B.TECH. CIVIL ENGINEERING SYLLABUS

CREDIT BASED CURRICULUM

CENTRE FOR RURAL TECHNOLOGY
THE GANDHIGRAM RURAL INSTITUTE
(DEEMED TO BE UNIVERSITY)
GANDHIGRAM
(2021 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
PCC	-	Professional Core Course
PEC	-	Professional Elective Course
OEC	**-**	Open Elective Course
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 i/c, Centre for Rural Technology

Academic Programme offered : B.Tech Civil Engineering

OBE Elements for B.Tech Civil Engineering programme

Programme Educational Objectives (PEO)

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

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

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

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

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

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

Program Outcome (PO)

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

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

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

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

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

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

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

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

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

PROGRAMME SPECIFIC OUTCOME (PSO)

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

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

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

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

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

Definition of credit

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

Distribution of Credits

S.No	Category	Credits As Per AICTE	Allotted Credits in GRI
1	Humanities and Social Sciences including Management courses	12	7
2	Basic Science courses	26	17
3	Engineering science courses including workshop, drawing, basics electrical/mechanical/computer etc..	29	26
4	Professional Core Courses	47	69
5	Professional Elective Courses relevant to chosen specialization/branch	23	24
6	Open Subjects – Electives from other technical and/or emerging subjects	11	10
7	Project work, seminar and internship in industry or appropriate work place/academic and research institutions in India/Abroad	12	15
8	Mandatory courses / Value Added courses	-	-
	Total	**160**	**168**

Humanities and Social Sciences including Management courses – 7 credits

S.NO	Category	Course Code	Course Title	Hours per Week			C	Marks		Total
				L	T	P		CFA	ESE	
1.	HSMC	21ENGU01C1	English	2	-	2	3	40	60	100
2.	HSMC	21BCEU0528	Professional practice, Law and Ethics	2			2	40	60	100
3.	HSMC	21BCEU0205	Introduction to Civil Engineering	2			2			
Total				**7**	**-**	**2**	**7**			

Basic Science courses – 17 credits

S.NO	Category	Course Code	Course Title	Hours per Week			C	Marks		Total
				L	T	P		CFA	ESE	
1.	**BSC**	**21MATU01C1**	Mathematics I – Calculus	3	-	-	3	40	60	100
2.	**BSC**	**21PHYU01C1**	Physics	3	-	-	3	40	60	100
3.	**BSC**	**21CHEU01C1**	Chemistry	3	-	-	3	40	60	100
4.	**BSC**	**21PHYU01C2**	Physics Laboratory	-	-	2	1	60	40	100
5.	**BSC**	**21CHEU01C2**	Chemistry Laboratory	-	-	2	1	60	40	100
6.	**BSC**	**21MATU02C2**	Mathematics II - Differential Equations & Transform Theory	3	-	-	3	40	60	100
7.	**BSC**	**21MATU03C3**	Engineering Mathematics III- (Matrix, Statistical Methods, Probability and distributions)	3	-	-	3	40	60	100
Total				**15**	**-**	**6**	**17**			

Engineering science courses including workshop, drawing, basics electrical/mechanical/computer etc.. : 26 credits										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**ESC**	**21CSAU01C1**	Python Programming and Its applications in Civil Engineering	2	-	-	2	40	60	100
2.	**ESC**	**21BCEU0101**	Basic Mechanical Engineering	2	-	-	2	40	60	100
3.	**ESC**	**21BCEU0102**	Engineering Graphics &Design	-	-	4	2	60	40	100
4.	**ESC**	**21CSAU01C2**	Python Programming Laboratory	-	-	2	1	60	40	100
5.	**ESC**	**21BCEU0203**	Engineering Mechanics	3	-	-	3	40	60	100
6.	**ESC**	**21BCEU0204**	Basic Electrical & Electronics Engineering	2	-	-	2	40	60	100
7.	**ESC**	**21BCEU0206**	Disaster Preparedness and Planning	2	-	-	2	40	60	100
8.	**ESC**	**21BCEU0207**	Energy science and Environment	2	-	-	2	40	60	100
9.	**ESC**	**21BCEU0208**	Workshop Manufacturing Practices	-	-	2	1	60	40	100
10.	**ESC**	**21BCEU0209**	Computer Aided Civil Engineering Drawing	-	-	4	2	60	40	100
11.	**ESC**	**21BCEU0210**	Basic Electrical & Electronics Engineering laboratory	-	-	2	1	60	40	100
12.	**ESC**	**21BCEU0314**	Engineering Geology	3	-	-	3	40	60	100
13.	**ESC**	**21BCEU0427**	Software Skill Development-I	-	-	-	1	40	60	100
14.	**ESC**	**21BCEU0536**	Software Skill Development-II	-	-	-	1	40	60	100
15.	**ESC**	**21BCEU0642**	Software Skill Development- III	-	-	-	1	40	60	100
			Total	**16**	**-**	**14**	**26**			

Professional Core Courses : 69 credits

S.NO	Category	Course Code	Course Title	Hours per Week			C	Marks		Total
				L	T	P		CFA	ESE	
1.	PCC	21BCEU0312	Mechanics of Solids I	3	-	-	3	40	60	100
2.	PCC	21BCEU0313	Fluid Mechanics	3	-	-	3	40	60	100
3.	PCC	21BCEU0315	Surveying	3	-	-	3	40	60	100
4.	PCC	21BCEU0316	Surveying Laboratory	-	-	3	1.5	60	40	100
5.	PCC	21BCEU0317	Strength of Materials Laboratory	-	-	3	1.5	60	40	100
6.	PCC	21BCEU0418	Mechanics of Solids II	3	-	-	3	40	60	100
7.	PCC	21BCEU0419	Hydraulics and Hydraulic Machineries	3	-	-	3	40	60	100
8.	PCC	21BCEU0420	Soil Mechanics	3	-	-	3	40	60	100
9.	PCC	21BCEU0421	Concrete Technology	3		-	3	40	60	100
10.	PCC	21BCEU0422	Fundamentals of Remote Sensing & GIS	3	-	-	3	40	60	100
11.	PCC	21BCEU0423	Fluid Mechanics and Machineries Laboratory	-	-	3	1.5	60	40	100
12.	PCC	21BCEU0424	Soil Mechanics Laboratory	-	-	3	1.5	60	40	100
13.	PCC	21BCEU0425	Fundamentals of Remote Sensing & GIS Laboratory	-	-	3	1.5	60	40	100
14.	PCC	21BCEU0529	Foundation Engineering	3	-	-	3	40	60	100
15.	PCC	21BCEU0530	Design of concrete Structures	3	-	-	3	40	60	100
16.	PCC	21BCEU0531	Water supply Engineering	3	-	-	3	40	60	100
17.	PCC	21BCEU0532	Highway and Pavement Engineering	3	-	-	3	40	60	100
18.	PCC	21BCEU0533	Structural Analysis I	3	-	-	3	40	60	100
19.	PCC	21BCEU0534	Concrete and Highway Engineering Laboratory	-	-	3	1.5	60	40	100
20.	PCC	21BCEU0535	Environmental Engineering Laboratory	-	-	3	1.5	60	40	100
21.	PCC	21BCEU0637	Irrigation Engineering & Hydraulic Structures	3	-	-	3	40	60	100
22.	PCC	21BCEU0638	Estimation, Costing and Valuation	2	1	-	-	40	60	100
23.	PCC	21BCEU0639	Structural Analysis II	3	-	-	3	40	60	100
24.	PCC	21BCEU0640	Irrigation and Environmental Engineering Drawing	-	-	3	1.5	60	40	100
25.	PCC	21BCEU0743	Design of Steel Structures	3	-	-	3	40	60	100
26.	PCC	21BCEU0744	Design of Brick and Concrete Structures	3	-	-	3	40	60	100
27.	PCC	21BCEU0745	Construction Engineering And Management	3	-	-	3	40	60	100
Total				**56**	**1**	**24**	**69**			

Professional Elective Courses relevant to chosen specialization/branch: 24 credits										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**PEC**	**21BCEU06EX**	Professional Elective –I	3	-	-	3	40	60	100
2.	**PEC**	**21BCEU06EX**	Professional Elective-II	3	-	-	3	40	60	100
3.	**PEC**	**21BCEU07EX**	Professional Elective – III	3	-	-	3	40	60	100
4.	**PEC**	**21BCEU07EX**	Professional Elective-IV	3	-	-	3	40	60	100
5.	**PEC**	**21BCEU07EX**	Professional Elective –V	3	-	-	3	40	60	100
6.	**PEC**	**21BCEU08EX**	Professional Elective-VI	3	-	-	3	40	60	100
7.	**PEC**	**21BCEU08EX**	Professional Elective-VII	3	-	-	3	40	60	100
8.	**PEC**	**21BCEU08EX**	Professional Elective-VIII	3	-	-	3	40	60	100
			Total	**24**	**-**	**-**	**24**			

Open Subjects – Electives from other technical and/or emerging subjects : 10 credits										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**OEC**	21BCEU03OX	Open Elective- I	2	-	-	2	40	60	100
2.	**OEC**	**-**	Open Elective- II	3	-	-	3	40	60	100
3.	**OEC**	21BCEU05OX	Open Elective- III	2	-	-	2	40	60	100
4.	**OEC**	**-**	Open Elective- IV	3	-	-	3	40	60	100
			Total	**10**			**10**			

Project work, seminar and internship in industry or appropriate work place/academic and research institutions in India/Abroad : 13 Credits										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**PROJ**	**21BCEU0211**	Summer Internship-I	-	-	-	1	40	60	100
2.	**PROJ**	**21BCEU0426**	Summer Internship-II	-	-	-	1	40	60	100
3.	**PROJ**	**21BCEU0641**	Summer Internship-III	-	-	-	1	40	60	100
4.	**PROJ**	**21BCEU0746**	Project-I	-	-	8	4	60	40	100
5.	**PROJ**	**21BCEU0847**	Project-II	-	-	12	6	125	75	200
			Total	**-**	**-**	**20**	**13**			

Mandatory courses										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
1.	**MC**	**21GTPU0001**	Gandhi's Life, Thought and work	2	-	-	-	20	30	50
2.	**MC**	**21YOGU0001**	Yoga Education	-	-	1	-	50	0	50
3.	**MC**	-	NSS/Sports & Games/ Fine Arts	-	-	1	-	50	0	50
4.	**MC**	-	Shantisena	1	-	-	-	50	-	50
5.	**MC**	**21EXNU03V1**	Village Placement Program (VPP)	-	-	-	-	50	-	50
6.	MC	**21PSDU04C1**	Constitution of India	2	-	-	-	50	-	50
			Total	**4**		**2**	**-**			

PROFESSIONAL ELECTIVES (21BCEU0XEX)

I. Construction Engineering and Management		
1.	**21BCEU0XE1**	Construction Techniques and Equipments
2.	**21BCEU0XE2**	Building Construction Practice
3.	**21BCEU0XE3**	Sustainable Construction Methods
4.	**21BCEU0XE4**	Infrastructure Planning and Management
5.	**21BCEU0XE5**	Repairs and Rehabilitation of Structures
6.	**21BCEU0XE6**	Materials Management
7.	**21BCEU0XE7**	Construction Technology
8.	**21BCEU0XE8**	Construction Engineering Materials
II. Transportation Engineering		
1.	**21BCEU0XE9**	Railways ,Airways and waterways
2.	**21BCEU0XE10**	Intelligent Transport System
3.	**21BCEU0XE11**	Airport Planning and Design
4.	**21BCEU0XE12**	Traffic Engineering and Management
5.	**21BCEU0XE13**	Railway Engineering
6.	**21BCEU0XE14**	Urban and Regional Planning
7.	**21BCEU0XE15**	Port and Harbour Engineering
8.	**21BCEU0XE16**	Pavement Materials
9.	**21BCEU0XE17**	Transportation Systems Planning
III. Environmental Engineering		
1.	**21BCEU0XE18**	Ecological Engineering
2.	**21BCEU0XE19**	Transport of water and Waste Water
3.	**21BCEU0XE20**	Environmental Laws and Policies
4.	**21BCEU0XE21**	Physico-Chemical Processes for Water and Waste Water Treatment
5.	**21BCEU0XE22**	Rural Water Supply and Onsite Sanitation Systems
6.	**21BCEU0XE23**	Air and Noise Pollution and Control
7.	**21BCEU0XE24**	Solid and Hazardous Waste Management
8.	**21BCEU0XE25**	Water and Air Quality Modelling
9.	**21BCEU0XE26**	Environmental Impact Assessment and Life Cycle Analyses
10	**21BCEU0XE27**	Waste water Engineering
IV. Hydraulics,. Hydrology & Water Resources Engineering		
1.	**21BCEU0XE28**	Pipeline Engineering
2.	**21BCEU0XE29**	Open Channel flow
3.	**21BCEU0XE30**	River Engineering
4.	**21BCEU0XE31**	Urban water Resource Management
5.	**21BCEU0XE32**	Ground water hydrology
6.	**21BCEU0XE33**	Hydrology & Water Resources Engineering
7.	**21BCEU0XE34**	Water Resources systems Analysis
8.	**21BCEU0XE35**	Surface water Hydrology
9.	**21BCEU0XE36**	Remote sensing and GIS in water Resources
10	**21BCEU0XE37**	Watershed conservation & Management
11	**21BCEU0XE38**	Environmental Hydraulics
V. Structural Engineering		
1.	**21BCEU0XE39**	Finite Element analysis
2.	**21BCEU0XE40**	Fire Resistance of structures
3.	**21BCEU0XE41**	Safety of Structures
4.	**21BCEU0XE42**	Analysis and Design of Sub-Structures
5.	**21BCEU0XE43**	Industrial Structures

6.	**21BCEU0XE44**	Design of Storage Structures
7.	**21BCEU0XE45**	Bridge Engineering
8.	**21BCEU0XE46**	Pre stressed concrete
9.	**21BCEU0XE47**	Masonry Structures
10.	**21BCEU0XE48**	Basics of dynamics and a seismic design
11.	**21BCEU0XE49**	Reliability of Structures
12.	**21BCEU0XE50**	Smart Materials and smart structures
VI. Geotechnical Engineering		
1.	**21BCEU0XE51**	Ground Improvement Techniques
2.	**21BCEU0XE52**	Earthquake Resistant Design of foundation
3.	**21BCEU0XE53**	Geo-environmental engineering
4.	**21BCEU0XE54**	Rock Mechanics and Applications
5.	**21BCEU0XE55**	Soil Structures Interaction

OPEN ELECTIVE COURSES
Open Elective III & IV

S.No	**Course Code OEC**	**Subject**
Open Elective I (AICTE offered Courses) offered at III Semester		
1	21BCEU03O1	Biology for Engineers
2	21BCEU03O2	Civil Engineering Societal and Global Impacts
3	21BCEU03O3	Architecture
Open Elective III (AICTE offered Courses) offered at V Semester		
1	21BCEU05O1	Life Science
2	21BCEU05O2	Instrumentation and sensor Technologies for Civil Engineering applications
3	21BCEU05O3	Cost Effective Construction Technology
Open Elective II & IV **(Offered by other departments of GRI) offered at IV & VI Semesters**		

SEMESTER I (I Year)										
S.NO	Category	Course Code	Course Title	Hours per Week			C	Marks		Total
				L	T	P		CFA	ESE	
THEORY										
1.	HSMC	21ENGU01T1	English	2	-	2	3	40	60	100
2.	BSC	21MATU01C1	Mathematics I – Calculus	3	-	-	3	40	60	100
3.	BSC	21PHYU01C1	Physics	3	-	-	3	40	60	100
4.	BSC	21CHEU01C1	Chemistry	3	-	-	3	40	60	100
5.	ESC	21CSAU01C1	Python Programming and Its applications in Civil Engineering	2	-	-	2	40	60	100
6	ESC	21BCEU0101	Basic Mechanical Engineering	2	-	-	2	40	60	100
7	MC	21YOGU0001	Yoga Education	-	-	1	-	50	-	50
PRACTICALS										
8	ESC	21BCEU0102	Engineering Graphics & Design	-	-	4	2	60	40	100
9	BSC	21PHYU01C2	Physics Laboratory	-	-	2	1	60	40	100
10	BSC	21CHEU01C2	Chemistry Laboratory	-	-	2	1	60	40	100
11	ESC	21CSAU01C2	Python Programming lab	-	-	2	1	60	40	100
Total				**15**	**0**	**13**	**21**			

SEMESTER II (I YEAR)										
S.NO	**Category**	**Course Code**	**Course Title**	**Hours per Week**			**C**	**Marks**		**Total**
				L	**T**	**P**		**CFA**	**ESE**	
THEORY										
1.	**BSC**	**21MATU02C2**	Mathematics II - Differential Equations & Transform Theory	3	-	-	3	40	60	100
2.	**ESC**	**21BCEU0203**	Engineering Mechanics	3	-	-	3	40	60	100
3.	**ESC**	**21BCEU0204**	Basic Electrical & Electronics Engineering	2	-	-	2	40	60	100
4.	**HSMC**	**21BCEU0205**	Introduction to Civil Engineering	2	-	-	2	40	60	100
5.	**ESC**	**21BCEU0206**	Disaster Preparedness and Planning	2	-	-	2	40	60	100
6.	**ESC**	**21BCEU0207**	Energy science and Environment	2	-	-	2	40	60	100
7.	**MC**	**21GTPU0001**	Gandhi's Life, Thought And work	2	-	-	-	20	30	50
PRACTICALS										
8.	**ESC**	**21BCEU0208**	Workshop Manufacturing Practices	-	-	2	1	60	40	100
9.	**ESC**	**21BCEU0209**	Computer Aided Civil Engineering Drawing	-	-	4	2	60	40	100
10.	**ESC**	**21BCEU0210**	Basic Electrical & Electronics Engineering laboratory	-	-	2	1	60	40	100
11.	**PROJ**	**21BCEU0211**	Summer Internship-I	-	-	-	1	40	60	100
12.	**MC**	-	NSS/Sports &Games/ Fine Arts	-	-	1	-	50	-	-
Total				**16**	**-**	**9**	**19**			

SEMESTER III(II YEAR)

S.NO	Category	Course Code	Course Title	Hours Per Week			Credit	Marks		Total
				L	T	P		CFA	ESE	
THEORY										
1.	BSC	21MATU03C3	Engineering Mathematics III-(Matrix, Statistical Methods, Probability and distributions)	3	-	-	3	40	60	100
2.	PCC	21BCEU0312	Mechanics of Solids I	3	-	-	3	40	60	100
3.	PCC	21BCEU0313	Fluid Mechanics	3	-	-	3	40	60	100
4.	ESC	21BCEU0314	Engineering Geology	3	-	-	3	40	60	100
5.	PCC	21BCEU0315	Surveying	3	-	-	3	40	60	100
6.	OEC	21BCEU03OX	Open Elective I	2	-	-	2	40	60	100
7.	MC	-	Shanti sena	1	-	-	-	50		50
PRACTICALS										
8	PCC	21BCEU0316	Surveying Laboratory	-	-	3	1.5	]60	40	100
9	PCC	21BCEU0317	Strength of Materials Laboratory	-	-	3	1.5	60	40	100
10	MC	21EXNU03VI	Village Placement Program (VPP)	-	-	-	-	50	-	50
Total				**18**	**0**	**6**	**20**			

SEMESTER IV (II YEAR)

S.NO	Category	Course Code	Course Title	Hours per Week			C	Marks		Total
				L	T	P		CFA	ESE	
THEORY										
1.	OEC	-	Open Elective II	3	-	-	3	40	60	100
2.	PCC	21BCEU0418	Mechanics of Solids II	3	-	-	3	40	60	100
3.	PCC	21BCEU0419	Hydraulics and Hydraulic Machineries	3	-	-	3	40	60	100
4.	PCC	21BCEU0420	Soil Mechanics	3	-	-	3	40	60	100
5.	PCC	21BCEU0421	Concrete Technology	3	-	-	3	40	60	100
6.	PCC	21BCEU0422	Fundamental of Remote Sensing & GIS	3	-	-	3	40	60	100
7	MC	21PSDU04C1	Constitution of India	2	-	-	-	50	-	50
PRACTICALS										
8.	PCC	21BCEU0423	Fluid Mechanics and Machineries Laboratory	-	-	3	1.5	60	40	100
9.	PCC	21BCEU0424	Soil Mechanics Laboratory	-	-	3	1.5	60	40	100
E310	PCC	21BCEU0425	Fundamentals of Remote Sensing & GIS Laboratory	-	-	3	1.5	60	40	100
11	PROJ	21BCEU0426	Summer Internship–II	-	-	-	1	40	60	100
12	ESC	21BCEU0427	Software Skill Development-I	-	-	-	1	40	60	100
Total				**20**	**-**	**9**	**24.5**			

SEMESTER V (III YEAR)										
S.NO	Category	Course Code	Course Title	Hours per Week			C	Marks		Total
				L	T	P		CFA	ESE	
THEORY										
1.	HSMC	21BCEU0528	Professional practice ,Law and Ethics	2	-	-	2	40	60	100
2.	PCC	21BCEU0529	Foundation Engineering	3	-	-	3	40	60	100
3.	PCC	21BCEU0530	Design of Concrete Structures	3	-	-	3	40	60	100
4.	PCC	21BCEU0531	Water supply Engineering	3	-	-	3	40	60	100
5.	PCC	21BCEU0532	Highway and Pavement Engineering	3	-	-	3	40	60	100
6.	PCC	21BCEU0533	Structural Analysis I	3	-	-	3	40	60	100
7	OEC	21BCEU05O X	Open Elective III	2	-	-	2	40	60	100
PRACTICALS										
8	PCC	21BCEU0534	Concrete and Highway Engineering Laboratory	-	-	3	1.5	60	40	100
9	PCC	21BCEU0535	Environmental Engineering Laboratory	-	-	3	1.5	60	40	100
10	ESC	21BCEU0536	Software Skill Development-II	-	-	-	1	40	60	100
			Total	**19**	**-**	**6**	**23**			

SEMESTER VI										
S.NO	Category	Course Code	Course Title	Hours per Week			C	Marks		Total
				L	T	P		CFA	ESE	
THEORY										
1	PCC	21BCEU0637	Irrigation Engineering & Hydraulic Structures	3	-	-	3	40	60	100
2	PCC	21BCEU0638	Estimation, Costing and Valuation	2	1	-	3	40	60	100
3	OEC	-	Open Elective-IV	3	-	-	3	40	60	100
4	PCC	21BCEU0639	Structural Analysis II	3	-	-	3	40	60	100
5	PEC	21BCEU06EX	Professional Elective–I	3	-	-	3	40	60	100
6	PEC	21BCEU06EX	Professional Elective-II	3	-	-	3	40	60	100
PRACTICALS										
7	PCC	21BCEU0640	Irrigation and Environmental Engineering Drawing	-	-	3	1.5	60	40	100
	PROJ	21BCEU0648	Project I	-	-	6	3	60	40	100
8	PROJ	21BCEU0641	Summer Internship–III	-	-	-	1	40	60	100
9	ESC	21BCEU0642	Software Skill Development-III	-	-	-	1	40	60	100
			Total	**17**	**1**	**9**	**24.5**			

SEMESTER VII (IV YEAR)

S.NO	Category	Course Code	Course Title	Hours per Week			C	Marks		Total
				L	T	P		CFA	ESE	
1	PCC	21BCEU0743	Design of Steel Structures	3	-	-	3	40	60	100
2	PCC	21BCEU0744	Design of Brick and Concrete Structures	3	-	-	3	40	60	100
3	PCC	21BCEU0745	Construction Engineering And Management	3	-	-	3	40	60	100
4	PEC	21BCEU07EX	Professional Elective-III	3	-	-	3	40	60	100
5	PEC	21BCEU07EX	Professional Elective-IV	3	-	-	3	40	60	100
6	PEC	21BCEU07EX	Professional Elective-V	3	-	-	3	40	60	100
PRACTICALS										
7	PROJ	**21BCEU0746**	Project-II	-	-	6	3	**60**	40	100
			Total	**18**	-	**6**	**21**			

SEMESTER VIII (IV YEAR)

S.NO	Category	Course Code	Course Title	Hours per Week			C	Marks		Total
				L	T	P		CFA	ESE	
1	PEC	21BCEU08EX	Professional Elective–VI	3	-	-	3	40	60	100
2	PEC	21BCEU08EX	Professional Elective–VII	3	-	-	3	40	60	100
3	PEC	21BCEU08EX	Professional Elective-VIII	3	-	-	3	40	60	100
4	PROJ	21BCEU0847	Project-III	-	-	12	6	125	75	200
			Total	**9**	**-**	**12**	**15**			

I SEMESTER

Course Title	ENGLISH										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21ENGU01T1	HSMC	I	2	2	-	-	40	60	-	-	100
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	**Objectives:** • to help the students of engineering improve their proficiency in the English language; • to help them improve their language skills through targeted practice using select texts.										

