1.1.3

List of Employability/ Entrepreneurship/ Skill Development Courses with Course Contents

Colour Codes		
Name of the Subjects	Yellow	
Employability Contents	Green	
Entrepreneurship Contents	Light Blue	
Skill Development Contents	Pink	

List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

Department : *Civil Engineering*

Programme Name : *B.Tech, M. Tech & Ph.D*

Academic Year : 2023-24

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
01.	IPUALL2	Engineering Workshop Practices
02.	CSUATE5	Computer Programming
03.	CSUALE5	Computer Programming Laboratory
04.	CEUBTE1	Engineering Mechanics
05.	CEUBLE1	Engineering Mechanics Laboratory
06.	MEUBLL1	Engineering Graphics
07.	CEUCTT1	Strength of Materials
08.	CEUCTT2	Fluid Mechanics-I
09.	CEUCTT3	Surveying & Geomatics
10.	CEUCTP1	Building Materials & Construction
11.	CEUCTP2	Engineering Geology
12.	CEUCLT1	Survey Lab
13.	CEUCLT2	Fluid Mechanics Lab
14.	CEUDTT1	Structural Analysis-I
15.	CEUDTT2	Fluid Mechanics-II
16.	CEUDTT3	Concrete Technology
17.	CEUDTP1	Estimation and Costing
18.	CEUDTO1	Remote Sensing & GIS
19.	CEUDLT1	Civil Engineering Drawing with Computer Applications
20.	CEUDLT2	Material Testing Lab
21.	CEUDPT1	Mini Project
22.	CE205TPC09	Design of Concrete Structures-I
23.	CE205TPC10	Structural Analysis - II
24.	CE205TPC11	Transportation Engineering
25.	CE205TPC12	Soil Mechanics - I
26.	CE205TPC13	Environmental Engineering - I

27.	CE205TPC14	Estimation and Costing
28.	CE205PPC04	Transportation Engineering Lab
29.	CE205PPC05	Soil Mechanics Lab
30.	CE206TPC15	Design of Steel Structures
31.	CE206TPC16	Environmental Engineering - II
32.	CE206TPC17	Water Resources Engineering -I
33.	CE206TPC18	Soil Mechanics - II
34.	CE206TPE01A	Structural Analysis by Matrix Methods
35.	CE206TPE01B	Advanced Surveying
36.	CE206TPE01C	Advanced Concrete Design
37.	CE206TPE01D	Construction Engineering Materials
38.	CE206TPE01E	Basics of Computational Hydraulics
39.	CE206TOE01	Metro Systems and Engineering
40.	CE206PPC06	Environmental Engineering Lab
41.	CE206PPC07	Computer Applications in Civil Engg. Lab
42.	CE207TPC19	Pre-Stressed Concrete
43.	CE207TPC20	Water Resources Engineering-II
44.	CE207TPE02A	Environmental Geo-technology
45.	CE207TPE02B	Air and Noise Pollution and Control
46.	CE207TPE02C	Solid and Hazardous Waste Management
47.	CE207TPE02D	Urban Hydrology and Hydraulics
48.	CE207TPE02E	Environmental Impact Assessment and Life Cycle Analysis
49.	CE207TPE03A	Engineering Hydrology
50.	CE207TPE03B	Structural Dynamics
51.	CE207TPE03C	Foundation Engineering
52.	CE207TPE03D	Rock Mechanics
53.	CE207TPE03E	Water Resources Planning & Management
54.	CE207TPE04A	Industrial Structures
55.	CE207TPE04B	Airport Planning and Design
56.	CE207TPE04D	Railway Engineering
57.	CE207TPE04D	Contracts Management
58.	CE207TPE04E	Construction Projects Planning & Systems
59.	CE07TOE02A CE207PPC08	Green Building and Sustainable Materials Seminar
60.	CE207PPC09	Minor project

61.	CE208TPC21	Earthquake Resistant Design of Structures
62.	CE208TPE05A	Offshore Engineering
63.	CE208TPE05B	Surface Hydrology
64.	CE208TPE05C	Bridge Engineering
65.	CE208TPE05D	Traffic Engineering
66.	CE208TPE05E	Construction Equipment & Automation
67.	CE208TPE06A	Low Cost Housing Techniques
68.	CE208TPE06B	Water and Air Quality Modelling
69.	CE208TPE06C	Repair and Rehabilitation of Structures
70.	CE208TPE06D	Finite Element Analysis
71.	CE208TPE06E	Urban Hydrology and Hydraulics
72.	CE208TOE03	Infrastructure Planning and Management
73.	CE208PPC11	Major Project
74.	CE208PPC12	Structural Detailing Lab
M. Tech (2023-24)		
1.	CEPATT1	Advanced Structural Analysis
2.	CEPATT2	Advanced Solid Mechanics
3.	CEPATP1	Theory of Thin Plates and Shells
4.	CEPATP2	Theory and Applications of Cement Composites
5.	CEPATP3	Theory of Structural Stability
6.	CEPATP6	Structural Optimization
7.	CEPATP7	Advance Concrete Technology
8.	CEPATP8	Advanced Steel Design
9.	CEPATP9	Design of Formwork
10.	CEPATP10	Design of High-Rise Structures
11.	CEPALT1	Advanced Concrete Lab
12.	CEPBTT1	FEM in Structural Engineering
13.	CEPBTT2	Structural Dynamics
14.	CEPBTP1	Design of Advanced Concrete Structures
15.	CEPBTP2	Advanced Design of Foundations
16.	CEPBTP3	Soil Structure Interaction
17.	CEPBTP4	Design of Industrial Structure
18.	CEPBTP5	Advanced Prestressed Concrete
19.	CEPBTP6	Laminated Composite Plates
20.	CEPBTP7	Fracture Mechanics of Concrete Structures

21.	CEPBTP8	Design of Plates and Shells
22.	CEPBLT1	Computer Applications Lab
23.	CEPBPT1	Mini Project
24.	CEPCPT1	Dissertation Stage–I
25.	CEPDPT1	Dissertation Stage–II
Ph. D (2023-24)		
1.	ETPHDT00	Research Methodology In Engineering
2.	CEPHDT01	Optimization Techniques
3.	CEPHDT02	Finite Element Methods
4.	CEPHDT03	Structural Dynamics
5.	CEPHDT04	Advanced Concrete Technology
6.	CEPHDT05	Concrete Fracture Mechanics
7.	CEPHDT06	Special Concretes
8.	CEPHDT07	Multimodal Transportation System
9.	CEPHDT08	Design And Construction Of Rural Roads
10.	CEPHDT09	Advanced Pavement Materials
11.	CEPHDT10	Transportation Geotechnics
12.	CEPHDT11	Geo-Environmental Engineering
13.	CEPHDT12	River Hydraulics
14.	CEPHDT13	Irrigation Technology and Water Management
15.	CEPHDT14	Open Channel Hydraulics
16.	CEPHDT15	Earthquake Engineering
17.	CEPHDT16	Advanced Solid Mechanics
18.	CEPHDT17	Geo-Informatics
19.	CEPHDT16	Transportation System Design and Management
20.	CEPHDT17	Advance Soil Mechanics
21.	CEPHDT18	Environmental Geotechnics
22.	CEPHDT19	Principles of Ground Modification
23.	CEPHDT20	Soil Remediation

