods- public participations in environmental Audit- Environmental Protection Acts- Air, Water, forest and wildlife.	5
IV	**Unit IV: Molecular genetics & Biotechnology** Basic concepts of molecular genetics – DNA& RNA, gene, gene regulation, e.g., Operon concept. History and Scope of biotechnology - Plant & animal tissue culture- Methods and applications in agriculture, medicine and health - Recombinant DNA technology- Techniques and applications.	5
V	**Unit -V: Laboratory & Fieldwork Sessions** Observation of different life forms on spotters(Algae, fungi, bryophytes, gymnosperms and angiosperms); Observation on structure of monocot and dicot flowers; Estimation of O_2 evolution and rate of respiration;Estimation of Osmotic potential by plasmolytic method;	15

	Quadrate study on population; Estimation of BOD & COD; seminar/ projects on EIA; Enumeration of bacteria from soil and water samples: bacterial isolation – pour plate, spread plate & Streak plate techniques; experiment on bacteriological staining; determination of bacterial growth curve; DNA isolation and analysis using UV –VIS spectroscopy and Gel electrophoresis	
References	**References** **<u>Text/Reference Books:</u>** 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. Molecular genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish kumar jain for CBS publisher 5. Jeffery C. Pommerville (2016). Alcamo's Fundamentals of Microbiology (Third Edition). Jones and Bartlett Learning. LLC, Burlington, MA 01803. 6. Wiley, J.M., Sherwood, L.M. and Wodverton, C.J. 2009. Prescott's principle of Microbiology, Mc Graw Hill, New York. 7. Pelczar, Jr., Michael, Chan E. C. S. and Kreig Noel. 2000. Microbiology. 5^{th} Ed. Tata McGraw Hill Book Company	
Course Outcomes	After studying the course, the student will be able to: CO1: Describe various biodiversity and its physiological roles and conservation stategies CO2: Classify ecosystem and describe biogeocycle CO3: Identify environmental pollution and to find the solution to control or min imize effects of contaminants CO4: Highlight the concepts of molecular genetics and biotechnology and their scopes CO5: demonstrate the various biological experiments on biodiversity, pollution and bacteriological culture techniques	

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	1	0	0	0	0	0	0	0	1	0
CO2	1	0	0	1	1	1	0	1	1	0
CO3	1	0	1	1	2	2	0	2	1	0
CO4	0	0	0	0	0	2	1	1	0	0
CO5	1	1	0	0	0	0	0	0	1	1

Course Title	INTRODUCTIONS TO SOLID MECHANICS										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0417	**PCC**	IV	2+1.5	2	-	3	40	60	30	20	150
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 pending and torsion and hoop stress. K-3: solve the problems related to solids stress , shear force, bending moment, simple pending, 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- Simple Stresses and Strains*- Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law– stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience– Gradual, sudden, impact and shock loadings – simple applications. Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.	11
II	*Bending moment and Shear Force Diagrams*- Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed 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. *Slope and deflection*- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.	11

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.	11
IV	Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.	10
V	Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.	10
Practicals	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 and stretching 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;	
References	1. Timoshenko, S. and Young, D. H., " Elements of Strength of Materials" , DVNC, New York, USA. 2. Kazmi, S. M. A., " Solid Mechanics" TMH, Delhi, India. 3. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004 4. 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 5. Laboratory Manual of Testing Materials - William Kendrick Hall 6. Mechanics of Materials - Ferdinand P. Beer, E. RusselJhonston Jr., John T. DEwolf– TMH 2002. 7. 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 shear forece and bending moments of various types of beams CO3 Understand the principles of simple pending 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	INTRODUCTION TO FLUID MECHANICS										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0418	**PCC**	IV	2+1.5	2	-	3	40	60	30	20	150
Cognitive Level	K-1: Define the basic concepts and definitions of fluid properties K-2: Understand the concept of fluid statics, kinematics and dynamics. K-3: solve the problems related to fluids deals with pipe flow, open channel flow, jets, turbines and pumps etc										
Course Objectives	The Course aims • To introduce the concepts of fluid mechanics useful in Civil Engineering applications. • To provides a first level exposure to fluid statics, kinematics and dynamics. • Measurement of pressure, computations of hydrostatic forces on structural components and the concepts of Buoyancy all find useful applications in many engineering problems. • 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										

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.	11
II	Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single ColumnManometer, U-Tube Differential Manometer, Micromanometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.	11
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 -dimensional continuity equations in Cartesian coordinates	11

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;	10
V	Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π-Theorem.	10
	Write a technical laboratory report **Fluid Mechanics Laboratory** 1. Measurement of viscosity 2. Study of Pressure Measuring Devices 3. Stability of Floating Body 4. Hydrostatics Force on Flat Surfaces/Curved Surfaces 5. Verification of Bernoulli's Theorem 6. Venturimeter 7. Orifice meter 8. Impacts of jets 9. Flow Visualisation -Ideal Flow 10. Length of establishment of flow 11. Velocity distribution in pipes 12. Laminar Flow	
References	1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010 2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House 3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill 4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill.	
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 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><td>Course Title</td><td colspan="12">SURVEYING AND GEOMATICS</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>18BCEU0419</td><td>PCC</td><td>IV</td><td>2+1.5</td><td>1</td><td>1</td><td>3</td><td>40</td><td>60</td><td>30</td><td>20</td><td>150</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">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</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, Photogrammetry and Remote Sensing.</td></tr>
</table>

Unit	**Content**	**No.of Hours**
I	Introduction to Surveying (8 hours): 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 (6 Hours): 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 (6 hours) 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 (8 Hours): 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 (8 Hours): Introduction, Basic	10

	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.	
V	Remote Sensing (9 Hours): 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		MATERIAL TESTING AND EVALUATION										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0420	PCC	IV	2+1.5	1	1	3	40	60	30	20	150
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										

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 mechanical testing; Discussion about mechanical testing; Naming systems for various irons, steels and nonferrous metals; Discussion about elastic	10

	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
	Materials Testing and Evaluation Laboratory 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	

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

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

Unit	Content	No.of Hours
I	**ARCHITECTURAL DESIGN** Architectural design - an analysis - Integration of function and aesthetics - Introduction to basic elements and principles of design.	11
II	**CLIMATE RESPONSIVE DESIGN** Factors that determine climate - Characteristics of climate types - Design for various climate types - Passive and active energy controls.	11
III	**BUILDING TYPES** Residential, institutional, commercial and Industrial - Planning concepts - Application of anthropometry and space standards - Interrelationships of functions - Safety standards - Building rules and regulations - Integration of building services.	11
IV	**SITE PLANNING** Surveys - Site analysis - Development control - Zoning regulations - Layout regulations - Urban planning standards - Layout design concepts.	10
V	**ENVIRONMENT DESIGN** Urban renewal - Conservation - Principles of Landscape design - Case studies	10

References	1. Francis D.K. Ching, " Architecture: Form, Space and Order ", VNR, N.Y., 1999. 2. Givoni B., " Man Climate and Architecture ", Applied Science, Barking ESSEX, 1982. 3. Edward D. Mills, " Planning the Architects Handbook ", Butterworth London, 1995. 4. Gallian B. Arthur and Simon Eisner, " The Urban Pattern - City Planning and Design ", Affiliated Press Pvt. Ltd., New Delhi, 1995. 5. Margaret Roberts, " An Introduction to Town Planning Planning Techniques ", Hutchinson,London,1990.	

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	**INTERNSHIP-I**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0422	PROJ	**IV**	1	-	-	-	-	-	100	-	100
Cognitive Level	K3: apply the knowledge in real issues related to civil engineering K4 : Analyse the issues of civil engineering field K5: Develop the plan for civil engineering related sectors										
Course Objectives	The main aim is 1. The students should understand and realize the real time projects planning and execution 2. They can acquire knowledge of various skill based areas										

1. 30 days In plant training is to be undergone by the students in any industry and certificate as to be enclosed along with a report about the works carried out during training.
2. Any software training in the reputed centre / organization and certificate as to be enclosed along with a report about the exercises carried out during training.

EVALUATION PROCEDURE

1. Evaluation of In plant Training Report :50 Marks
2. Viva voce examination : 50marks

(Evaluated by the internal examiner appointed by the HOD)

<table>
<tr><td>Course Title</td><td colspan="12">SURVEY CAMP</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>PCC</td><td>IV</td><td>2</td><td>1</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"></td></tr>
<tr><td>Course Objectives</td><td colspan="11">The objective of the survey camp is to enable the students to get practical training in the field work. Groups of not more than six members in a group will carry out each exercise in survey camp. The camp must involve work on a large area of not less than 40 acres outside the campus (Survey camp should not be conducted inside the campus). At the end of the camp, each student shall have mapped and contoured the area. The camp record shall include all original field observations, calculations and plots.</td></tr>
<tr><td></td><td colspan="11">Two weeks Survey Camp will be conducted during summer vacation in the following activities:
1. Traverse - using Total station
2. Contouring
(i). Radial tachometric contouring - Radial Line at Every 45 Degree and Length not less than 60 Meter on each Radial Line
(ii). Block Level/ By squares of size at least 100 Meter x 100 Meter atleat 20 Meter interval
(III). L.S & C.S - Road and canal alignment for a Length of not less than 1 Kilo Meter atleast L.S at Every 30M and C.S at every 90 M
3. Offset of Buildings and Plotting the Location
4. Sun observation to determine azimuth (guidelines to be given to the students)
5. Use of GPS to determine latitude and longitude and locate the survey camp location
6. Traversing using GPS
7. Curve setting by deflection angle
Apart from above students may be given survey exercises in other area also based on site condition to give good exposure on survey.</td></tr>
</table>

Course Title	SOFTWARE SKILL DEVELOPMENT - I										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0423	ESC	IV	1	-	-	-	50	-	-	-	50
Cognitive Level	K3 : Apply the knowledge in the software K2 : analyze the various software usages and applications K3 :develop the various drawings										
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 plan related to civil engineering drawings										

Drafting software like AutoCAD, Archicad, QCAD, Revit Architecture or any other open source software etc…..

LIST OF EXPERIMENTS

1. Buildings with load bearing walls with flat roof
2. Buildings with load bearing walls with pitched roof
3. Details of doors and windows
4. RCC framed structures single storey
5. RCC framed structures Multi storey
6. Industrial buildings – North light roof structures
7. Industrial buildings — trusses
8. Perspective view of one storey building
9. Perspective view of two storey buildings
10. 3d views of multi storey buildings

TEXT BOOKS:

1. Civil Engg. Drawing & House Planning – B.P. Verma, Khanna publishers, Delhi
2. Building drawing & detailing – Dr. Balagopal & T.S. Prabhu, Spades Publishers, Calicut.

REFERENCE BOOKS:

1. Building drawing – Shah, Tata McGraw-Hill
2. Building planning & Drawing – Dr. N. Kumaraswamy, A. Kameswara Rao, Charotar Publishing
3. Shah, Kale and Patki, Building Drawing, Tata McGraw-Hill.