Unit	**Content**	**No.of Hours**
I	Text: “An Astrologer's Day” by RK Narayan Reading: Skimming, scanning, predicting, close reading Vocabulary: Word formation: Prefixes, suffixes, compounds; register Grammar: Parts of speech, nouns (countable/uncountable), articles Listening: Tips for effective listening Speaking: Introducing oneself, giving personal information Writing: Sentence structures, Wh- questions, Yes/No questions, writing paragraphs, developing hints	
II	Text: “Building a New State” by A.P.J. Abdul Kalam Reading: Pre-reading, in-reading, post-reading Vocabulary: Word formation: Derivatives, synonyms, antonyms Grammar: Finite verbs, modals, non-finite verbs, prepositions, conjunctions Listening: Telephone conversations	
III	Text: “Water: The Elixir of Life” by C.V. Raman Reading: Additional reading Vocabulary: One-word substitutes Grammar: Pronouns, adverbs, degrees of comparison, direct-indirect speech Listening: Listening to short talks, texts, product description Speaking: Describing daily routines, making suggestions, offering advice, expressing opinions	

IV	Text: “The Woodrose” by Abburi Chaya Devi Reading: Additional reading: from magazine Vocabulary: Phrasal verbs Grammar: Tenses Listening: Listening for specific information Speaking: Narrating, expressing opinions, formal conversation Writing: Informal or personal letters and emails	
V	Text: “Progress” by St John Ervine Reading: Text reading and glossary Vocabulary: Collocations, idioms Grammar: Conditionals Listening: Listening for opinions and attitude Speaking: Group conversations/discussions Writing: Planning and writing essays	7
References	Board of Editors. Using English: A Coursebook for Undergraduate Engineers and Technologists. Orient Blackswan, 2015. Hewing, Martin. Advanced English Grammar. Cambridge, 1999.	
Course Outcomes	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

<table>
<tr><td>Course Title</td><td colspan="11">MATHEMATICS I- Calculus</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>21MATU01C1</td><td>BSC</td><td>I</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- 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.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• Understand the concept of functions, limits and continuity.
• Compute derivatives and apply in solving engineering problems.
• Employ partial derivatives to find maxima minima of functions of two variables.
• Demonstrate the techniques of integration and apply in different fields of engineering.
• Apply integrals of multivariable’s to find areas enclosed between two curves and volume enclosed between surfaces.</td></tr>
</table>

Unit	**Content**	**No.of Hours**
I	**Differential Calculus** Representation of functions - New functions from old functions - Limit of a function - Continuity - Limits at infinity - Derivative of a function - Differentiation rules(formula and problems only) - Maxima and Minima of functions of one variable. Functions of Several Variables: Partial derivatives – Chain rule - Maxima and minima of functions of two variables - Lagrange Multipliers.	10
II	**Integral Calculus** The definite integrals – Fundamental theorem of calculus – Indefinite integral and net change theorem - Integration by parts - Volume of solid of revolution - Area of surface of revolution - Improper integrals.	10
III	**Multiple Intergrals** Double integrals – Change the order of integration – Double integrals in polar coordinates – Areas enclosed by plane curves - Triple integrals – Volume of solids – Change the variables.	10
IV	**Vector Calculus** Differentiation of vectors – Scalar and vector point functions – Gradient – Divergence and Curl– Line integrals – Surface integrals – Green’s theorem – Stokes theorem – Gauss divergence theorem(Problems only).	8

V	**Analytic Functions** Derivative of complex functions - Analytic functions – Cauchy Riemann Equations – Conformal transformation – Schwarz-Christoffel transformation – Integration of complex functions – Cauchy integral formula – Laurent's series – Singularities – Residues – Cauchy residue Theorem.	7
References	**Text Books & Reference Books:** 1. James Stewart, "Calculus Early Transcendentals", 7e, Cengage Learning, New Delhi,2017. 2. B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers, 43rd edition, 2015. 3. George B. Thomas, " Thomas Calculus: early transcendentals ", Pearson,New Delhi, 2013. 4. T.Veerarajan, "Engineering Mathematics", Volume I, Tata Mcgraw Hill, New delhi, 2008. 5. Erwin Kreszig, "Advanced Engineering Mathematics",10th edition, Wiley, 2017.	
Course Outcomes	**CO1** 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 by using the Fundamental Theorem of Calculus. **CO4** 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.	

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

Course Title	**PHYSICS**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21PHYU01C1	BSC	I	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Understanding the importance dynamics of rigid bodies . K-2: Express the knowledge of acoustics and ultrasonics K-3: Understanding the importance of Laser and sensors.										
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**
I	**DYNAMICS OF RIGID BODIES** Rigid bodies-rotational kinetic energy, moment of inertia and its physical significance- angular momentum-law of conservation of angular momentum - conservation of linear momentum – Newton's law of motion –young's modulus by uniform loading –compound pendulum – Determination of acceleration due to gravity and radius of gyration	10
II	**ACOUSTICS AND ULTRASONICS** Wave Motion – Characteristics – Relation between Frequency and Wavelength- Transverse and Longitudinal Mode of Vibrations - Sound Acoustics - Buildings Acoustics Ultrasonics – Properties of Ultrasonics – Function of Ultrasonics – Applications of Ultrasonic With Specific Reference to Civil Engineering	10
III	**LASERS** Lasers – Characteristics of Laser – Working Mechanism of Lasers (Qualitative Explanations) – Type of Lasers – Applications of Lasers in Civil Engineering	8
IV	**SENSORS** Sensors – Principle of Sensing – Properties- Classification – Application of Sensors in Civil Engineering	7

V	**HEAT AND THERMODYNAMICS** Heat - Conduction, Radiation and Convection – Enthalpy and Entropy - Latent Heat - Heat Capacity - Specific Heat Capacity - Thermal Conductivity- Heat Conduction in Solids - Determination Of Thermal Conductivity of A Poor Conductors by Lee’s Disc Method: Theory and Experiment	10
References	**Text Books & Reference Books:** 1. Brijlal, N.Subrahmanyam& Jivan Seshan. Mechanics and Electrodynamics, S.Chand & Company Ltd, New Delhi 2. Brijlal and N.Subrahmanyam. Heat and Thermodynamics, S.Chand & Company Ltd, New Delhi 3. Brijlal and N.Subrahmanyam. A Textbook of Sound, Vikas Publishing House, 1985 4. Principles of Industrial Instrumentation – Patranabis D. TMH. End edition 1997	
Course Outcomes	**CO 1:** Understanding the importance of mechanics. **CO 2**: Express the knowledge of electromagnetic waves. **CO 3:** Know the basics of oscillations, optics and lasers. **CO4:** Understanding the importance of quantum physics. **CO 5:** Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.	

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

Course Title	CHEMISTRY										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
21CHEU01C1	BSC	I	3	3	-	-	40	60	-	-	100
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	This course is designed to address the following: • To emphasize the importance of atomic and molecular structure • To give an overview of various types of spectroscopic techniques and applications • To stress the importance of corrosion of use of free energy in chemical equilibria • To make the students understand the need of periodic properties & stereochemistry										

Unit	Content	No.of Hours
I	**ATOMIC AND MOLECULAR STRUCTURE** Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties.	9
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. Intermolecular forces and potential energy surfaces Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena.	9
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.	9

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.	9
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. **ORGANIC REACTIONS AND SYNTHESIS OF A DRUG MOLECULE** Introduction to reactions involving substitution, addition, elimination, oxidation, and reduction,. Synthesis of a commonly used drug molecule.	9
References	**Text Books & Reference Books:** 1. University chemistry, by B. H. Mahan 2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane 3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell 4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan 5. Physical Chemistry, by P. W. Atkins 6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition 7. http://bcs.whfreeman.com/vollhardtschore5e/default.asp	
Course Outcomes	**CO1:** 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 **CO4:** Rationalise periodic properties such as ionization potential, electro negativity, oxidation states and electronegativity. **CO 5:** List major chemical reactions that are used in the synthesis of molecules.	

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

<table>
<tr><td>Course Title</td><td colspan="12">PYTHON PROGRAMMING AND ITS APPLICATIONS IN CIVIL 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>21CSAU01C1</td><td>ESC</td><td>I</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">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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">This course is designed to address the following:
• Introduce the concepts of computer basics and terminologies.
• Enlarge the programming concepts
• Provide an in-depth training with Python programming</td></tr>
</table>

Unit	**Content**	**No.of Hours**
I	**Introduction to Programming Languages** Introduction to Computer - History of Computer and Programming Languages- Types of Programming Languages-Introduction to Python-Benefits of Python- Applications of Python-Parts of Python Programming Language : Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Comments, Type conversions	7
II	**Statements in Python** Decision control statements: if, else, if..elif. - Looping Statements: for, while-Continue and break statements- Exception handling statements	10
III	**Functions and Strings** Built-in functions-Commonly used modules - Function definition and calling - return statement and void function - command line arguments- Strings: Basic String Operations, Accessing Characters in String, String slicing and joining, String Methods, Formatting Strings	8
IV	**Lists, Dictionaries and Tuples** Lists: Creating Lists, Basic List Operations, Indexing and Slicing Lists, Built-In Functions used on Lists, List Methods-Dictionaries: Creating Dictionary, Dictionary methods- Tuples and sets: Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Tuple Methods. Sets, Set Methods	10
V	**Unit 5- Machine Learning Algorithms** Regression, Decision Tree, Naïve-Bayes classifier, Support Vectors Machine and K- Nearest Neighbor, Applications in Civil Engineering: Population forecasting for urban planning, water supply & sewerage system - Risk assessment and mitigation such as prediction of floods, earthquakes, cyclones-Soil simulation and modeling- Finite element applications - Construction management	10

Text and Reference	**Text Books & Reference Books:** 1. Introduction to Python Programming, Gowrishankar S, Veena A, CRC Press, Taylor & Francis Group, 2019. 2. Learn Python in 7 Days, MohitBhaskar N. Das, Packt Publishing, 2017 3. Learn Programming in Python with Cody Jackson, Cody Jackson, Packt Publishing, 2018 4. Paresh Chandra Deka, A Primer on Machine Learning Applications in	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Recall the fundamental concept of computer and programming languages **CO2:** Be familiar with the programming concepts **CO3:** Employ the built-in functions, dictionaries and tuples in programs **CO4:** Develop python programs using Packages and String and List Methods, and Exceptions **CO5:** Understand the application areas and apply the Python programming in Civil Engineering	

<u>Mapping of COs with PSOs:</u>

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

Course Title	BASIC MECHANICAL ENGINEERING										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
21BCEU0101	ESC	I	2	2	-	-	40	60	-	-	100
Cognitive Level	**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										
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	Fundamental Concepts and Definitions: Definition of Thermodynamics, System, surrounding and universe, Phase, Concept of continuum, Macroscopic & microscopic point of view. Density, Specific volume, Pressure, temperature. Thermodynamic equilibrium, Property, State, Path, process, Cyclic process, Energy and its form, Work and heat, Enthalpy. 3 Laws of thermodynamics: Zeroth law: Concepts of Temperature, Zeroth law. 1 First law: First law of thermodynamics. Concept of processes, Flow processes and control volume, Flow work, Steady flow energy equation, Mechanical work in a steady flow of process. 4 Second law : Essence of second law, Thermal reservoir, Heat engines, COP of heat pump and refrigerator. Statements of second law, Carnot cycle, Clausius inequality. Concept of Entropy.	**6**
II	Introduction to Foundry - Steps involved in casting, advantages, limitations and applications of casting process. Pattern types, allowances for pattern, pattern materials, color coding and storing of patterns Moulding -Moulding methods and processes-materials, equipment, Moulding sand ingredients, essential requirements, sand preparation and control, testing, cores and core making. Design considerations in casting, gating and Riser - directional solidification in castings, Metallurgical aspects of Casting	6
III	Types of welding-gas welding, -arc welding,-shielded metal arc welding, GTAW, GMAW, SAW, ESW-Resistance welding (spot, seam, projection, percussion, flash types)-atomic hydrogen arc welding-thermit welding, Flame cutting - Use of Oxyacetylene, modern cutting processes, arc cutting,	6
IV	Soldering, brazing and braze welding and their application., welding of special materials – Stainless steel, Aluminium etc. weldability of cast iron, steel, stainless steel, aluminium alloys. Introduction to Electron beam and Laser welding.	6

V	Forging principle, classification, equipment, tooling-processes, parameters and calculation of forces and power requirements during forging post forging heat treatment - defects (cause and remedy) & application; Principles of rolling processes, classification, types of rolling mills, ring comparison tests calculation of forces and geometrical relationship in rolling, analysis of rolling load, torque and power, rolling mill control, , effects of friction. Form rolling, rolling defects, causes and remedies	6
Text Book	1. PK Nag, Engineering Thermodynamics, 2017, Mcgraw 2 Dieter "Mechanical Metallurgy", Revised edition 1992, Mcgraw	
References	1. E. Paul DeGarmo, J. T. Black, Ronald A. Kohser, "Materials and Processes in Manufacturing", Wiley; 9 edition (December 6, 2002) ISBN: 0471033065 2. Lindberg, "Processes and Materials of Manufacture ", Prentice Hall of India (p) Ltd 3. George.E. Dieter, "Engineering design (A materials and processing approach)", McGraw Hill – EditionII 1991 4. Serope Kalpakjian, Steven R. Schmid "Manufacturing Engineering and Technology" (4th 19 Edition) Prentice Hall 2000-06-15 ISBN: 0201361310 5. P.N.Rao "Manufacturing Technology", TMH Ltd 1998(Revised edition)	
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	**YOGA EDUCATION**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21YOGU0001	**MC**	I	-	--	-	1	50	-	-	-	50
The course is offering by Centre for Physical Education and yoga											

<table>
<tr><th>Course Title</th><th colspan="11">ENGINEERING GRAPHICS & 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>21BCEU0102</td><td>ESC</td><td>I</td><td>2</td><td>-</td><td>-</td><td>4</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: 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.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">This course is designed to address the following:
• With the construction of geometrical figures
• With the projection of 1D, 2D and 3D elements
• With the sectioning of solids and development of surfaces
• With the Preparation and interpretation of building drawing</td></tr>
</table>

Unit	Content	No.of Hours
I	Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.	**10**
II	Principles of Orthographic Projections- Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes.	**10**
III	Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method and change of reference plane (Auxiliary projection method) method	**10**
IV	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; Development of lateral surfaces of two Intersecting solids – prism & cylinder, cylinder & cylinder – Axis at right angles with no offset.	**10**
V	Buildings with load bearing walls (Flat and pitched roof) – Including details of doors and windows RCC framed structures Introduction to drafting packages and demonstration of their use	**10**

References	**Text Books &Reference Books:** 1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House 2. K.V. Nataraajan “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2006. 3. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education 4. Agrawal B. &Agrawal C. M. (2012), Engineering Graphics, TMH Publication 5. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers 6. (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 creating working drawings CO 6 Exposure to engineering communication	

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	PHYSICS LABORATORY										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
21PHYU01C2	BSC	I	1	-	-	2	-	-	60	40	100
Cognitive Level	K-1: Understanding the importance dynamics of rigid bodies . K-2: Express the knowledge of acoustics and ultrasonics K-3: Understanding the importance of Laser and sensors.										
Course Objectives	This course is designed to address the following: • To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties. • To induce the students to familiarize with experimental determination of velocity of										

Unit	Content	No.of Hours
I	**List of Experiments:** 1. Spectrometer - Diffraction Grating Normal Incidence Method. 2. Air Wedge –Determination thickness of a wire. 3. Young's Modulus – Non Uniform Bending Method. 4. Young's Modulus – Uniform Bending Method. 5. Torsional pendulum –Determination of Rigidity Modulus & Moment of Inertia. 6. Compound Pendulum – Determination of acceleration due to gravity. 7. Carey Foster's Bridge- Determination of specific resistance of the material of the wire. 8. Spectrometer- Determination of dispersive power of a Prism. 9. Lee's disc - Determination of thermal conductivity of a bad conductor. 10. Newton's Rings – Radius of curvature of a lens. 11. Determination of viscosity of liquid – poiseuille's method.	30
References	**Text Books &Reference Books:** 1. Brijlal, N.Subrahmanyam& Jivan Seshan. Mechanics and Electrodynamics, S.Chand & Company Ltd, New Delhi 2. Brijlal and N.Subrahmanyam. Heat and Thermodynamics, S.Chand & Company Ltd, New Delhi 3. Brijlal and N.Subrahmanyam. A Textbook of Sound, Vikas Publishing House, 1985 4. Principles of Industrial Instrumentation – Patranabis D. TMH. End edition 1997	

Course Out Comes	**CO1** : To determine various moduli of elasticity and also various thermal and optical properties of materials. **CO2**: To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.	

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

Course Title	CHEMISTRY LABORATORY										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
21CHEU01C2	BSC	I	1	-	-	2			60	40	100
Cognitive Level	K-1: To develop skill in titrimetric analysis, K-2: To gain practical knowledge in oil analysis and K-3:To develop skill in identification of water quality parameters.										
Course Objectives	This course is designed to address the following: • To enhance knowledge in basic principles of titrimetry, • To develop skill in titrimetric analysis, • To gain practical knowledge in oil analysis and • To develop skill in identification of water quality parameters.										

Unit	Content	No.of Hours
I	**List of Experiments:** 1. Determination of total hardness in water 2. Thin Layer Chromatography 3. Determination of chloride content of water 4. Saponification /acid value of an oil 5. Synthesis of a polymer/drug 6. Determination of amount and type of alkalinity in water 7. Determination of the rate constant of a reaction 8. Determination of cell constant and conductance of solutions 9. Potentiometry - determination of redox potentials and emfs 10. Saponification /acid value of an oil	**30**

References	**Text Books &Reference Books:** 1. University chemistry, by B. H. Mahan 2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane 3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell 4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan 5. Physical Chemistry, by P. W. Atkins 6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5^{th} Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp	
Course Out Comes	**CO1** The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. **CO2** Estimate rate constants of reactions from concentration of reactants/products as a function of time **CO3** Measure conductance of solutions, redox potentials, chloride content of water, etc **CO4** Synthesize a small drug molecule	

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

<table>
<tr><th>Course Title</th><th colspan="11">PYTHON PROGRAMMING LABORATORY</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>21CSAU01C2</td><td>ESC</td><td>I</td><td>2</td><td>2</td><td>-</td><td>-</td><td></td><td></td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1 To develop higher-order programming skills in core Python.
K-2 To apply the theoretical elements of Python for problem solving
K-3 To provide hands-on training to solve data-intense real-world problems</td></tr>
<tr><td>Course Objectives</td><td colspan="11">On successful completion of this course, students shall be able to:
• Contextually apply Python Programming for problem solving.
• Apply the potential of Python for data processing and visualization
• Develop programming solutions using Python libraries and tools in applications domains</td></tr>
</table>

Unit	Content	No.of Hours
I	**List of Experiments:** 1. Arithmetic and Boolean Operations 2. Control Structures : Conditional and Looping 3. Creation of User-defined Functions 4. String Operations 5. Errors and Exceptional Handling 6. Create and Import Built-in and Custom Modules 7. Working with Files 8. Packages	**45**

Course Outcomes	**On successful completion of the course, the students will be able to** **CO1:** Analyse and understand the various programming constructs through simple python programs **CO2:**Write the python programs using control structures **CO3:**Trace the execution of programs and debug the programs **CO4:**Implement python programs with exception handling **CO5:**Illustrate file concept through python programs

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

II SEMESTER

<table>
<tr><th>Course Title</th><th colspan="11">MATHEMATICS-II (Differential Equations & Transform Theory)</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>21MATU02C2</td><td>BSC</td><td>II</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">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.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The objective of the course is
• Understand the concept of finding general solution for the ordinary differential equations.
• Apply Laplace transform technique to solve the given ordinary differential equation.
• Understand the concept of finding general solution for the partial differential equations.
• Formulate simple Engineering problems as Partial Differential Equations and state the boundary conditions.</td></tr>
</table>

Unit	Content	No.of Hours
I	**Ordinary Differential Equations** Formation of Differential equation – Solution of Differential equations – Variables separable – Homogeneous equations – Linear equations – Equations of first order and higher degree – Clairauts equation – Linear higher order Differential equations – Complementary functions – Particular integral – Cauchy Euler equations.	**9**
II	**Laplace Transform** Definition – Conditions for existence - Transform of elementary functions – Properties of Laplace transform – Inverse Laplace transform – Convolution theorem(Problems only) – Applications to differential equations.	**9**
III	**Partial Differential Equations** Formation of partial differential equations – Solutions of partial differential equations – Linear equations of first order – non linear equations of first order – Homogeneous linear equations with constant coefficients -	**9**
IV	**Applications of Partial Differential Equations** Fourier Series – Half range series – Methods of separation of variables – Vibrations of stretched string – Wave equations – One dimensional heat flow – Two dimensional heat flow(Cartesian and Polar coordinates).	**9**
V	**Z-Transform** Definition - Standard Z-Transform – Properties – Inverse Z-Transform – Convolution theorem –Application to Difference equation.	**9**

References	**Text Books &Reference Books:** 1. T.Veerarajan, “Engineering Mathematics”, Volume II, Tata Mcgraw Hill, New Delhi, 2008. 2. B.S.Grewal, ”Higher Engineering Mathematics”, Khanna publishers, 43rd edition, 2015. 3. Erwin Kreszig, "Advanced Engineering Mathematics",10th edition, Wiley, 2017. 4. W. E. Boyce and R. C. DiPrima, “Elementary Differential Equations and Boundary Value Problems”, 9th Edition, Wiley India, 2009.	
Course Out Comes	**Students should be able to** CO 1 Solving ordinary differential equations first order as well as higher order. CO 2 Apply Laplace transform techniques to solve ordinary differential equations. CO 3 Solving partial differential equations first order (linear/non linear) as well as higher order. CO 4 Formulate simple engineering problems as partial differential equations and state the boundary conditions. CO 5 Apply Z-Transform techniques to solve difference equation.	

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

<table>
<tr><th>Course Title</th><th colspan="11">ENGINEERING MECHANICS</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>21BCEU0203</td><td>ESC</td><td>II</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

Unit	Content	No.of Hours
I	Equilibrium of Particles Covering; Introduction, Rigid Bodies, Laws of Mechanics, Lame’s theorem, Parallelogram and triangular Law of forces, Principle of transmissibility, Coplanar Forces, Resolution and Composition of forces, Equivalent systems of forces, Single equivalent force, Forces in space, Equilibrium of a particle in 2D and 3D - Vectorial representation of forces.	10
II	Equilibrium of rigid bodies covering; Free body diagram, Types of supports and their reactions, requirements of stable equilibrium, Moments and Couples, Scalar components of a moment, Moment of a force about a point and about an axis, Vectorial representation of moments and couples, Varignon’s theorem, Equilibrium of Rigid bodies in two dimensions, Equilibrium of Rigid bodies in three dimensions, Principle of virtual work.	9
III	Friction Covering; Frictional force, Laws of Coulomb friction, Simple contact friction, Sliding Friction, Inclined planes, Angle of Repose, Belt friction, Ladder friction, Wedge Friction, Rolling resistance.	8
IV	Centroid and Center of Gravity Covering; Centroid of simple figures from first principle, centroid of composite sections - Center 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 (T section and I section) - Mass moment inertia of circular plate, Cylinder, Cone, Sphere- Principal moment of inertia.	9

V	Dynamics covering, Review of particle dynamics - Displacements, velocity and acceleration, their relationship - Equations of motions - Rectilinear motion- Plane curvilinear motion - Newton’s 2nd law- Impulse, momentum, impact - 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 - Virtual Work and Energy Method - Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies.	9
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. Palanichamy, M.S., Nagan, S. (2013), “Engineering Mechanics – Statics & Dynamics”, Tata McGraw–Hill. 4. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press. 5. Merriam, J.L. (2017), Engineering Mechanics, Volume I – Statics, and Volume – II, Dynamics 2/e, Wiley International, Seventh Edition. 6. Ashok Gupta (2002), “Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)”, Pearson Education Asia Pvt., Ltd. 7. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press 8. Shanes and Rao (2006), Engineering Mechanics, Pearson Education, 9. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education 10. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer’s Engineering Mechanics 11. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications 12. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co. 13. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications	
Course Outcome	**CO1:** Apply the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D. **CO2:** Apply the concept of reaction forces (non-concurrent coplanar and non coplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D. **CO3:** Apply the concepts of locating centroids / center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids. **CO4:** Apply the concepts of frictional forces at the contact surfaces of various engineering systems. **CO5:** Apply the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar	

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

Course Title	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
21BCEU0204	ESC	II	2	2	-	-	40	60	-	-	100
Cognitive Level	K-1: To understand the basic law concepts in AC & DC circuits. K-2: To Gain knowledge about the fundamentals of digital electronic system. K-3: To impart basic knowledge of communication engineering										
Course Objectives	At the end of the course students will be able: • To understand the basic law concepts in AC & DC circuits. • To explain the working principle, construction, applications of DC machines, AC machines & measuring instruments. • To Gain knowledge about the fundamentals of digital electronic system. • To impart basic knowledge of communication engineering.										