Scheme and Syllabus

SCHOOL OF STUDIES OF ENGINEERING AND TECHNOLOGY

Scheme of Teaching and Evaluation 2022-2023 (As per NEP-2020)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

(Effective from the Academic Year 2022–2023)

I-SEMESTER BTech Mechanical/IP/Chemical/Civil Engineering

S.N.	Course Code	Course Title	Teaching Hours/week			Examination				Credits
			Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIA Marks	SEA Marks	Total Marks	
			L	T	P					
1	AMUATB1	Engineering Mathematics - A	3	1	-	03	40	60	100	4
2	CYUATB3	Engineering Chemistry	3	-	-	03	40	60	100	3
3	ECUATE4	Basic Electrical and Electronics Engineering	3	-	-	03	40	60	100	3
4	FOUATC2	Environmental Science and Ecology	2	-	-	03	40	60	100	2
5	CSUATE5	Computer Programming	3	-	-	03	40	60	100	3
6	LAUATC1	Indian Constitution	1	-	-	01	50	-	50	1
7	CYUALB3	Engineering Chemistry Laboratory	-	-	2	03	25	25	50	1
8	CSUALE5	Computer Programming Laboratory	-	-	2	03	25	25	50	1
9	IPUALL2	Engineering Workshop Practices	-	-	2	03	25	25	50	1
10	PEUALS2	Sports and Yoga	-	-	2		25	25	50	1
Total			**15**	**1**	**08**	**25**	**350**	**400**	**750**	**20**

Note: AM:Mathematics, PP:Physics, ME: Mechanical Engineering, IP: Industrial & Production Engineering, CE: Civil Engineering, CS: Computer Sc. & Engg., IT: Information Technology, PE: Physical Education, FO: Forestry, LA: Law, NS: NSS, U: Undergraduate, T: Theory, L: Laboratory,

BASIC SCIENCE (B)	ENGINEERING SCIENCE (E)	SKILL ENHANCEMENT COURSE (L)	HUMANITIES SCIENCE (H)	MANDATORY COURSE (C)	EXTRA-CURRICULAR ACTIVITIES (S)
1. Mathematics – A 2. Physics 3. Chemistry 4. Mathematics - B	1. Engineering Mechanics 2. Introduction to Information Technology 3. Basic Electrical Engineering 4. Basic Electrical and Electronics Engineering 5. Computer Programming 6. Basic Communication Engineering	1. Engineering Graphics 2. Engineering Workshop Practices	1. English for communication 2. Human Values and Ethics	1. Indian Constitution 2. Environmental Science & Ecology	1. NSS 2.Sports and Yoga

SCHOOL OF STUDIES OF ENGINEERING AND TECHNOLOGY

Scheme of Teaching and Evaluation 2022-2023 (As per NEP-2020)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the Academic Year 2022–2023)

II-SEMESTER BTech Mechanical/IP/Chemical/Civil Engineering

S.N.	Course Code	Course Title	Teaching Hours/week			Examination				Credits
			Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIA Marks	SEA Marks	Total Marks	
			L	T	P					
1	AMUBTB4	Engineering Mathematics-B	3	1	-	03	40	60	100	4
2	PPUBTB2	Engineering Physics	3	1	-	03	40	60	100	4
3	ITUBTE2	Introduction to Information Technology	3	-	-	03	40	60	100	3
4	ELUBTH1	English for Communication	3	-	-	03	40	60	100	3
5	CEUBTE1	Engineering Mechanics	3	-	-	03	40	60	100	3
6	ME UBTH2/CH UBTH2/ IP UBTH2/CEUBTH2	Human Values and Ethics	1	-	-	02	50	-	50	1
7	PPUBLB2	Engineering Physics Laboratory	-	-	2	03	25	25	50	1
8	CEUBLE1	Engineering Mechanics Laboratory	-	-	2	03	25	25	50	1
9	MEUBLL1	Engineering Graphics	1	-	3	03	25	25	50	3
10	NSUBLS1	NSS	-	-	2	01	25	25	50	1
Total			**17**	**2**	**09**	**27**	**350**	**400**	**750**	**24**

Note: AM:Mathematics, PP:Physics, ME: Mechanical Engineering, IP: Industrial & Production Engineering, CE: Civil Engineering, CS: Computer Sc. & Engg., IT: Information Technology, PE: Physical Education, NS: NSS, U: Undergraduate, T: Theory, L: Laboratory,

BASIC SCIENCE (B)	ENGINEERING SCIENCE (E)	SKILL ENHANCEMENT COURSE (L)	HUMANITIES SCIENCE (H)	MANDATORY COURSE (C)	EXTRA-CURRICULAR ACTIVITIES (S)
1. Mathematics – A 2. Physics 3. Chemistry 4. Mathematics - B	1. Engineering Mechanics 2. Introduction to Information Technology 3. Basic Electrical Engineering 4. Basic Electrical and Electronics Engineering 5. Computer Programming 6. Basic Communication Engineering	1. Engineering Graphics 2. Engineering Workshop Practices	1. English for communication 2. Human Values and Ethics	1. Indian Constitution 2. Environmental Science & Ecology	1. NSS 2.Sports and Yoga

Scheme of B.Tech. III Semester Civil Engineering (As per NEP 2020, CBCS & OBE)
W.E.F 2023-24 (Even Semester)

S. No	Course Code	Subjects	Periods			Evaluation Scheme				Credits
		Theory	L	T	P	TA	IA	ESE	Total	
1	AMUCTB1	Engineering Mathematics-III	3	0	0	10	30	60	100	3
2	CEUCTT1	Strength of Materials	3	1	0	10	30	60	100	4
3	CEUCTT2	Fluid Mechanics-I	3	0	0	10	30	60	100	3
4	CEUCTT3	Surveying & Geomatics	3	0	0	10	30	60	100	3
5	CEUCTP1	Building Materials & Construction	3	0	0	10	30	60	100	3
	CEUCTP2	Engineering Geology								
	CEUCTP3	Ancient Philosophy of Civil Engineering								
6	CEUCTO1	Green Buildings	3	0	0	10	30	60	100	3
	CHUCTO1	Engineering Materials								
	CSUCTO1	Data Structure with C++								
	ITUCTO1	Computer Organization and Architecture								
	IPUCTO1	I.C. Engine								
	MEUCTO1	Introduction to Thermodynamics								
	ECUCTO1	Data Communication								
Total (A)			18	1	0				600	19
Practical's/Labs										
7	CEUCLT1	Survey Lab	0	0	2		25	25	50	1
8	CEUCLT2	Fluid Mechanics Lab	0	0	2		25	25	50	1
Total(B)			0	0	4				100	2
Total Credits (A+B)									700	21