V- SEMESTER

Course Title	PROFESSIONAL PRACTICE LAW AND ETHICS

Course Code	Catego ry	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CF A	ESE	CF A	ESE	
18BCEU0524	**BSC**	V	2	2	-		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.	4
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.	18

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	2
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><th>Course Title</th><th colspan="12">GEOTECHNICAL ENGINEERING</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>18BCEU0525</td><td>PCC</td><td>V</td><td>2+1.5</td><td>2</td><td>-</td><td>3</td><td>40</td><td>60</td><td>30</td><td>20</td><td>150</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K 1 - Recall the formation and types of soil.
K 2 - Understand the soil phase relation, properties, consistency of soil and soil classification systems.
K 3 - Compute the consolidation time and shear strength of soil.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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</td></tr>
</table>

Unit	Content	No.of Hours
I	**Unit 1:** Introduction–Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Basic Definitions and Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight, voids ratio- moisture content, unit weight- percent air voids, saturation- moisture content, moisture content- specific gravity etc. Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsional 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.	11
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	11

	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. 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.	
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.	11
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, relationbetween major and minor principal stresses,Mohr-Coulomb theory, types of shear tests: directshear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU andCD tests, pore-pressure measurement, computation of effective shear strengthparameters.unconfined compression test, vane shear test	10
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. Soil Exploration- Introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advance soil exploration methods.	10

	Geotechnical Engineering Laboratory 1. Field Density using Core Cutter method. 2. Field Density using Sand replacement method. 3. Natural moisture content using Oven Drying method. 4. Field identification of Fine Grained soils. 5. Specific gravity of Soils. 6. Grain size distribution by Sieve Analysis. 7. Grain size distribution by Hydrometer Analysis. 8. Consistency limits by Liquid limit 9. Consistency limits by Plastic limit 10. Consistency limits by Shrinkage limit. 11. Permeability test using Constant-head test method. 12. Permeability test using Falling-head method. 13. Compaction test: Standard Proctor test. 14. Compaction test: Modified Proctor test. 15. Relative density. 16. Consolidation Test. 17. Triaxial Test (UU) 18. Vane shear test 19. Direct Shear Test 20. Unconfined Compression Strength Test.	
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 Out Comes	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	STRUCTURAL ENGINEERING										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0526	PCC	V	3	2	-	1	40	60	-	-	100
Cognitive Level	K 1 - Recall the equilibrium conditionsand the behavior of materials. K 2 - Understand the design concepts of various structural elements K 3 –design the various structural elements by different method										
Course Objectives	The Course aims 1. To explain the concepts behind the behavior of structures 2. student should be able to solve the problems related to structural design 3. students should be able to design the structures 4. should be able to understand the design project										

Unit	Content	No.of Hours
I	Introduction- concepts of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium; what is a structural engineer, role of engineer, architect, user, builder; what are the functions' what do the engineers design, first principles of process of design	9
II	PlanningandDesignProcess;Materials,Loads,andDesignSafety;Behaviour and Properties of Concrete and Steel; Wind and Earthquake Loads	9
III	*Materials and Structural Design Criteria:* Introduction to the analysis and design ofstructuralsystems.Analysesofdeterminateandindeterminatetrusses,beams,andframes, and design philosophies for structural engineering. Laboratory experiments dealing with the analysis of determinate and in determinate structures;	9
IV	*Design of Structural Elements;* Concrete Elements, Steel Elements, Structural Joints; Theories and concepts of both concrete and steel design and analysis both at the element and system levels. Approximate Analysis Methods as a Basis for Design; Design of Reinforced Concrete Beams for Flexure; Design of Reinforced Concrete Beams for Shear; Bond, Anchorage, and Service ability; Reinforced Concrete Columns; Reinforced Concrete Slabs; Introduction to Steel Design; Tension Members and Connections; Bending Members; Structural Systems	9
V	*System Design Concepts;* Special Topics that may be Covered as Part of the Design Project Discussions; Cable Structures; Prestressed Concrete Bridges; Constructability and Structural Control ;Fire Protection	9
References	1. Nilson, A.H.*Design ofConcreteStructures.*13thedition.McGrawHill,2004 2. McCormac, J.C.,Nelson,J.K.Jr.,*StructuralSteelDesign*.3rdedition.Prentice	

	Hall,N.J.,2003. 3. Galambos,T.V.,Lin,F.J.,Johnston,B.G.,*BasicSteelDesignwithLRFD*,PrenticeHall,1996 4. Segui,W.T.,*LRFDSteelDesign*,2ndEd.,PWSPublishing, Boston. 5. Salmon,C.G.and Johnson,J.E.,*Steel Structures: Design andBehavior*,3rdEdition, Harper&Row,Publishers,NewYork,1990. 6. MacGregor,J.G.,*ReinforcedConcrete:MechanicsandDesign*,3rdEdition, PrenticeHall,NewJersey,1997. 7. Nawy,E.G.,*Reinforced Concrete:A Fundamental Approach*,5thEdition, PrenticeHall, NewJersey. 8. Wang C-K.andSalmon,C.G.,*Reinforced ConcreteDesign*,6thEdition,AddisonWesley,NewYork. 9. Nawy,E.G.*PrestressedConcrete:AFundamental Approach*,PrenticeHall,NJ, (2003). 10. Related Codes of Practice ofBIS 11. Smith,J.C.,*Structural Analysis*, Harporand Row, Publishers,NewYork. 12. .McGuire,R.H.GallagherandR.D.Ziemian.“Matrix Structural Analysis", 2ndEdition,JohnWileyandSons, 2000. 13. NBC, *National Building Code*, BIS(2017). 14. ASCE, *Minimum Design Loads for Buildings and Other Structures,ASCE7-02* AmericanSocietyofCivilEngineers,Virginia,2002.	
Course Out Comes	On completion of the course, students should be able to do CO1: understand the principles of stability, equilibrium,,role of structural engineer, CO2: know the behavior and properties of concrete ,steel and all other materials CO3: understand the concept of structural systems CO4: design the various structural elements CO5 : design the prestress concrete bridge	

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

Course Title	HYDRALIC ENGINEERING										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0527	PCC	V	2+1.5	2	-	3	40	60	30	20	150
Cognitive Level	K-1: Identify the flow patterns and its properties K-2: Understand 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-.Most economical section of channel. Computation of Uniform flow, Normal depth.	11
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 analyticalapproaches. 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

	Fluid Mechanics Laboratory 1. Flow Visualization 2. Studies in WindTunnel 3. BoundaryLayer 4. Flow around an Aerofoil / circularcylinder 5. UniformFlow 6. Velocity Distribution in Open channelflow 7. VenturiFlume 8. Standing WaveFlume 9. Gradually VariedFlow 10. HydraulicJump 11. Flow under SluiceGate 12. Flow throughpipes 13. Turbulent flow throughpipes 14. Flowvisualization 15. Laminar flow throughpipes 16. Major losses / Minor losses inpipe	
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 Out Comes	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	ENVIRONMENTAL ENGINEERING										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0528	PCC	V	2+1.5	2	-	3	40	60	30	20	150
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	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 andagricultural 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	11
II	Sewage- Domestic and Storm water, Quantity of Sewage, Sewage flow variations.Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance ofsewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage andSullage, 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 –	11

	quality requirements for various purposes.	
III	Air - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution-Occupational hazards, Urban air 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	11
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.	10
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.	10
	Write a technical laboratory report **Practical Work: List of Experiments** 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. Analysis of ions: copper, chloride and sulfate 5. Optimum coagulant dose 6. Chemical Oxygen Demand (COD)	

	7. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD) 8. Break point Chlorination 9. Bacteriological quality measurement: MPN, 10. Ambient Air quality monitoring (TSP, RSPM, SOx, NOx) 11. Ambient noise measurement	
References	1. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey. 2. Introduction to Environmental Engineering by P. AarneVesilind, 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 Out Comes	On completion of the course, students should **CO1:** Understand the impact of humans on environment and environment on humans **CO2:** Be able to identify and value the effect of the pollutants on the environment: atmosphere, water and soil. **CO3:** Be able to plan strategies to control, reduce and monitor pollution. **CO4 :** Be able to select the most appropriate technique for the treatment of water, wastewater solid waste and contaminated air. **CO5:** Be conversant with basic environmental legislation.	

Mapping of COs with PSOs:

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

Course Title	TRANSPORATION ENGINEERING										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0529	PCC	V	2+1.5	2	-	3	40	60	30	20	150

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 verticalalignment • implement traffic studies, traffic regulations and control, and intersectiondesign • determine the characteristics of pavementmaterials • design flexible and rigid pavements as perIRC

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.	11
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	11
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	11
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.	10
V	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	10

References	Text/Reference Books:	
	Text/Reference Books: 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. ParthaChakraborty, ' Principles Of Transportation Engineering, PHI Learning, 4. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of HighwayEngineering 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 StudentEdition, 2009.	
Course Out Comes	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 andintersection design **CO4:** characterize pavement materials and **CO5:** design flexible and rigid pavements as per IRC	

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

<table>
<tr><td rowspan="2">Course Title</td><td colspan="12">INSRUMENTATION AND SENSOR TECHNOLOGIES FOR CIVIL ENG INEERING APPLICATIONS</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>18BCEUO530</td><td>PCC</td><td>V</td><td>2+1</td><td>1</td><td>1</td><td>2</td><td>40</td><td>60</td><td>30</td><td>20</td><td>150</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: List the types of Instrumentations
K-2:Understand the sensor installation and operations
K-3:Apply the various sensor systems for different civil engineering fields</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• To understand instrumentation, sensor theory and technology, data acquisition, digital signal processing, damage detection algorithm, life time analysis and decision making.
• This course introduces theoretical and practical principles of design of sensor systems.
• The principles of state-of-the-art systems being used in physical infrastructure/bridges/buildings/pavements, etc.
• Providing principle knowledge, practical training and measurement best practice for a range of temperature, pressure, electrical, velocity, acceleration and vibration systems</td></tr>
</table>

Unit	Content	No.of Hours
I	*damentals of Measurement, Sensing and Instrumentation covering* definition of measurement and instrumentation, physical variables, common types of sensors; Describe the function of these sensors; Use appropriate terminology to discuss sensor applications; and qualitatively interpret signals from a known sensor type, types of instrumentation, Sensor Specifics, Permanent installations, Temporary installations	9
II	*Sensor Installation and Operation covering to:* i) Predict the response of sensors to various inputs; ii) Construct a conceptual instrumentation and monitoring program; iii) Describe the order and methodology for sensor installation; and iv) Differentiate between types of sensors and their modes of operation and measurement	9

III	Approach to Planning Monitoring Programs, Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Advanced topic, Sensor design, Measurement uncertainty	9
IV	*Data Analysis and Interpretation covering* a) Fundamental statistical concepts, b) Data reduction and interpretation, c) Piezometer, Inclinometer, Strain gauge, etc. d) Time domain signal processing, e) Discrete signals, Signals and noise and f) a few examples of statistical information to calculate are: Average value (mean), On average, how much each measurement deviates from the mean (standard deviation), Midpoint between the lowest and highest value of the set (median), Most frequently occurring value (mode), Span of values over which your data set occurs (range)	9
V	*Frequency Domain Signal Processing and Analysis covering* Explain the need for frequency domain analysis and its principles; Draw conclusions about physical processes based on analysis of sensor data; Combine signals in a meaningful way to gain deeper insight into physical phenomena, Basic concepts in frequency domain signal processing and analysis, Fourier Transform, FFT (Fast Fourier Transform), Example problems: Noise reduction with filters, Leakage, Frequency resolution	9
	PRACTICLAS Instrumentation of typical civil engineering members/structures/structural elements Use of different sensors, strain gauges, inclinometers, Performance characteristics Errors during the measurement process Calibration of measuring sensors and instruments Measurement, noise and signal processing Analog Signal processing Digital Signal Processing Demonstration & use of sensor technologies	

References	**Text Books & Reference Books:** 1. Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann 2. David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press 3. S. Tumanski (2006), Principle of Electrical Measurement, Taylor &Francis 4. Ilya Gertsbakh (2010), Measurement Theory for Engineers,Springer	
Course Out Comes	On completion of the course, students should be able CO1: To analyze the errors during measurements CO2: To specify the requirements in the calibration of sensors and instruments CO3: To describe the noise added during measurements and transmission CO4: To describe the requirements during the transmission of measured signals CO5: To suggest proper sensor technologies for specific applications	