Unit	Content	No.of Hours
I	**ELECTRICAL CIRCUITS AND MEASURMENTS** Ohm's Law – Kirchhoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits. Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters.	**7**
II	**UNIT II - ELECTRICAL MACHINES** Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.	**5**
III	**UNIT III - SEMICONDUCTOR DEVICES AND APPLICATIONS** Characteristics of PN Junction Diode – Zener Diode and its Characteristics, Applications – Photodiode-Half wave and Full wave Rectifiers. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics- FET Characteristics.	**6**
IV	**UNIT IV - DIGITAL ELECTRONICS** Binary Number System – Logic Gates – Boolean algebra: Laws and Theorems, Combinational Circuits: Adder, Subtractor. Sequential Circuits: Flip-Flops (SR, JK, D, T) – A/D and D/A Conversion (simple concepts).	**6**
V	**UNIT V - FUNDAMENTALS OF COMMUNICATION ENGINEERING** Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations. Communication Systems: Satellite and Optical Fiber (Block Diagram Approach only)- Super Heterodyne-receiver.	6

References	**Text Books &Reference Books:** 1. Mittle V.N., “Basic Electrical Engineering”, TMH Edition, New Delhi, 1990. 2. Sedha, R.S., “Applied Electronics” S. Chand and Co., 2006. 3. Muthusubramanian R, Salivahanan S and Muraleedharan K A, “Basic Electrical,Electronics and Computer Engineering”, TMH, Second Edition, (2006). 4. Nagsarkar T K and Sukhija M S, “Basics of Electrical Engineering”, Oxford press (2005). 5. Mehta V K, “Principles of Electronics”, S.Chand and Company Ltd, (1994). 6. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series,McGraw Hill,(2002). 7. Premkumar N, “Basic Electrical Engineering”, Anuradha Publishers, (2003). 8. Morris Mano, ”Digital Design”, Pearson Education, 2006.	
Course Out Comes	**CO1:** To understand the basic law concepts in AC & DC circuits. **CO2:** To explain the working principle, construction, applications of DC machines, AC machines & measuring instruments. **CO3:** To Gain knowledge about the fundamentals of digital electronic system. **CO4:** To impart basic knowledge of communication engineering.	

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

<table>
<tr><th>Course Title</th><th colspan="11">INTRODUCTION TO CIVIL 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>21BCEU0205</td><td>ESC</td><td>II</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">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</td></tr>
<tr><td>Course objectives</td><td colspan="11">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.</td></tr>
</table>

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, fundamentals of architectural design & town planning; Building Systems (HVAC, Acoustics, Lighting, etc.); LEED ratings; Development of Smart cities	6

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; 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, various types of foundations; basics of rock mechanics & tunneling	6
III	1. **Hydraulics, Hydrology &Water Resources Engineering:** Fundamentals of fluid flow, basics of water supply systems; Multipurpose reservoir projects 2. **Ocean Engineering:** Basics of Wave and Current 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;	6
IV	1. **Surveying & Geomatics:** Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR; 2. **Traffic &Transportation Engineering:** Developments and challenges in integrated transport development in India: road, rail, port and harbour and airport sector; PPP in transport sector; Intelligent Transport Systems; **Repairs & Rehabilitation of Structures:** Basics of corrosion phenomena some simple systems of rehabilitation of structures; Non-Destructive testing systems; Use of carbon fibre wrapping and carbon composites in repairs.	**6**
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, …)	6
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	
Course Out come	**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 **CO4:** Exploration of the various possibilities of a career in this field **CO5:** Understanding the vast interfaces this field has with the society at large **CO6:** Providing inspiration for doing creative and innovative work **CO7:** 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 **CO9:** Providing a foundation for the student to launch off upon an inspired academic pursuit into this branch of engineering	

Course outcome	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	2	1	1	1	2
CO 2	1	2	1	2	1
CO 3	1	1	2	1	1
CO 4	1	1	1	2	2
CO 5	1	1	1	1	1
CO 6	1	2	1	2	1
CO 7	1	1	2	1	1
CO 8	1	1	1	2	2
CO 9	1	1	1	1	1

Course Title	**DISASTER PREPAREDNESS AND PLANNING**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0206	ESC	II	2	-	-	-	40	60	-	-	100
Cognitive Level	K-1: state the fundamentals of disaster Vulnerability K-2: Understand the natural and man-made disasters K-3: interpredit the impact and consequences of various disasters										
Course Objectives	To make student conversant • To Understand basic concepts in Disaster Management • To Understand Definitions and Terminologies used in Disaster Management • To Understand Types and Categories of Disasters • To Understand the Challenges posed by Disasters										

Unit	**Content**	**No.of Hours**
I	Introduction to Disaster Management -Contemporary Natural and Man-made Disasters-Fundamentals of Disasters, Causal Factors of Disasters, Poverty, Population Growth, Rapid Urbanization, Transitions in Cultural Practices, Environmental Degradation, War and Civil Strife.-Earthquakes, Tropical Cyclones, Floods, Droughts, Environmental Pollution, Deforestation, Desertification, Epidemics, Chemical and Industrial Accidents.	**7**
II	Hazard classification and assessment - Hazard evaluation and hazard control - Concept And Elements of disaster risk - Techniques of Risk Assessment - Vulnerability Concept and Parameters, Risk and Vulnerability Relationship, Observation and Perception Of Vulnerability, Vulnerability Identification, Socio-Economic Factors of Vulnerability, Vulnerability Analysis.	**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 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.	**6**
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.),	**5**

	sustainable and environmental friendly recovery; reconstruction and development methods.	
References	**Text Books &Reference Books:** 1. http://ndma.gov.in/ (Home page of National Disaster ManagementAuthority) 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 PublishingCorporation 6. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003 7. Thomas D.Schneid., "Disaster Management and Prepardness," Tata McGraw Hill, New Delhi,2001. 8. William L Waugh., "Living with hazards,dealing with disasters:An Introduction to Emergency Management," Amazon Publications, 2002. 9. Patrick Leon Abbott, "Natural Disasters," Amazon Publications, 2002. 10. Ben Wisner., "At Risk: Natural Hazards, People vulnerability and disasters," AmazonPublications, 2001	
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	**ENERGY SCIENCE AND ENVIRONMENT**										
Course Code	**Categor Y**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0207	ESC	II	2	2	-	-	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										
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	5
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)	7
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	6

IV	*Civil Engineering Projects connected with the Energy Sources:* Coal mining technologies, Oil exploration offshore platforms, 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	6
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	6
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 sustainability	

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	**GANDHI'S LIFE, THOUGHT AND WORK**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
-	MC	I	-	2	-	-	20	30	-	-	50

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

<table>
<tr><th>Course Title</th><th colspan="11">WORKSHOP MANUFACTURING PRACTICES</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>21BCEU0208</td><td>ESC</td><td>II</td><td>1</td><td>-</td><td>-</td><td>2</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: 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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">This course is designed to address the following:
• Understanding different manufacturing techniques and their relative advantages/disadvantages with respect to different applications
• The selection of a suitable technique for meeting a specific fabrication need
• Acquire a minimum practical skill with respect to the different manufacturing methods and develop the confidence to design & fabricate small components for their project work and also to participate in various national and international technical competitions.</td></tr>
</table>

Unit	Content	No.of Hours
	Lectures & videos 1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 lectures) 2. CNC machining, Additive manufacturing (1 lecture) 3. Fitting operations & power tools (1 lecture) 4. Carpentry (1 lecture) 5. Plastic moulding, glass cutting (1 lecture) 6. Metal casting (1 lecture) 7. Welding (arc welding & gas welding), brazing (2 lecture) 8. [More hours can be given to Welding for Civil Engineering students as they may have to deal with Steel structures fabrication and erection; 3D Printing is an evolving manufacturing technology and merits some lectures and hands-on training.	5
	work shop practice 1.Machine shop 2. Fitting shop 3. carpentry 5. Welding shop 6. Casting 7. Smithy 8. Plastic moulding& Glass Cutting	25

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

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

Course Title	**COMPUTER AIDED CIVIL ENGINEERING DRAWING**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0209	ESC	II	2	-	-	4	-	-	60	40	100
Cognitive Level	K1: To get exposure to national standards relating to technical drawings using Computer Aided Design and Drafting practice K2: Do a detailed study of an engineering artefact K3: Develop drawings for conventional structures using practical norms.										
Course Objectives	This course is designed to address the following: • Develop Parametric design and the conventions of formal engineering drawing • Produce and interpret 2D & 3D drawings • Communicate a design idea/concept graphically/ visually • Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3Dsoftware. • Get a Detailed study of an engineering artifact										

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

V	**List of titles for the Drawing Practice:** 1. Buildings with load bearing walls including details of doors and windows. 2. RCC framed structures-Residential 3. Reinforcement drawings for typical slabs, beams, columns and spread footings. 4. Industrial buildings –Steel- roof Trusses	15
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.	

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

Course Title	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0210	ESC	II	1	-	-	2	-	-	60	40	100
Cognitive Level	K-1: To become familiar with the basic circuit components and K-2: To know how to connect them to make a real electrical circuit K-3: To get a knowledge on logic gates										
Course Objectives	This course is designed to address the following: • To impart hands on experience in verification of circuit laws and measurement of circuit parameters • To train the students in performing various tests on electrical motors. • It also gives practical exposure to the usage of CRO, power sources & function generators										

Unit	**Content**	**No.of Hours**
I	1. Measurement of electrical quantities –voltage, current, power 2. Measurement of energy using single phase energy meter. 3. Study of Electronic components and equipments. 4. Study of CRO. 5. Soldering practice–Components Devices and Circuits–Using general purpose PCB. 6. Wiring Switches, Fuse, Indicator and Lamp etc. such as in basic household 7. Wiring Stair case light 8. Wiring tube – light 9. Wiring Study: 10. Studying an Iron-Box wiring. 11. Studying a Fan Regulator wiring. 12. Studying an Emergency Lamp wiring. 13. Verification of Ohm’s Law 14. Verification of Kirchhoff’s Law. 15. Steady state response of AC and DC circuits (Mesh, Node Analysis) 16. Performance characteristics of single phase induction motor. 17. Characteristics of PN diode and Zener diode 18. Characteristics of Zener diode 19. Half wave and full wave Rectifiers 20. Application of Zener diode as shunt regulator. 21. Characteristics of BJT and JFET 22. Study of logic gates AND, OR, XOR and NOT	**60**

References	**Text Books &Reference Books:** 1. Mittle V.N., “Basic Electrical Engineering”, TMH Edition, New Delhi, 1990. 2. Sedha, R.S., “Applied Electronics” S. Chand and Co., 2006. 3. Muthusubramanian R, Salivahanan S and Muraleedharan K A, “Basic Electrical,Electronics and Computer Engineering”, TMH, Second Edition, (2006). 4. Nagsarkar T K and Sukhija M S, “Basics of Electrical Engineering”, Oxford press (2005). 5. Mehta V K, “Principles of Electronics”, S.Chand and Company Ltd, (1994). 6. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series,McGraw Hill,(2002). 7. Premkumar N, “Basic Electrical Engineering”, Anuradha Publishers, (2003). Morris Mano, ”Digital Design”, Pearson Education, 2006.	
Course Out Comes	**CO1:** To become familiar with the basic circuit components and **CO2:** know how to connect them to make a real electrical circuit; **CO3:** Ability to perform speed characteristic of different electrical machines **CO4:** Ability to use logic gates and Flip flops	

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

Course Title	**SUMMER INTERNSHIP I**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0211	PROJ	II	1	-	-	-	-	-	40	60	100
Cognitive Level	K1: To familiar with field practices K2: To understand the industrial practices										
Course Objectives	• To train the students in field work so as to have a firsthand knowledge of practical problems in carrying out engineering tasks. • To develop skills in facing and solving the field problems.										

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

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

III - SEMESTER

<table>
<tr><td>Course Title</td><td colspan="11">MATHEMATICS-III (MATRIX, PROBABILITY AND DISTRIBUTIONS)</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>-</td><td>-</td></tr>
<tr><td>21MATU03C3</td><td>BSC</td><td>III</td><td>3</td><td>3</td><td>-</td><td>3</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1:Understand the concept of consistency of system of linear equations.
K2:Using sample measures to find the relationship between two samples or sample and population.
K3:Apply distribution theory to solve problems in probability theory</td></tr>
<tr><td>Course Objectives</td><td colspan="11">• Understand the concept of eigen value, eigen vector and diagonalization process.
• Apply the statistical measures in the concept of comparison of population and sample.
• Infer axioms of probability, elementary theorems, conditional probability, discrete and continuous random variables</td></tr>
</table>

Unit	**Content**	**No.of Hours**
I	**[Matrices]** Solution of Linear system of equations – Cramer's rule – Consistency of a linear system of equations – Eigen values – Properties of eigen values – Cayley Hamilton theorem – Reduction to Diagonal form.	10
II	**[Statistical Methods]** Collection and classification of data – Measures of central tendency – Measures of dispersion – Coefficient of variations – Standard deviation	9
III	**[Correlations and Regressions]** Correlation – Coefficient of correlation – Rank correlation – Lines of regressions	10
IV	**[Probability]** principle of counting – Permutation and Combination – Probability – Properties – Conditional probability – Baye's theorem.	9

V	**[Distributions]** Random variables – Discrete probability distribution – Continuous probability distribution – Expectations, variance and moments - Binomial distributions – Poisson distributions – Normal distributions.	10

	Text Books: **1.** B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers, 43rd edition, 2015. Unit-I [Sections: 2.9,2.10,2.13 to 2.16] Unit-II [Sections: 25.2,25.5 to 25.8] Unit-III [Sections: 25.12,25.13,25.16,25.14] Unit-IV [Sections: 26.1 to 26.6] Unit-V [Sections: 26.7 to 26.10,26.14 to 26.16]	
Reference book	**1.** T.Veerarajan, "Engineering Mathematics", Volume I, Tata Mcgraw Hill, New delhi, 2008. **2.** Erwin Kreszig, "Advanced Engineering Mathematics",10th edition, Wiley, 2017. **3.** Miller Freund's, "Probability and Statistics for Engineers", Eighth edition, PHI Learning Private Limited, Delhi, 2003.	
Course Out Comes	After completing this course, students should demonstrate competency in the following skills: CO1: Use both orthogonal transformation and similar transformation to diagonalize the matrix. CO2: Evaluation of mean, median, mode and other measures in the concept of frequency distributions. CO3: Identify the relationship between two samples by using correlation and regression. CO4: Understand the concept of probability theory and solving problems related to Bayes theorem. CO5: Formulate simple engineering problems as discrete and continuous random variables and understand the concept of distribution theory.	

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

Course Title	**MECHANICS OF SOLIDS I**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CF A**	**ESE**	**-**	**-**	
18BCEU0312	**PCC**	**III**	**3**	**3**	**-**	**3**	**40**	**60**	**-**	**-**	**100**
Cognitive Level	K-1: Define the basic concepts and definitions of stress strain, shearforce ,bending moment properties of solid sections K-2: Understand the concept of simple Bending and torsion and hoop stress. K-3: solve the problems related to solids stress , shear force, bending moment, simple bending, torsion and hoop stress for thin cylinders										
Course Objectives	1. To develop the theoretical basis about the stress, strain and elastic modulus concepts in various components. 2. To understand the mechanical behavior of materials. 3. To familiarize about finding shear force, bending moment, deflection and slopes in various types of beams with different load conditions 4. To enable students to solve practical problems related to springs and shafts										

Unit	**Content**	**No.of Hours**
I	Simple Stresses and Strains- Concept of stress and strain, stress and strain diagrams, Elasticity and plasticity – Types of stresses and strains, Hooke’s law–stress – strain diagram for mild steel – Working stress – Factor of safety – Bars of varying section – composite bars-Thermal stresses. Elastic Constants-Lateral strain, Poisson’s ratio and volumetric strain –and the relationship between them.	8
II	Bending moment and Shear Force Diagrams- BM and SF diagrams for cantilevers simply supported beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.	9
III	Flexural Stresses-Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections. Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.	8
IV	Analysis of Truss: Truss – Types- Analysis-methods of joints – methods of sections – graphical method. Deflection of truss: By Williot Mohr’s diagram.	6
V	Springs-Types-Analysis of closed-coiled-helical springs. Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.	5

References	1. Strength of Materials R.K.Rajput 2. Strength of Materials R.K.Bansal 3. Strength of Materials R.S.Khurmi 4. Timoshenko, S. and Young, D. H., “Elements of Strength of Materials” , DVNC, New York, USA. 5. Kazmi, S. M. A., “ Solid Mechanics” TMH, Delhi, India. 6. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004	
Text book	❖ Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979 ❖ Laboratory Manual of Testing Materials - William Kendrick Hall ❖ Mechanics of Materials - Ferdinand P. Beer, E. RusselJhonston Jr., John T. DEwolf– TMH 2002. ❖ Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.	
Course Out Comes	On completion of the course, students should be able to do CO1: Understand the basic principles of stress-strain concepts CO2: calculate the shear force and bending moments of various types of beams CO3: Understand the principles of simple bending and its theory CO4: Able to find the torsion for cylinders and shaft CO5: Understand the internal pressure of the cylindrical section and its stress	

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

Course Title	**FLUID MECHANICS**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CF A**	**ESE**	**-**	**-**	
21BCEU0313	**PCC**	III	3	3	-	-	40	60	-	-	100

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: Ability to the problems related to Dimensional Analysis.
Course objectives	The Course aims • To introduce the concepts of fluid mechanics useful in Civil Engineering applications. • To provides a first level exposure to fluid statics, kinematics and dynamics. • Measurement of pressure, computations of hydrostatic forces on structural components and the concepts of Buoyancy • Find solutions for many engineering problems.

Unit	**Content**	**No.of Hours**
I	Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.	**7**
II	Fluid Statics - Fluid Pressure: Pressure at a point, Pascal’s law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micro manometers. Pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.	**7**
III	Fluid Kinematics- Classification of fluid flow: steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluidflow; one, two and three dimensional flows; Stream line, path line, streakline and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates	**8**
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 : venture	**7**

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

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

<table>
<tr><th>Course Title</th><th colspan="11">ENGINEERING GEOLOGY</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>21BCEU0314</td><td>ESC</td><td>III</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- To recall the features of earth structure
K2-Understand the formation and classification of minerals and rocks
K3-Apply the knowledge of structural feature of rocks in Civil construction</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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.	8
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-	7
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.	7
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.	7
V	**GEOLOGICAL INVESTIGATIONS IN CIVIL ENGINEERING:** Geological Conditions necessary for Construction of Reservoirs and Dams, Tunnels, Buildings, Road Cuttings - Important building stones -	7

	Improvement of sites. Causes and Preventions of Land Slides –. Sea Erosion and Coastal Protection structures.	
References	1. 1. Parbin Singh. "Engineering and General Geology", S.K. Kataria & Sons, Katson Publishing House Ludhiana, 2022. 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 applications. 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

<table>
<tr><th>Course Title</th><th colspan="12">SURVEYING</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>21BCEU0315</td><td>PCC</td><td>III</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1-to recall the basics terms of surveying
K2-to understand the concept of control surveying and adjustments
K3-to understand the concept of modern surveying techniques
K4-to understand the concept of Route surveying, Hydrographic surveying and Field Astronomical surveying.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The main objective of this course to
• Introduce knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities
• Translate the knowledge gained for the implementation of Civil infrastructure facilities
• Relate the knowledge on Surveying to the new frontiers of science like curve setting, Electronic Distance Measurement, Global Positioning System, Route survey, Hydrographic survey and Field Astronomical survey.</td></tr>
</table>

Unit	Content	No.of Hours
I	FUNDAMENTALS OF SURVEYING :Classifications and basic principles of surveying – Equipment and accessories for ranging and chaining – Basic principles Compass surveying - Plane Table Surveying accessories and methods Levels and staves - Methods of levelling - Booking - Reduction – Curvature and refraction correction – Contouring.	7
II	THEODOLITE SURVEYING AND COMPUTATIONS :Horizontal and vertical angle measurements by Theodolite – Heights and distances–Tacheometric surveying – Trigonometric levelling - Computation of cross sectional areas and volumes - Earthwork calculations - Mass haul diagrams	7
III	CONTROL SURVEYING AND ADJUSTMENT :Horizontal and vertical control- Methods – Triangulation - Traversing - Gale‘s table - Trilateration Concepts of measurements and errors – error propagation and linearization – adjustment methods – least square methods– angles, lengths and levelling network.	7
IV	MODERN FIELD SURVEY SYSTEMS Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations. Photogrammetry Surveying Introduction,	7

	Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy,	
V	MISCELLANEOUS : Route Surveying - Reconnaissance - Route surveys for highways, railways and waterways Simple curves – Compound and reverse curves – Transition curves - Setting out different methods of simple curve - Vertical curves - Hydrographic surveying – Tides - MSL - Sounding methods Three-point problem – Determination of depth and position using multi-beam sounder and GPS Astronomical terms and definitions - Celestial coordinate systems – different time systems - Field observations and determination of azimuth by altitude and hour angle method.	8
References	**Text/Reference Books:** 1. T.P.Kanetkar and S.V.Kulkarni, Surveying and Levelling, Parts1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008 2. Dr.B.C.Punmia, Ashok K.Jain and Arun K Jain, Surveying Vol.I & II, Lakshmi Publications Pvt Ltd, New Delhi, 2005. 3.Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010 4.Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015. 5.R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012. 6. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004 7. S.K. Roy, Fundamentals of Surveying, Second Edition, Prentice‘ Hall of India 2004	
Course Out Comes	The course will enable the students to: CO1: Introduce the rudiments of various surveying and its principles. CO2: Imparts concepts of Theodolite Surveying and computation of area and volume calculation. CO3: Understand the procedure for establishing horizontal and vertical control and its adjustment procedure. CO4: Introduce the basics of Electronic Surveying and Photogrammetry Surveying CO5: Initiate the knowledge in Route surveying, Hydrographic surveying and Field Astronomical surveying.	

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

Course Title	**OPEN ELECTIVE – I**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU3OX	**OEC**	III	3	3	-	-	40	60	--	-	100
• The students should undergone the courses which are offered by the Centre for Rural Technology , GRI											

Course Title	**SHANTI SENA**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
-	**MC**	III	-	1	-	-	50	-	-	-	50
The students should undergo the courses which are offered by the Department of Gandhian thought and Peace Science											

<table>
<tr><th>Course Title</th><th colspan="12">SURVEYING LABORATORY</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>21BCEU0316</td><td>PCC</td><td>III</td><td>1.5</td><td>-</td><td>-</td><td>3</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">k1-to recall the basics terms of surveying
K2- to understand the concept of control surveying and adjustmets
K3-to understand the concept of modern surveying techniques
K4-to understand the concept of Route surveying, Hydrographic surveying and Field Astronomical surveying.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The main objective of this course to
• Introduce knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities
• Translate the knowledge gained for the implementation of Civil infrastructure facilities
• Relate the knowledge on Surveying to the new frontiers of science like curve setting, Electronic Distance Measurement, Global Positioning System, Route survey, Hydrographic survey and Field Astronomical survey.</td></tr>
</table>

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

References	**Text/Reference Books:** 1. T.P.Kanetkar and S.V.Kulkarni, Surveying and Levelling, Parts1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008 2. Dr.B.C.Punmia, Ashok K.Jain and Arun K Jain, Surveying Vol.I & II, Lakshmi Publications Pvt Ltd, New Delhi, 2005. 3.Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010 4.Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015. 5.R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012. 6.. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004 7.. S.K. Roy, Fundamentals of Surveying, Second Edition, Prentice‘ Hall of India 2004	
Course Out Comes	The course will enable the students to: CO1:Introduce the rudiments of various surveying and its principles. CO2: Imparts concepts of Theodolite Surveying and computation of area and volume calculation. CO3: Understand the procedure for establishing horizontal and vertical control and its adjustment procedure. CO4: Introduce the basics of Electronic Surveying and Photogrammetry Surveying CO5: Initiate the knowledge in Route surveying, Hydrographic surveying and Field Astronomical surveying.	