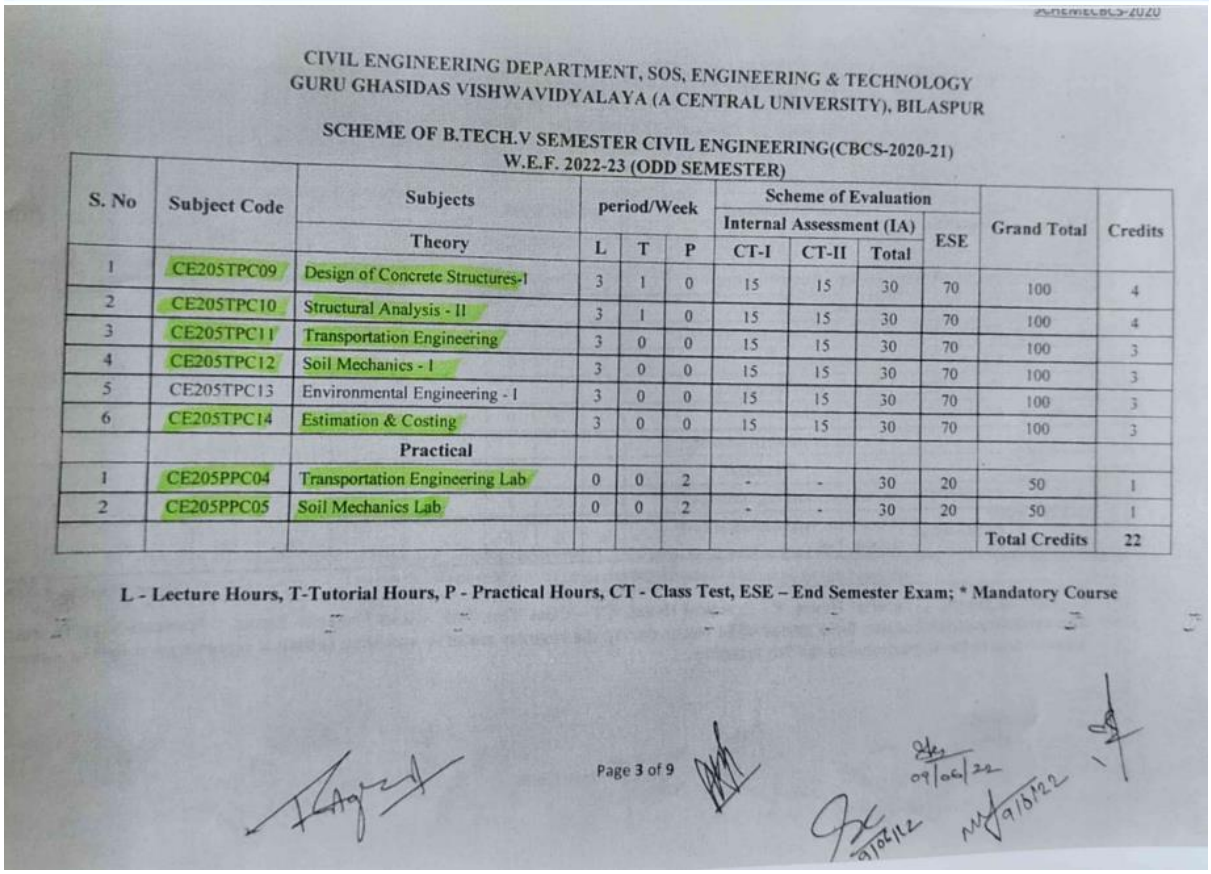
L-Lecture, T-Tutorial, P-Practical, TA-Teacher Assessment, IA- Internal Assessment {Based on two class tests (CT)of marks-15 each}, ESE-End Sem Examination, NEP-National Education Policy, CBCS-Choice Based Credit System, OBE-Outcome Based Education

Scheme of B.Tech. IV Semester Civil Engineering (As per NEP 2020, CBCS & OBE)
W.E.F 2023-24 (Even Semester)

S.No	Course Code	Subjects	Periods				Evaluation Scheme			Credits
		Theory	L	T	P	TA	IA	ESE	Total	
1	CEUDTT1	Structural Analysis-I	3	1	0	10	30	60	100	4
2	CEUDTT2	Fluid Mechanics-II	3	0	0	10	30	60	100	3
3	CEUDTT3	Concrete Technology	3	0	0	10	30	60	100	3
4	CEUDTP1	Estimation and Costing	3	0	0	10	30	60	100	3
	CEUDTP2	Sustainable Construction								
	CEUDTP3	Ocean Engineering								
5	CEUDTO1	Remote Sensing & GIS	3	0	0	10	30	60	100	3
	CHUDTO1	Fluidization Engineering								
	CSUDTO1	Introduction to Information Science								
	ITUDTO1	Computer Network								
	ITUDTO1	Fundamentals of python programming								
	IPUDTO1	Automobile Engineering								
	MEUDTO1	Introduction to Fluid Mechanics								
	ECUDTO1	Introduction to Electronic Devices & Circuits								
6	CEUDTM1	Management and Organizational Behaviour	2	0	0					0
Total (A)			17	1	0				500	16
Practical's/Labs										
7	CEUDLT1	Civil Engineering Drawing with Computer Applications	0	0	2		25	25	50	1
8	CEUDLT2	Material Testing Lab	0	0	2		25	25	50	1
9	CEUDPT1	Mini Project	0	0	4		50	50	100	2
Total(B)			0	0	8				200	4
Total Credits(A+B)									700	20

L-Lecture, T-Tutorial-Practical, TA-Teacher Assessment, IA- Internal Assessment (Based on two class tests (CT)of marks-15 each), ESE-End Sem Examination, NEP-National Education Policy, CBCS-Choice Based Credit System, OBE-Outcome Based Education

3



CIVIL ENGINEERING DEPARTMENT, SOS, ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA (A CENTRAL UNIVERSITY), BILASPUR

SCHEME OF B.TECH.V SEMESTER CIVIL ENGINEERING(CBCS-2020-21)
W.E.F. 2022-23 (ODD SEMESTER)