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

Course Title	SOFTWARE SKILL DEVELOPMENT -II										
Course Code	Category	Sem	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0530	ESC	V	1	-	-	-	50	-			50

Cognitive Level	K3 : 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 drawings

Remote Sensing and GIS software

List of Exercises:

1. Image Rectification and Image Restoration(Pre Processing)
    a. Image Registration(Geometric correction)
    b. Radiometric Correction(Atmospheric correction)
    c. Noise Removal
2. Image Enhancement
    a. Single band Enhancement
        i. Band Thresholding
        ii. Level Slicing
        iii. Contrast Manipulation
    b. Multiband Enhancement
        i. Band Ratioing
        ii. Vegetative analysis
        iii. Principle component Analysis
    c. Image Classification
        i. Supervised classification
        ii. Unsupervised classification
        iii. Hybrid classification
3. Accuracy Assessment
4. Image change Detection
5. Topographic analysis
6. 3D Modeling
7. Layout preparation

<table>
<tr><td>Course Title</td><td colspan="11">CONSTITUTION OF INDIA</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>18PSDU0501</td><td>MC</td><td>V</td><td>-</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">K1: Recall the basic constitution of India
K2 : understand the fundamental rights and principles
K3 : Apply the knowledge and interpret the reality</td></tr>
<tr><td>Course Objectives</td><td colspan="11">1. To introduce the basic principles and features of the Indian Constitution.
2. To familiarize students on the fundamental rights and their application
3. To help students to understand the working of executive, legislature and Judiciary in India.</td></tr>
</table>

Unit	Content	No.of Hours
I	**Making of Indian Constitution** Philosophy- Preamble- Salient Features of Indian Constitution.	5
II	**Fundamental Rights and Directive Principles** Fundamental Rights- Directive Principles of State Policy – Fundamental Duties.	5
III	**Executive** Union Executive : President – Prime Minister -Council of Ministers. State Executive: Governor – Chief Minister – Council of Ministers.	5
IV	**Legislature** Parliament : Structure, Powers and Functions. State Legislature: Structure, Powers and Functions.	5
V	**Judiciary in India** Supreme Court: Composition of Judiciary - Power and Functions. High Court: Power and Functions Judicial Review.	5
References	1. Basu D.D., Introduction to Indian Constitution, New Delhi: Prentice Hall of India Private Limited, 1994. 2. Pylee M.V., Constitutional Government in India, New Delhi: S. Chand and Company, 1984.	

	3. Basu D.D., Shorter Constitution of India, New Delhi: Prentice Hall, 1981. 4. Johari, Indian Government and Politics, Delhi: Vishal Publications, 1984. 5. Siwach J.R., Dynamics of Indian Government and Politics, New Delhi: Sterling Publishers Private Limited, 1985.	
Course Out Comes	At the end of the course, students must be in a position to: **CO1**: Understand basics of constitution **CO2**: understand the Fundamental Rights and Directive Principles **CO3**: understand the executive roles and responsiblities **CO4**: Understand the basics of legislative **CO5**: Understand the Judiciary in India functions and responsibilities	

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

SEMESTER -VI

<table>
<tr><td>Course Title</td><td colspan="12">HYDROLOGY AND WATER RESOURCE 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>18BCEU0632</td><td>PCC</td><td>VI</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">KI : recall the fundamental principles of hydrologic cycle and their components
K2: Understand the basics principles of various components
K3: Apply the knowledge to field issues and solve the problems</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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 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	9

	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**: S tudy 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

<table>
<tr><td>Course Title</td><td colspan="13">ENGINEERING AND ECONOMICS, ESTIMATION & COSTING</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></td><td>VI</td><td>4+1.5</td><td>3</td><td>1</td><td>3</td><td>4</td><td>60</td><td>30</td><td>20</td><td>150</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">k1-to recall the basics principles of economics and its government policies,cash flow in managerial economics
K2- to understand the concept of estimation of various items of work
K3-to understand the detailed specifications for different buildings, roads,bridges ,industrial structures
K4-to calculate the total quantities and their cost for different structures,and to prepare the tender documents and bid preparations</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The main objective of this course to
Introduce knowledgeabout the basic principles of economics,market structure,intrest rates ,taxes,cost flows and investment analysis and their policies
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, specitation and bid process</td></tr>
</table>

Unit	Content	No.of Hours
I	Basic Principles and Methodology of Economics. Demand/Supply – elasticity – Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes Public Sector Economics –Welfare, Externalities, Labour Market.Components of Monetary and Financial System, Central Bank – Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets.Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve.	
II	Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method. Indian economy - Brief overview of post-independence period – plans. Post	

	reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors.	
III	*Estimation /* Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying	
IV	Specifications-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures. Rate analysis-Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity.	
v	Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management ,Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.	
PRACTICALS	**Term Work Assignments may** include 1. Deriving an approximate estimate for a multistoried building by approximatemethods. 2. Detailed estimate for the following with the required material survey for thesame. a. Ground plus three storied RCC Framed structure building with blockworkwalls b. bridge with minimum 2spans c. factorybuilding d. roadwork e. cross drainage work f. Ground plus three storied building with load-bearing walls g. Cost of finishes, MEP	

	works for (f)above 3. Preparation of valuation report in standard Government form. 4. Assignments on rate analysis, specifications and simpleestimates. 5. Detailed estimate of minorstructure. 6. Preparation of Bar bendingschedule.	
References	**Text/Reference Books:** 1. Mankiw Gregory N. (2002), *Principles of Economics,* ThompsonAsia 2. V. Mote, S. Paul, G. Gupta(2004), *Managerial Economics,* Tata McGrawHill 3. Misra, S.K. and Puri (2009), *Indian Economy*,Himalaya 4. PareekSaroj (2003), *Textbook of Business Economics*, SunrisePublishers 5. M Chakravarty, Estimating, Costing Specifications &Valuation 6. Joy P K, Handbook of Construction Management,Macmillan 7. B.S. Patil, Building & EngineeringContracts 8. Relevant Indian StandardSpecifications. 9. World Bank Approved ContractDocuments. 10. FIDIC ContractConditions. 11. Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration 12. Typical PWD Rate Analysisdocuments. 13. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification andValuations,2016 14. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers,2016 :	
Course Out Comes	CO1:Have an idea of Economics in general, Economics of India particularly for public sector agencies and private sector businesses CO2: Be able to perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives. Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives. CO3: Be able to understand the technical specifications for various works to be performed for a project and how they impact the cost of astructure. CO4: Be able to quantify the worth of a structure by evaluating quantities of constituents, derive their cost rates and build up the overall cost of the structure. CO5: Be able to understand how competitive bidding works and how to submit a competitive bid proposal.	

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	CONSTRUCTION ENGINEERING AND MANAGEMENT											
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0634	PCC	VI	3	2	1		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.

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	9
II	Detailed construction planning work break-down structure; 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, 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.	9
III	Construction Methods and Equipment 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 structure; Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes,	9

	Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities	
IV	Planning for manpower materials Equipments; resource aggregation, allocation, smoothening and levelingResource Scheduling- Bar chart, line of balance technique, resource constraints and conflictsFunds: cash flow, sources of funds; Histograms and S-Curves. Earned Value;Construction Costs: Make-up of construction costs; Classification of costs, timecost trade-off in construction projects, compression and decompression. Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses;; Delays, penalties and liquidated damages; Termination; Dispute Resolution methods.	9
V	Project Monitoring & Control- Supervision, record keeping, periodic progress reports. 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 quality control. Accidents-their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health	9
References	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 Out Comes	**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		OPEN ELECTIVE – II									
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
-	**OEC**	VI	3	3	-	-	40	60	--	-	100

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

Course Title		OPEN ELECTIVE – III									
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU06OX	**OEC**	VI	3	3	-	-	40	60	--	-	100

- The students should undergone the courses 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**	
18BCEU06EX	PEC-CE	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 I										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU06EX	PEC-CE	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	**INTERNSHIP-II**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0635	PROJ	**VI**	1	-	-	-	-	-	100	-	100
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 1. The students should understand and realize the real time projects planning and execution 2. They can acquire knowledge of various skill based areas										

1. 30 days In plant training is to be undergone by the students in any industry and certificate as to be enclosed along with a report about the works carried out during training.
2. Any software training in the reputed centre / organization and certificate as to be enclosed along with a report about the exercises carried out during training.

EVALUATION PROCEDURE

1. Evaluation of In plant Training Report :50 Marks
2. Viva voce examination : 50marks

(Evaluated by the internal examiner appointed by the HOD)

<table>
<tr><th>Course Title</th><th colspan="11">SOFTWARE SKILL DEVELOPMENT -III</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Sem</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>18BCEU0636</td><td>ESC</td><td>VI</td><td>1</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">K3 : 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>

SUGGESTED TOPICS:

1. Design and drawing of RCC cantilever and counter fort type retaining walls with reinforcement details
2. Design of solid slab and RCC Tee beam bridges for IRC loading and reinforcement details
3. Design of pressed, rectangular and hemispherical bottomed steel tank – Staging – Detailed drawings
4. Design and drafting of Into type water tank, Detailing of circular and rectangular water tanks
5. Design of plate girder bridge – Twin Girder deck type Railway Bridge – Truss Girder bridges – Detailed Drawings including connections.

TEXT BOOKS:

1. Krishna Raju, "Structural Design & Drawing (Concrete & Steel)", CBS Publishers
2. Punmia, B.C., Ashok Kumar Jain, Arun Kumar Jain, "Design of steel structures", Lakshmi publications Pvt. Ltd.
3. Civil Engineering Drawing & House Planning – B.P. Verma, Khanna Publishers, Delhi.
4. Building Drawing & Detailing – Dr. Bala Gopal & T.S.Prabhu, Spades Publishers, Calicut

REFERENCES:

1. Krishnamurthy, D., "Structural Design & Drawing – Vol. II", CBS Publishers & Distributors, New Delhi
2. Krishnamurthy, D., "Structural Design & Drawing – Vol. III Steel Structures", CBS Publishers & Distributors, New Delhi

SEMESTER- VII

Course Title	PROFESSIONAL ELECTIVE - III											
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU07EX	PEC-CE	VII	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 - IV										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU07EX	PEC-CE	VII	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 - V										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU07EX	PEC-CE	VII	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	
18BCEU07EX	PEC-CE	VII	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><td>Course Title</td><td colspan="13">PROJECT -I</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semest er</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>CF A</td><td>ESE</td><td>CF A</td><td>ESE</td></tr>
<tr><td>18BCEU0737</td><td>PROJ</td><td>VII</td><td>4</td><td>-</td><td>-</td><td>8</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K4: Analyze the current issues related to civil engineering
K5 : Examine the possibilities of solutions of civil engineering sector
K6 : develop or find the solutions for that issues</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The objective of this course is
1. To impart and improve the design capability of the student.</td></tr>
</table>

- 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

SEMESTER – VIII

<table>
<tr><th>Course Title</th><th colspan="12">PROFESSIONAL ELECTIVE - VII</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>18BCEU08EX</td><td>PEC-CE</td><td>VIII</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 - VIII</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>18BCEU08EX</td><td>PEC-CE</td><td>VIII</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 elective courses at civil engineering related sectors which are offered by the Centre for Rural technology , GRI</td></tr>
</table>

<table>
<tr><th colspan="2">Course Title</th><th colspan="10">OPEN 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>18BCEU08OX</td><td>OEC</td><td>VIII</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 Centre for Rural Technology , GRI</td></tr>
</table>

Course Title	PROJEACT-II										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0838	PROJ	VIII	6	-	-	12	-	-	125	75	200
Cognitive Level	K4: Analyze the current issues related to civil engineering K5 : Examine the possibilities of solutions of civil engineering sector K6 : develop or find the solutions for that issues										
Course Objectives	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										