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

COURSE TITLE	STRENGTH OF MATERIALS LABORATORY										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	-	-	
21BCEU0317	PCC	III	3	3	-	3	40	60	-	-	100

Cognitive Level	K-1: Define the basic concepts and definitions of stress strain, shear force ,bending moment and properties of Materials K-2: Understand the mechanical properties of materials subjected to simple Bending and torsion and Shear. K-3: solve the problems related to the field of specialization
Course Objectives	1. To develop the practical knowledge in the stress, strain and elastic modulus concepts of materials. 2. To understand the mechanical behavior of materials. 3. To familiarize about finding tensile strength, modulus of elasticity, compression strength, shear force, bending moment, deflection in various types of materials with different load conditions 4. To enable students to solve practical problems related to material quality
Practical's	List of Experiments: • Tension test on Mild Steel • Hardness test on Metals (Rockwell and Brinell Hardness Tests) • Bending and Deflection tests on simply supported beam and Cantilever beam. • Compression test on Wood, Brick, and concrete • Impact test on steel (Izode and Charpy Tests) • Double Shear test on steel • Torsion test on steel
References	1. Strength of Materials R.K.Rajput 2. Strength of Materials R.K.Bansal 3. Strength of Materials R.S.Khurmi 4. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials" , DVNC, New York, USA. 5. Kazmi, S. M. A., " Solid Mechanics" TMH, Delhi, India. 6. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004 ❖ Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979 ❖ Laboratory Manual of Testing Materials - William Kendrick Hall ❖ Mechanics of Materials - Ferdinand P. Beer, E. RusselJhonston Jr., John T. DEwolf– TMH 2002. 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 of materials CO2 calculate the material strengths against tension, compression and shear CO3 Understand the principles of quality of materials CO4 Able to select the suitable materials for the construction CO5 understand the mechanical properties of materials

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

Course Title	**VILLAGE PLACEMENT PROGRAMME**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21EXNU03VI	**MC**	**III**	**-**	**-**	**-**	**-**	**50**	**-**	**-**	**-**	**50**
Cognitive Level	**K1 :** Analyse the issues in the village **K2:** Asses the various village problem related to Civil Engineering **K3 :** Develop the master plan to resolve the village problems.										
Course Objectives	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										

IV SEMESTER

<table>
<tr><th colspan="2">Course Title</th><th colspan="10">OPEN ELECTIVE – II</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>-</td><td>OEC</td><td>VI</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>--</td><td>-</td><td>100</td></tr>
<tr><td colspan="12">• The students should undergone the courses which are offered by the other schools/Departments/ Centres of GRI</td></tr>
</table>

<table>
<tr><td>Course Title</td><td colspan="11">MECHANICS OF SOLIDS II</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>-</td><td>-</td></tr>
<tr><td>21BCEU418</td><td>PCC</td><td>IV</td><td>3</td><td>3</td><td>-</td><td>3</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: Define compound stress and Strains
K-2: Understand the concept of analysis of beams and thick cylinders.
K-3: Solve the problems related to principal stress, shear force, bending moment, and stresses in thick cylinders.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">1. To develop the theoretical basis about the Principal stress and strains.
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 trusses and Energy theorems</td></tr>
</table>

Unit	**Content**	**No. of Hours**
I	Compound Stresses and Strains: Two dimensional systems, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress analytical and graphical methods, 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.	8
II	Indeterminate Beams: Propped Cantilever beams, Fixed Beams – Fixed end moments reactions, slope and deflection for Standard cases of loading — Continuous beams – support reactions and moments– Shear Force and Bending Moment Diagrams.	9
III	Beam deflection-Relationship between moment, slope and deflection, Double Integration method – Macaulay’s method – moment Area method – Conjugate beam Method.	8
IV	Strain Energy: Introduction-Resilience-proof of Resilience-Modulus-types of loading-Problems. Thick Cylinders: Lame’s Theory-stresses in Thick cylinders-compound thick cylinders.	6
V	Theory of columns: Column-Types-Failure of Column-Axial load- Euler's theory-End conditions-Euler’s formula-slenderness ratio-Rankines formula, combined bending and axial load-problems.	5

References	8. Strength of Materials R.K.Rajput 9. Strength of Materials R.K.Bansal 10. Strength of Materials R.S.Khurmi 11. Timoshenko, S. and Young, D. H., “Elements of Strength of Materials” , DVNC, New York, USA. 12. Kazmi, S. M. A., “ Solid Mechanics” TMH, Delhi, India. 13. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004 14. 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 15. Laboratory Manual of Testing Materials - William Kendrick Hall 16. Mechanics of Materials - Ferdinand P. Beer, E. RusselJhonston Jr., John T. DEwolf– TMH 2002. 17. 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 force and bending moments of various types of beams CO3 Analyse the roof trusses CO4 able to find the applications of energy theorems CO5 understand the internal pressure of the thick 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

<table>
<tr><th>Course Title</th><th colspan="12">HYDRAULICS AND HYDRAULIC MACHINERIES</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>21BCEU419</td><td>PCC</td><td>IV</td><td>3</td><td>3</td><td>-</td><td>3</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 flow patterns and its properties

K-2: To understand the application of momentum principles

K-3: classify the pipe losses and pipe network analysis methods</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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 .</td></tr>
</table>

Unit	Content	No.of Hours
I	Open channel flow – Types and regimes of flow – Velocity distribution in open channel – Wide open channel – Specific energy – Critical flow and its computation.	**7**
II	Uniform flow – Velocity measurement – Manning's and Chezy's formula – Determination of roughness coefficients – Determination of normal depth and velocity – Most economical sections – Non-erodible channels	**7**
III	Dynamic equations of gradually varied flow – Assumptions – Characteristics of flow profiles – Draw down and back water curves – Profile determination – Graphical integration, direct step and standard step method – Flow through transitions Hydraulic jump – Types – Energy dissipation – Surges – Surge channel transitions	**7**
IV	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	**7**

	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.	
V	Application of momentum principle – Impact of jets on plane and curved plates - turbines - classification - radial flow turbines - axial flow turbines – Impulse and Reaction turbines - draft tube and cavitations - performance of turbines - similarity laws - centrifugal pump - minimum speed to start the pump – multistage Pumps – Jet and submersible pumps - Positive displacement pumps - reciprocating pump - negative slip - flow separation conditions - air vessels -indicator diagram and its variation - savings in work done - rotary pumps.	**8**
References	**Text Books &Reference Books:** 1. Subramanya K., "Flow in Open channels", Tata McGraw-Hill Publishing Company, 1994. 2. Bansal R.K., “Fluid Mechanics & Hydraulic Machines”, Lakshmi publications, 2006 3. Kumar K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, (7th Edition), 1995. 4. Jain A.K., "Fluid Mechanics (including Hydraulic Machines)", Khanna Publishers, 8th edition, 1995. 5. Ranga Raju, K.G., “Flow through Open Channels”, Tata McGraw-Hill. 6. Ven Te Chow, “Open-Channel Hydraulics”, McGraw-H: Q Book company, 1996. 7. Ramamirtham S., “Fluid Mechanics, Hydraulics and Fluid Machines”, Dhanpat Rai & Sons, Delhi, 1998. 8. John A. Roberson, “Hydraulic Engineering”, Jaico Publishing House, 1998.	
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	SOIL MECHANICS										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	-	-	
21BCEU0420	PCC	IV	3	3	-	-	40	60	-	-	100

Cognitive Level	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.
Course objectives	The Course aims • To explain Soil mechanics Engineering is and it is important to civil engineering • To discuss three phase system is used in soil and its soil properties • To explain role of water in soil behaviour and 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 non-destructive testing methods

Unit	Content	No.of Hours
I	Introduction–Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Basic Definitions and Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight, voids ratio- moisture content, unit weight- percent air voids, saturation- moisture content, moisture content- specific gravity etc. Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsion balance method, nuclear method, alcohol method and sensors. Specific gravity by density bottle method, pycnometer method, measuring flask method. Unit weight by water displacement method, submerged weight method, core-cutter method, sand-replacement method. Grain size distribution – sieve analysis – sedimentation analysis	7

II	Unit 2: Plasticity Characteristics of Soil - Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils-Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system. Identification: field identification of soils, general characteristics of soil in different groups. Soil water-types-Permeability of Soil - Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant-head method, falling-head method. Field method: pumping- in test, pumping- out test. Permeability aspects: permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis- Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets. Effective Stress Principle - Introduction, effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition.	8
III	Compaction of Soil-Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control. Stresses in soils – Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart. Contact pressure under rigid and flexible area, computation of displacements from elastic theory.	7
IV	Consolidation of Soil - Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation. Shear Strength - Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters. unconfined compression test, vane shear test	7
V	Stability of Slopes - Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts. problems ,Slope protection measures.	7

References	1. Soil Mechanics by Craig R.F., Chapman & Hall 2. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons 3. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ 4. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning 5. Principles of Foundation Engineering, by Braja M. Das, Cengage Learning 6. Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy 7. Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri. 8. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy 9. Soil Mechanics and foundation Engineering by Dr.B.C.Punmia	
Course 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	**CONCRETE TECHNOLOGY**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0421	PCC	V	3	3	-	-	40	60	-	-	100
Cognitive Level	K 1 - understand the properties of ingredients of concrete K 2 –Identify the concrete and various applications relative to satisfy the requirement in the construction field K 3 – Design the suitable concrete mix proportions and maintenance of structures.										
Course Objectives	• To study the behaviour of materials in concrete technology at its fresh and hardened state • Study about the concrete mix design by various methods to reach the target strength. • Study the various types of concretes and concreting methods and their specific applications • Ensure the quality control while testing/sampling and acceptance criteria.										

Unit	**Content**	**No.of Hours**
I	**PROPERTIES AND TESTING OF CEMENT, AGGREGATES, FRESH CONCRETE & ADMIXTURES** Cement – history of Cement – Composition - manufacturing process – types of Cement - heat of hydration - tests for cement - Aggregates – sources of aggregates – types of aggregates - tests for aggregates – Fresh Concrete - Properties of fresh concrete – workability – tests of fresh concrete - Admixtures – functions, classification, types: mineral and chemical, IS: specifications (9103 and 456), compatibility of admixtures.	7
II	**PROPERTIES AND TESTING OF HARDENED CONCRETE** Hardened concrete: Testing of hardened concrete (compressive strength, Tensile strength) – Engineering properties of concrete Elasticity – Creep and shrinkage, ductility - factors affecting the properties – chemical attack on concrete – other properties failure criteria of concrete – Non destruction testing methods. Advanced Testing Methods: SEM, EDAX, FTIR, XPS, RCPT etc.	7
III	**SPECIAL CONCRETE AND CONCRETING METHODS** Lightweight concrete – High density concrete – Fibre reinforced concrete – polymer concrete – Types - application – Special concreting methods – Cold weather concreting – Hot weather concreting – Sulphur Infiltrated concrete - prepacked concrete - Vacuum concrete - gunite / shotcrete – Ferrocement – applications.	7

IV	**MIX DESIGN BY VARIOUS METHODS** Methods of concrete mix design - concept of mix design - variables in proportioning – common terminologies – calculation of standard deviation – coefficient of variation – relation between average design strength and specified minimum strength - factors affecting concrete mix design – concrete mix design by Indian Standard method – ACI method – DOE method of concrete mix design.	8
V	**QUALITY CONTROL AND MAINTENANCE** Statistical & Quality control of concrete Materials – Qualities of water – use of sea water for mixing concrete - Corrosion in concrete – effects – corrosion of steel - prevention from corrosion. Damage Assessment Procedure- cracking-crack repairing techniques. Weather proofing Agents.	7
References	1. M.S.Shetty., "Concrete Technology Theory and Practice" S.Chand & Company Limited, New Delhi, 2011. 2. Gambhir.M.L, "Concrete Technology Theory and Practice" 5th Edition, Tata McGraw Hill Education Pvt.Ltd, New Delhi, 2013. 3. Neville A.M, Brooks J.J, "Concrete Technology" Pearson Education Ltd., New Delhi, 2008. 4. A.R.Shanthakumar., "Concrete Technology" Oxford University Press-New Delhi, 2006.	
Course Out Comes	CO1: Understand the different types of cements and concretes CO2: Determine the qualities of concrete ingredients CO3: Evaluate the strength and durability parameters of concrete CO4: Understand various mix design for computation of strength of concrete materials and concrete CO5: Specify the suitability of the cement and concrete with respect to the strength and grades.	

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

Course Title	**Fundamentals of Remote Sensing & GIS**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0422	PCC	V	3	3	-	-	40	60	-	-	100
Cognitive Level	K1 :To understand the Concept of Remote sensing and satelites K2: To discuss the data input and Image analysis techniques. K3:To apply the Remote sensing and GIS in various sectors for finding the solutions .										
Course Objectives	• To introduce the principles and basic concepts of Remote Sensing and GIS • To introduce the remote sensing systems, data products and analysis • To introduce the spatial data models, analysis and presentation techniques • To study the applications of Remote Sensing and GIS in agriculture, soil and water resources										

Unit	**Content**	**No.of Hours**
I	**CONCEPTS OF REMOTE SENSING AND SATELLITES** Definition- Historical background - Components of remote sensing – Energy source, electromagnetic spectrum, radiation principle, platforms and sensors - Active and passive remote sensing interference - Atmospheric effects on remote sensing – Energy interaction with earth surface feature - Data acquisition - Reflectance, spectral signatures for water, soil and vegetation.- Satellites - Types - Sun synchronous - Geo synchronous remote sensing satellites - LANDSAT,SPOT & IRS - Resolution - Spectral, spatial, radiometric and Temporal resolution - Recent satellites with its applications	8
II	**DATA PRODUCTS AND IMAGE ANALYSIS** Data products –based on level of processing– scale – area/coverage – data availability – data ordering- data price - Image interpretation – Visual interpretation elements – interpretation key. Digital image processing – Image enhancement – image classification – Supervised and unsupervised – Vegetation Indices.	7
III	. **CONCEPTS OF GIS** Definition – Map and their influences – Characteristics of Maps – Elements – Map scale, Projection, Coordinate systems – Sources of spatial data – History and development of GIS – Definition – Components – Hardware and Software.	7

IV	**DATA INPUT AND ANALYSIS** Data – Spatial, Non-Spatial – Database models – Hierarchical network, Relational and Object-Oriented Data Models – Raster and Vector – Methods of Data input – Data Editing – Files and formats – Data structure – Data compression. Introduction to analysis – Measurements – Queries – Reclassification – Simple spatial analysis – Buffering – Neighboring functions – Map overlay – Vector and raster – Spatial interpolation – Modelling in GIS – Digital Elevation Modelling – Expert systems	7
V	**APPLICATION OF REMOTE SENING AND GIS** Introduction to GPS and its applications – Integration of Remote Sensing and GIS – Hydrological & Water resources assessment and mapping – Soil erosion mapping – Land use and Land cover mapping – water shed management - – Environmental assessment and Planning – Urban sprawl mapping and Transportation studies.	7
References	**TEXT BOOKS:** 1. Anji Reddi, Remote Sensing and Geographical Information Systems, BS publications, 2001 2. Lillesand T.M. and Kiefer W, “Remote Sensing and Image Interpretations” John Wiley & Sons, New York. **REFERENCES:** 1. Prithvish Nag and M.Kudrat, “Digital Remote Sensing”, Concept Publishing Company, New Delhi, 1998. 2. John R. Jensen, “Remote Sensing of the environment – An Earth resource perspective, “ Pearson Education Publication (Singapore – low prized ed.,) Indian branch, Delhi 2005 3. 1987Srinivas M.G. (Edited by) Remote Sensing Applications, Narosa Publishing House 2001 4. Burrough, P.A. “ Principles of Geographical Information systems for Land resources assessment” Clarandone Press, Oxford, 1986	
Course Out Comes	CO1: students will understand the basic principles of Remote sensing, EMR interactions and satellites with sensor CO2: students will understand the data product and image analysis CO3: They will understand the basic concept and components of GIS CO4: students will able to understand different types of data analysis CO5: students can able to apply the remote sensing and GIS techniques in real time issues	

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

Course Title	**CONSTITUTION OF INDIA**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21PSDU04C1	MC	IV	-	2	-	-	50	-	-	-	50
Cognitive Level	K1: Recall the basic constitution of India K2 : understand the fundamental rights and principles K3 : Apply the knowledge and interpret the reality										
Course Objectives	1. To introduce the basic principles and features of the Indian Constitution. 2. To familiarize students on the fundamental rights and their applic 3. ation 4. To help students to understand the working of executive, legislature and Judiciary in India.										

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 responsibilities **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

Course Title	FLUID MECHANICS AND MACHINERIES LABORATORY

Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
21PSDU0423	PCC	IV	1.5	-	-	3	-	-	60	40	100

CognitiveLevel	K-1: Determine the co efficient of discharge K-2: Measure friction factor in pipes K-3: Determine the performance characteristics of turbines
Course objectives	To make student conversant • To Determine the Co efficient of discharge , • To Determine the major and minor losses in pipes • Performance characteristics of pumps and turbines.

Unit	Content	No.of Hours
I	1. Measurement of fluid pressure using manometers 2. Determination of co-efficient of discharge for orifice and mouth piece (Constant and Variable Head) 3. Measurement of viscosity 4. Determination of co-efficient of discharge for orificemeter and venturimeter 5. Verification of Bernoulli's Theorem 6. Determination of co-efficient of discharge through notches (Triangular, Rectangular, Trapezoidal notechs) 7. Hydraulic Jump 8. Flow under Sluice Gate 9. Turbulent flow through pipes 10. Flow visualization 11. Laminar flow through pipes 12. Study of friction losses in pipes 13. Study of minor losses in pipes 14. Study on performance characteristics of Pelton turbine 15. Study on performance characteristics of Francis turbine 16. Study on performance characteristics of Kaplan turbine 17. Study on performance characteristics of Centrifugal	**36**

	pumps (Constant speed/ variable speed) 18. Study on performance characteristics of reciprocating pump 19. Study on performance characteristics of Jet pump 20. Study on performance characteristics of submersible pump	
References	**Text Books &Reference Books:** 15. Bansal R.K., “Fluid Mechanics & Hydraulic Machines”, Lakshmi publications, 2006 16. Kumar K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, (7th Edition), 1995. 17. Jain A.K., "Fluid Mechanics (including Hydraulic Machines)", Khanna Publishers, 8th edition, 1995. 18. Ranga Raju, K.G., “Flow through Open Channels”, Tata McGraw-Hill. 19. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2015. 20. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House. New Delhi, 2017. 21. Subramanya K, Fluid Mechanics and Hydraulic Machines, Tata McGraw Hill Edu. Pvt. Ltd. 2011	
Course Out Comes	CO1: Determine the co efficient of discharge for orifice and mouth piece CO2: Determine the co efficient of discharge through orifice meter and venturimeter. CO3: Determine the co efficient of discharge for various notches. CO4: Apply Bernoulli equation for calibration of flow measuring devices. CO5: Determine the performance characteristics of pumps and Turbines.	

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

Course Title	**SOIL MECHANICS LABORATORY**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0424	PCC	IV	1.5	-	-	3	-	-	60	40	100
Cognitive Level	K 1 – Understand the basic definitions and soil phase relation. K 2 – Calculate the engineering properties of soil. K 3 – Analyse and interpret the data for identify the soil.										
Course objectives	The Course aims • To explain Geotechnical Engineering is and how it is important to civil engineering • To explain how three phase system is used in soil and how are soil properties estimated using three phase system • To explain role of water in soil behavior and how soil stresses, permeability and quantity of seepage including flow net are estimated • To determine shear parameters and stress changes in soil due to foundation loads • To estimate the magnitude and time-rate of settlement due to consolidation										

Unit	**Content**	**No.of Hours**
	Soil mechanics Engineering Laboratory 1. Natural moisture content using Oven Drying and torsion balance methods. 2. Specific gravity of Soils. 3. Relative density of Sand. 4. Field Density using Core Cutter method. 5. Field Density using Sand replacement method. 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. Direct Shear Test (Demonstration Only) 15. Consolidation Test. 16. Unconfined Compression Strength Test. 17. Triaxial Test. 18. Vane shear test	**36**

References	10. Soil Mechanics by Craig R.F., Chapman & Hall 11. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons 12. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., Prentice Hall, NJ 13. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning 14. Principles of Foundation Engineering, by Braja M. Das, Cengage Learning 15. Essentials of Soil Mechanics and Foundations: Basic Geotechnics by David F. McCarthy 16. Soil Mechanics in Engineering Practice by Karl Terzaghi, Ralph B. Peck, and Gholamreza Mesri. 17. Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering (Civil and Environmental Engineering) by V.N.S. Murthy 18. 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 Moisture content CO5: Specify a strategy to identify the soil properties and to find the suitability of soil for the construction purpose	

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

Course Title	**Fundamentals of Remote Sensing & GIS Laboratory**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0425	**PCC**	**V**	**1.5**	**3**	**-**	**-**	**-**	**-**	**60**	**40**	**100**
Cognitive Level	K1 :To understand the Concept of Remote sensing and GIS K2: To discuss the data input and Image analysis techniques. K3 :To apply the Remote sensing and GIS in various sectors for finding the solutions .										
Course Objectives	• To introduce the principles and basic concepts of Remote Sensing and GIS • To understand the Image correction, image rectification for data preparation • To understand the image interpretation and classification • To prepare a new digitized map for decision making. • To apply the knowledge in civil engineering sector										

Unit	**Content**	**No.of Hours**
I	**Remote Sensing:** 1. Data Preparation a. Subset image b. Geometric Correction c. Mosaic images 2. Visual Image Interpretation 3. Image Rectification a. Evaluation methods like alarm and Histogram 4. Geo referencing of image 5. Image Enhancement 6. Image Classification a. Supervised classification b. Unsupervised classification **Geographical Information System:** 7. Digitization of Map/Toposheet 8. Creation of thematic maps. 9. Estimation of features and interpretation 10. Developing Digital Elevation model 11. Simple applications of Remote sensing and GIS	36
References	**TEXT BOOKS:** 3. Anji Reddi, Remote Sensing and Geographical Information Systems, BS publications, 2001 4. Lillesand T.M. and Kiefer W, “Remote Sensing and Image Interpretations” John Wiley & Sons, New York.	

	REFERENCES: 5. Prithvish Nag and M.Kudrat, “Digital Remote Sensing”, Concept Publishing Company, New Delhi, 1998. 6. John R. Jensen, “Remote Sensing of the environment – An Earth resource perspective, “ Pearson Education Publication (Singapore – low prized ed.,) Indian branch, Delhi 2005 7. 1987Srinivas M.G. (Edited by) Remote Sensing Applications, Narosa Publishing House 2001 8. Burrough, P.A. “ Principles of Geographical Information systems for Land resources assessment” Clarandone Press, Oxford, 1986	
Course Out Comes	CO1: students will understand the remote sensing and GIS software CO2: students will understand the data product and image analysis CO3: They will understand image Rectification and image interpretation CO4: students will able to understand different types of image classification and digitization CO5: students can able to apply the remote sensing and GIS techniques in real time issues	

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

Course Title	**SUMMER INTERNSHIP-II**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0426	**PROJ**	**IV**	**1**	**-**	**-**	**-**	**-**	**-**	**40**	**60**	**100**
Cognitive Level	K1: apply the knowledge in real issues related to civil engineering K2 : Analyze the issues of civil engineering field K3: Develop the plan for civil engineering related sectors										
Course Objectives	The main aim is ✚ To train the students in field to have a firsthand knowledge of practical problems in engineering tasks. ✚ To develop skills in facing and solving the field problems.										

OUTCOMES:

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

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

EVALUATION PROCEDURE

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

<table>
<tr><th>Course Title</th><th colspan="11">SOFTWARE SKILL DEVELOPMENT -II</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>21BCEU0427</td><td>ESC</td><td>IV</td><td>1</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1 : Apply the knowledge in the software
K2: Analyze the various software usages and applications
K3: Develop the various models related to civil engineering</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The main of this course is
• The student can acquire knowledge of latest software
• They can able to develop the digital format of the solution related to civil engineering</td></tr>
</table>

V SEMESTER

Course Title	PROFESSIONAL PRACTICE LAW AND ETHICS										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
21BCEU0528	HSMC	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)	8
	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.	
2	General principles of contracts management: Indian contract Act 1972 and its amendments. General principles of contract- Types of contract- prime and subcontracts, joint ventures and consortium, complex contract terminology, Tenders, Bids, Proposals, contract conditions, critical / red flag conditions. Variations and changes in contracts - cost escalation, time extension, suspensions and terminations. Delay Analysis, contract documentation, contract notices, wrong practices in contracting, Reverse auction, Public - Private partnerships, International commercial terms.	5
3	Arbitration conciliation and ADR(Alternative Dispute Resolution) system: Arbitration - meaning - scope and types - distinction between laws of 1940 and 1996, UNCTTRAI model law - Arbitration and expert determination, Arbitration Tribunal. Award - Grounds for setting aside an award - Enforcement of foreign awards - New York and Geneva convention Awards, Distinction between conciliation, negotiation, mediation and arbitration, Dispute Resolution Boards, Lok Adalats.	5

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

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

<table>
<tr><td>Course Title</td><td colspan="11">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>21BCEU0529</td><td>PCC</td><td>V</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">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.	7
II	**SHALLOW FOUNDATION** Introduction – Location and depth of foundation – codal provisions – bearing capacity of shallow foundation on homogeneous deposits – Terzaghi’s formula and BIS formula – factors affecting bearing capacity – problems – Bearing capacity from insitu tests (SPT,SCPT and PLT) – Allowable bearing pressure, Settlement – Components of settlement – determination of settlement of foundations on granular and clay deposits-equal settlement - differential settlement – allowable settlements – Codal provision – Methods of minimizing settlement.	8
III	**FOOTINGS AND RAFTS** Types of foundation – Contact pressure distribution below footings & raft – Isolated and combined footings – types – proportioning – mat foundation-types – uses –proportioning – floating foundation	7
IV	**PILES**	7

	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.	
V	**RETAINING WALLS** Plastic equilibrium in soils – active and passive states – Rankine's cohesionless and cohesive soil – Coloumbo's wedge theory – condition for critical failure plane – Earth pressure on retaining walls of simple configurations – Graphical methods (Rebhann and Culmann) – pressure on the wall due to line load Stability of retaining walls.	7
References	**TEXT BOOKS:** 1. Punmia, B.C, "Soil Mechanics and foundations"' Laximi publication pvt.Ltd., New Delhi1, 2005. 2. Gopal Ranjan and Rao, A.S.R. "Basic and Applied Soil Mechanics", Wiley Eastern Ltd., New Delhi (India), 2003. **REFRENCE BOOKS:** 1. Varghese P.C.,"Foundation Engineering", PHI Learning Private Limited, New Delhi, 2005. 2. Das, B.M. "Principles of Foundation Engineering (Fifth Edition), Thomson Books/COLE, 2003 3. Murty, V.N.S. ``Soil Mechanics and Foundation Engineering", UBS Publishers Distribution Lts., New Delhi,1999. 4. Swamisaran, "Analysis and Design of Structures – Limit state Design:, Oxford IBH Publishing Co-Pvt. Ltd., New Delhi, 1998.	
Course Out Comes	After completion of the course the students should be **CO1:** Able to understand the various sampling techniques **CO2:** Know about the various insitu tests to find the bearing capacity of the soil. **CO3:** Ability to select the suitable footings for the soil conditions. **CO4:** knowledge about the piles and pile groups under various loading conditions **CO5:** able to design the various retaining walls as per Indian standard code.	