S. No	Subject Code	Subjects	period/Week			Scheme of Evaluation				Grand Total	Credits
						Internal Assessment (IA)			ESE		
		Theory	L	T	P	CT-I	CT-II	Total			
1	CE205TPC09	Design of Concrete Structures-I	3	1	0	15	15	30	70	100	4
2	CE205TPC10	Structural Analysis - II	3	1	0	15	15	30	70	100	4
3	CE205TPC11	Transportation Engineering	3	0	0	15	15	30	70	100	3
4	CE205TPC12	Soil Mechanics - I	3	0	0	15	15	30	70	100	3
5	CE205TPC13	Environmental Engineering - I	3	0	0	15	15	30	70	100	3
6	CE205TPC14	Estimation & Costing	3	0	0	15	15	30	70	100	3
		Practical									
1	CE205PPC04	Transportation Engineering Lab	0	0	2	-	-	30	20	50	1
2	CE205PPC05	Soil Mechanics Lab	0	0	2	-	-	30	20	50	1
										Total Credits	22

L - Lecture Hours, T-Tutorial Hours, P - Practical Hours, CT - Class Test, ESE – End Semester Exam; * Mandatory Course

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CIVIL ENGINEERING DEPARTMENT, SOS, ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA (A CENTRAL UNIVERSITY), BILASPUR

SCHEME OF B.TECH.VI SEMESTER CIVIL ENGINEERING (CBCS-2020-21)
W.E.F. 2022-23 (EVEN SEMESTER)

S. No	Subject Code	Subjects	period/Week			Scheme of Evaluation				Grand Total	Credits
						Internal Assessment (IA)			ESE		
		Theory	L	T	P	CT-I	CT-II	Total			
1	CE206TPC15	Design of Steel Structures	3	1	0	15	15	30	70	100	4
2	CE206TPC16	Environmental Engineering - II	3	0	0	15	15	30	70	100	3
3	CE206TPC17	Water Resources Engineering -I	3	0	0	15	15	30	70	100	3
4	CE206TPC18	Soil Mechanics - II	3	0	0	15	15	30	70	100	3
5	CE206TPE1X	Professional Elective -1X	3	0	0	15	15	30	70	100	3
6	CE206TOE01	Open Elective	3	0	0	15	15	30	70	100	3
		Internship/Industrial Training*									
		Practical									
1	CE206PPC06	Environmental Engineering Lab	0	0	2	-	-	30	20	50	1
2	CE206PPC07	Computer Applications in Civil Engg. Lab	0	0	2	-	-	30	20	50	1
										Total Credits	21

L - Lecture Hours, T-Tutorial Hours, P - Practical Hours, CT - Class Test, ESE – End Semester Exam; * Students have to undergo internship/industrial training for a period of 04 weeks during the summer vacation and shall submit a report signed by the concerned organization to the Department in the 7th Semester.

List of Professional (Core) Electives

Sl. No.	Subject Code	Name of Subject	Credits	Semester
x	CE206TPE1X	Professional Elective-1 (PE Group-1)	3	VI
A	CE206TPE1A	Structural Analysis by Matrix Methods		
B	CE206TPE1B	Advanced Surveying		
C	CE206TPE1C	Advanced Concrete Design		
D	CE206TPE1D	Construction Engineering Materials		
E	CE206TPE1E	Basics of Computational Hydraulics		

Sl. No.	Subject Code	Name of Subject	Credits	Semester
x	CE207TPE2X	Professional Elective-2 (PE Group-2)	3	VII
A	CE207TPE2A	Environmental Geo-technology		
B	CE207TPE2B	Air and Noise Pollution and Control		
C	CE207TPE2C	Solid and Hazardous Waste Management		
D	CE207TPE2D	Urban Hydrology and Hydraulics		
E	CE207TPE2E	Environmental Impact Assessment and Life Cycle Analysis		

Sl. No.	Subject Code	Name of Subject	Credits	Semester
x	CE207TPE3X	Professional Elective-3 (PE Group-3)	3	VII
A	CE207TPE3A	Engineering Hydrology		
B	CE207TPE3B	Structural Dynamics		
C	CE207TPE3C	Foundation Engineering		
D	CE207TPE3D	Rock Mechanics		
E	CE207TPE3E	Water Resources Planning & Management		

List of Open Electives

Sl. No.	Subject Code	Name of Subject	Credits	Semester
1	CE206TOE01	Metro Systems and Engineering	3	VI
2	CH206TOE01	Industrial utilities and safety	3	VI
3	CS206TOE01	Opps with C++	3	VI
4	EC206TOE01	Introduction to Electronics and Circuits	3	VI
5	IP206TOE01	Operation Research	3	VI
6	IT206TOE01	Computer Graphics	3	VI
7	ME206TOE01	Automobile Engineering	3	VI

Sl. No.	Subject Code	Name of Subject	Credits	Semester
2	CE207TOE02	Green Building and Sustainable Materials	3	VII

Sl. No.	Subject Code	Name of Subject	Credits	Semester
3	CE208TOE03	Infrastructure Planning and Management	3	VIII

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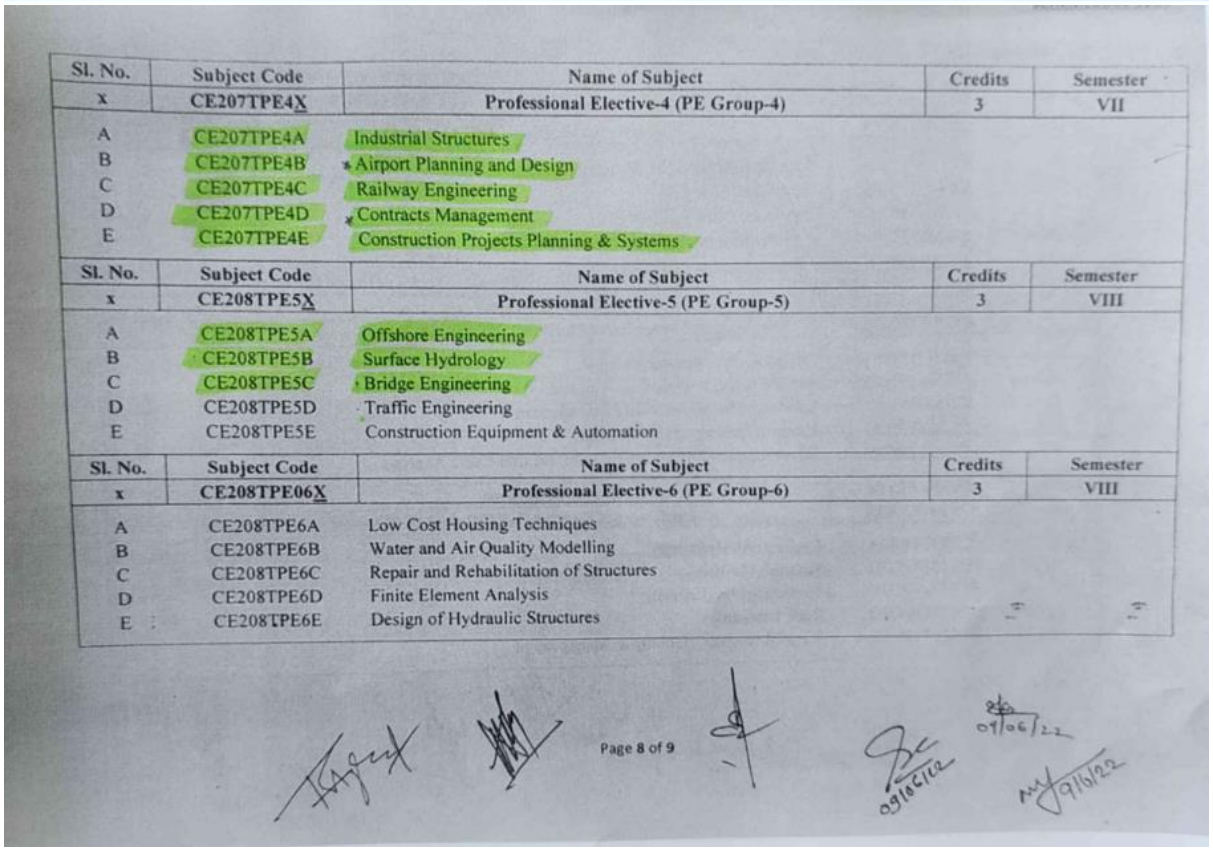