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 AND MANAGEMENT

Course Title	BUILDING CONSTRUCTION PRACTICE										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0XEX	PEC-CE	-	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 inventorymanagement.	9
IV	**Stores Management** Receipt and inspection, care and safety in handling, loss on storage,wastage, Bulk purchasing, site layout and site organization, scheduling of men, materials and equipment.	9
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

<table>
<tr><td>Course Title</td><td colspan="12">SUSTAINABLE CONSTRUCTION METHODS</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>18BCEU0XEX</td><td>PEC-CE</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 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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

<table>
<tr><th>Unit</th><th>Content</th><th>No.of Hours</th></tr>
<tr><td>I</td><td>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);</td><td>9</td></tr>
<tr><td>II</td><td>Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures;</td><td>9</td></tr>
<tr><td>III</td><td>Basic construction methods for steel structures; Basics of construction methods for Bridges; Identification of cutting edge sustainable construction materials, technologies,</td><td>9</td></tr>
<tr><td>IV</td><td>Project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity.</td><td>9</td></tr>
<tr><td>V</td><td>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.</td><td>9</td></tr>
<tr><td>References</td><td>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</td><td></td></tr>
<tr><td>Course Out Comes</td><td>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</td><td></td></tr>
</table>

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

<table>
<tr><td>Course Title</td><td colspan="12">INFRASTRUCTURE PLANNING AND MANAGEMENT</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>18BCEU0XEX</td><td>PEC-CE</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- Cite the role of infrastructure in economic development
K2- Explain the factors and demand for infrastructure development
K3- Apply the knowledge of emerging trends for infrastructural development</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• To promote infrastructural development as per the demand and level of service needed
• To promote planned economical and artistic infrastructural development</td></tr>
</table>

Unit	Content	No.of Hours
I	Introduction: Definition of basic terminologies, role of infrastructure in economic development, types of infrastructure, measurement of infrastructure capacity, bases for quantification of demand and supply of various types of infrastructure, Indian scenario in respect of adequacy and quality.	9
II	Infrastructure Planning: Goals and objectives of infrastructure planning; Identification and quantification of the casual factors influencing the demand for infrastructure; review and application of techniques to estimate supply and demand for infrastructure; use of econometric, social and land use indicators and models to forecast the demand and level of service of infrastructure and its impact on land use;	9
III	Critical review of the relevant forecasting techniques; infrastructure planning to identify and prioritize preferred areas for development; Integration of strategic planning for infrastructure at urban, regional and national levels; case studies in infrastructure planning	9
IV	Infrastructure Management: Concepts, Common aspects of urban and rural infrastructure management systems; pavement and bridge management systems, integrated infrastructure management, Case studies;	9
V	Emerging trends in infrastructure: Overview of Public-Private Sector Participation in infrastructure projects, Understanding stakeholders' concerns, regulatory framework, risk management in infrastructure projects, public policy for infrastructure Sectoral Overview: Highways, railways, waterways, airports, urban and rural infrastructure: roads, housing, water supply, sanitation – case study examples.	9

References	• Construction Engineering & management of Projects (For Infrastructure & Civil Works) by S. C.Sharma, Khanna Publishers, 2nd Edition, 2011 • Infrastructure Today – Magazine • Public Private Partnership in Infrastructure by R. N. Joshi Vision Publications – 2010.	
Course Out Comes	At the end of this course students able to **CO1:** Develop different types of infrastructure **CO2:** Plan the infrastructural development based on demand and level of service needed **CO3:** Plan infrastructure at urban, Regional and National level **CO4:** Manage the projects in all the aspects of urban and rural systems ***CO5:*** Use the recent trends in public and private sector infrastructure projects	

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	REPAIR AND REHABILITATION OF STRUCTURES										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XEX	PEC-CE	-	3	3	-	-	40	60	-	-	100
Cognitive Level	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										
Course Objectives	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.										

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

<table>
<tr><td>Course Title</td><td colspan="11">MATERIALS MANAGEMENT</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>18BCEU0XEX</td><td>PEC-CE</td><td>-</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>Cognitive Level</td><td colspan="11">K1- Recall standards for materials and its management
K2-understand the inventory control techniques
K3- apply the knowledge of inventory control in material management</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• To know about the basics and importance of material management and quality control concepts</td></tr>
</table>

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 materialsmanagement, Role of materials manager.	5
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 analysisconcept of (MRP) Material requirement planning, planning, purchase procedure, legalaspects.	5
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 inventorymanagement.	5
IV	**Stores Management** Receipt and inspection, care and safety in handling, loss on storage,wastage, Bulk purchasing, site layout and site organization, scheduling of men, materials and equipment.	5
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.	5

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 TECHNOLOGY**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0XEX	PEC-CE	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- Recall the construction Equipments and management of materials K2-understand properties of ingredients of concrete to satisfy the construction field requirements K3-apply the knowledge of underwater construction in the field of civil engineering										
Course Objectives	The Course aims to • Study about the concrete mix design by various methods to reach the target strength • Study the various methods of construction and Equipments used for the construction										

Unit	Content	No.of Hours
I	**Underground &Under water Construction :**Underground and Underwater Construction – Tunnel-Shaft sinking, Micro Tunneling, Tunnel driving in hard and soft strata, bedding of conduits. Problems encountered. Underwater drilling, blasting, Grouting methods in soft and hard soil including Jet grouting and Chemical grouting, Dewatering in shallow and deep excavations using different methods, Vacuum Dewatering and Well pointsystem.	9
II	**Construction using Concrete Technology:**Concrete – Various methods of shuttering, ReadyMix Concrete, PumpedConcrete, Concrete mix design with various methods of concretingand also underwater concreting using tremie method, Concreting for under water Construction.	9
III	**Pile Construction:** Pile Capacity - Load test on piles initial and routine, failure and causes, Methods of pile driving by Vibration and Construction of micro piles, Diaphragm Walls. Piling – Single pile and a group piles (Bored and Driven) duringdriving, Working loads and ultimate loads on driven and cast- in-situ piles, Piles in land and marine structures. Construction details of precast piles, pre stressed piles, steel piles and frictionpiles.	9
IV	**Coffer Dams&Caissons** Cofferdam and its types, design and construction of single, double wall. Cofferdam. Sheet pile cofferdams, concrete wall movable cofferdam, land cofferdams, soldier construction method. Cofferdam wall by ICOS method. Types, box, pneumatic and open caissons, Well foundations, details, design and construction of caissons.	9

V	**Equipment &Construction Management:** Equipment Management, Costing, Optimum utilization and Equipment selection, depreciation, interest on capital, Manpower, Spare parts etc, Documentation, Log-Books, History Books, Periodical MIS Report. Construction Equipments – Understanding basics and functions of Equipment Earthmoving Machinery, Concreting Equipment, Material Handling Equipment and Transportation of Equipments.	9
References	1. 1.Construction Technology: Analysis,and Choice, 2ed,Bryan, Wiley India 2. Construction Planning, Equipment and methods – Peurifoy-Tata McGraw Hill Publication 3. Construction Equipment Planning and Applications – Dr. Mahesh Varma 4. Brochures Published by various agencies associated with construction. 5. Journals such as CE & CR. Construction world, International Construction. 6. Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005.	
Course Out Comes	Students able to **CO1:** Construct any underground and underwater construction **CO2:** Design and construct the underwater structures **CO3:** Familiarize the students with basic understanding of pile construction **CO4:** Design and construct the coffer dam **CO5:** Equipment that are needed for various types of structures	

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	2	1	2
CO 4	3	2	3	2	2
CO 5	3	1	2	2	3

II. TRANSPORTATION ENGINEERING

<table>
<tr><td>Course Title</td><td colspan="12">INTELLIGENT TRANSPORTATION SYSTEMS</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>18BCEU0XEX</td><td>PEC-CE</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 historical background of ITS
K2-Understand advanced traffic management systems
K3- Apply the knowledge of automated highway systems for ITS programs</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• To expose the recent advancements in Transport Systems</td></tr>
</table>

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	Telecommunicationsin 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, Advanced Vehicle safety systems, Information Management;	9
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: anage 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 ANDDESIGN											
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XEX	PEC-CE	-	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	**AIRPORTPLANNING** 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	**AIRPORTCOMPONENTS** Airport Classification, Planning of Airfield Components – Runway, Taxiway, Apron, Hanger, PassengerTerminals	9
III	**AIR ROUTE PLANNINGANDEVALUATION** 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 Passenger Choice Models, Decision Window Model, Fleet Assignment	9
V	**AIRLINEECONOMICS** 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	
18BCEU0XEX	PEC-CE	-	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 OFTRANSPORTINFRASTRUCTURE** 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. Wolfgang S.Homburger et.al., „Fundamentals of Traffic Engineering‟ 15th Edition, Institute of Transportation Studies, University of California, Berkely,2001 2. James L.Pline (Edr) „Traffic Engineering Hand Book‟, Institute of Transportation Engineers, Washington DC, USA,1999 3. Nicholas T.Garber, Lester A Hoel, „Traffic and Highway Engineering‟, Revised Second Edition, ITP, California, USA,1999 4. Thomas Curinan, „An Introduction to Traffic Engineering – A Manual for Data Collection and Analysis‟, Books Cole, UK,2001 5. Kadiyali, L.R., „Traffic Engineering and Transport Planning‟, Khanna Publishers, Delhi,2002	
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

<table>
<tr><td>Course Title</td><td colspan="12">RAILWAY ENGINEERING</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semest er</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>CF A</td><td>ESE</td><td>CF A</td><td>ESE</td></tr>
<tr><td>18BCEU0XE X</td><td>PEC-CE</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="12">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</td></tr>
<tr><td>Course Objectives</td><td colspan="12">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</td></tr>
</table>

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	9

	and Yards, Rolling Stock, Tractive Power, Track Resistance, Level Crossings	
References	1. Rangwala, Railway Engineering, Charotar Publishing House, 1995 2. SaxenaSubhash C and SatyapalArora, A Course in Railway Engineering, DhanpatRai and Sons, Delhi, 1998 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

Course Title	URBAN AND REGIONAL PLANNING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XEX	PEC-CE	-	3	3	-	-	40	60	-	-	100
Cognitive Level	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										
Course Objectives	The Course aims • Provides a basic knowledge on Urbanization and itstrend. • Deals with different types of plan, its implementation, regional development and management for sustainable urbangrowth.										