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	DESIGN OF CONCRETE STRUCTURES										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
21BCEU0530	PCC	V	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- recall the basic properties of material and it inter relationships K2-understand the design concepts of various super structure elements K3-understand the design concepts of various sub structure elements K4- design the beam, column, staircase, and footing of structures										
Course Objectives	1. To introduce the Role of structural engineer in structural design of concrete structures 2. To understand the limit state concepts and the analysis of beam as per codes 3. To introduce the moment capacity of section and the design of slab 4. To understand the concepts and design of column 5. To know the soil properties and footing design for colums										

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

	Uniaxial and Biaxial bending using Column Curves-design of spiral reinforced concrete column.	
V	**DESIGN OF FOOTINGS** Introduction, Types of Footings, Concepts of Proportioning of footings and foundations based on soil properties -Soil Pressures for footings- General Design Considerations and Code Requirements, Design of wall footing –Design of Isolated footings with axial and eccentric loading-– Design of Combined Rectangular footing for two columns only.	7
References	**Text Books** 1. 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 of slab and staircase in RCC. CO4 :Design of flexural members CO5: Analyze and design for shear, torsion bond and Redistribution of moments in continuous reinforced concrete beam.	

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

Course Title	**WATER SUPPLY ENGINEERING**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0531	**PCC**	**V**	**3**	**3**	**-**	**-**	**40**	**60**	**-**	**-**	**100**
Cognitive Level	K1: Understand the population forecasting and water demand. K2: Understand the concepts of water treatment processes K3: Understand the concepts of advanced water treatment and water distribution systems.										
Course Objectives	The students completing the course will have • an insight into the structure of drinking water supply systems, including water transport, treatment and distribution • an understanding of water quality criteria and standards, and their relation to public health the ability to design and evaluate water supply project alternatives on basis of chosen selection criteria										

Unit	**Content**	**No.of Hours**
I	**PLANNING FOR WATER SUPPLY SYSTEM** Public water supply system -Planning - Objectives -Design period - Population forecasting -Water demand -Sources of water and their characteristics -Surface and Groundwater- Impounding Reservoir Well hydraulics -Development and selection of source - Water quality - Characterization and standards- Impact of climate change.	
II	**CONVEYANCE SYSTEM** Water supply -intake structures -Functions and drawings -Pipes and conduits for water- Pipe materials - Hydraulics of flow in pipes - Transmission main design -Laying, jointing and testing of pipes - Drawings appurtenances - Types and capacity of pumps -Selection of pumps and pipe materials.	
III	**WATER TREATMENT** Objectives - Unit operations and processes - Principles, functions design and drawing of Chemical feeding, Flash mixers, flocculators, sedimentation tanks and sand filters - Disinfection- Residue Management - Construction and Operation & Maintenance aspects of Water Treatment Plants.	
IV	**ADVANCEDWATERTREATMENT** Principles and functions of Aeration - Iron and manganese removal, Defluoridation and demineralization -Water softening - Desalination - Membrane Systems - Recent advances.	
V	**WATERDISTRIBUTIONANDSUPPLYTOBUILDINGS**	

	Requirements of water distribution -Components -Service reservoirs -Functions and drawings -Network design -Economics -Computer applications -Analysis of distribution networks -Appurtenances -operation and maintenance -Leak detection, Methods. Principles of design of water supply in buildings -House service connection -Fixtures and fittings -Systems of plumbing and drawings of types of plumbing.	
References	**TEXT BOOKS:** 1. Garg, S.K., "Environmental Engineering", Vol.1 Khanna Publishers, New Delhi, 2005. 2. Modi, P.N. "Water Supply Engineering", Vol. I Standard Book House, New Delhi, 2005. 3. Punmia, B.C., Ashok K Jain and Arun K Jain, "Water Supply Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 2005 **REFERENCES:** 1. Government of India, "Manual on Water Supply and Treatment", CPHEEO, Ministry of Urban Development, New Delhi, 2003 2. Syed R. Qasim and Edward M. Motley Guang Zhu, "Water Works Engineering Planning", Design and Operation, Prentice Hall of India Private Limited, New Delhi, 2006.	
Course Out Comes	CO1: Able to understand the sources of water and water quality standards. CO2: Able to know the water conveyance system through hydraulics of flow. CO3: To understand the concepts of water treatment system. CO4: To understand the recent advanced water treatment system. CO5: Able to understand the water distribution systems, and its system of plumbing.	

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

<table>
<tr><td>Course Title</td><td colspan="11">HIGHWAY AND 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>21BCEU0532</td><td>PCC</td><td>V</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- Understand the role of IRC and elements of highway
K2- Design the elements of highway as per IRC
K3- Design of pavements as per IRC
K4-Understand the maintenance and stabilisation of pavements</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims to
• carry out highway planning and alignment
• design of cross section elements, sight distance, horizontal and vertical alignment
• design flexible and rigid pavements as per IRC</td></tr>
</table>

Unit	**Content**	**No.of Hours**
I	**HIGHWAY PLANNING AND ALIGNMENT** Highway Development in India - Jayakar Committee Recommendations and Realizations, Institutions for Highway Development at National level - Indian Roads Congress, Highway Research Board, National Highway Authority of India, Ministry of Road Transport and Highways (MORTH) and Central Road Research Institute. Requirements of Ideal Alignment, Factors Controlling Highway Alignment Engineering Surveys for Alignment - Conventional Methods and Modern Methods (Remote Sensing, GIS and GPS techniques) Classification and Cross Section of Urban and Rural Roads (IRC), Highway Cross Sectional Elements – Right of Way, Carriage Way, Camber, Kerbs, Shoulders and Footpaths [IRC Standards], Cross sections of different Class of Roads.	
II	**GEOMETRIC DESIGN OF HIGHWAYS** Design of Horizontal Alignments – Super elevation, Widening of Pavements on Horizontal Curves and Transition Curves [Derivation of Formulae and Problems] Design of Vertical Alignments – Rolling, Limiting, Exceptional and Minimum Gradients, Summit and Valley Curves Sight Distances - Factors affecting Sight Distances, PIEV theory, Stopping Sight Distance (SSD), Overtaking Sight Distance (OSD), Sight Distance at Intersections, Intermediate Sight Distance and Illumination Sight Distance [Derivations and Problems in SSD and OSD] Geometric Design of Hill Roads [IRC Standards Only]	

III	**DESIGN OF RIGID AND FLEXIBLE PAVEMENTS** Rigid and Flexible Pavements- Components and their Functions, Design Principles of Flexible and Rigid Pavements, Factors affecting the Design of Pavements - ESWL, Climate, Sub-grade Soil and Traffic Design Practice for Flexible Pavements [CBR method, IRC Method and Recommendations- Problems] Design Practice for Rigid Pavements – [IRC Recommendations-Problems] – Joints	
IV	**HIGHWAY MAINTENANCE** Types of defects in Flexible pavements – Surface defects, Cracks, Deformation, Disintegration – Symptoms, Causes and Treatments.Types of Pavement, Failures in Rigid Pavements – Scaling, Shrinkage, Warping, Structural Cracks Spalling of Joints and Mud Pumping – and Special Repairs.Pavement Evaluation – Pavement Surface Conditions and Structural Evaluation, Evaluation of pavement Failure and strengthening - Overlay design by Benkelman Beam Method [Procedure only], Principles of Highway Financing	
V	**STABILISATION OF PAVEMENTS** Stabilisation with special reference to highway pavements-Choice of Stabilisers-Testing and field control- Stabilisation for rural roads in India-Use of geosynthetics (geotextiles & geogrids)in roads	
References	1. Khanna K, Justo C E G and Veeraragavan.A, Highway Engineering, Khanna Publishers, Roorkee, 2001. 2. Kadiyali L R, Principles and Practice of Highway Engineering, Khanna Technical Publications, Delhi, 2000. 3. IRC Standards (IRC 37 - 2001 & IRC 58 -1998) 4. Bureau of Indian Standards (BIS) Publications on Highway Materials 5. Specifications for Road and Bridges, MORTH	
Course Out Comes	On completion of the course, the students will be able to: **CO1**: involved for planning and highway alignment **CO2:** Design the geometric elements of highways and expressways **CO3:** Design flexible and rigid pavements as per IRC **CO4:** Structural evaluation of pavements and stabilization pavements **CO5** :Design by Benkelman Beam Method	

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>Course Title</td><td colspan="11">STRUCTURAL ANALYSIS I</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>21BCEU0533</td><td>PCC</td><td>V</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- Understand the different analysis methods
K2- Understand the moving loads on structures and influence line diagram
K3- Understand the concept of Eddy’s theorem and analysis of arches</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The main objective of this course to
• To understand the concept of analysis of indeterminate structures by various classical methods
• to study the use of ILD for determinate structure
• to learn the concepts of moving loads and its effect on structures
• to understand the concept of equivalent UDL and study the reversal of stress under live load</td></tr>
</table>

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

IV	**KANE'S METHOD** Principle – rotation and translation – contribution factors – analysis of continuous frames without joint translation – symmetrical frames and frames with side sway.	
V	**ARCHES** Theory of Arches – Eddy's theorem – Analysis of three hinged and two hinged arches – Parabolic & semi – circular – Determination of reaction, Normal thrust, radial shear & BM – I.L. for stress resultants in two hinged & three hinged arches – Load position for maximum values – Rib shortening. .	
References	**Text/Reference Books:** 1. Theory of structures – B.C.Punmia, Ashokkumar Jain & Arunkumar Jain, Laxmi Publications, New Delhi. 2. Structural Analysis – L.S.Negi & R.S.Jangid, Tata McGraw Hill, New Delhi. 3. Basic structural Analysis – C.S.Reddy, Tata McGraw Hill 4. Analysis of structures – V.N.Vazirani & M.M.Ratwani, Khanna Publishers, Delhi. 5. Indeterminate Structures – R.L.Jindal, .Chand & Company, New Delhi. 6. Theory and Analysis of Structures Vol. II – O.P. Jain 7 A.S.Arya, NemChand & Bros., Roorkee, U.P.	
Course Out Comes	On completion of the course, students should be able to do CO1: use various classical methods for analysis of indeterminate structures CO2:to determine the effect of support settlements for indeterminate structures CO3:to apply the concepts of ILD and moving loads on determinate structures CO4:to apply the concept of equivalent UDL CO5:to determine the reversal of stresses in trusses using ILD	

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

Course Title		**OPEN ELECTIVE – III**									
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU05OX	**OEC**	V	2	2	-	-	40	60	--	-	100
• The students should undergone the courses which are offered by the Centre for Rural Technology , GRI											

<table>
<tr><td>Course Title</td><td colspan="11">CONCRETE AND HIGHWAY ENGINEERING LABORATORY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>21BCEU0534</td><td>PCC</td><td>V</td><td>1.5</td><td>-</td><td>-</td><td>3</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K 1 – Understand the basic definitions and Properties of concrete and higway materials.
K 2 – Calculate the engineering properties of Materials.
K 3 – Analyse and interpret the data for identify the suitability of materials.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">• To learn the principles and procedures of testing Concrete and Highway materials
• Assess the quality of the concrete through laboratory tests.
• Assess the durability properties of concrete
• Design the mix proportion for the required strength
• Assess the quality of bitumen through laboratory tests.</td></tr>
</table>

Unit	**Content**	**No.of Hours**
	Concrete and Highway Engineering Laboratory **Test on Cement** 1. Specific gravity test 2. Fineness Test 3. Consistency Test 4. Initial and Final Setting Time test 5. Compressive Strength test **Test on Fine Aggregate** 6. Water Absorption Test 7. Specific gravity Test 8. Sieve Analysis Test **Test on Coarse Aggregate** 9. Water Absorption Test 10. Specific gravity Test 11. Sieve Analysis Test 12. Crushing Strength Test 13. Flakiness and Elongation Index Test 14. Impact Strength Test 15. Abrasion Test **Test on Fresh Concrete** 16. Slump Test 17. Compaction factor Test 18. Flow Test 19. Vee bee consistometer Test **Test on Hardened Concrete** 20. Compressive strength Test	36

	21. Split tensile Test 22. Flexure test **Test on Soil** 23. CBR Test on Soil **Test on Bitumen** 24. Penetration Test 25. Softening Point Test 26. Viscosity Test 27. Ductility Test 28. Flash and Fire Point Test	
References	19. Soil Mechanics and Foundation Engineering Dr.B.C.Punmia 20. Highway Engineering manual by Khanna, Justo and A.Veeraragavan	
Course Out Comes	CO1: Understand the different types of Materials using for concrete and Highways CO2: Determine the properties of Cement, Aggregate and other concrete and pavement materials CO3: Evaluate the quality of the materials to suit the construction requirement CO4: Understand various methods used for assessing the quality of the materials CO5: Specify a strategy to identify the materials and their properties and to find the suitability of soil for the construction purpose	

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

<table>
<tr><td>Course Title</td><td colspan="12">ENVIRONMENTAL ENGINEERING LABORATORY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>21BCEU0535</td><td>PCC</td><td>V</td><td>1.5</td><td>-</td><td>-</td><td>3</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Collect proper sample for analysis
K-2: To perform field oriented testing of water, and wastewater
K-3: To perform the coliform analysis</td></tr>
<tr><td>Course objectives</td><td colspan="11">To make student conversant
• This subject includes the list of experiments to be conducted for characterization of water and municipal sewage.
• At the end of the course, the student is expected to be aware of the procedure for quantifying quality parameters for water and sewage.</td></tr>
</table>

Unit	**Content**	**No.of Hours**
I	**List of Exercises** 1. Determination of total alkalinity of water. 2. Determination of (i) pH of water (ii) pH of sand 3. Determination of Electrical conductivity of water 4. Determination of Optimum Coagulant Dosage by Jar test apparatus 5. Estimation of total hardness of water. 6. Estimation of ferrous Iron. 7. Estimation of Sulphate. 8. Estimation of available chlorine in bleaching powder and residual chlorine in water. 9. Determination of fluoride in water by spectrophotometric method /ISE 10. Estimation of Chloride. 11. Determination of (i) Total solids (ii) Total Dissolved solids (iii) Total Suspended solids. 12. Determination of Ammonia Nitrogen in wastewater 13. Determination of (i) BOD (ii) COD 14. Determination of dissolved oxygen 15. Determination of coliform (Demonstration only)	**10**

References	**Text Books &Reference Books:** 1. APHA, "Standard Methods for the Examination of Water and Wastewater", 22nd Ed.Washington, 2012. 2. "Laboratory Manual for the Examination of water, wastewater soil Rump", H.H. and Krist,H. – Second Edition, VCH, Germany, 3rd Edition, 1999. 3. "Methods of air sampling & analysis",James P.Lodge Jr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.	
Course Out Comes	CO1 Calibrate and standardize the equipment CO2 Collect proper sample for analysis CO3 To know the sample preservation methods CO4 To perform field oriented testing of water, wastewater CO5 To perform coliform analysis	

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

<table>
<tr><td>Course Title</td><td colspan="12">SOFTWARE SKILL DEVELOPMENT -III</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>21BCEU0536</td><td>ESC</td><td>V</td><td>1</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>40</td><td>60</td><td>100</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>

VI SEMESTER

<table>
<tr><th>Course Title</th><th colspan="11">IRRIGATION ENGINEERING & HYDRAULIC STRUCTURES</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>21BCEU0637</td><td>PCC</td><td>VI</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 are exposed to different phases in irrigation practices and Planning and management of irrigation
2. imparted knowledge on Irrigation storage and distribution canal system
3. Understand the water management for Irrigation.</td></tr>
</table>

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

	IRRIGATION WATER MANAGEMENT 8 Modernization techniques – Rehabilitation – Command Area Development - Systems of rice intensification - Water delivery systems - Participatory Irrigation Management – Farmers' organization and turn over – Water users' associations - Economic aspects of irrigation, Water logging-causes, Reclamation, Drainage principles and practice	
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

Course Title	**ESTIMATION, COSTING AND VALUATION**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0638	**PCC**	**VI**	**3**	**2**	**1**	**-**	**40**	**60**	**-**	**-**	**100**
Cognitive Level	K1- to understand the concept of estimation of various items of work K2-to understand the detailed specifications for different buildings, roads,bridges ,industrial structures K3-to calculate the total quantities and their cost for different structures, K4 to prepare the tender documents ,bid preparations, valuation and report preparation										
Course Objectives	The main objective of this course to • To gain the knowledge about to Measure the various items of work as per the Indian Standard Specifications for buildings,road,industrial structures etc • to prepare the tender, and its process, specitation and bid preparations,valuation and report preparation										

Unit	**Content**	**No.of Hours**
I	**ESTIMATE OF BUILDINGS** Load bearing and framed structures – Calculation of quantities of brick work, RCC, PCC, Plastering, white washing, colour washing and painting / varnishing for shops, rooms, residential building with flat and pitched roof – Various types of arches – Calculation of brick work and RCC works in arches – Estimate of joineries for panelled and glazed doors, windows, ventilators, handrails etc.by manual and software packages.	
II	**ESTIMATE OF OTHER STRUCTURES** Estimating of septic tank, soak pit – sanitary and water supply installations – water supply pipe line – sewer line – tube well – open well – estimate of bituminous and cement concrete roads – estimate of retaining walls – culverts – estimating of irrigation works – aqueduct, syphon, fall.	
III	**SPECIFICATION AND TENDERS** Data – Schedule of rates – Analysis of rates by manual and software packages-– Specifications – sources – Preparation of detailed and general specifications – Tenders – TTT Act – e-tender – Preparation of Tender Notice and Document – Contracts – Types of contracts – Drafting of contract documents – Arbitration and legal requirements.	
IV	**VALUATION** Necessity – Basics of value engineering – Capitalised value – Depreciation – Escalation – Value of building – Calculation of Standard rent – Mortgage – Lease.	

V	**REPORT PREPARATION** Principles for report preparation – report on estimate of residential building – Culvert – Roads – Water supply and sanitary installations – Tube wells – Open wells.	
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 above 3. Preparation of valuation report in standard Government form. 4. Assignments on rate analysis, specifications and simpleestimates. 5. Detailed estimate of minorstructure. 6. Report preparation for various works.	
References	**Text/Reference Books:** 1. B.N Dutta ‘Estimating and Costing in Civil Engineering’, UBS Publishers & Distributors (P) Ltd, 2010. 2. B.S.Patil, ‘Civil Engineering Contracts and Estimates’, University Press, 2006 3. Hand Book of Consolidated Data – 8/2000, Vol.1, TNPWD 4. Tamil Nadu Transparencies in Tenders Act, 2000 5. Standard Databook for analysis and rates 6. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996:	
Course Out Comes	CO1: Explain the basic concept of quantity estimation for building, roads, canals and hydraulic structures by manual and software packages. CO2: Develop the specification for the materials used in construction, online and offline tender procedures and tender document preparation. CO3: Acquire the knowledge to calculate rate analysis and man-hours required for the common civil works by manual and software	

	packages CO4: Acquire the knowledge of construction contracts and contract document preparation. Identify the valuation for building, land and plant and machineries, calculation of rent, mortgage and lease. CO5: Acquire the knowledge of report preparation.	

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

<table>
<tr><th colspan="2">Course Title</th><th colspan="11">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>-</td><td>OEC</td><td>VI</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>--</td><td>-</td><td>100</td></tr>
<tr><td colspan="12">• The students should undergone the courses which are offered by the other schools/Departments/ Centres of GRI</td></tr>
</table>

Course Title	**STRUCTURAL ANALYSIS II**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0639	**PCC**	**VI**	**3**	**3**	**-**	**-**	**40**	**60**	**-**	**-**	**150**
Cognitive Level	K1- understand the forces and behavior of bridges and cables K2- understand the concept of matrix method for continuous beams K3-understand the concept of finite element method										
Course Objectives	The main objective of this course to • To understand the influence line concepts for indeterminate structures • to understand the methods of analysis of intermediate trusses for external loads • to know the concept and analysis of cable stayed bridge • to understand matrix method of analysis • to understand the concept of finite element method of analysis										

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

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

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

Course Title	**PROFESSIONAL ELECTIVE - I**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU06EX	PEC	VI	3	3	-	-	40	60	-	-	100

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

Course Title	**PROFESSIONAL ELECTIVE - II**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU06EX	PEC	VI	3	3	-	-	40	60	-	-	100

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

<table>
<tr><td>Course Title</td><td colspan="11">IRRIGATION AND ENVIRONMENTAL ENGINEERING LABORATORY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td rowspan="2">Semester</td><td rowspan="2">Credits</td><td colspan="3">Hours</td><td colspan="2">Theory</td><td colspan="2">Practical</td><td rowspan="2">Total</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>CFA</td><td>ESE</td><td>CFA</td><td>ESE</td></tr>
<tr><td>21BCEU0640</td><td>PCC</td><td>VI</td><td>1.5</td><td>-</td><td>-</td><td>3</td><td>-</td><td>-</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K 1 – Understand the basic definitions and Properties of concrete and higway materials.
K 2 – Calculate the engineering properties of Materials.
K 3 – Analyse and interpret the data for identify the suitability of materials.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The students will be able to design and draw the various irrigation and environmental structures</td></tr>
</table>

Unit	**Content**	**No.of Hours**
	PART-A IRRIGATION ENGINEERING DESIGN AND DRAWING 1. Tank sluices with Tower Head 2. Surplus weirs 3. Siphon well drop 4. Syphon aqueducts 5. Canal drops 6. Canal regulator 7. Spillway PART –B ENVIRONMENTAL ENGINEERING DESIGN AND DRAWING 1. Intake towers 2. Clariflocculator 3. Settling tanks 4. Rapid sand filter 5. Screen Chamber and Grit channel 6. Activated sludge process 7. Oxidation ditch 8. Trickling filters 9. Up flow anaerobic sludge blanket reactor 10. Stabilization ponds 11. Septic tanks and disposal arrangements 12. House service connection for water supply and drainage	36
References	21. 1.Santosh Kumar Garg, Irrigation Engineering and Hydraulics Structures, Khanna Publications Pvt.Ltd, NewDelhi, 2002. 22. 2. Birde.G.S and Birde.J.S, ―Water supply and sanitary Engineering‖, Dhanpat Rai Publications Pvt.Ltd NewDelhi, 2001.	