Sl. No.	Subject Code	Name of Subject	Credits	Semester
x	CE207TPE4X	Professional Elective-4 (PE Group-4)	3	VII
A	CE207TPE4A	Industrial Structures		
B	CE207TPE4B	Airport Planning and Design		
C	CE207TPE4C	Railway Engineering		
D	CE207TPE4D	Contracts Management		
E	CE207TPE4E	Construction Projects Planning & Systems		

Sl. No.	Subject Code	Name of Subject	Credits	Semester
x	CE208TPE5X	Professional Elective-5 (PE Group-5)	3	VIII
A	CE208TPE5A	Offshore Engineering		
B	CE208TPE5B	Surface Hydrology		
C	CE208TPE5C	Bridge Engineering		
D	CE208TPE5D	Traffic Engineering		
E	CE208TPE5E	Construction Equipment & Automation		

Sl. No.	Subject Code	Name of Subject	Credits	Semester
x	CE208TPE06X	Professional Elective-6 (PE Group-6)	3	VIII
A	CE208TPE6A	Low Cost Housing Techniques		
B	CE208TPE6B	Water and Air Quality Modelling		
C	CE208TPE6C	Repair and Rehabilitation of Structures		
D	CE208TPE6D	Finite Element Analysis		
E	CE208TPE6E	Design of Hydraulic Structures		

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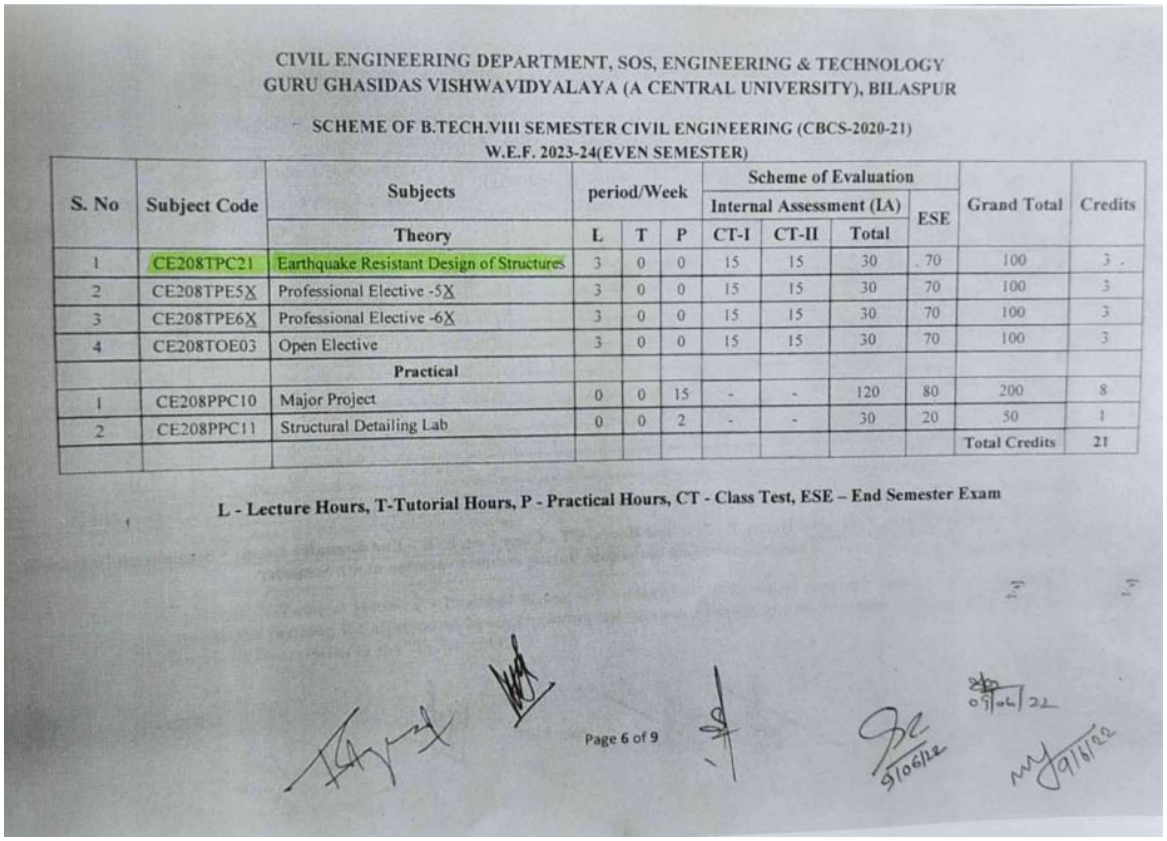
CIVIL ENGINEERING DEPARTMENT, SOS, ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA (A CENTRAL UNIVERSITY), BILASPUR

SCHEME OF B.TECH.VII SEMESTER CIVIL ENGINEERING (CBCS-2020-21)
W.E.F. 2023-24 (ODD SEMESTER)

S. No	Subject Code	Subjects	period/Week			Scheme of Evaluation				Grand Total	Credits
						Internal Assessment (IA)			ESE		
		Theory	L	T	P	CT-I	CT-II	Total			
1	CE207TPC19	Pre-stressed Concrete	3	0	0	15	15	30	70	100	3
2	CE207TPC20	Water Resources Engineering-II	3	0	0	15	15	30	70	100	3
3	CE207TPE2X	Professional Elective -2X	3	0	0	15	15	30	70	100	3
4	CE207TPE3X	Professional Elective -3X	3	0	0	15	15	30	70	100	3
5	CE207TPE4X	Professional Elective -4X	3	0	0	15	15	30	70	100	3
6	CE207TOE02	Open Elective	3	0	0	15	15	30	70	100	3
		Practical									
1	CE207PPC08	Seminar*	-	-	2	-	-	50	-	50	1
2	CE207PPC09	Minor project	0	0	6	-	-	60	40	100	3
										Total Credits	22