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	**PLANNINGPROCESS** 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 Regionalplanning.	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 (74th 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	
18BCEU0XEX	PEC-CE	-	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	OZA.H.P and Oza.g.H" A course in docks and harbor Enginnering" anandchartor publishing house pvt.Gujarat 2010 S.P.Bindra A course in Docks and Harbour Engineering DhanpatRai publications New delhi 1993	
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

<table>
<tr><td>Course Title</td><td colspan="12">PAVEMENT MATERIALS</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>18BCEU0XEX</td><td>PEC-CEEL</td><td>-</td><td>2</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 soil classifications and its characteristics
K-2: Understand the preparation, properties and tests for Bitumen
K-3: Solve the pavement mix design problems</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• Togivethestudentstohandsonexperienceonthevarioustestingproceduresofpavement materials as per the IRCstandards.</td></tr>
</table>

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.	5
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:	5
III	Mechanical properties: Resilient modulus, dynamic modulus and fatigue characteristics of bituminous mixes. bituminousmixdesign methods and specifications.	5
IV	Weathering and Durability of Bituminous Materials and Mixes. Performance based Bitumen Specifications;	5
V	Superpavement mix design method: design example problems. Cement Concrete for Pavement Construction: Requirements, and design of mix for CC pavement, IRC and IS specifications and tests, joint filler and sealer materials.	5
References	1. Khanna SK and Justo CEG, “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	On completion of the course, students should be CO1: To know about the soil strength evaluations	

Comes	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

<table>
<tr><td>Course Title</td><td colspan="12">TRANSPORTATION SYSTEMS PLANNING</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semest er</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>CF A</td><td>ESE</td><td>CF A</td><td>ESE</td></tr>
<tr><td>18BCEU0XE X</td><td>PEC-CE</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 existing transportation systems in India
K2-understand the systems of simulation modelling
K3-apply the theories for land use transportation models</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
To impart knowledge in the rudiments and advancements Transportation Planning and Travel DemandForecasting</td></tr>
</table>

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)** Accessibility Measures and Basic Theories – Lowry Derivatives Model- Garin Model –Approach and Simulation Modeling in LUT Model - Multimodal Transportation Planning.	9
References	1. John Khisty C, Kent Lall B, "Transportation Engineering – An Introduction, 3rd Edition, PrenticeHall of India, New Delhi,2002 2. Papacostas C.S., Prevedouros, "Transportation Engineering and Planning, 3rd Edition, Prentice Hall of India, New Delhi,2002 3. John D.Edwards (Edr.), "Transportation Planning Hand Book", 2nd Edition, Institute of Transportation Engineers, Prentice Hall Inc., Washington DC, USA,1999 4. 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

III. ENVIRONMENTAL ENGINEERING

<table>
<tr><th>Course Title</th><th colspan="12">ECOLOGICAL ENGINEERING</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>18BCEU0XEX</td><td>PEC-CE</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 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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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,</td></tr>
</table>

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

<table>
<tr><td>References</td><td>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 (5th 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.</td><td></td></tr>
<tr><td>Course Out Comes</td><td>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</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><th>Course Title</th><th colspan="12">TRANSPORT OF WATER AND WASTE WATER</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>18BCEU0XEX</td><td>PEC-CE</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 continuity, energy and momentum principles
K-2 Understand the various pipe materials and their fixtures.
K-3 Apply the software tools for network desgin</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

Unit	Content	No.of Hours
I	Fluid flow - Fluid flow: continuity, energy and momentum principles; frictional head losses in free and pressure flow, major and minor head losses and their estimation. Pumping of fluids and selection of pumps. Flow measurement.	9
II	Water transmission and distribution - Planning factors. Water transmission main design. Pipe material and economics; water distribution pipe networks, and methods for their analysis and optimisation. Laying and maintenance of pipelines; in situ: lining, appurtenances and corrosion prevention	9
III	Wastewater collection and conveyance -Design of sanitary sewer; partial flow in sewers, economics of sewer design; sewer appurtenances; material, construction, inspection and maintenance of sewers; design of sewer outfalls: mixing conditions; conveyance of corrosive wastewaters.	9
IV	Storm water drainage - Run-off estimation, rainfall data analysis, storm water drain design. Rainwater harvesting	9
V	Software applications -Use of computer automated tools in water transmission, water distribution and sewer design. LOOP, SEWER, BRANCH, and other tools.	9
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 Out Comes	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	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	2	1	2	2	2
CO 2	3	2	2	3	2
CO 3	3	2	2	3	2
CO 4	2	2	1	2	1
CO 5	3	2	2	3	2

<table>
<tr><td rowspan="2">Course Title</td><td colspan="12">ENVIRONMENTAL LAWS AND POLICIES</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>18BCEU0XEX</td><td>PEC-CE</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 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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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	9

	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	
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
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 Out Comes	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	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	1	2	2	1
CO 2	1	1	2	2	2
CO 3	2	2	2	2	1
CO 4	2	1	2	2	1
CO 5	1	1	2	1	1

<table>
<tr><td rowspan="2">Course Title</td><td colspan="13">PHYSICO-CHEMICAL PROCESSES OF WATER AND WASTE WATER</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>18BCEU0XEX</td><td>PEC-CE</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 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.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

Unit	Content	No. of Hours
I	Introduction - Pollutants in water and wastewater – characteristics, Standards for performance - Significance of physico-chemical treatment – Selection criteria-types of reactor-reactor selection-batch continuous type-kinetics	9
II	Treatment Principles - Physical treatment - Screening – Mixing, Equalization – Sedimentation – Filtration – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption – Isotherms – Membrane separation, Reverse Osmosis, nano filtration, ultra filtration and hyper filtration electrodialysis, distillation – stripping and crystallization – Recent Advances. Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends	9
III	Design of Municipal Water Treatment Plants- Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation – clarifier – tube settling – filters – Rapid sand filters, slow sand filter, pressure filter, dual media Disinfection - Displacement and gaseous type - Flow charts – Layouts – Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Up gradation of existing plants – Recent Trends.	9
IV	Design of Industrial Water Treatment Plants - Design of Industrial Water Treatment Units- Selection of process – Design of softeners – Demineralizers –Reverse osmosis plants –Flow charts – Layouts –Hydraulic Profile, PID - construction and O&M	9

	aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.	
V	Design of Wastewater Treatment Plants - Design of municipal wastewater treatment units-screens-detritors-grit chamber-settling tanks sludge thickening-sludge dewatering systems-sludge drying beds - Design of Industrial Wastewater Treatment Units-Equalization- Neutralization-Chemical Feeding Devices-mixers floatation units-oil skimmer Flow charts – Layouts –Hydraulic Profile, PID, construction and O&M aspects – case studies, Retrofitting - Residue management – Upgradation of existing plants – Recent Trends.	9
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 Out Comes	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	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	1	1	1	1
CO 2	1	2	2	1	1
CO 3	2	2	3	2	3
CO 4	2	2	2	2	3
CO 5	2	2	3	2	3

<table>
<tr><th>Course Title</th><th colspan="12">RURAL WATER SUPPLY AND ON-SITE SANITATION SYSTEMS</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Sem.</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>18BCEU0XEX</td><td>PEC-CE</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 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 - 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
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 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 ground water pollution	

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

<table>
<tr><td>Course Title</td><td colspan="13">AIR AND NOISE POLLUTION CONTROL</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>18BCEU0XEX</td><td>PEC-CE</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 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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

Unit	Content	No.of Hours
I	Air pollution and its effects -Air Pollutants: sources, classification, effect on animal health, vegetation, materials, and atmosphere. Chemical and photochemical reactions in the atmosphere and their effects: smoke, smog, acid rain and ozone layer depletion. Greenhouse gases, global warming and its implications. Air pollution legislation and standards.	9
II	Air pollution dispersion and modeling -Meteorology and air pollution: atmospheric stability and inversions, behavior of air pollutant plumes as effected by nature of source, meteorology, obstacles and terrain; maximum mixing depth. Effluent dispersion theories: models for point and line sources based on Gaussian plume dispersion and their limitations: models for heavy gas dispersion. Box model for area sources. Prediction of effective stack height: Holland's and Briggs equations. Issues of indoor air quality.	9
III	Air pollution prevention and control – Reduction in the generation of particulate matter by process modification, good housekeeping, and other means. Control of SPM: concepts and the design elements of gravitational settlers, centrifugal collectors, wet collectors, electrostatic precipitators, fabric filters, condensers.	9
IV	Air pollution prevention and control – II (16 contact hours) Sources of air pollution from fossil fuels and industrial processes. Prevention and reduction of emissions, cleaner production. Air pollution control by absorption, adsorption, condensation, incineration, bio-scrubbers, bio-filters, etc. Design and performance equations, case studies.	9

V	Noise pollution and its control - Generation and propagation of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources; multiple sources; outdoor and indoor noise propagation; psycho-acoustics and noise criteria. Effects of noise on health. Annoyance rating schemes; noise standards and limit values. Noise pollution measuring instrumentation and monitoring procedure. Noise pollution prevention and control.	9
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 Out Comes	On completion of the course, students should be **CO1:** Apply sampling techniques **CO2:** Apply modeling techniques **CO3:** Suggest suitable air pollution prevention equipments 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	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	2	1	1	1
CO 2	2	2	1	1	1
CO 3	2	2	1	1	2
CO 4	2	2	1	1	2
CO 5	2	2	1	1	2

<table>
<tr><td>Course Title</td><td colspan="12">SOLID AND HAZARDOUS 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>18BCEU0XEX</td><td>PEC-CE</td><td>-</td><td>2</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 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">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.</td></tr>
</table>

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 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,	5

	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

<table>
<tr><td>Course Title</td><td colspan="12">WATER AND AIR QUALITY MODELS</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>18BCEU0XEX</td><td>PEC-CE</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 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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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	9

	modeling techniques, modeling for non-reactive pollutants, single 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	**ENVIRONMENTAL IMPACT ASSESSMENT**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0XEX	PEC-CE	-	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 – Industrial - Thermal Power - River valley and Hydroelectric – coastal projects-Nuclear Power	9
Referen ces	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.	
Course Out Comes	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	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

IV. HYDRAULICS

<table>
<tr><td>Course Title</td><td colspan="12">IRRIGATION 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>18BCEU0XEX</td><td>PEC-CE</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: 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, Duty and delta relation, Introduction to various methods of application of irrigation water, Irrigation efficiency, assessment of irrigation water	9
II	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-fill dams, Spillways, Types of spillways, Spillways gates and energy dissipation works.	9
III	Diversion Works: Different stages of a river and their flow characteristics, Weir and barrages, Various parts of a weir and	9

	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-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	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. REFERENCES: 4. 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 5. Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGrawHill Inc., New Delhi, 1997. 69 6. Sharma R.K.. "Irrigation Engineering", S.Chand & Co. 2007. 7. Michael A.M., Irrigation Theory and Practice, 2nd Edition, Vikas Publishing House Pvt. Ltd., Noida, Up, 2008 8. Asawa, G.L., "Irrigation Engineering", NewAge International Publishers, New Delhi, 2000. 9. 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

<table>
<tr><td>Course Title</td><td colspan="13">PIPE LINE 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>18BCEU0XEX</td><td>PEC-CE</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 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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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</td></tr>
</table>

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 – gravity flow design, pressurized flow- rigid and flexible pipes – installation – trenchless technology	9
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.	9

	Method of characteristics. Transients caused by centrifugal pumps and hydroelectric power plants.	
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

<table>
<tr><td>Course Title</td><td colspan="12">OPEN CHANNEL FLOW</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>18BCEU0XEX</td><td>PEC-CE</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 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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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. Recent advancement in open channel flow measurements. Physical modeling in hydraulics. Dimensional analysis. Modeling closed flows and free surface flows.	9

	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	

<table>
<tr><td>Course Title</td><td colspan="12">RIVER 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>18BCEU0XEX</td><td>PEC-CE</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 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.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">1. To understand theoretical concepts of water and sediment movements in rivers
2. To inculcate the benefits of fluvial system to the society</td></tr>
</table>

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 Quality and ecological model	9
V	**RIVER MANAGEMENT** River training works and river regulation works – Flood	9

	plain management – waves and tides inEstuaries - Interlinking of rivers – River Stabilization	
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 Out Comes	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

<table>
<tr><td rowspan="2">Course Title</td><td colspan="12">URBAN WATER RESOURCES MANAGEMENT</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>18BCEU0XEX</td><td>PEC-CE</td><td>-</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>Cognitive Level</td><td colspan="11">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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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	5

	measures – Measures of urban drainage and flood control benefits – Effective urban water user organizations.	
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	1. At the completion of the course the student should be able to apply appropriate management techniques for planning, operating and maintaining the different components of urban and drainage system.	
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**	
18BCEU0XEX	PEC-CE	-	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 drains and wells. Recharge through sewage pits, shafts and wells.	9
V	**sea water intrusion:** Occurrence of sea water intrusion - Ghypon-Heizberg relation	9