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

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

<table>
<tr><th>Course Title</th><th colspan="11">SUMMER INTERNSHIP-II</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>21BCEU0641</td><td>PROJ</td><td>VI</td><td>1</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1: apply the knowledge in real issues related to civil engineering
K2 : Analyze the issues of civil engineering field
K3: Develop the plan for civil engineering related sectors</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The main aim is
• To train the students in field work so as to have a firsthand knowledge of practical problems in carrying out engineering tasks.
• To develop skills in facing and solving the field problems.</td></tr>
</table>

OUTCOMES:

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

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

EVALUATION PROCEDURE

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

Course Title	**SOFTWARE SKILL DEVELOPMENT -III**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0642	**ESC**	**VI**	**1**	**-**	**-**	**-**	**-**	**-**	**40**	**60**	**100**
Cognitive Level	K1 : Apply the knowledge in the software K2 : analyze the various software usages and applications K3 :develop the various models related to civil engineering										
Course Objectives	The main of this course is • The student can acquire knowledge of latest software • They can able to develop the digital format of the solution related to civil engineering										

SEMESTER- VII

<table>
<tr><th>Course Title</th><th colspan="11">DESIGN OF STEEL STRUCTURES
(Limit State Design as per IS 800-2007)</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>21BCEU0743</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- recall the basic properties of steel sections and its inter relationships
K2-understand the design concepts of various structural elements
K3-understand the design concepts of IS800:2007
K4- design the Steel structural elements for industrial structures</td></tr>
<tr><td>Course Objectives</td><td colspan="11">To study the Sections and properties of steel sections available and design of various building elements (beam, column, foundation, truss, etc.,) by steel sections.</td></tr>
</table>

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

References	**TEXT BOOK:** 1. Duggal.S.K, Limit state design of Steel structures, Tata McGraw Hill education private limited, New Delhi, 2010 **REFERENCES:** 1. Bhavikatti,S.S, Design of Steel Structures, I.K International Publishing House Pvt,Ltd ,New Delhi,2009 2. Subramanian,N. Design of Steel Structures, Oxford University Press, NewDelhi,2008. 3. Duggal.S.K, Design of Steel structures, Tata McGraw Hill education private limited, New Delhi, 2010.	
Course Out Comes	After learning the course the students should be able to CO1: know the different types of steel sections and its combinations CO2: Understanding principles of limit state design concepts for design of structural steel elements. CO3 : Understand and design various types of bolted and welded connections CO4 : Design the column, beam, truss, gantry girders etc. CO5: Analyze and design for shear, torsion bond and Redistribution of moments in the steel elements	

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

Course Title	DESIGN OF REINFORCED CONCRETE & BRICK MASONRY STRUCTURES										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0744	PCC	VII	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- Recall renkine”s theory and behavior of retaining walls and water pressure on water tanks K2- understand the design concept of various structural elements K3-understand yield line theory of slabs and design concept of brick masonary structures s										
Course Objectives	The main objective of this course to • to understand the design concept of retaining walls and water tanks • to understand the design concept of different types of staircase and flat slabs • students should be able to solve the problems related to yield line theory of slabs • to understand the design concept of brick masonary structures										

Unit	Content	No.of Hours
I	**RETAINING WALLS** Introduction- types of retaining walls- Rankines theory of active earth pressure- passive earth pressure- Stability of cantilever retaining wall-Design detailing of cantilever and counter fort RCC retaining walls.	
II	**WATER TANKS** Types of water tanks- Underground rectangular tanks – introduction – Domes– Overhead circular and rectangular tanks– Design of staging and foundations- Design as per BIS Codal Provisions.	
III	**SELECTED TOPICS** Types of staircases-Design of staircases (ordinary and doglegged) – introduction –components of flat slab construction-Design of flat slabs – Design of Reinforced concrete walls –types of foundation- Principles of design of mat foundation	
IV	**YIELD LINE THEORY** Introduction- Characteristics of yield line - Application of virtual work method - square, rectangular, circular and triangular slabs - Design problems	
V	**BRICK MASONRY** Introduction, Classification of walls, Lateral supports and stability, effective height of wall and columns, effective length of walls, design loads, load dispersion, permissible stresses, design of axially and eccentrically loaded brick walls.	
References	**Text/Reference Books:** 1. Krishna Raju, N., “Design of RC Structures”, CBS Publishers and Distributors, Delhi. 2. Varghese, P.C., “Limit State Design of Reinforced Concrete Structures”	

	3. Punmia,P.C, Ashok.K.Jainand Arun.K.Jain.“Reinforced Concrete Structures”VolII,LaxmiPublications,NewDelhi,2000 4. Mallick, D.K. and Gupta A.P., “Reinforced Concrete”, Oxford and IBH Publishing Company 5. Syal, I.C. and Goel, A.K., “Reinforced Concrete Structures”, A.H. Wheelers & Co., Pvt., Ltd., 1994 6. Ram Chandra, “Limit State Design”, Standard Book House	
Course Out Comes	On completion of the course, students should be able to do CO1: understand the earth pressure and design of retaining wall CO2: know the water pressure and design of water tanks CO3: design the different tyes of staircase and flat slabs CO4: understand the concept of yield line theory and CO5 : design the different types of brick masonary structures	

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

<table>
<tr><td>Course Title</td><td colspan="11">CONSTRUCTION ENGINEERING 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>21BCEU0745</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">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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities	9

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	**PROFESSIONAL ELECTIVE - III**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU07EX	PEC	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**	
21BCEU07EX	PEC	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**	
21BCEU07EX	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	**PROJECT -I**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0746	PROJ	VII	4	-	-	8	-	-	60	40	100
Cognitive Level	K1: Analyze the current issues related to civil engineering K2 : Examine the possibilities of solutions of civil engineering sector K3 : develop or find the solutions for that issues										
Course Objectives	The objective of this course is 1. To impart and improve the design capability of the student.										

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

EVALUATION PROCEDURE

The method of evaluation will be as follows:

1. Internal Marks : 20 marks (Decided by conducting 3 reviews by the guide appointed by the Institution)
2. Evaluation of Project Report : 30 marks (Evaluated by the external examiner) Every student belonging to the same group gets the same mark
3. Viva voce examination : 50 marks (Evaluated by the internal examiner appointed by the HOD with the approval of HOI, external examiner– with equal Weightage)

At the end of course the students will be able to

CO1: Explain design philosophies of structure as a whole

CO2: Design RC and Steel framed structures

CO3: Design Environmental structures

CO4: Design Geotechnical structures

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

SEMESTER – VIII

Course Title	**PROFESSIONAL ELECTIVE - VI**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU08EX	PEC	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 - VII**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU08EX	PEC	VIII	3	3	-	-	40	60	-	-	100

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

Course Title	**PROFESSIONAL ELECTIVE - VIII**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU08EX	PEC	VIII	3	3	-	-	40	60	-	-	100

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

<table>
<tr><th>Course Title</th><th colspan="11">PROJEACT-II</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>21BCEU0847</td><td>PROJ</td><td>VIII</td><td>6</td><td>-</td><td>-</td><td>12</td><td>-</td><td>-</td><td>125</td><td>75</td><td>200</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1: Analyze the current issues related to civil engineering
K2 : Examine the possibilities of solutions of civil engineering sector
K3 : develop or find the solutions for that issues</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The objective of this course is to impart creativity by means of new product or design or find solutions for existing problems by working in a group</td></tr>
</table>

CO1: define the necessity of the project

CO2: compare the previous findings

CO3: Execute the work

CO4: Organize the project work with team coordination

CO5: Crate new findings

I . CONSTRUCTION ENGINEERING AND MANAGEMENT

<table>
<tr><td>Course Title</td><td colspan="11">CONSTRUCTION TECHNIQUES AND EQUIPMENTS</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>21BCEU0XE1</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- To explain erection techniques for high rise structures
K2- To gain knowledge on various procedures for foundations and to apply different construction techniques.
K3- To describe handling of various equipments</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• The main objective of this course is to make the student aware of the various construction techniques and equipments needed for different types of construction activities.
• At the end of this course the student shall have a reasonable knowledge about the various construction procedures for sub to super structure and also the equipment needed for construction of various types of structures from foundation to super structure.</td></tr>
</table>

Unit	**Content**	**No.of Hours**
I	**PRELIMINARY INVESTIGATION** Principles of Planning - Planning regulations and bye-laws - Site works and setting out - Excavations and Timbering - Sub soil drainage - Electricity Lighting on Building sites - Winter building - Preparation of layout - Site Plan - Orientation of buildings.	8
II	**SUPER STRUCTURE** Stone and Brick masonry - Composite masonry Load bearing walls - Cavity Walls - Partition walls - Reinforced Brick masonry. Flooring - Ground floors - Components - Types - suspended flooring - Upper floors - Types - Methods of laying. Roofs - Types of roofs -Types of Pitched roof - Shell roofs - Folded Plate roofs - Constructional Practices - Roof covering details. Staircase - Requirement of a good staircase - Types of staircase calculation for geometry - Ramps, Escalators, Lifts, and Types - Handling Capacity.	22
III	**SUB STRUCTURE** Bearing capacity of soils - Soil investigations - Plate load Test - Methods of Improving bearing capacity - Shallow Foundation - Deep Foundations - Machine Foundations.	6

IV	**CONSTRUCTION TECHNIQUES** Special construction techniques – Shorting, underpinning, Slip form construction, Vacuum dewatering – ready mix concrete – prepacked concrete – low cost techniques	5
V	**CONSTRUCTION EQUIPMENTS** Uses of the following: plumb bob, spirit level, level tube, rammer, spade, shovels, straight edge, mortar pan, sieves, trolley, vibrators, bulldozers, drag lines, cable ways and belt conveyors, batching plants – transit mixers and vibratory trucks used for ready mix concrete – pumps – air compressors – hoist and cranes – choice of construction equipment for different types of works.	7
References	**TEXT BOOKS:** 1. Arora S.P. and Bindra S.P., " Building Construction Planning Techniques and method of Construction " , Dhanpat Rai and Sons, New Delhi, 1997. 2. Punmia B.C., Ashok Kumar Jain, Arun Kumar Jain, " Building Construction ", Laxmi Publications Pvt.Ltd., New Delhi, 1997. **REFERENCES:** 1. Chudley.R., “Construction Technology ", Vol.1, 2, 3, 4. ELBS Publisher, 1997. 2. " National Building Code of India ", Parts III, IV, VII and IX, 1983.	
Course Out Comes	**CO1:** Student will be able to explain erection techniques for high rise structures. **CO2:** Student will be able to apply different construction techniques in underwater construction. **CO3:** Student will be able to apply grouting techniques. **CO4:** Student will be able to find output of earth moving equipment. **CO5:** Student will be able to describe safety of equipment	

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

<table>
<tr><th>Course Title</th><th colspan="11">BUILDING CONSTRUCTION PRACTICE</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>21BCEU0E2</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- Recall 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.	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 analysisconcept 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

Course Title	**SUSTAINABLE CONSTRUCTION METHODS**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0XE3	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-Recall the various methods of sub and super structure construction K2-Explain the modular method of construction and methods of steel construction K3- Apply the LEED concept in new construction projects										
Course Objectives	The Course aims • To have idea about foundation construction methods • To get knowledge about methods of steel and modular construction • To understand the strategies used in construction industry.										

Unit	**Content**	**No.of Hours**
I	Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with block work walls);	9
II	Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures;	9
III	Basic construction methods for steel structures; Basics of construction methods for Bridges; Identification of cutting edge sustainable construction materials, technologies,	9
IV	Project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity.	9
V	Examination of the current LEED for New Construction rating system, and case study analysis of highly successful recent "green construction projects" through student team assignments and presentations. Preparation for the LEED Green Associate professional licensing exam.	9
References	Building Construction by Dr. B. C. Punamia Building Construction by P.C Varghese,Prentice-Hall of India, New Delhi 6. Indian Standard Institution, National Building Code of India, ISI, 1984, New Delhi	
Course Out Comes	After completion of this course students should able to **CO1:** To construct foundation for various types of construction **CO2:** Able to build different precast elements **CO3:** To construct the structures with sustainable materials and technologies **CO4:** Able to apply the strategies in construction industries **CO5:** Explain the new construction rating system of LEED	

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

<table>
<tr><td>Course Title</td><td colspan="11">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>18BCEU0XE4</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- 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

<table>
<tr><th>Course Title</th><th colspan="12">REPAIR AND REHABILITATION OF STRUCTURES</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>18BCEU0XE5</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1-recall the special types of concrete
K2-understand the strategies for repair and maintenance of structures
K3- Apply the techniques for the protection of structure</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• To make the students to gain the knowledge on Assess the quality of concrete, and study the durability aspects, causes of deterioration, assessment criteria for damaged structures, repairing of structures and demolition procedures.
• Students must gained knowledge on quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing of structures and demolition procedures.</td></tr>
</table>

Unit	Content	No.of Hours
I	**MAINTENANCE AND REPAIR STRATEGIES** Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.	9
II	**STRENGTH AND DURABILITY OF CONCRETE** Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete - Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion - Effects of cover thickness.	9
III	**SPECIAL CONCRETES** Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes	9
IV	**TECHNIQUES FOR REPAIR AND PROTECTION METHODS** Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, Cathodic protection.	9
V	**REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES** Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake – Demolition Techniques - Engineered demolition methods - Case studies.	9
References	**TEXT BOOKS:** 1. Denison Campbell, Allen and Harold Roper, “Concrete Structures, Materials, Maintenance and Repair”, Longman Scientific and Technical	

	UK, 1991. 2. Allen R.T. & Edwards S.C, Repair of Concrete Structures, Blakie and Sons, UK, 1987 **REFERENCES:** 1. Shetty M.S., "Concrete Technology - Theory and Practice", S.Chand and Company, 2008. 2. DovKominetzky.M.S., "Design and Construction Failures", Galgotia Publications Pvt. Ltd., 2001 3. Ravishankar.K., Krishnamoorthy.T.S, "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004.96 4. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008. 5. Gambhir.M.L., "Concrete Technology", McGraw Hill, 2013	
Course Out Comes	Students able to **CO1:** Inspect and evaluate various structural damages and can access the cause of deterioration **CO2:** Can assure the qualities of concrete **CO3:** Rectify the damages using different types of special concrete **CO4:** Protect the structures using various techniques **CO5:** Demolish the structure with safe engineering methods	

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

<table>
<tr><th>Course Title</th><th colspan="11">MATERIALS MANAGEMENT</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Category</th><th rowspan="2">Semester</th><th rowspan="2">Credits</th><th colspan="3">Hours</th><th colspan="2">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>18BCEU0XE6</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- Recall 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

<table>
<tr><th>Course Title</th><th colspan="12">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>18BCEU0XE7</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- Recall the 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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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</td></tr>
</table>

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	9

	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.	
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

<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>18BCEU0XE8</td><td>PEC</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 <i>civil engineering materials</i> 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

II. TRANSPORTATION ENGINEERING

Course Title	**RAILWAYS, AIRWAYS AND WATERWAYS**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0XE09	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1: Understand railway element construction and maintenance K2: explain planning and design of airport K3: knowledge about planning and design of harbour										
Course Objectives	• To introduce the students about Railways planning, design, construction and maintenance and planning design principles of airport and harbour										

Unit	**Content**	**No.of Hours**
I	**RAILWAY PLANNING AND CONSTRUCTION** Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges - Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods--Geometric design of railway, gradient, super elevation, widening of gauge on curves- Level Crossings. .	9
II	**RAILWAY CONSTRUCTION AND MAINTENANCE** Earthwork – Stabilization of track on poor soil - Track drainage – Calculation of Materials required for track laying - Construction and maintenance of tracks – Railway Station and yards and passenger amenities-Signalling	9
III	**AIRPORT PLANNING** Air transport characteristics - airport classification – ICAO - airport planning: Site selection typical Airport Layouts, Case Studies, parking and Circulation Area	9
IV	**AIRPORT DESIGN** Runway Design: Orientation, Wind Rose Diagram, Problems on basic and Actual Length, Geometric Design – Elements of Taxiway Design – Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings.	9
V	**HARBOUR ENGINEERING** Definition of Basic Terms: Harbour, Port, Satellite Port, Docks, Waves and Tides – Planning and Design of Harbours: Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break	9

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

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

<table>
<tr><td>Course Title</td><td colspan="11">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>18BCEU0XE10</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1-recall 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	Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC).	9
III	Vehicle – Road side communication – Vehicle Positioning System; ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS);	9
IV	ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, 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 AND DESIGN**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0XE11	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-Recall the modes of transports in India K2-explain the different components of airfield K3-Apply the knowledge of airline economics for pricing										
Course Objectives	The Course aims • Provides a basic understanding on Airport Systems Planning and Operation										

Unit	**Content**	**No.of Hours**
I	**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, Passenger Terminals	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**	
18BCEU0XE12	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-Recall the physical and physiological characteristics for traffic survey K2-understand the various studies that are involved in traffic volume and capacity K3-apply the knowledge of signals and signs for control of traffic										
Course Objectives	The Course aims • Provides a basic understanding on Traffic Engineering – Planning, Design, Operation and Management										

Unit	Content	No.of Hours
I	**TRAFFIC CHARACTERISTICS** Physical, Physiological, Psychological, Environmental Characteristics, Traffic Stream Characteristics, Vehicle Characteristics – Static and Dynamic, Urban Road and Road Characteristics Geometric Design – An Overview	9
II	**SURVEYS AND STUDIES INTRAFFIC ENGINEERING** Conventional and Modern Methods of Traffic Survey and Studies – Volume and Capacity – Headway concepts and applications – Speed and Delay – Origin and Destination, Parking, Accident – Level of Services (LoS)	9
III	**DESIGN OFTRANSPORT INFRASTRUCTURE** Sight Distance, Design of Cycle Tracks, Pedestrian Facilities, Parking Facilities – On Street, Off Street Multi level Street Lighting	9
IV	**INTERSECTION DESIGN** Design of Intersection – At grade intersection – Uncontrolled, Channelisation, Rotary, Traffic Signal Control, Signal Co-ordination, Grade Separated Intersection - Types and Design	9
V	**TRAFFIC OPERATION ANDMANAGEMENT** Traffic Sign, Road Markings, Traffic Control Aids, Street furniture, Road Arboriculture - Traffic Regulation, Cost Effective Management Measures – Traffic Systems Management and Travel Demand Management - Congestion Management, Traffic Calming and Pricing	9

References	1. Kadiyali, L.R., „Traffic Engineering and Transport Planning‟, Khanna Publishers, Delhi,2002 2. Wolfgang S.Homburger et.al., „Fundamentals of Traffic Engineering‟ 15th Edition, Institute of Transportation Studies, University of California, Berkely,2001 3. James L.Pline (Edr) „Traffic Engineering Hand Book‟, Institute of Transportation Engineers, Washington DC, USA,1999 4. Nicholas T.Garber, Lester A Hoel, „Traffic and Highway Engineering‟, Revised Second Edition, ITP, California, USA,1999 5. Thomas Curinan, „An Introduction to Traffic Engineering – A Manual for Data Collection and Analysis‟, Books Cole, UK,2001	
Course Out Comes	Students would be aware of CO1: The characteristics of traffic stream and vehicle CO2: Various survey methods for the calculation of capacity and volume of traffic CO3: Basic Principles and Design of traffic infrastructure CO4: Design of intersections CO5: Management of signals and signs for traffic operation	

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

<table>
<tr><th>Course Title</th><th colspan="11">RAILWAY 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>18BCEU0XE13</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- Recall the 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="11">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 and Yards, Rolling Stock, Tractive Power, Track Resistance, Level Crossings	9

References	1. SaxenaSubhash C and SatyapalArora, A Course in Railway Engineering, DhanpatRai and Sons, Delhi, 1998 2. Rangwala, Railway Engineering, Charotar Publishing House, 1995 3. J.S. Mundrey, “A course in Railway Track Engineering	
Course Out Comes	Students able to CO1: Carry out the survey using modern techniques for railways CO2:Plan the components of permanent ways and railway tracks CO3: Design and construct the railway tracks CO4: Operate and control the tracks and trains CO5: Construct and maintain the track by conventional and modern methods	

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

Course Title	URBAN AND REGIONAL PLANNING										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0XE14	PEC	-	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 it strend. • Deals with different types of plan, its implementation, regional development and management for sustainable urban growth.										

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 Regional planning.	9

IV	**PROJECT FORMULATION AND EVALUATION** Constraints for plan implementation – Industrial, Financial and Legal Constraints, Institutional Arrangements for Urban Development – Financing of Urban Developments - Legislation related to Urban Development. Urban infrastructure projects planning, appraisal, formulation, feasibility and preparation of detailed project report, site planning, layout, road network, and service ducts under the road, Environmental impact assessment, and Traffic assessment.	9
V	**URBAN GOVERNANCEAND MANAGEMENT** Planning laws; Town and Country planning act: Urban Development authorities Act, Constitutional (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**	
18BCEU0XE15	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Identify the Location, Traffic estimation, ship characterization. K-2: Understand the design of Harbour K-3: Classify the waterways										
Course Objectives	The Course aims • Students become conversion with definition purpose location materials of coastal structures • Students acquire knowledge on planning and design of harbours										

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

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

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

Course Title	**PAVEMENT MATERIALS**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0XE16	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recall the soil classifications and its characteristics K-2: Understand the preparation, properties and tests for Bitumen K-3: Solve the pavement mix design problems										
Course Objectives	The Course aims • Togivethestudentstohandsonexperienceonthevarioustestingproceduresofpavement materials as per the IRC standards.										

Unit	**Content**	**No.of Hours**
I	Soil - Classification, characteristics, compaction, evaluation of soil strength; stabilized pavement materials; Aggregates: requirements, properties and tests on road aggregates for flexible and rigid pavements.	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. Bituminous mix design methods and specifications.	5
IV	Weathering and Durability of Bituminous Materials and Mixes. Performance based Bitumen Specifications;	5
V	Super pavement mix design method: design example problems. Cement Concrete for Pavement Construction: Requirements, and design of mix for CC pavement, IRC and IS specifications and tests, joint filler and sealer materials.	5
References	1. Khanna SK Justo CEG and Veeraragavan.A, “Highway Engineering”, Nem Chand & Bros, Roorkee, 2010. 2. Brase/Brase “Understandable Statistics 3rd edition”,D C Health and Company, Lexington, Massachusetts,Toronko,1987. 3. Jason C.yu, Transportation Engineering: Introduction to Planning, Design and Operations, Elsevier,1992.	
Course Out Comes	On completion of the course, students should be CO1: To know about the soil strength evaluations CO2: To understand the selection of binding materials for pavements CO3: Capable to identify the mechanical properties of bitumen. CO4: To know about the Performance of Bitumen Specifications CO5: Able to design the pavement as per indian standard.	

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

<table>
<tr><th>Course Title</th><th colspan="11">TRANSPORTATION SYSTEMS PLANNING</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>18BCEU0XE17</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1-Recall 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	9

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

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

III. ENVIRONMENTAL ENGINEERING

Course Title	ECOLOGICAL ENGINEERING										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XE18	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: identify the eco technology which is relevance to the human civilization. K-2: Understand about the system approach and Ecological engineering processes. K-3: Apply the eco technology for various waste treatment										
Course Objectives	The Course aims • To know about the environment • To understand about environmental pollution • To apply the knowledge in understanding various environmental issues and problems • To apply the acquired knowledge and skill on the ecological control of air, water and soil systems,										

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

	• Smith, R.L. and Thomas M. Smith (2003), Elements of Ecology (5thed.). San Francisco: Benjamin Cummings. • White, I.D, Mottershed, D.N and Harrison, S.L., Environmental Systems – An Introductory Text, Chapman Hall, London,2004. • Kangas, P.C. and Kangas, P., Ecological Engineering: Principles and Practice, Lewis Publishers, New York, 2003.	
Course Out Comes	On completion of the course, students should be **CO1** Able to solve environmental problems and issues under ecological engineering. **CO2** Able to visualize the application of control principles on the ecological control of natural and manmade systems. **CO3** Able to understand the Ecological engineering process **CO4** Able to adopt the eco technology for various waste treatment process. **CO5** Able to provide the solution for the various ecological engineering systems	

Course outcome	**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

Course Title	**TRANSPORT OF WATER AND WASTE WATER**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0XE19	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1 Recall the continuity, energy and momentum principles K-2 Understand the various pipe materials and their fixtures. K-3 Apply the software tools for network desgin										
Course Objectives	The Course aims • To educate the students in detailed design concepts related to water transmission mains, water distribution system • To educate and give analytical skill for solving sewer networks and storm water drain by computer application on design.										

Unit	**Content**	**No.of Hours**
I	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	On completion of the course, students should be **CO1** Able to understand the basics of fluid properties	

Comes	**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>Course Title</td><td colspan="11">ENVIRONMENTAL LAWS AND POLICIES</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>18BCEU0XE20</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1 Identify the 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 Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of	9

	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

Course Title	**PHYSICO-CHEMICAL PROCESSES OF WATER AND WASTE WATER**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
18BCEU0XE21	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1 Recall the characteristics of water and waste water K-2 understand the municipal and Industrial water and waste water treatment plants K-3 apply the advanced treatment techniques for water and waste water treatment systems.										
Course Objectives	The Course aims • To educate the students on the principles and process designs of various treatment systems for water and wastewater • To students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.										

Unit	**Content**	**No. of Hours**
I	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 aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.	9
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	9

	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.	
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

Course Title	RURAL WATER SUPPLY AND ON-SITE SANITATION SYSTEMS										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
18BCEU0XE22	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1 Recall the sources of water and pipes and pump selection K-2 understands the water quality standards for rural water supply systems. K-3 Apply the suitable techniques for sewage disposal and reuse.										
Course Objectives	The Course aims • Understand the importance rural water supply and principles of water supply with their components • Understand the various onsite sanitation system.										