L - Lecture Hours, T-Tutorial Hours, P - Practical Hours, CT - Class Test, ESE – End Semester Exam; * Seminar on Industrial Training/Internship undergone during summer vacation of 6th Semester

09/06/22



CIVIL ENGINEERING DEPARTMENT, SOS, ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA (A CENTRAL UNIVERSITY), BILASPUR

SCHEME OF B.TECH.VIII SEMESTER CIVIL ENGINEERING (CBCS-2020-21)
W.E.F. 2023-24(EVEN SEMESTER)

S. No	Subject Code	Subjects	period/Week			Scheme of Evaluation				Grand Total	Credits
						Internal Assessment (IA)			ESE		
		Theory	L	T	P	CT-I	CT-II	Total			
1	CE208TPC21	Earthquake Resistant Design of Structures	3	0	0	15	15	30	70	100	3
2	CE208TPE5X	Professional Elective -5X	3	0	0	15	15	30	70	100	3
3	CE208TPE6X	Professional Elective -6X	3	0	0	15	15	30	70	100	3
4	CE208TOE03	Open Elective	3	0	0	15	15	30	70	100	3
		Practical									
1	CE208PPC10	Major Project	0	0	15	-	-	120	80	200	8
2	CE208PPC11	Structural Detailing Lab	0	0	2	-	-	30	20	50	1
										Total Credits	21

L - Lecture Hours, T-Tutorial Hours, P - Practical Hours, CT - Class Test, ESE – End Semester Exam

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M.Tech. II-Semester

SL	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	CEPBTT1	FEM in Structural Engineering	3	0	0	40	60	100	3
2.	CEPBTT2	Structural Dynamics	3	0	0	40	60	100	3
3.		Elective – IV	3	0	0	40	60	100	3
	CEPBTP1	1. Design of Advanced Concrete Structures							
	CEPBTP2	2. Advanced Design of Foundations							
	CEPBTP3	3. Soil Structure Interaction							
	CEPBTP4	4. Design of Industrial Structure							
4.		Elective – V	3	0	0	40	60	100	3
	CEPBTP5	1. Advanced Prestressed Concrete							
	CEPBTP6	2. Laminated Composite Plates							
	CEPBTP7	3. Fracture Mechanics of Concrete Structures							
	CEPBTP8	4. Design of Plates and Shells							
5		Open Elective	3	0	0	40	60	100	3
	MSPBTO1	1. Business Analytics							
	IPPBTO2	2. Industrial Safety							
	IPPBTO3	3. Operations Research							
	CEPBTO4	4. Cost Management of Engineering Projects (Other than Civil Engg.)							
	MEPBTO5								
	CHPBTO6	5. Composite Materials							
	ECPBTO7	6. Waste to Energy							
	MCPBTO8	7. IoT							
		8. MOOCs							
6.	CEPBLT1	Computer Applications Lab	0	0	3	30	20	50	2
7.	CEPBPT1	Mini Project	0	0	4	30	20	50	2
8.		Audit Course/Value Added Course	2	0	0	40	60	100	2
	ELPBTX1	1. English for Research Paper Writing							
	PEPBTX2	2. Disaster Management							
	CEPBTX3	3. Constitution of India							
	LAPBTX4	4. Stress Management by Yoga							
Total			17	0	08	300	400	700	21

Note: Under MOOCs the students have to opt any subject other than Civil Engineering from NPTEL/UGC SWAYAM

DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF STUDIES IN ENGINEERING & TECHNOLOGY, GGV, BILASPUR, C.G.
(INDIA)

SCHEME OF EXAMINATION

M.TECH. STRUCTURAL ENGINEERING

M.Tech. I-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	CEPATT1	Advanced Structural Analysis	3	0	0	40	60	100	3
2.	CEPATT2	Advanced Solid Mechanics	3	0	0	40	60	100	3
3.		Elective – I	3	0	0	40	60	100	3
	CEPATP1	1. Theory of Thin Plates and Shells							
	CEPATP2	2. Theory and Applications of Cement Composites							
	CEPATP3	3. Theory of Structural Stability							
4.		Elective – II	3	0	0	40	60	100	3
	CEPATP4	1. Analytical and Numerical Methods for Structural Engg.							
	CEPATP5	2. Structural Health Monitoring, Repairs and Rehabilitation of Structures							
	CEPATP6	3. Structural Optimization							
	CEPATP7	4. Advance Concrete Technology							
5		Elective – III	3	0	0	40	60	100	3
	CEPATP8	1. Advanced Steel Design							
	CEPATP9	2. Design of Formwork							
	CEPATP10	3. Design of High-Rise Structures							
	CEPATP11	4. Bridge Engineering							
6.	CEPALT1	Advanced Concrete Lab	0	0	3	30	20	50	2
7.	IPPATC1	Research Methodology and IPR	2	0	0	-	50	50	2
Total			17	0	3	230	370	600	19

CIVIL ENGINEERING DEPARTMENT

SoS, ENGINEERING & TECHNOLOGY

GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.), 495009

EVALUATION SCHEME OF Pre-Ph. D COURSE WORK

EFFECTIVE FROM SESSION 2023-24

SN.	Name of the Subject	Subject Code	Periods / Week L–T–P	ESE Duration	ESE MARKS		Credits
					Max.	Min.	
1	Research Methodology in Engineering	ETPHDT00	3–1–0	3 Hrs.	100	50	4
2	Elective-I	CEPHDTXX	3–1–0	3 Hrs.	100	50	4
3	Elective–II	CEPHDTYY	3–1–0	3 Hrs	100	50	4
4.	Seminar	CEPHDS01	-	-	Qualified/Not Qualified		-
Total			**9–3–0**	-	**300**	**150**	**12**

L: Lecture, **T**: Theory, **P**: Practical,

Max.: Maximum Marks in ESE; **Min.**: Minimum Pass Marks in each subject as 50%;

XX and **YY** in the subject code respectively denotes the number value of papers opted by the Scholar from the List of Elective-I & II.