	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	
References	Raghunath H.M., Ground Water Hydrology, New-Age International, 2nd Edition, 1990.	
Course Out Comes	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

V. HYDROLOGY AND WATER RESOURCE ENGINEERING

<table>
<tr><td>Course Title</td><td colspan="11">WATER RESOURCES SYSTEMS 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>CF A</td><td>ESE</td><td>CF A</td><td>ESE</td></tr>
<tr><td>18BCEU0XE X</td><td>PEC-CE</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 basics sytems analysis concept
K2 : understand the principles of different types of programming
K3 : Apply the principles in model development for water resources</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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

<table>
<tr><th>Course Title</th><th colspan="12">SURFACE WATER HYDROLOGY</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Sem.</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>CF A</th><th>ESE</th><th>CF A</th><th>ESE</th></tr>
<tr><td>18BCEU0XE X</td><td>PEC-CE</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 basics principles of hydro metrology
K2 : understand the principles of hydrology components
K3 : Apply the principles for real life situations and solve the problems.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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	**8**

	measurement – Area Velocity method - Area Slope method – Discharge Measuring Structures - Dilution Technique – Stage Discharge relationship – Selection of a Stream Gauging Site.	
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, 2nd 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	

<table>
<tr><td>Course Title</td><td colspan="11">REMOTE SENSING AND GIS IN WATER RESOURCES</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>18BCEU0XEX</td><td>PEC-CE</td><td>-</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>Cognitive Level</td><td colspan="11">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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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 Merging	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 standards.	5
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 –	5

	AM/FM/GIS – Web Based GIS	
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	
18BCEU0XEX	PEC-CE	-	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 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	9

	Models and Case Studies	
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 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

Course Title	ENVIRONMENTAL HYDRAULICS										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XEX	PEC-CE	-	3	3	-	-	40	60	-	-	100
Cognitive Level	**K1** :Recall the basics principles of hydraulics **K2** : understand the principles of different types of ground water flow and their applications **K3** : Apply knowledge to classify the different hydraulic parameters										
Course Objectives	The Course aims 1. To apply the knowledge of fluid mechanics to analyze and predict mixing in natural bodies of water. 2. To study the hydrodynamic aspects of water quality management in natural bodies of water.										

Unit	Content	No.of Hours
I	**INTRODUCTION TO ENVIRONMENTAL TRANSPORT PROCESSES** Concentration and units of measure – Conservation laws – Systems and Control Volume approach – Differential element approach – Sources, Sinks and box-models – Mixing. Advection-Diffusion equation. Analytical and numerical solution to Advection-Diffusion equation.	9
II	**GROUNDWATER FLOW AND QUALITY MODELING** Dupuit"s approximation – Basic contaminant transport equation – Application of boundary layer approximations – Saltwater intrusion into aquifers – Non-aqueous phase liquid (NAPL) in groundwater – numerical modeling.	9
III	**TRANSPORT PROCESSES IN RIVERS** Mixing in Rivers – Continuous point discharges – Two rivers mixing – Dispersion in rivers.	9
IV	**TRANSPORT PROCESSES IN LAKES AND RESERVOIRS** Reservoir classification – External energy sources – Surface layer – mixing in the hypolimnion – inflows and outflows.	9
V	**TRANSPORT PROCESSES IN THE ESTUARIES** Classification – Forces – wind, tides, rivers –	9

	Trapping and pumping – Estuarine Circulation.	
References	**REFERENCES:** 1. Fischer, H.B., List, E.G., Koh, R.C.Y., Imberger, J and Brooks, N.H. "Mixing in Inland and Coastal Waters" Academic Press, New York, 1979. 2. 2. Clark, M.M., "Transport Modeling for Environmental Engineers and Scientists" John Wiley andSons, New York. 1996. 3. Martin J.L. and McCutcheon S.C. "Hydrodynamics and Transport for Water Quality Modeling" CRC Press, Inc. ISBN:0-87371-612-4, 1999. 4. Chapra, S.C. "Surface Water Quality Modeling" McGraw Hill Book Co. Singapore, 1997. 5. M.Thomann, R.V. and Mueller, J.A. "Principles of Surface Water Quality Modeling and Control" Harper and Row, New York, 1987. 6. Csanady, G.T., "Turbulent Diffusion in the Environment D.Reidel Publishing Co. Holland, 1973. 7. Rubin H. and Atkinson J. "Environmental Fluid Mechanics" Marcel Dekker, Inc. New York. 2001	
Course Out Comes	The students can able to **CO1**:understand fundamental of environmental transport processes **CO2**: understand the ground water flow to develop the valuable modeling **CO3:** understand the river mixing principles **CO4**understand the principles in lake and reservoirs transport processes **CO5** : understand the classification of transport process.	

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

VI. STRUCTURAL ENGINEERING

<table>
<tr><th>Course Title</th><th colspan="11">FINITE ELEMENT ANALYSIS</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Sem.</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>18BCEU0XEX</td><td>PEC-CE</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><th>Course Title</th><th colspan="12">FIRE RESISTANCE OF STRUCTURES</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Sem.</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>18BCEU0XEX</td><td>PEC-CE</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-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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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</td></tr>
</table>

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 BuildingStructures**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, Temperature regime of the tests, Test pieces of structures, Conditions of loading and supporting of structures	9
IV	**Fire Resistance of Reinforced Concreter 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	9

	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	
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

<table>
<tr><td>Course Title</td><td colspan="12">SAFETY OF 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>CF A</td><td>ESE</td><td>CF A</td><td>ESE</td></tr>
<tr><td>18BCEU0XEX</td><td>PEC-CE</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 basic concepts and fundamentals on structural safety and reliability analysis and design .

K-2:Understand the concept of reliability analysis and designon 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..</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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	9

	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	ANALYSIS & DESIGN OF SUB-STRUCTURES											
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XEX	PEC-CE	-	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, performance function and limiting state. Reliability Methods-First Order Second Moment Method (FOSM), Point Estimate Method (PEM), and Advanced First Order Second	9

	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** 5. Ranganathan, R. "Structural Reliability Analysis and design"- Jaico publishing house, Mumbai, India – 1999. 6. 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. 7. 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. 8. 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.	

[

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>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>18BCEU0XEX</td><td>PEC-CE</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 theindustrial 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:** 9. Ramamrutham.S., "Design of Reinforced Concrete Structures", Dhanpat Rai Publishing Company, 2007. 10. Varghese.P.C., " Limit State Design of Reinforced Concrete", Prentice Hall of India Eastern Economy Editions, 2nd Edition, 2003. 11. Bhavikatti.S.S., "Design of Steel Structures", J.K. International Publishing House Pvt.Ltd., 2009. **REFERENCES:** 12. Henn W. "Buildings for Industry", Vol.I and II, London Hill Books, 1995 13. SP32-1986, Handbook on Functional Requirements of Industrial buildings, Bureau of Indian Standards, 1990 14. Structural Engineering Research Centre,Course Notes on Modern Developments in the Design and Construction of Industrial Structures, Madras, 1982 15. 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

<table>
<tr><td>Course Title</td><td colspan="12">DESIGN OF STORAGE STRUCUTRES</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>CF A</td><td>ESE</td><td>CF A</td><td>ESE</td></tr>
<tr><td>18BCEU0XEX</td><td>PEC-CE</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 Fundamentalsof 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/Reerence 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. 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

Course Title	STRUCTURAL ANALYSIS BY MATRIX METHOD										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XEX	PEC-CE	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recalling the basic concepts and fundamentals on behavour of the analysis structural analysis. K-2:Understand the concept of stiffness and flexibility matrices on the analysis of determinate and indeterminate structures. K-3:Apply the principle and laws used for analyzing the of determinate and indeterminate structures K-4: Analyze the member by using flexibility method by the choice of redundant.										
Course Objectives	The Course aims • To study the behaviour of the structure and its degrees of freedom • To Analyse framed structures using flexibility and stiffness method. • Able to analyse the structure subjected to internal thermal stress and expansion due to lack of fit										

Unit	Content	No.of Hours
I	Generalised measurements - Degrees of freedom - Constrained Measurements - Behaviour of structures -.Principle of superposition. Stiffness and flexibility matrices.- Constrained measurements - Stiffness and flexibility coefficients from virtual work.	9
II	Strain energy - Stiffness and flexibility matrices from strain energy - Symmetry and other properties of stiffness and flexibility matrices - Betti's law and its applications - Strain energy in systems and in elements.	9
III	Determinate and indeterminate structures - Transformation of element matrices to system matrices - Transformation of system vectors to element vectors - Normal coordinates and orthogonal transformations	9
IV	Flexibility method applied to statically determinate and indeterminate structures - Choice of redundants - Transformation of redundants - Internal forces due to thermal expansion and lack of fit.	9
V	Development of the method - Internal forces due to thermal expansion and lack of fit - Application to symmetrical	9

	structures - Comparison between stiffness and flexibility methods	
References	16. Moshe, F., Rubenstein, Matrix Computer Analysis of Structures, Prentice Hall, New York, 1986. 17. Rajasekaran S, Computational Structural Mechanics, Prentice Hall of India, New Delhi, 2001 18. Manickaselvam V.K., Elements of Matrix and Stability Analysis of Structures, Khanna Publishers, New Delhi, 1998.	
Course Out Comes	• Able to Analyse framed structures using flexibility and stiffness method. • Able to Analysethe structure having member discontinuities, curved members, non-prismatic members, elastic supports, semi-rigid connections etc. • To know the concepts of indeterminate analysis by flexibility matric method.	

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

Course Title	STRUCTURAL ANALYSIS - I										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XEX	PEC-CE	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recalling the basic concepts and fundamentals on behavour of the the analysis structural analysis. K-2:Understand the concept of stiffness and flexibility matrices on the analysis of determinate and indeterminate structures. K-3:Apply the principle and laws used for analyzing the of determinate and indeterminate structures K-4: Analyze the member by using flexibility method by the choice of redundant.										
Course Objectives	The Course aims • To study the behaviour of the structure and its degrees of freedom • To Analyse framed structures using flexibility and stiffness method. • Able to analyse the structure subjected to internal thermal stress and expansion due to lack of fit										

Unit	Content	No.of Hours
I	Generalised measurements - Degrees of freedom - Constrained Measurements - Behaviour of structures -.Principle of superposition. Stiffness and flexibility matrices.- Constrained measurements - Stiffness and flexibility coefficients from virtual work.	9
II	Strain energy - Stiffness and flexibility matrices from strain energy - Symmetry and other properties of stiffness and flexibility matrices - Betti's law and its applications - Strain energy in systems and in elements.	9
III	Determinate and indeterminate structures - Transformation of element matrices to system matrices - Transformation of system vectors to element vectors - Normal coordinates and orthogonal transformations	9
IV	Flexibility method applied to statically determinate and indeterminate structures - Choice of redundants - Transformation of redundants - Internal forces due to thermal expansion and lack of fit.	9
V	Development of the method - Internal forces due to thermal expansion and lack of fit - Application to symmetrical structures - Comparison between stiffness and flexibility	9

	methods	
References	19. Moshe, F., Rubenstein, Matrix Computer Analysis of Structures, Prentice Hall, New York, 1986. 20. Rajasekaran S, Computational Structural Mechanics, Prentice Hall of India, New Delhi, 2001 21. Manickaselvam V.K., Elements of Matrix and Stability Analysis of Structures, Khanna Publishers, New Delhi, 1998.	
Course Out Comes	At the end of the course the student will • Able to Analyse framed structures using flexibility and stiffness method. • Able to Analyse the structure having member discontinuities, curved members, non-prismatic members, elastic supports, semi-rigid connections etc. • know the concepts of indeterminate analysis by flexibility matric method.	