Unit	Content	No.of Hours
I	Development of Water Sources - Sources of water – Surface and ground water sources – Development of deep bore wells; Estimation of yield – Alternate sources of water supply – Rain water harvesting - pumps – Types and selection of pumps for deep bore wells – Construction, operation and maintenance.	9
II	Water Treatment - Quality of water – Standards - conventional water treatment – Technologies for removal of specific contaminants; Iron, Arsenic, Fluoride, T.D.S; Disinfection – Alternate disinfection methods – solar disinfection.	9
III	Sanitation - Basic requirement of sanitation; Decentralized / onsite wastewater management; small bore / settled effluent sewer system – Design and operation.	9
IV	Sewage Treatment - Fundamentals of sewage treatment; Decentralized sewage treatment; Septic tank with depression pit – DEWATS, Intermittent sand filters – Anaerobic filters – Waste stabilization ponds – Design and operation.	9
V	Sewage Disposal and Reuse - Methods of disposal, Land disposal, sewage farms – Artificial recharge of ground water; Recycle and Reuse of sewage – Grey water Harvesting – Salt water intrusion and remediation – Ground water pollution and remediation.	9
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><th>Course Title</th><th colspan="11">AIR AND NOISE POLLUTION CONTROL</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>18BCEU0XE23</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1 Identify the 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;	9

	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.	
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>18BCEU0XE24</td><td>PEC</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="12">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="12">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, plastic and e-waste: waste categorization, generation, collection, transport, treatment and disposal	5

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><th>Course Title</th><th colspan="11">WATER AND AIR QUALITY MODELS</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>18BCEU0XE25</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1 Identify the 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 modeling techniques, modeling for non-reactive pollutants, single source – short term impact, multiple sources and area sources, model performance and utilization, computer models.	9

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**	
18BCEU0XE26	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1 Identify the Components and methods For EIA K-2 Understand the Socio-Economic Impact Assessment K-3 Prepare the EIA Report for various sectors										
Course Objectives	The Course aims • To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment • To develop the skill to prepare environmental management plan. • Ability to prepare draft and detailed reports under EIA.										

Unit	**Content**	**No.of Hours**
I	Introduction - Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA – Cross sectoral issues and terms of reference in EIA – Public Participation in EIA. EIA process- screening – scoping - setting – analysis – mitigation	9
II	Components and Methods for EIA - Matrices – Networks – Checklists – Connections and combinations of processes - Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment – Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation. EIA methods in other countries.	9
III	Socio-Economic Impact Assessment - Definition of social impact assessment. Social impact assessment model and the planning process .Rationale and measurementforSIAvariables.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
References	1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York.1996 2. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley- Interscience, New Jersey,2003. 3. Petts,J.,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. . 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

<table>
<tr><th>Course Title</th><th colspan="11">WASTE WATER 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>18BCEU0XE27</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: To Know the concept of sewer designs
K-2: To understand the concept of primary and secondary treatment system
K-3: To able to understand the sludge management system.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The students completing the course will have
• ability to estimate sewage generation and design sewer system including sewage pumping stations
• required understanding on the characteristics and composition of sewage, self purification of streams
• ability to perform basic design of the unit operations and processes that are used in sewage treatment</td></tr>
</table>

Unit	Content	No.of Hours
I	**PLANNING FOR SEWERAGE SYSTEMS** Sources of wastewater generation – Effects – Estimation of sanitary sewage flow – Estimation of storm runoff – Factors affecting Characteristics and composition of sewage and their significance – Effluent standards – Legislation requirements.	8
II	**SEWER DESIGN** Sewerage – Hydraulics of flow in sewers – Objectives – Design period - Design of sanitary and storm sewers – Small bore systems - Computer applications – Laying, joining & testing of sewers – appurtenances – Pumps – selection of pumps and pipe Drainage -. Plumbing System for Buildings – One pipe and two pipe system.	9
III	**PRIMARY TREATMENT OF SEWAGE** Objective – Selection of treatment processes – Principles, Functions, Design and Drawing of Units - Onsite sanitation - Septic tank with dispersion - Grey water harvesting – Primary treatment – Principles, functions design and drawing of screen, grit chambers and primary sedimentation tanks – Construction, operation and Maintenance aspects.	10
IV	**SECONDARY TREATMENT OF SEWAGE**	12

	Objective – Selection of Treatment Methods – Principles, Functions, Design and Drawing of Units - Activated Sludge Process and Trickling filter – Oxidation ditches, UASB – Waste Stabilization Ponds – Reclamation and Reuse of sewage - sewage recycle in residential complex - Recent Advances in Sewage Treatment – Construction and Operation & Maintenance of Sewage Treatment Plants.	
V	**DISPOSAL OF SEWAGE AND SLUDGE MANAGEMENT** Standards for Disposal - Methods – dilution – Self purification of surface water bodies – Oxygen sag curve – Land disposal – Sludge characterization – Thickening – Sludge digestion – Biogas recovery – Sludge Conditioning and Dewatering – disposal – Advances in Sludge Treatment and disposal.	9
References	**TEXT BOOKS:** 1. Garg, S.K., "Environmental Engineering" Vol. II, Khanna Publishers, New Delhi, 2003. 2. Punmia, B.C., Jain, A.K., and Jain. A., "Environmental Engineering", Vol.II, Lakshmi Publications, News letter, 2005. **REFERENCES:** 1. "Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1997. 2. Metcalf & Eddy, "Wastewater Engineering" – Treatment and Reuse, Tata McGraw Hill Company, New Delhi, 2003. 3. Karia G L & Christian R A, "Wastewater Treatment", Prentice Hall of India, New Delhi, 2013.	
Course Out Comes	On completion of the course, students should be **CO1:** Able to planning for sewerage system **CO2:** Able to design the sewer **CO3:** Able to design the primary treatment system **CO4:** Able to design the secondary treatment system **CO5:** Able to understand the sludge management system.	

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

IV. HYDRAULICS, HYDROLOGY & WATER RESOURCES ENGINEERING

<table>
<tr><td>Course Title</td><td colspan="11">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>21BCEU0XE28</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1 : recall the 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. Method of characteristics. Transients caused by centrifugal pumps	9

	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

Course Title	OPEN CHANNEL FLOW										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0XE29	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	**K1** :Recall the basics principles of various flow with their concepts **K2** : understand the principles of different types of flow like steady and unsteady flow **K3** : Apply the principles in hydraulic structures for flow of water										
Course Objectives	The Course aims 1. Application of principles of fluid mechanics to the solution of problems encountered in both natural and constructed water systems. 2. Use of model studies and computers in solving a host of problems in hydraulic engineering.										

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

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><th>Course Title</th><th colspan="11">RIVER 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>21BCEU0XE30</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1 :Recall the 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 plain management – waves and tides inEstuaries - Interlinking of rivers – River Stabilization	9

References	1. Janson PL.Ph., Lvan BendegamJvanden Berg, Mdevries A. Zanen (Editors), Principles of RiverEngineering – The non tidal alluvial rivers – Pitman, 1979. 2. Pierre Y. Julien ., "River Mechanics" ,Cambridge University Press, 2002. 3. K.L Rao , INDIA"s WATER WEALTH – Orient Longman Ltd., 1979.	
Course 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

Course Title	**URBAN WATER RESOURCES MANAGEMENT**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0XE31	PEC	-	2	2	-	-	40	60	-	-	100
Cognitive Level	**K1** :Recall the basics principles hydrological cycle and their components **K2** : understand the different types of management models for urban water management. **K3** : Apply the knowledge to develop the Master Plan for Urban water Management										
Course Objectives	The Course aims 1. To introduce the concepts of urbanization and its impact on the natural water cycle 2. The student is exposed to the use the urban storm water models for better storm water management. 3. Students also exposed for the preparation of urban storm water master plan and different types of operation and maintenance.										

Unit	**Content**	**No.of Hours**
I	**URBAN HYDROLOGIC CYCLE** Water in the urban eco-system – Urban Water Resources – Major problems – Urban hydrological cycle – Storm water management objectives and limitations – Storm water policies – Feasibility consideration.	5
II	**URBAN WATER RESOURCES MANAGEMENT MODELS** Types of models – Physically based – conceptual or unit hydrograph based – Urban surface runoff models – Management models for flow rate and volume control rate – Quality models.	5
III	**URBAN STORM WATER MANAGEMENT** Storm water management practices (Structural and Non-structural Management measures) – Detention and retention concepts – Modelling concept – Types of storage – Magnitude of storage – Hydraulic analysis and design guidelines – Flow and storage capacity of urban components – Temple tanks.	5
IV	**MASTER PLANS** Planning and organizational aspects – Inter dependency of planning and implementation of goals and measures – Socio – economics financial aspects – Potential costs and benefit measures – Measures of urban drainage and flood control benefits – Effective urban water user organizations.	5

V	**OPERATION AND MAINTENANCE** General approaches to operations and maintenance – Complexity of operations and need for diagnostic analysis – Operation and maintenance in urban water system – Maintenance Management System – Inventories and conditions assessment – Social awareness and involvement.	5
References	1. Geiger, W.F., Marsalek, F., and Zuidena, F.C., (Ed), manual ondrainage in urbanized areas –Vol.1 and Vol.II, UNESCO, 1987. 2. Hengeveld, H. and C. De Voch.t (Ed)., Role of Water in Urban Ecology, 1982. 3. Martin, P. Wanelista and Yousef, A. Yousef., Storm Water Management, John Wiley and sons,1993. 4. Neil S. Grigg., Urban Water Infrastructure Planning, Management and Operations, John Wiley and Sons, 1986. 5. Overtens D.E. and Meadows M.E., Storm Water Modelling, Academic Press, New York, 1976.	
Course Out Comes	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

<table>
<tr><th>Course Title</th><th colspan="11">GROUND 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>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>21BCEU0XE32</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1: Recall the 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</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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 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 -	9

	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

Course Title	**HYDROLOGY AND WATER RESOURCE ENGINEERING**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0XE33	**PCC**	**VI**	**3**	**2**	**1**	**-**	**40**	**60**	**-**	**-**	**100**
Cognitive Level	**KI :** recall the fundamental principles of hydrologic cycle and their components **K2:** Understand the basics principles of various components **K3: A**pply the knowledge to field issues and solve the problems										
Course Objectives	The Course aims • Students can understand the basics of hydrology processes and their components . • They can understand the water resources processes and their related structures.										

Unit	**Content**	**No.of Hours**
I	*Introduction* - hydrologic cycle, water-budget equation, history of hydrology, world water balance, applications in engineering, sources of data. *Precipitation* - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth-area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.	9
II	*Abstractions from precipitation* - evaporation rocess, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices.	9
III	*Runoff* - runoff volume, SCS-CN method of estimating runoff volume, flow-duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows.	9
IV	*Ground water and well hydrology* - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests. *Water withdrawals and uses* – water for energy production, water for agriculture, water for hydroelectric generation; flood control. Analysis of surface water supply, Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation.	9
V	*Distribution systems* - canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels,	9

	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.	
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><th>Course Title</th><th colspan="11">WATER RESOURCES SYSTEMS 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>21BCEU0XE34</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1 :Recall the basics systems 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="11">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>CFA</th><th>ESE</th><th>CFA</th><th>ESE</th></tr>
<tr><td>21BCEU0XE35</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1 :Recall the 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 measurement – Area Velocity method - Area Slope method – Discharge Measuring Structures - Dilution Technique – Stage Discharge relationship – Selection of a Stream Gauging Site.	**8**

V	**RUNOFF AND WATER CONSERVATION** Concept of catchment – Linear, Areal and Relief Aspects – Detailed study of Runoff process – Factors affecting Runoff – Hydrograph – Unit Hydrograph – Synthetic Hydrograph – Runoff estimation - Strange and SCS methods – Water Conservation – Rain water and Runoff Harvesting in Rural and Urban Areas Reservoir Sedimentation.	**12**
References	**REFERENCES:** 1. Chow V.T., Maidment D.R., Mays L.W., "Applied Hydrology", McGraw Hill Publications, NewYork, 1995. 2. Subramanya K., "Hydrology,Tata McGraw Hill Co., New Delhi, 1994. 3. Patra.K.C, "Hydrology and Water Resources Engineering", Narosa Publications, 2008, 2ndEdition, 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><th>Course Title</th><th colspan="12">REMOTE SENSING AND GIS IN WATER RESOURCES</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>21BCEU0XE36</td><td>PEC</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 – AM/FM/GIS – Web Based GIS	5

V	**WATER RESOURCES APPLICATIONS** Spatial data sources – 4M GIS approach water resources system – Thematic maps - Rainfall-runoff modelling – Groundwater modeling – Water quality modeling - Flood inundation mapping and Modelling – Drought monitoring – Cropping pattern change analysis – Performance evaluation of irrigation commands. Site selection for artificial recharge - Reservoir sedimentation.	5
References	1. Lillesand, T.M. and Kiefer, R.W., "Remote Sensing and Image Interpretation" 3rd Edition. JohnWiley and Sons, New York. 1993. 2. Burrough P.A. and McDonnell R.A., "Principles of Geographical Information Systems",.OxfordUniversity Press. New York. 1998. 3. Ian Heywood Sarah, Cornelius and Steve Carver "An Introduction to Geographical InformationSystems". Pearson Education. New Delhi, 2002. 4. "Centre for Water Resources", Change in Cropping Pattern in Drought Prone Chittar Sub-basin, Project Report, Anna University, Chennai, 2002. 5. "Centre for Water Resources", Post-Project Evaluation of Irrigation Commands	
Course Out Comes	The students can be **CO1**:Understand fundamental principles of Remote sensing and Introduce the technology and principles of Satellite Imaging **CO2**: understand the principles of digital image processing and Theoretical explanations on Image processing and information extraction from Satellite Data Products **CO3**:understand the basic principles of GIS and Functional elucidation of GIS integrating Satellite Data Products into the GIS platform for Decision making **CO4**: understand the spatial analysis. **CO5**:Apply the Potential of remote sensing and GIS is solving problems in water resources through case studies.	

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

Course Title	**WATERSHED CONSERVATION AND MANAGEMENT**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0XE37	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	**K1** :Recall the basics principles of various flow with their concepts **K2** : understand the principles of different types of flow like steady and unsteady flow **K3** : Apply the principles in hydraulic structures for flow of water										
Course Objectives	The Course aims 1. To provide the technical, economical and sociological understanding of a watershed. 2. To provide a comprehensive discourse on the engineering practices of watershed management for realizing the higher benefits of watershed management.										

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

	of Decision Support System – Conceptual 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	
21BCEU0XE38	PEC	-	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 – Trapping and pumping – Estuarine Circulation.	9

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

V. STRUCTURAL ENGINEERING

Course Title	FINITE ELEMENT ANALYSIS										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
21BCEU0XE39	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	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										
Course Objectives	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										

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>
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<tr><td>21BCEU0XE40</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1-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 Building Structures** Initial condition for calculating fire resistance of structures, Duration of fire, Temperature of fire, Main points on the method of investigating temperature regimes of fires, Results of experimental investigations on fires, Simulation of temperature regimes of fires, Determination of fire in residential and public buildings, Determination of fire duration of fire in industrial buildings and warehouses: Standardization of fire resistance of structures.	9
III	**Methods of Testing Structures for Fire Resistance** Problems of testing for fire resistance, Set-up for testing fire resistance, Temperature regime of the tests, Test pieces of structures, Conditions of loading and supporting of structures	9
IV	**Fire Resistance of Reinforced Concrete Structures** Main aspects of the calculations for fire resistance, Thermo technical part of the calculation Boundary conditions, Calculation of temperature in plane structures (one-dimensional temperature field), Calculation of temperature in	9

	bar type structures (Two- dimensional temperature field), Calculation of depth at which a given temperature is reached, Effect of moisture in concrete on the heating of structures, Thermo physical properties of concrete at high temperatures ,Statics part of calculations, Change in the strength of reinforcement steel with increase of temperature, Change in the strength of concrete in compression with increase in temperature, 9Coefficients of thermal expansion of reinforcement bars and concrete, Axially loaded columns, Statically determinate elements subjected to bending stresses	
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

Course Title	**SAFETY OF STRUCTURES**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0XE41	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recalling the basic concepts and fundamentals on structural safety and reliability analysis and design K-2: Understand the concept of reliability analysis and design on structures safety. K-3: Apply the simulation techniques for reliability analysis for the design of structural safety. K-4: Analyze the structural safety by using Reliability analysis..										
Course Objectives	The Course aims • To study the basic concepts and fundamental on structural safety. • To measure of probability by using total probability theorem and Baye's theorem • Able to analyse the structure by various simulation techniques. • Able to Design the structure safety by reliability based design.										

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

<table>
<tr><th>Course Title</th><th colspan="11">ANALYSIS & DESIGN OF SUB-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>21BCEU0XE42</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 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.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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</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 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	9

	Estimate Method (PEM), and Advanced First Order Second Moment Method (Hasofer- Lind’s method).Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample size and accuracy, Generation of random numbers-random numbers with standard uniform distribution, continuous random variables..	
V	**Reliability Based Design** Determination of partial safety factors, safety checking formats – LRFD format, CEB format, processes in reliability based design, IS Code provisions	9
References	**Text/Reference Book** 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.	

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

Course Title	**INDUSTRIAL STRUCTURES**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0XE43	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recalling the classifications of industries and industrial structures and its requirements. K-2:Understand the functional requirements such lighting, ventilation, fire safety and guidelines for factories. K-3:Apply the concept concrete and steel design techniques in the design of industrial structures K-4: Analyze and design the industrial roofs and prefabrication of various elements										
Course Objectives	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										

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

Course Title	**DESIGN OF STORAGE STRUCUTRES**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0XE44	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recalling the Fundamentals of concrete design. K-2: Understand the design concept of bunkers & silos, water tanks K-3: Applying the design principles used to design the elements.										
Course Objectives	• The students will able to Design bunkers and silos, water tanks .n. • To know about the functions of water storage structures										

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

<table>
<tr><th>Course Title</th><th colspan="11">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>21BCEU0XE45</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Recalling the fundamentals on site selection and IRC code loading.
K-2: Understand the various theories used for the design of bridge elements.
K-3: Apply the concept concrete and steel design techniques.
K-4: Analyze and design the various bridge elements.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
• To develop an understanding of and appreciation for basic concepts in proportioning and design of bridges in terms of aesthetics, geographical location and functionality.
• To help the student develop an intuitive feeling about the sizing of bridge elements, ie. Develop a clear understanding of conceptual design.
• To understand the load flow mechanism and identify loads on bridges.
• To carry out a design of bridge starting from conceptual design, selecting suitable bridge, geometry to sizing of its elements</td></tr>
</table>

Unit	Content	No.of Hours
I	Introduction – Selection of site for bridge – Linear waterway – Free board – Economical span – Scour depth – Components of a bridge – Types of bridges – IRC Loading Classifications – Specifications for a road bridge – Specifications for railway bridge.	9
II	**DESIGN OF RCC BRIDGES.** Design of T beam slab bridges for IRC loading – Design of deck slab, longitudinal and cross girders Design of balanced cantilever bridge – Design of slab, main girder, cantilever and articulation	9
III	**DESIGN OF STEEL BRIDGES** Design of through type steel bridge for railway loading – design 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) – Check for stresses at various sections – Check for diagonal tension – Forces in anchorage zone.	9
V	**SUBSTRUCTURE AND BEARINGS** Design principles and construction methods of pier, abutment and Caissons Types of bearings – Design of elastomeric bearing – Segmental construction of bridge – TestingAndstrengthening of bridge – Inspection and Maintenance of bridges.	9
References	**TEXT BOOKS:** 1. Victor D.J "Essential of bridge Engineering", Oxford & IBH publishing co. 1980. 2. Krishnaraju N. "Bridge Engineering", CBS Publications, New Delhi. 3. Bindra.S.P., "Principle and practice of Bridge Engineering", DhanpatRai& sons 1979. 4. Ramchandra S. "Design of Steel Structures" Vol I & II, Standard book house, New Delhi, 1978. **REFERENCES:** 1. Ponnusamy "Bridge Engineering", Tata Mcgraw hill Publishing co, 1995 2. Raina "Concrete bridges practice Analysis design and Economics", Tata Mcgraw Hill Publishing co 1995. 3. Jagadesh, T.R &Jeyaram M.A., "Design of bridge structures", Prentice Hall of India Pvt Ltd. 2001 4. Rowe, R.E. "Concrete Bridge Design", John Wiley& Sons, New York, USA, 1962. 5. Phatak, D.R. "Bridge Engineering", SatyaPrakhasam, New Delhi, 1990 **IS Codes:** 1. IRC: 78, "Standard specifications & Code of practice for Road Bridges". Section VII-Foundation and Substructures. 2. IRC: 6-2000, " Standard specifications & Code of practice for Road Bridges". Section II-Loads and Stresses. 3. IRC: 21-2000, "Standard specifications& Code of practice for Road Bridges". Section III-Cement Concrete (Plain and Reinforced). 4. IRC: 83 Part II-1987, "Standard specifications & Code of practice for Road Bridges". Section: 9 Bearing, Part II – Elastomeric Bearings. 5. IRC: 45-1972, "Recommendations for Estimating the resistance of soil below the maximum scour level in the	

	Design of Well foundations of Bridges. 6. IRC: 78-2000 “Standard specifications & code of practice for Road bridges”.	
Course Out Comes	At the end of the course the student will CO1: Able to develop the clear understanding on conceptual design of bridge elements CO2: Able to identify the IRC class loading on the bridges CO3: Able to design the steel and concrete bridge structure CO4: Able to design the pre-stressed concrete bridge structure CO5: Able to design the foundation and bearings for bridge structure	

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

Course Title	**PRE-STRESSED CONCRETE STRUCTURES**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0XE46	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1-to recall the basic design concepts of rc elements and prestress concept K2-to understand the prestress effect and design concepts beam , columns and continuous beams K3-to understand concept of circular pre stressing K4-design calculation of beams ,end block, anchorage, compression member, concrete pipes and composite sections										
Course Objectives	To learn the principles, materials, methods and systems of prestressing and to know the different types of losses and deflection of prestressed members and to learn the design of prestressed concrete beams for flexural, shear and tension and to calculate ultimate flexural strength of beam and to learn the design of anchorage zones, composite beams, analysis and design of continuous beam On completion of the course, the students will be able to design a prestressed concrete beam accounting for losses and to design the anchorage zone for post tensioned members and to design composite members and to design continuous beams										

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

III	**ANCHORAGE TENSION & COMPRESSION MEMBERS** Design of Anchorage: Stress distribution in end block – Design of end block – IS code provision. Design of compression and tension 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

Course Title	**MASONRY STRUCTURES**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0XE47	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K1- to recall the different types of masonary ,behaviou, properties of masonary units K2- to understand the elstic properties and its strength behaviour of compression shear and flexure. K3-design of load bearing masonary buildings										
Course Objectives	Student will be able to 1. Understand masonry materials and its mechanical properties. 2. Analyze the behavior of structural masonry 3. Demonstrate testing, analysis and design methodologies 4. Summarize construction practices, specifications and inspection of masonry buildings										

Unit	**Content**	**No.of Hours**
I	**Introduction, Masonry units, materials and types:** History of masonry, historical buildings, Masonry arches, domes and vaults: Components, classification and construction procedure.	7
II	**Characteristics of masonry constituents:** Types of masonry units such as stone, bricks, concrete blocks, clay blocks and stabilized mud blocks. Properties of masonry units like strength, modulus of elasticity and water absorption. Masonry mortars – Classification and properties of mortars, selection of mortars.	8
III	**Strength of Masonry in Compression:** Behaviour of Masonry under compression, strength and elastic properties, factors influencing of compressive strength masonry, Effects of slenderness andeccentricity, water absorption, curing, ageing and workmanship on compressive strength Prediction of strength of masonry in Indian context.	9
IV	**Shear and Flexure Behavior of Masonry :** Bond between masonry unit and mortar, test methodsfor determining flexural and shear bond strengths, test procedures for evaluating flexural and shearstrength, factors affecting bond strength, effect of bond 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.	10

	Increase in permissible stresses for eccentric vertical andlateral loads, permissible tensile and shear stresses, Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels; Wall carrying axial load, eccentric load with different eccentricity ratios, wall with openings, freestanding wall; Design of load bearing masonry for buildings up to 3 to 8storeys using BIS codal provisions.	
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="11">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>21BCEU0XE48</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- to 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	9

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

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

Course Title	**RELIABILITY ANALYSIS OF STRUCTURES**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0XE49	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recalling the fundamentals on reliability and probability concepts. K-2:Understand the concept of probability. K-3:Apply the concept probability mass function, dnsity function.										
Course Objectives	The Course aims • To learn principles ofreliability. • To implement the Probability Concepts for the Reliability Analysis • To evaluate different methods of reliability analysis.										