Note

LIST OF ELECTIVES

S.N.	SUBJECT CODE	TITLE OF THE SUBJECT
ELECTIVE-I & II		
1	CEPHDT01	OPTIMIZATION TECHNIQUES
2	CEPHDT02	FINITE ELEMENT METHOD
3	CEPHDT03	STRUCTURAL DYNAMICS
4	CEPHDT04	ADVANCED CONCRETE TECHNOLOGY
5	CEPHDT05	CONCRETE FRACTURE MECHANICS
6	CEPHDT06	SPECIAL CONCRETES
7	CEPHDT07	MULTIMODAL TRANSPORTATION SYSTEM
8	CEPHDT08	DESIGN AND CONSTRUCTION OF RURAL ROADS
9	CEPHDT09	ADVANCED PAVEMENT MATERIALS
10	CEPHDT10	TRANSPORTATION GEOTECHNICS
11	CEPHDT11	GEO-ENVIRONMENTAL ENGINEERING
12	CEPHDT12	RIVER HYDRAULICS
13	CEPHDT13	IRRIGATION TECHNOLOGY AND IRRIGATION WATER MANAGEMENT
14	CEPHDT14	OPEN CHANNEL HYDRAULICS
15	CEPHDT15	EARTHQUAKE ENGINEERING
16	CEPHDT16	TRANSPORTATION SYSTEM DESIGN AND MANAGEMENT
17	CEPHDT17	ADVANCE SOIL MECHANICS
18	CEPHDT18	ENVIRONMENTAL GEOTECHNICS
19	CEPHDT19	PRINCIPLES OF GROUND MODIFICATION
20	CEPHDT20	SOIL REMEDIATION

SYLLABUS	(SEMESTER-I)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	CSUATE5	L	T	P	CT-I	CT-II	Attendance & Assignments	TOTAL	60	100	03
Subject:	COMPUTER PROGRAMMING	3	-	-	15	15	10	40			

Course Objectives:

- To learn the basic ideas of the Algorithms and Flowcharts.
- To learn Basic C concepts Data types and Control statements.
- To learn the Functions and Structure of Array.
- To learn the concepts of Sorting and Searching Algorithms.
- To learn basic concepts of Linked List Notations.

Course Content:

UNIT-1: Introduction to Programming
Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) -
Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

UNIT-2: Arithmetic expressions and precedence
Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching Iteration and loops, **Arrays** (1-D, 2-D), Character arrays and strings

UNIT-3: Basic Algorithms
Searching, concept of binary search etc., Basic Sorting Algorithms Bubble sort etc., Finding roots of equations, introduction of Algorithm complexity

UNIT-4: Function
Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference binary search etc.
Recursion functions Recursion, as a different way of solving problems. Example programs, such as, Finding Factorial, Fibonacci series, etc.

UNIT -5: Structure
Structures, Defining structures and Array of Structures
Pointers Idea of pointers, defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Course Outcomes- At the end of the course students will be able to

1. Understand the designing of basic level Algorithm and Flowcharts.
2. Understand the C programming fundamentals on the different Control Statements, Functions and Arrays.
3. Understand the Searching, Sorting Algorithms and concepts of linked list operations.

Textbooks/References:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

3. Brian W. Kernighan and Dennis M. Ritchie, the C Programming Language, Prentice Hall of India

Course Outcomes and their mapping with Programme Outcomes: COMPUTER PROGRAMMING (CSUATE5)

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2				1	2	2	1	3	2	2	3
CO2	3	2	3	2	3			1	2	2	1	3	2	2	3
CO3	3	2	3	2	3				2	2	1	3	2	2	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

SYLLABUS	(SEMESTER-I)	Periods/ Week			INTERNAL ASSESSMENT (IA)			ESE	Grand total	Credits
Subject Code:	CSUALE5	L	T	P	IA	MSE	TOTAL			
Subject:	COMPUTER PROGRAMMING LABORATORY	-	-	2	25	--	25	25	50	01

Course Learning Objectives:

- To learn the Branching and logical expressions and Loops
- To learn the Arrays and Function
- To understand the Numerical methods and Recursion

Course Content:

The laboratory should be preceded or followed by a tutorial to explain the approach or Algorithm to be implemented for the problem given.

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:
Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical Integration):
Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures

Course Outcomes- At the end of the course students will be able to

1. Design basic level Algorithms and Flowcharts.
2. Understand C programming fundamentals on the different Control Statements, Functions and Arrays.
3. Understand the programing concepts of Recursion, Searching, Sorting Algorithms.

SYLLABUS	(SEMESTER-I)	Periods/ Week			INTERNAL ASSESSMENT (IA)			ESE	Grand total	Credits
Subject Code:	IPUALL2	L	T	P	IA	MSE	TOTAL			
Subject:	ENGINEERING WORKSHOP PRACTICES	-	-	2	25	--	25	25	50	01

Course objectives:

- To impart student knowledge on various hand tools for usage in engineering applications.
- Be able to use analytical skills for the production of components, electrical switch board wiring and logic gate.

Course Content:

1. Study of M/C tools in lathe machine
   Demonstration of different operations of lathe machine
   Practice of facing plain turning, taper turning etc
2. Study of Carpentry tools, equipments and different jobs
   Practice of Lap joints, Butt joints, T-Lab joints
3. Practice of Lap joint, Butt Joint, T-joint
4. Preparation of ₹ shape, square shape, work pieces as per the given specification
5. Replacement of fuse, condenser of fan/motor and fan regulator;
   Installation of switch board with wiring;
   Concepts of measuring instruments.
6. Identification of various electronics components and their terminals;
   Study of logic gates AND, OR, XOR and NOT, NAND, NOR;
   Study of Basic ICs.

Course Outcomes: At the end of the course, students will be able to:

1. Understand the appropriate tools, materials, instruments required for specific operations in workshop.
2. Understand the figures of the hand tools used in fitting, carpentry, welding shop and machine tools such as lathe machine.
3. Understand report of procedures followed for a given task in fitting, carpentry, welding and machine shops.
4. Basic understanding of electrical equipment fitting and understanding of electronic logic gates AND, OR, NOT and ICs.
5. Basic understanding of electrical equipment fitting and understanding of electronic logic gates AND, OR, NOT and ICs. Apply techniques to perform basic operations with hand tools and power tools such as center lathe machine, fitting shop, carpentry, welding using given job drawing.

Textbooks/References:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of WorkshopTechnology", Vol. I 2008 and Vol. II 2010, Media promoters and publishersprivate 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" Pearson Education, 2008. (iv)Roy A. Lindberg, "Processes and Materials of Manufacture", 4thedition, PrenticeHallIndia, 1998.
4. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata Mc-Graw Hill House,2017.

Course Outcomes and their mapping with Programme Outcomes: ENGINEERING WORKSHOP PRACTICES (IPUALL2)

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2								2						
CO2	2								3						
CO3	2								1						
CO4	2								2					1	
CO5	1								3					1	

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

SYLLABUS	(SEMESTER-II)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	CEUBTE1	L	T	P	CT-I	CT-II	Attendance & Assignments	TOTAL	60	100	03
Subject:	ENGINEERING MECHANICS	3	0	-	15	15	10	40			

Course Learning Objectives:

- To learn the basics of engineering mechanics and force systems.
- To learn the different type of support reactions and the basics of friction.
- To learn the concepts of centroid, centre of gravity and moment of inertia.
- To learn the basics of linear, curvilinear motions, centripetal and centrifugal forces under dynamics.