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

Course Title	STRUCTURAL ANALYSIS - II										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0XEX	PEC-CE	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recalling the basic concepts and fundamentals ofbehavior of theanalytical structural analysis. K-2:Understand the concept of force and displacement method of analysis on structures. K-3:Apply the principle and laws used for analyzing the of determinate and indeterminate structures K-4: Analyze the member by using flexibility method by the choice of redundant.										
Course Objectives	The Course aims • To study the behaviour of the structure and its degrees of freedom • To Analyse framed structures and truess using force method. • Able to analyse the structure subjected to internal thermal stress and expansion due to lack of fit • Able to analyse the single story structure by Kani's method • Able to analyse the cantilever beam curved in plan.										

Unit	Content	No.of Hours
I	Generalised measurements - Degrees of freedom - Constrained Measurements - Behaviour of structures -.Principle of superposition. Stiffness and flexibility matrices.- Constrained measurements - Stiffness and flexibility coefficients from virtual work.	9
II	Strain energy - Stiffness and flexibility matrices from strain energy - Symmetry and other properties of stiffness and flexibility matrices - Betti's law and its applications - Strain energy in systems and in elements.	9
III	Determinate and indeterminate structures - Transformation of element matrices to system matrices - Transformation of system vectors to element vectors - Normal coordinates and orthogonal transformations	9
IV	Flexibility method applied to statically determinate and indeterminate structures - Choice of redundants - Transformation of redundants - Internal forces due to thermal expansion and lack of fit.	9
V	Development of the method - Internal forces due to thermal	9

	expansion and lack of fit - Application to symmetrical structures - Comparison between stiffness and flexibility methods	
References	1. Moshe, F., Rubenstein, Matrix Computer Analysis of Structures, Prentice Hall, New York, 1986. 2. Rajasekaran S, Computational Structural Mechanics, Prentice Hall of India, New Delhi, 2001 3. Manickaselvam V.K., Elements of Matrix and Stability Analysis of Structures, Khanna Publishers, New Delhi, 1998.	
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	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><th>Course Title</th><th colspan="12">BRIDGE ENGINEERING</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Sem.</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>18BCEU0XEX</td><td>PEC-CE</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 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	9
IV	**DESIGN OF PRESTRESSED CONCRETE BRIDGES** Preliminary sections – Flexural and Tensional parameters – Courban’s theory – Design of girder section (I section only) –	9

	Check for stresses at various sections – Check for diagonal tension – Forces in anchorage zone.	
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="12">DESIGN OF CONCRETE STRUCTURES-I</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>18BCEU0XEX</td><td>PEC-CE</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 peoperties of material and its inter relationships
K2-understand the design concepts of various super structurelements
K3-understand the design concepts of various sub structurl elements
K4- design the beam, column, staircase and footing of structures</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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 and footing design</td></tr>
</table>

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-Loading Standard- methods of design- Introduction for WorkingStress Method, Ultimate Load Method (ULM), Limit States Method (LSM), Code Recommendations for Limit States Design - Permissible stresses-Factor of Safety	9
II	**DESIGN OF BEAMS** Limit State Concepts- Assumptions- Characteristic Strength and Load, Partial Safety Factors- Limit state analysis and design of section for shear and torsion,bond, anchorage and development length, I.S. code provisions. Limit state analysis and design of singly reinforced, doubly reinforced, T and L beam -limit state Designof RC members for combined Bending, Shear and Torsion.	9
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.	9

IV	IV DESIGN OF COLUMNS Introduction,buckling of columns,Types of columns –Axially Loaded columns – Design of short Rectangula Square and circular columns –Design of Slender columns- Design for Uniaxial and Biaxial bending using Column Curves-design of spiral reinforced concrete column.	9
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.	9
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

<table>
<tr><td>Course Title</td><td colspan="12">DESIGN OF CONCRETE STRUCTURES-II</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>CF A</td><td>ESE</td><td>CF A</td><td>ESE</td></tr>
<tr><td>18BCEU0XEX</td><td>PEC-CE</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 recall the basic design concepts of rc elements and special rc elements
K2- to understand the design concepts of advanced rc elements
K3-to understand the inelastic behaviour of concrete and ductile detailing for concrete
K4-design calculation of beams columns specilal members and composite sections</td></tr>
<tr><td>Course Objectives</td><td colspan="11">1. To introduce the limit state concepts in structural design and the methods of design
2. To understand the analysis and design for special rc elements as per IS
3. To introduce the yield line theory and its design
4. To understand the concepts of inelastic behaviour
ductile detailing of different structural elements</td></tr>
</table>

Unit	Content	No.of Hours
I	**DESIGN PHILOSOPHY** Building Frames- Approximate methods – substitute frame analysis- - Limit state design -beams, slabs and columns according to IS Codes. Calculation of deflectionand crack width according tIS Code. Design of beamcolumn joints.Design of reinforced concrete braced and un-braced walls. Design offlat slabs.	9
II	**DESIGN OF SPECIAL RC ELEMENTS** Design of slender columns - Design of RC walls. Strut and tie method of analysis for corbels and Deep beams, Design of corbels, Deep-beams and grid floors. Design of beams curved in plan. Design of Silos and Bunkers.	9
III	**FLAT SLABS AND YIELD LINE BASED DESIGN** Yield line theory and Hillerborg's strip method of design of slabs. Equilibrium and Virtual Work method- Analysis and Design of Square, Rectangular and Circular Slabs with different boundary conditions subjected to UDL and Concentrated loads, Hillerborg's method of design of slabs. Analysis and Design of Grid floors by approximate analysis.Design of flat slabs and flat plates according to IS method – Check for shear - Design of spandrelbeams	9
IV	**INELASTIC BEHAVIOUR OF CONCRETE BEAMS AND COLUMNS** Redistribution of moments in RC beams- introduction-conditions- advantages- moment curvature relation- ACI guidelines , Design for serviceability Limit states – Design calculations of deflectiosn and crack width as per IS456-2000.	9
V	**DUCTILE DETAILING AND COMPOSITE CONSTRUCTION** Concept of Ductility – Detailing for ductility – Design of beams, columns for ductility - Design of cast-in-situ joints in frames.Introduction to Composite	9

	Construction – behavior and design principles. Steel– Concrete Composite Beams, Beams with in – situ slab and pre cast rib.	
References	**TEXT BOOKS**: Purushothaman ,P, Reinforced concrete structural elements : Behavior, analysis and design, Tata Mc Graw , 1986. 2. Varghese P.C, Advanced Reinforced Concrete Design –- Prentice- Hall of India PrivateLimited , New Delhi, 2002 3. Unnikrishna pillai and Devdas Menon, ‘ Reinforced Concrete Design’, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2002 **REFERENCES:** 1. Shah VL and Karve SR , Advanced Reinforced concrete Design”, Structures Publications Pune , 2002. 2. Sinha S N , Reinforced Concrete Design , Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 1996 3. Johnson R.P. , Composite Structures Vol.-I 4. Punmia B.C., R.C Structures Vol.II, Lakshmi Publication, New Delhi. 5. Shah H.J. , Reinforced concrete Vol. I, Charotar Publishing House, 2005. 6. Gambhir.M. L., “Design of Reinforced Concrete Structures”, Prentice Hall of India, 2012.	
Course Out Comes	After learning the course the students should be able to CO1: know the concepts of approximate methods of analysis and Limit state design method .and its Design CO2: Understanding the analysis the corbel and other special elements and design CO3 :to know the yield line theory and design the flat slab CO4 :to calculate the inelastic behaviour of concrete beams and columns CO5: to understand the concept of ductile detailing and composite construction	

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

Course Title	PRE-STRESSED CONCRETE STRUCTURES											
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0XEX	PEC-CE	-	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 members: Tension member elastic design – Tension member cracking and ultimate strength – Compression members – Design.	9
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
CO 5	2	1	-	2	2

<table>
<tr><td>Course Title</td><td colspan="11">CONSTRUCTION ENGINEERING MATERIALS</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>18BCEU0XEX</td><td>PEC-CE</td><td>-</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>Cognitive Level</td><td colspan="11">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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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</td></tr>
</table>

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.	5
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.	5
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.	5
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.	5

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.	5
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 Out Comes	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

<table>
<tr><th>Course Title</th><th colspan="13">MASONRY STRUCTURES</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Sem.</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>CF A</th><th>ESE</th><th>CF A</th><th>ESE</th></tr>
<tr><td>18BCEU0XEX</td><td>PEC-CE</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 recall the different types of masonary ,behaviour,propertiesof masonary units
K2- to understand the elstic properties and its strength behaviour of compression shear and flexure.
K3-design of load bearing masonary buildings</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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</td></tr>
</table>

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 strength on compressive strength, flexureand shear strength of masonry. Concept of Earthquake resistant masonry buildings.	11
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	10

	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.	
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

<table>
<tr><th>Course Title</th><th colspan="12">BASICS OF DYNAMICS AND ASESISMIC DESIGN</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Sem.</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>18BCEU0XEX</td><td>PEC-CE</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 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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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</td></tr>
</table>

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 – Natural frequencies – Mode shapes - Introduction to MDOF systems – Decoupling of equations of motion – Concept of mode superposition (No derivations).	9
III	**ELEMENTS OF SEISMOLOGY** Causes of Earthquake – Geological faults – Tectonic plate theory	9

	– 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.	
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	RELIABILITY ANALYSIS OF STRUCTURES										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XEX	PEC-CE	-	2	2	-	-	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$y = ab^x$, 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	SMART MATERIALS AND SMART STRUCTURE										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XEX	PEC-CE	-	2	2	-	-	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 – ActuationSystems and effectors.	**9**
II	**MEASURING TECHNIQUES** Strain Measuring Techniques using Electrical strain gauges, Types – Resistance – Capacitance– Inductance – Wheatstone bridges – Pressure transducers – Load cells – TemperatureCompensation – Strain Rosettes	**9**
III	**SENSORS** Sensing Technology – Types of Sensors – Physical Measurement using Piezo Electric StrainMeasurement – 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 ElectrostrictiveMaterial – 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 –	**8**

	Control System – Linear and Non-Linear.	
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

II. GEOTECHNICAL ENGINEERING

Course Title	GROUNDIMPROVEMENTTECHNIQUES										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XEX	PEC-CE	-	2	2	-	-	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	**5**

	clays–case studies.	
References	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><th>Course Title</th><th colspan="11">EARTHQUAKE RESISTANTDESIGNOF FOUNDATIONS</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Sem.</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>CF A</th><th>ESE</th><th>CF A</th><th>ESE</th></tr>
<tr><td>18BCEU0XEX</td><td>PEC-CE</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**
IV	**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.	**9**

	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.	**8**
References	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.	
Course Out Comes	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	

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">FOUNDATION 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>18BCEU0XEX</td><td>PEC-CE</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 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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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.	9
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.	9

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	9
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.	9
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.	9
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	GEOENVIRONMENTAL ENGINEERING										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XEX	PEC-CE	-	3	3	-	-	40	60	-	-	100
Cognitive Level	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										
Course Objectives	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.										

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, electrokinetic remediation, soil heating, vitrification, bio remediation, phyto remediation – ground water remediation – pump and treat , Insitu flushing, permeable reacting barrier, Insitu air sparging - case studies.	**9**

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**	
18BCEU0XEX	PEC-CE	-	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	
18BCEU0XEX	PEC-CE	-	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	**9**

	reaction and elastic analysis, Interaction analysis, pile raft system, solutions through influence charts and Application packages.	
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 CO1To 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 CO3To 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

OPEN ELECTIVES

course Title	ARCHITECTURE										
Course Code	Category	Sem	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
21BCEUXO1	OCE	-	2	2	-	-	40	60	-	-	100
Cognitive Level	K-1 To understand the concepts of Architecture K-2 To understand the climate , types of building and site analysis K-3 To analyze the various case studies.										
Course Objectives	The course aims • To make the students to study the basic Architectural design concepts. • At the end of the course the student gain the knowledge in the Architectural design, climate responsive design, types of climates and design, types of buildings, site planning, zoning and study the regulations for layout planning and urban planning and the landscape design.										