Unit	**Content**	**No.of Hours**
I	**Preliminary Data Analysis:** Graphical representation-Histogram, frequency polygon, Measures of central tendency-grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve fitting and Correlation: Fitting a straight line, curve of the form$y = ab^x$, 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	
21BCEU0XE50	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recall the material property testing K-2: Understand the various measuring devices K-3: Apply the knowledge of sensors and actuators for civil engineering materials										
Course Objectives	The Course aims • the fundamentals of smart materials, devices and electronics, in particular those related to the development of smart structures and products; • the skills, knowledge and motivation in the design, analysis and manufacturing of smart structures and products										

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

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

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

VI. GEOTECHNICAL ENGINEERING

Course Title	**GROUND IMPROVEMENT TECHNIQUES**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU0XE51	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Remember the concepts of Ground water lowering, soil compaction and soil stabilization K-2: Understand the stone column and soil nailing K-3: Apply the principles of earth reinforcing and Grouting										
Course Objectives	The Course aims Studentswillbeexposedtovariousproblemsassociatedwithsoildepositsandmethods to 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	**5**

	with cement, lime- Stabilization of expansive 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

Course Title	EARTHQUAKE RESISTANTDESIGNOF FOUNDATIONS										
Course Code	Category	Semester	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
21BCEU0XE51	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	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										
Course Objectives	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.										

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><th>Course Title</th><th colspan="11">GEOENVIRONMENTAL 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>21BCEU0XE53</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Identify the soil contaminants and its classifications
K-2: Understand the various remedial methods for contaminant removal.
K-3: Apply the suitable method for contaminant removal</td></tr>
<tr><td>Course Objectives</td><td colspan="11">The Course aims
The student acquires the knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques thereby protecting environment.</td></tr>
</table>

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

	soil heating, vitrification, bio remediation, phyto remediation – ground water remediation – pump and treat , Insitu flushing, permeable reacting barrier, Insitu air sparging - case studies.	
IV	**LANDFILLS AND SURFACE IMPOUNDMENTS** Source and characteristics of waste - site selection for landfills – components of landfills – liner system – soil, geomembrane, geosynthetic clay, geocomposite liner system – leachate collection – final cover design – monitoring landfill.	**9**
V	**STABILISATION OF WASTE** Evaluation of waste materials – flyash, municipal sludge, plastics, scrap tire, blast furnace slag, construction waste, wood waste and their physical, chemical and biological characteristics – potential reuse – utilization of waste and soil stabilization – case studies.	**10**
References	**REFERENCES:** 1. Daniel B.E, Geotechnical Practice for waste disposal, Chapman & Hall, London, 1993. 2. Hari D. Sharma and Krishna R.Reddy, Geo-Environmental Engineering – John Wiley and Sons, INC, USA, 2004. 3. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995. 4. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989. 5. Proceedings of the International symposium of Environmental Geotechnology (Vol.I and II), Environmental Publishing Company, 1986 and 1989. 6. Ott, W.R., Environmental Indices, Theory and Practice, Ann Arbor, 1978. 7. Fried, J.J., Ground Water Pollution, Elsevier, 1975. 8. ASTM Special Tech. Publication 874, Hydraulic Barrier in Soil and Rock, 1985. 9. Lagrega, M.d., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.	
Course Out Comes	CO1: To understand the soil failure due the contaminants CO2 To assess the contamination in the soil and to select suitable remediation methods based on contamination. CO3: To prepare the suitable disposal system for particular waste. CO4: To utilize the treated soil for land filling CO5: To utilize the waste materials for soil stabilization	

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

<table>
<tr><td>Course Title</td><td colspan="11">ROCK MECHANICS AND APPLICATIONS</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>21BCEU0XE54</td><td>PEC</td><td>-</td><td>3</td><td>3</td><td>-</td><td>-</td><td>40</td><td>60</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1: Recall the 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.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">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.</td></tr>
</table>

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**	
21BCEU0XE55	PEC	-	3	3	-	-	40	60	-	-	100
Cognitive Level	K-1: Recall the soil and foundation engineering definitions and derivations K-2: understand the different Infinite and finite beams on elastic foundations K-3: predict the deflection for laterally loaded piles										
Course Objectives	The Course aims • Focus is on idealization of soil response to closely represent continuum behavior and interaction analysis between the soil-structure with reference to relative stiffness of beams, slabs and piles under different loading conditions.										

Unit	**Content**	**No.of Hours**
I	**SOIL RESPONSE MODELS OF INTERACTION ANALYSIS** Introduction to soil – Foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, soil-foundation interaction analysis, soil response models, Elastic continuum, Winkler, Two parameter elastic models, Elastic – plastic behavior, Time dependent behavior.	**9**
II	**INFINITE AND FINITE BEAMS ON ELASTIC FOUNDATIONS** Infinite beam, General solution of the elastic line – concentrated and distributed loads on beams – Idealization of semi-infinite and finite beams. Classification of finite beams, different end conditions and loads – solutions by general method, finite difference and application packages.	**9**
III	**PLATE ON ELASTIC MEDIUM** Infinite plate, elastic continuum, Winkler, Two parameters, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, simple solution, ACI method, Numerical analysis of finite plates, Analysis of highway and airfield pavements – Application packages.	**9**
IV	**ANALYSIS OF PILE AND PILE GROUPS** Elastic analysis of single pile – Methods of analysis for settlement of pile – Solutions for settlement and load distribution in pile – Pile tip load – settlement of pile groups – Analysis – Interaction between piles – end bearing and floating piles – Effect of pile cap – Piled raft – Application packages.	**9**
V	**LATERALLY LOADED PILE** Load - deflection prediction for laterally loaded piles, subgrade	**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 CO1: To Solve the Foundation interaction problems. CO2: To Provide the solutions of the elastic lines for infinite and finite beams with different Ends and loading conditions CO3: To analyses the highway and airfield pavements. CO4: To analyses the pile and pile groups. CO5: to predict the deflection for latterly loaded piles.	

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

OPEN ELECTIVE COURSES

OPEN ELECTIVE III & IV

<table>
<tr><th>course Title</th><th colspan="12">BIOLOGY (Biology for Engineers)</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>21BCEU03O1</td><td>OEC</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">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 in historical aspects and development of biology
• to acquire an overall knowledge on cell biology and biomolecules of life.
• to develop knowledge in enzymology and metabolism
• to make the students knowledgeable on genetic concepts
• to give an overview on various aspects in microbiology</td></tr>
</table>

UNIT	Content	No.of Hours
I	**Unit: I Introduction to Biology** (Source NPTEL course) Concept, history and scope of biology. Hierarchy of life forms at phenomenological level. Three major kingdoms of life and Classification systems in biology and relationships. Classification of life forms based on cellularity- unicellular to multi-cellular organisms; ultrastructure- prokaryotes & eukaryotes; energy and carbon utilization –Autotrophs, hetrotrophs,& lithotrophs; ammonia excretion – aminotelic & uricoteliec; and Habitat- acquatic & terrestrial. Model organisms for the biological studies – *Escherichia coli, Saccharomyces cerevisiae, Drosophila melanogaster,and Arabidopsis thaliana*	10
II	**Unit: II Cell Biology and Biomolecules of Life** Cell as basic unit of life – cell growth, reproduction & cellular differentiation. Molecules of life – DNA & RNA as genetic materials. DNA structure- from single stranded to double helix to nucleosomes. Concept of Genetic code. Universality and degeneracy of genetic code. Proteins-structure and function. Structure and properties of carbohydrates and lipids.	10
III	**Unit: III Enzymology and Cellular metabolism** Enzyme classification - Mechanism of enzyme action - Metabolic concepts –Anabolism & Catabolism - Thermodynamics as applied to biological systems. Exothermic and Endothermic versus endergonic and exergonic reactions. Cellular respiration and energetics - Glycolysis, Krebs Cycle, & ETC.	10
IV	**Unit: IV Genetics** Mental's laws - Concept of allele, recessiveness and dominance.	08

	Concept of segregation and independent assortment. Gene interaction-Epistasis & complementations - Concept of mapping of phenotype to genes. Genetic disorders in humans. Concept of Meiotic and Mitotic cell divisions.	
V	**Unit: V Microbiology** Historical and recent developments in microbiology: Invention of microscopy; Principle and applications of various microscopy: Simple, Compound, Dark field, Phase contrast, Fluorescence and Electron microscopy. Microbial taxonomy & phylogeny and Concepts of species and strains. Microbiological culture techniques - culture media, sterilization and culture methods. concepts of spontaneous generation, biogenesis, germ theory of disease, and fermentation.	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="12">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>21BCEU3O2</td><td>OEC</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 ensuring Sustainability;	6
III	Environment- Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River	6

	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.	
IV	Built environment – Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability	6
V	Civil Engineering Projects – Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution toemployment(projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development;	6
References	1. *Ž iga* Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for and Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht 2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition 3. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004. 4. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio. 5. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options 6. http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx	

Course Out Comes	CO1:The impact which Civil Engineering projects have on the Society at large and on the global arena and using resources efficiently and effectively. CO2:The extent of Infrastructure, its requirements for energy and how they are met: past, present and future CO3:The Sustainability of the Environment, including its Aesthetics, CO4:The potentials of Civil Engineering for Employment creation and its Contribution to the GDP CO5:The Built Environment and factors impacting the Quality of Life	

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

course Title	ARCHITECTURE										
Course Code	Category	Sem	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
21BCEU3O3	OCE	III	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 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 difeereent types of buldings 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

Course Title	**LIFE SCIENCE**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU05O1	**OCE**	V	1+1	1	-	2	20	30	30	20	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 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										

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- Carbon, nitrogen, sulphur and - 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: Waste recycling and microbial leaching** Waste management – Utilization of solid and liquid waste pollutants for production of single cell protein. Nature of sewage and its composition. Physical, chemical and biological properties of sewage (BOD,COD etc). Microbial leaching-*in situ* and *ex situ* methods -copper and uranium mining	5

V	**Unit -V: Bio resources utilization** Botanical name, family, morphology of useful part and uses of Cereals-Paddy, Wheat. Millets-Sorghum, Ragi. Legumes-Black gram, Pigeon pea, Green gram. Fibres-Cotton and Jute. Wood -Teak, Rose wood. Essential oil-Sunflower oil, Sesame oil, Beverages-Coffee, Cocoa, Spices and condiments-Cinnamom, Pepper, Cardamom, Clove, Turmeric. Dyes-Indigo and Henna	15
References	**References** **Text/Reference Books:** 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. 5th 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	

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

Course Title	**INSRUMENTATION AND SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING APPLICATIONS**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU05O2	OEC	V	2	2	-	-	40	60	-	-	100
Cognitive Level	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										
Course Objectives	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										

Unit	Content	No.of Hours
I	**Introduction:** Definition of sensor/transducer-Block Diagram-elements of measurement system-classification of sensors/transducers-static characteristics-accuracy, precision, resolution, linearity, sensitivity, range, loading effect, threshold, dead time, dead zone, span. **Errors in measurement**: True value, static error, static correction, scale range and scale span, error calibration curve, readability, repeatability & reproducibility,drift and noise	9
II	**Resistive Transducers:** Potentiometers-Linear POT, Rotary POT, characteristics of POT. Thermistors - Construction and its Resistance - Temperaturecharacteristics. Thermocouples- Construction and its Resistance- emf characteristics **Inductive Transducers**:	9

	Principle of change of self inductance, Principle of change of mutualinductance, Linear variable differential transformer(LVDT), Rotary variable differential transformer(RVDT).	
III	**Capacitive Transducers**: Introduction-Variable area type-variable air gap type- differential arrangement in capacitive transducers, variation of dielectric constant for measurement of liquid level, , variation of dielectric constant for measurement of displacement, advantages & disadvantages of Capacitive transducers . **Piezoelectric Transducers**: Measurement of Force, Modes of operation of Piezoelectric crystals,properties of Piezoelectric crystals, use of Piezoelectric Transducers.	9
IV	**Hall effect Transducers:** Hall effect element, Measurement of displacement, current and power. **Optical Transducers:** Vacuum photo emissive cell and its characteristics, semi conductor photo electric transducer- Photo conductive cell and its characteristics, photo diode and its characteristics, photo voltaic cell and its characteristics.	9
V	**Digital and Smart Sensors:** Introduction to digital encoding transducer- digital displacement transducers- shaft encoder-optical encoder, Introduction to Smart Sensors, Overview in Applications of sensors in Civil Engineering.	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. A.K.Ghosh, “Introduction to Measurements & Instrumentation”,IIIrded, PHI 2. A.K.Sawhney&PuneetSawhney, “A Course in Mechnanical Measurements & Instrumentation”,Dhanapat Rai & Co. 3. D.V.S.Murty, “Transducers & Instrumentation”, PHI. 4. Raman Pallas-Arney& John G.Webster, “Sensors & SignalConditioning”,2012. 5. D.Patranabis, “Sensors and Transducers” 2nd edition., PHI, 2013. 6. BC Nakra, KK Chaudhry “Instrumentation, Measurement and Analysis”,2nd Edition,TMH	
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

<table>
<tr><th>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>21BCEU05OX</td><td>OEC</td><td>V</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.	
II	Pre cast stone clock – Introduction – method of production – types of moulds – selection of materials – casting blocks – physical properties – compressive strength of stone masonry blocks – water absorption – cost economic – hollow concrete blocks introduction – advantages of hollow concrete blocks – masonry precaution – economic method of production – mix ratio curing stocking transportation – compressive strength manufacturing machineries.	
III	Pre cast roof and floor system: Pre cast reinforced concrete L – pans for roof – interlocution – materials – Element for roof supporting beam method of casting curing erection pre cast RC plank flooring preparation method of pre cast RCC joist moulds cast and curing pre caution during casting and placing Economics funicular shell micro concrete tiles method of manufacturing support beam erection.	
IV	Pre cast Brick panel roofing system – manufacturing method of Brick panel – suitable joist curved brick panel method of laying roof fly ash bricks manufacturing methods	
V	Ferrocement – introduction advantages manufacturing process mud mould construction – casting procedure for roof channel curing stocking fabrication and specification of ferrocement doors – manufacturing method of Ferrocement products – innovation painting installation and maintenance manufacturing methods of small capacity	

	Ferrocement water tanks economics.	
References	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

VALUE ADDED COURSES

S.No	**Semester**	**Course Code & Course title**
Odd Semester		
1	I	**21BCEU1VA1 /** Building Materials and construction
2	III	**21BCEU3VA3 /** Environmental impact Assessment
3	V	**21BCEU5VA5 /** Water supply and Sanitation system
Even Semester		
4	II	**21BCEU2VA2 /** Solid Waste Management
5	IV	**21BCEU4VA4 /** Watershed conservation & Management
6	VI	**21BCEU6VA6 /** Cost Effective Construction Technology

<table>
<tr><td>Course Title</td><td colspan="11">BUILDING MATERIALS AND CONSTRUCTION</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>21BCEU1VA1</td><td>-</td><td>-</td><td>2</td><td>2</td><td>-</td><td>-</td><td>50</td><td>-</td><td>-</td><td>-</td><td>50</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K1- to recall the different types of building materials and its applications
K2- to understand the nature, characteristics, performance, and behaviour of <i>civil engineering materials</i> 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
• Identification of construction materials required for the assigned work.
• Provide procedural knowledge of the simple testing methods of cement and concrete.
• Provide knowledge on foundations and its types
• List the requirements of stairs and provide knowledge on building by laws.</td></tr>
</table>

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

	mat footings, deep foundation – pile foundation	
V	**STAIRS AND BUILDING PLANNING** Stairs: Definitions, technical terms and types of stairs, requirements of good stairs; Geometrical design of RCC doglegged and open-well stairs; Principles of building planning, classification building, planning and building by laws.	5
References	**TEXT BOOKS:** 1. S. K. Duggal, “Building Materials”, New Age International Publishers. 2. Sushil Kumar “Building Materials and construction”, Standard Publishers, 20th edition, reprint, 2015. 3. Dr.B. C. Punmia, Ashok kumar Jain, Arun Kumar Jain, “Building Construction”, Laxmi Publications (P) ltd., New Delhi. 4. Rangawala S. C. “Engineering Materials‖”, Charter Publishing House, Anand, India **REFERENCE BOOKS:** 1. PC Varghese, “Building Construction”, PHI. 2. R. Chuddy, “Construction Technology”,Vol 1&2, Longman UK. 3. Subhash Chander, “Basic Civil Engineering”, Jain Brothers.	
Course Out Comes	After learning the course the students should be able to CO1: Predict, Understand and identify the building materials and select suitable type of building material for given situation. CO2: Students can explore the importance of cement, mineral and chemical admixtures, and requirements of the concrete in construction. CO3: To be aware of various building components and its construction procedures. CO4: Students can explain the foundations and uses of different types of foundations. CO5: Students can understand the requirements and different types of stairs and Principle of building planning and by laws and standards of building material Components and orientation of the building	

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="11">SOLID WASTE MANAGEMENT</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>21BCEU2VA2</td><td>-</td><td>-</td><td>2</td><td>2</td><td>-</td><td>-</td><td>50</td><td>-</td><td>-</td><td>-</td><td>50</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">K-1 Identify the Solid and hazardous waste sources and its characteristics
K-2 Explain the solid and hazardous waste management systems
K-3 Apply the legislations on management of solid and hazardous wastes.</td></tr>
<tr><td>Course Objectives</td><td colspan="11">• To make the students conversant with different aspects of the types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste
• The students completing the course will have an understanding of the nature and characteristics of municipal solid wastes and the regulatory requirements regarding municipal solid waste management and ability to plan waste minimization and design storage, collection, transport, processing and disposal of municipal solid waste</td></tr>
</table>

Unit	Content	No.of Hours
I	**SOURCES AND TYPES** Sources and types of solid wastes-waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes-Public health and environmental effects. Elements of solid waste management –Social and Financial aspects – integrated management-Public awareness; Role of NGO‟s.	10
II	**ON-SITE STORAGE AND PROCESSING** On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and economic aspects of open storage – waste segregation and storage – case studies under Indian conditions – source reduction of waste – Reduction, Reuse and Recycling.	9

III	**COLLECTION AND TRANSFER** Methods of Residential and commercial waste collection – Collection vehicles – Manpower– Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems- solving.	10
IV	**OFF-SITE PROCESSING** Objectives of waste processing – Physical Processing techniques and Equipments; Resource recovery from solid waste composting and biomethanation; Thermal processing options – case studies under Indian conditions.	9
V	**DISPOSAL** Land disposal of solid waste; Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor– Dumpsite Rehabilitation.	10
References	1. Tchobanoglous, G., Theisen, H. M., and Eliassen, R. "Solid. Wastes: Engineering Principles and Management Issues". McGraw Hill, New York, 1993. 2. Vesilind, P.A. and Rimer, A.E., “Unit Operations in Resource Recovery Engineering”, Prentice Hall, Inc., 1981 3. Paul T Willams, "Waste Treatment and Disposal", John Wiley and Sons, 2000 4. Government of India, "Manual on Municipal Solid Waste Management", CPHEEO, Ministry of Urban Development, New Delhi, 2000. 5. Bhide A.D. and Sundaresan, B.B. "Solid Waste Management Collection", Processing and Disposal, 2001 6. Manser A.G.R. and Keeling A.A.," Practical Handbook of Processing and Recycling of Municipal solid Wastes", Lewis Publishers, CRC Press, 1996 7. George Tchobanoglous and Frank Kreith"Handbook of Solidwaste Management", McGraw Hill, New York, 2002	
Course Out Comes	On completion of the course, students should be **CO:** Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation **CO2:** Define and explain important concepts in the field of solid	

	waste management **CO3:** suggest suitable technical solutions for treatment of municipal and industrial waste **CO4**: Understand the role legislation and policy drivers play in stakeholders' response to the waste a **CO5:** Apply the basic scientific principles for solving practical waste management challenges	

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

Course Title	**ENVIRONMENTAL IMPACT ASSESSMENT**										
Course Code	**Category**	**Semester**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU2VA3	**-**	**-**	**2**	**2**	**-**	**-**	**50**	**-**	**-**	**-**	**50**
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	• To impart knowledge on Environmental management and Environmental Impact Assessment. • The broad education necessary to understand the impact of engineering solutions in global, economic, environmental and social context.										

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

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

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

Course Title	**WATERSHED CONSERVATION AND MANAGEMENT**										
Course Code	**Category**	**Sem.**	**Credits**	**Hours**			**Theory**		**Practical**		**Total**
				L	**T**	**P**	**CFA**	**ESE**	**CFA**	**ESE**	
21BCEU1VA4	**-**	**-**	**2**	**2**	**-**	**-**	**50**	**-**	**-**	**-**	**50**
Cognitive Level	**K1** :Recall the basics principles of various flow with their concepts **K2** : understand the principles of different types of flow like steady and unsteady flow **K3** : Apply the principles in hydraulic structures for flow of water										
Course Objectives	The Course aims 3. To provide the technical, economical and sociological understanding of a watershed. 4. To provide a comprehensive discourse on the engineering practices of watershed management for realizing the higher benefits of watershed management.										

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

V	**GIS FOR WATERSHED MANAGEMENT** Applications of Remote Sensing and Geographical Information System - Role of Decision Support System – Conceptual Models and Case Studies	9
References	10. Ghanashyam Das, Hydrology and Soil Conservation engineering, Prentice Hall of India PrivateLimited, New Delhi, 2000. 11. Glenn O. Schwab, Soil and Water Conservation Engineering, John Wiley and Sons, 1981. 12. Gurmail Singh, A Manual on Soil and Water Conservation, ICAR Publication, New Delhi, 1982. 13. Suresh, R. Soil and Water Conservation Engineering, Standard Publication, New Delhi, 1982. 14. Vir Singh, Raj , Watershed Planning and Management, Yash Publishing House, Bikaner, 2000. 15. Brooks, K. N., P. F. Ffolliott, H. M. Gregersen and L. F. DeBano. 1997. Hydrology and the Management of Watersheds. Second Edition. Iowa State University Press. Ames, Iowa. 502 pp. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York. 16. Lal, Ruttan. 2000. Integrated Watershed Management in the Global Ecosystem. CRC Press, NewYork. 17. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York. 18. Dhruva Narayana, G. Sastry, V. S. Patnaik, “Watershed Management”, CSWCTRI, Dehradun, ICAR Publications, 1997.	
Course Out Comes	The students can be **CO1**: understand fundamental principles of water shed and morphological characteristics **CO2**: understand the principles soil conservation **CO3**: Apply decision to methods of rain water harvesting techniques **CO4**: develop the managing skill for water shed **CO5**: Apply the Potential of remote sensing and GIS is solving problems in water resources through case studies.	

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

Course Title	WATER SUPPLY AND SANITATION SYSTEM										
Course Code	Category	Sem.	Credits	Hours			Theory		Practical		Total
				L	T	P	CFA	ESE	CFA	ESE	
21BCEU2VA5	-	-	2	2	-	-	50	-	-	-	50
Cognitive Level	K-1 Recall the sources of water and pipes and pump selection K-2 understands the water quality standards for rural water supply systems. K-3 Apply the suitable techniques for sewage disposal and reuse.										
Course Objectives	The Course aims • Understand the importance rural water supply and principles of water supply with their components • Understand the various onsite sanitation system.										

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

Course Out Comes	On completion of the course, students should be **CO1:** able to understand the sources of surface and sub-surface sources **CO2:** able to know about the specific contaminants removal **CO3:** able to develop the on-site sanitation managements **CO4:** able to Design the anaerobic treatment systems **CO5:** able to provide the remedial solution for sewage disposal	

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

<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>21BCEU2VA6</td><td></td><td>-</td><td>2</td><td>2</td><td>-</td><td>-</td><td>50</td><td>-</td><td>-</td><td>-</td><td>50</td></tr>
<tr><td>Cognitive Level</td><td colspan="11">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.	
II	Pre cast stone clock – Introduction – method of production – types of moulds – selection of materials – casting blocks – physical properties – compressive strength of stone masonry blocks – water absorption – cost economic – hollow concrete blocks introduction – advantages of hollow concrete blocks – masonry precaution – economic method of production – mix ratio curing stocking transportation – compressive strength manufacturing machineries.	
III	Pre cast roof and floor system: Pre cast reinforced concrete L – pans for roof – interlocution – materials – Element for roof supporting beam method of casting curing erection pre cast RC plank flooring preparation method of pre cast RCC joist moulds cast and curing pre caution during casting and placing Economics funicular shell micro concrete tiles method of manufacturing support beam erection.	
IV	Pre cast Brick panel roofing system – manufacturing method of Brick panel – suitable joist curved brick panel method of laying roof fly ash bricks manufacturing methods	
V	Ferrocement – introduction advantages manufacturing process mud mould construction – casting procedure for roof channel curing stocking fabrication and specification of ferrocement doors – manufacturing method of Ferrocement products – innovation painting	

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

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