UNIT	Content	No.of Hours
I	**ARCHITECTURAL DESIGN** Architectural design - an analysis - Integration of function and aesthetics - Introduction to basic elements and principles of design.	10
II	**CLIMATE RESPONSIVE DESIGN** Factors that determine climate - Characteristics of climate types - Design for various climate types - Passive and active energy controls.	10
III	**BUILDING TYPES** Residential, institutional, commercial and Industrial - Planning concepts - Application of anthropometry and space standards - Interrelationships of functions - Safety standards - Building rules and regulations - Integration of building services.	10
IV	**SITE PLANNING** Surveys - Site analysis - Development control - Zoning regulations - Layout regulations - Urban planning standards - Layout design concepts.	08
V	**ENVIRONMENT DESIGN** Urban renewal - Conservation - Principles of Landscape design - Case studies	10

References	1. Francis D.K. Ching, " Architecture: Form, Space and Order ", VNR, N.Y., 1999. 2. Givoni B., " Man Climate and Architecture ", Applied Science, Barking ESSEX, 1982. 3. Edward D. Mills, " Planning the Architects Handbook ", Butterworth London, 1995. 4. Gallian B. Arthur and Simon Eisner, " The Urban Pattern - City Planning and Design ", Affiliated Press Pvt. Ltd., New Delhi, 1995. 5. Margaret Roberts, " An Introduction to Town Planning Techniques ", Hutchinson,London,1990. 7.
Course Outcomes	After studying the course, the student will be able to: CO1: students will able to understand concepts of architecture CO2: students will able to understand the climate CO3: students will able to understand different types of buildings CO4: students will able to analyse the site CO5: they can able to apply the knowledge in doing case studies

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

<table>
<tr><td rowspan="2">Course Title</td><td colspan="12">BUILDING SERVICES</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>18BCEU0XO2</td><td>BCE</td><td>-</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>Cognitive Level</td><td colspan="11">K1- Design the Fire Safety Installation
K2-Identify the types of building and its requirements for services systems
K3- understand the different methods of fire resistance in different types of structures</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The course aims
• To make the students to study the electrical systems and lighting. At the end of the course the student gain the knowledge in the Architectural aspects of modern lighting.
• To understand the design concept of Fire Safety and Installation techniques.
• To understand the refrigeration principles & applications for building services systems.</td></tr>
</table>

Unit	Content	No.of Hours
I	**MACHINERIES** Hot Water Boilers – Lifts and Escalators – Special features required for physically handicapped and elderly – Conveyors – Vibrators – Concrete mixers – DC/AC motors – Generators – Laboratory services – Gas, water, aid and electricity.	8
II	**ELECTRICAL SYSTEMS IN BUILDINGS** Basics of electricity – Single/Three phase supply – Protective devices in electrical installations – Earthling for safety – Types of earthling – ISI specifications – Types of wires, wiring systems and their choice – Planning electrical wiring for building – Main and distribution boards – Transformers and switch gears – Layout of substations.	8
III	**PRINCIPLES OF ILLUMINATION & DESIGN** Visual tasks – Factors affecting visual tasks – Modern theory of light and colour – Synthesis of light – Additive and subtractive synthesis of colour – Luminousflux – Candela – Solid angle illumination – Utilisation factor – Depreciation factor – MSCP – MHCP – Lans of illumination – Classification of lighting – Artificial light sources – Spectral energy distribution – Luminous efficiency – Colour temperature – Colour rendering. Design of modern lighting – Lighting for stores, offices, schools, hospitals and house lighting.Elementary idea of special features required and minimum level of illumination required for physically challenged and elderly in building types.	8
IV	**REFRIGERATION PRINCIPLES & APPLICATIONS** Thermodynamics – Heat – Temperature, measurement transfer – Change of state – Sensible heat – Latent heat of fusion, evaporation,	8

	sublimation – saturation temperature – Super heated vapour – Sub cooled liquid – Pressure temperature relationship for liquids – Refrigerants – Vapour compression cycle – Compressors – Evaporators – Refrigerant control devices – Electric motors – Starters – Air handling units – Cooling towers – Window type and packaged air-conditions, - Chilled water plant – Fan coil systems – Water piping – Cooling load – Air conditioning system for different types of buildings – Protection against fire to be caused by A.C. systems.	
V	**FIRE SAFETY INSTALLATION** Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. systems. Special features required for physically handicapped and elderly in building types – Heat and smoke detectors – Fire alarm system, snorkel ladder – Fire lighting pump and water storage – Dry and wet risers – Automatic sprinklers.	8
References	**REFERENCES** 1. E.R.Ambrose, "Heat Pumps and Electric Heating", John and Wiley and Sons, Inc., New York, 1968. 2. Handbook for Building Engineers in Metric systems, NBC, New Delhi, 1968 3. Philips Lighting in Architectural Design, McGraw – Hill, New York, 1964. 4. R.G.Hopkinson and J.D.Kay, "The Lighting of buildings", Faber and Faber, London, 1969. 5. William H.lSeverns and Julian R.Fellows, "Air-conditioning and Refrigeration", John Wiley and Sons, London, 1988. 6. A.F.C. Sherratt, "Air – conditioning and Energy Conservation", The Architectural Press, London, 1980. 7. National Building Code.	
Course Out Comes	CO1: Develop different types of building services systems. CO2: understand fundamental of building services systems. CO3: design the Fire Safety Installation CO4: understand the refrigeration principles & applications for building services systems. CO5: Use the recent trends in building services.	

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	CONTRACT LAWS AND REGULATIONS										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XO3	BCE	-	2	2	-	-	40	60	-	-	100
Cognitive Level	KI: understand contract , tender process, Arbitration K2: knowledge of laws related to insurance bonding and taxes K3: knowledge of laws related to labour welfare.										
Course Objectives	Law of Contracts is designed to give students a theoretical and practical understanding of the Indian Law of contract. The course focuses on solving problem questions on contract law and examines fundamental concepts such as tenders, arbitration, and the control of unfair terms, as well as the remedies arising from breach of contract.										

Unit	Content	No.of Hours
I	**CONSTRUCTION CONTRACTS** Indian Contracts Act – Elements of Contracts – Types of Contracts – Features – Suitability –Design of Contract Documents – International Contract Document – Standard Contract Document – Law of Torts	8
II	**TENDERS** Prequalification – Bidding – Accepting – Evaluation of Tender from Technical, Contractual and Commercial Points of View – Contract Formation and Interpretation – Potential Contractual Problems – World Bank Procedures and Guidelines – Transparency in Tenders Act.	8
III	**ARBITRATION** Comparison of Actions and Laws – Agreements – Subject Matter – Violations – Appointment of Arbitrators – Conditions of Arbitration – Powers and Duties of Arbitrator – Rules of Evidence – Enforcement of Award – Costs.	8
IV	**LEGAL REQUIREMENTS** Insurance and Bonding – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax, Excise and Custom Duties and Their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local Government Laws for Approval – Statutory Regulations	8

V	**LABOUR REGULATIONS** Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration– Insurance and Safety Regulations – Workmen's Compensation Act –Indian Factory Act – Tamil Nadu Factory Act – Child Labour Act - Other Labour Laws	8
References	1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India, M.M.Tripathi Private Ltd., Bombay, 1982 2. Tamilnadu PWD Code, 1986 3. Jimmie Hinze, Construction Contracts, Second Edition, McGraw Hill, 2001 4. Joseph T. Bockrath, Contracts and the Legal Environment for Engineers and Architects, Sixth Edition, McGraw Hill, 2000	
Course Out Comes	After studying the course, the student will be able to: CO1: Understand elements of Indian contract act and types of contract CO2: An idea of process involved in bidding. CO3: An idea of process involved in arbitration CO4: Ability to demonstrate Taxes CO5: knowledge labour legislature related laws.	

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">TOWN AND COUNTRY 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>18BCEU0XO4</td><td>BCE</td><td>-</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>Cognitive Level</td><td colspan="12">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.</td></tr>
<tr><td>Course Objectives</td><td colspan="12">The course aim is
To advance the study of town planning, civic design and kindred subjects and of the sciences and arts as applied to those subjects.
To promote planned, economic, scientific and artistic development of towns, cities and rural areas.
To promote the general interests of those engaged in the practice in town and country planning.</td></tr>
</table>

Unit	**Content**	**No.of Hours**
I	**PLANNING OF TOWNS** Town planning Objective – Necessity and principles of town planning – Origin, growth and stages in development of towns – Brief history of evolution of towns – Ancient and modern towns with historicExamples and international contributions to modern planning Forms of planning – Requirement of new towns – Planning of modern towns – The town and environment – Climate, humidity, wind and radiation – Factors for the selection of site for new town – Powers required to enforce town planning schemes – Present position of planning in India	8
II	**TOWN SURVEY NECESSITY** Collection of data – Types of surveys – Uses of surveys – Methods adopted to collect data – Drawings – Reports – Plan structure of a town and layouts	8
III	**ZONING, HOUSING AND SLUMS** **Zoning :**Objective – Principles of zoning – Advantage and aspect of zoning – Zoning power – Maps for zoning **Housing :**Importance – Demand for houses – Building site – Rural housing – Agencies for housing – Housing problem in India – Residential neighborhoods **Slums :**Causes – Characterizes and effect of slums – Slum clearance and refocusing – Prevention of slum formation – Resources for slum	8

	clearance programs	
IV	**PLANNING FOR PARKS AND PLAYGROUNDS** Types of recreation – Location of urban green spaces – Classification of parks – Park system – Finance for park – Playground – Space standards – Landscape architecture **Planning for Industries :**Classification – Requirements of industry – Setting for industries – Industrial townships – Measures to control location of industries – Planning for new industrial towns **Planning for public buildings :**Location – Classification – Principles of design of public buildings	8
V	**RE-PLANNING OF EXISTING TOWNS** Objects of re-planning – Defects of existing towns – Urban renewal and re-development – Decentralization and recentralization – Garden city concept – Surface drains – Refuse of towns Development control – Building bye-laws and planning acts – Master-plan – Objective –Necessity – Features of master plan – Planning standards – Report – Stages of preparation – Method of Execution	8
References	**TEXT BOOKS:** 1. Modal, N.V & Ambedkar, V.N "Town and Country Planning and Housing", Orient Longman Ltd. 2. New Delhi. .1971 3. Gupta, R.G. "Planning and development of towns", Oxford and IBH Publishing Co. New Delhi. 1983 4. Rangwala,S.C, Rangwala, K.S and Rangwala, P.S "Town Planning", Charotar Publishing House, Anand, 2002 **REFERENCES:** 1. John Rat Cliffe, 91974 "An introduction to town and country planning", Hutchinson of London, 1999 2. Luis Keeble, "Principles and practice of town and country planning", MIR Publishers, Moscow, 1989 3. A. Rinishe, "Town planning in hot climates", MIR Publishers, Moscow,1989	
Course Out Comes	After studying the course, the student will be able to: 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	

	CO5: Able to Re-Planning of Existing Towns	

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

<table>
<tr><th>Course Title</th><th colspan="11">COST EFFECTIVE CONSTRUCTION TECHNOLOGY</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>18BCEU0XO5</td><td>BCE</td><td>-</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>Cognitive Level</td><td colspan="11">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.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The course aim is
• To understand the basic concepts of cost effective building materials and technologies.</td></tr>
</table>

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	8
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	8

	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	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