UNIT – I

INTRODUCTION: Basic idealization of mechanics, particle, rigid body, mass, time, continuum, force, force system, system of units, principle of transmissibility of forces, principle of superposition.

COPLANAR CONCURRENT FORCE SYSTEM: Resultant of forces. Resolution of forces, Composition of coplanar concurrent, parallel and non-concurrent forces, Moment of a force, Varignon's theorem, free body diagram, equilibrant, equilibrium of particles and rigid bodies.

Self-Study Component: Application of triangle and polygon Law, vector method of resolution and Composition of forces.

UNIT – II

SUPPORT REACTIONS: Types of loads and types of supports, statically determinant beams, Numerical problems on support reactions for beams with point loads (normal and inclined), uniformly distributed load, uniformly varying load and moment.

FRICTION: Introduction, types of friction, laws of friction, angle of friction, angle of repose , cone of friction, characteristics of dry friction, application –body on horizontal plane and inclined plane and ladder friction.

Self-Study Component: Numerical problems on support reaction of beams loaded with trapezoidal loads, Support reactions for Compound beams and wedge friction - numerical problems.

UNIT – III

CENTROID AND CENTRE OF GRAVITY: Introduction to centroid and centre of gravity, Centroid of rectangular, triangular, circle, semicircle, quarter circle lamina and sector from first principles. Numerical problems on Centroid of composite lamina.

Self-Study Component: Determining Centroid for Composite Lamina with openings.

UNIT – IV

MOMENT OF INERTIA: Introduction, radius of gyration, parallel axis theorem, perpendicular axis theorem, polar moment of inertia, moment of inertia of standard geometrical figures by first principles. Numerical problems on moment of inertia of composite sections.

Self-Study Component: Determining moment of Inertia of Composite sections with reference to given axis.

UNIT – V

DYNAMICS: Introduction to dynamics, Classification, linear and curvilinear motion- projectiles, centripetal and centrifugal forces, banking/super elevation.

Introduction to work, power and energy, impulse – numerical problems.

Self-Study Component: Concept of motion with varying acceleration. Collision of elastic bodies.

Text Book(s):

1. S.S Bhavikatti, A text on elements of Civil Engineering and mechanics, New age International publishers, 2015.
2. R.S. Khurmi, A text book of engineering mechanics, S. CHAND & COMPANY LTD.

Reference Book(s):

1. Ramamrutham S: A text book of applied mechanics, Dhanpatrai and sons
2. S. Rajashekaran, G Shankar Subramanian: Engineering Mechanics- Statics and Dynamics, Vikas

Publishing House 1999.
3. Ferdinand Beer and Johnson F.R (Jr) Mechanics for Engineers, Tata Mc Graw-hill Publishing comp. Ltd New Delhi.

Course Outcome:

At the end of this course, students will demonstrate the ability to:

1. Determine the resultant force and moment for a given system of forces
2. Determine the support reactions under different loading conditions in structural members and problems related to friction.
3. Determine the centroid and centre of gravity
4. Determine the moment of inertia
5. Calculate the motion characteristics of a body under dynamic conditions

Course Outcomes and their mapping with Programme Outcomes: ENGINEERING MECHANICS (CEUBTE1)

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2			1								3	
CO2	3	3	2			1								3	
CO3	3	3	2			1								3	
CO4	3	3	2			1								3	
CO5	3	3	2			1								3	

Weightage: 1-Sightly, 2-Moderately, 3-Strongly

SYLLABUS	(SEMESTER-II)	Periods/ Week			INTERNAL ASSESSMENT (IA)			ESE	Grand total	Credits
Subject Code:	MEUBLL1	L	T	P	IA	MSE	TOTAL	25	50	01
Subject:	ENGINEERING GRAPHICS	1	-	3	25	--	25			

Course Learning Objectives:

1. To learn the basic of Engineering Drawing and Orthographic Projections
2. To learn the Sections and Sectional Views of Right Angular Solids
3. To learn the Isometric Projections covering and overview of Computer Graphics

UNIT 1:Introduction Engineering Graphics and Engineering Curves: Principles of engineering graphics and their significance – drawing instruments and their use – conventions in drawing – lettering – BIS conventions. Dimensioning rules, geometrical construction. Engineering Curves - Conic Sections, Special Curves-Cycloids, Epicycloids, Hypocycloids, Involutes and trochoid.

UNIT 2:Projection of Points, Straight lines and Planes: Principles of orthographic projections – conventions – first and third angle projections. Projections of points and lines inclined to both the planes. Projections of regular planes, inclined to both planes

UNIT 3:Projections Solids: Introduction, Type of solid, Projections of solids in simple position, Projection of solids with axes inclined to one of the reference planes and parallel to the other, Projections of solids with axes inclined to both H.P. and the V.P.

UNIT 4: Section of Solids and Development of Surfaces: Sectioning of regular solids - Section planes perpendicular to one plane and parallel or inclined to other plane - Development of surfaces of right, regular solids – development of prisms, cylinders, pyramids, cones and their parts.

UNIT 5: Isometric Projections and Orthographic Views: Principles of Isometric Projections-Isometric Scale- Isometric Views Conventions-Plane Figures, Simple and Compound Solids. Conversion of isometric views to orthographic views. Conversion of orthographic views to isometric projections, vice-versa. Introduction to perspective projection.

Computer Aided Drafting: Introduction to computer aided drafting package to make 2-D drawings. Demonstration purpose only - not to be included in examinations.

Textbooks/References:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, PearsonEducation
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. CAD Software Theory and User Manuals

Course Outcomes:

At the end of the course, the student shall be able to

1. Describe the fundamentals of engineering drawing and construct basic engineering curves.
2. Enhance visualization skill using projections of points, lines and planes.
3. Enhance visualization skill using projections of solids.
4. Enhance visualization skill using construction of sections of solids and development of surfaces.
5. Comprehend the theory of Orthographic and Isometric projections and views

Course Outcomes and their mapping with PO and PSO: ENGINEERING GRAPHICS (MEUBLL1)

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2									2					
CO2	1									1					
CO3	3									3					
CO4	3									3				1	
CO5	1									1				1	

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

SYLLABUS	(SEMESTER-II)	Periods/ Week			INTERNAL ASSESSMENT (IA)			ESE	Grand total	Credits
Subject Code:	CEUBLE1	L	T	P	IA	MSE	TOTAL			
Subject:	ENGINEERING MECHANICS LABORATORY	-	-	2	25	--	25	25	50	01

Course Objectives:

- To perform the practical giving basic understanding to fundamental principles of mechanics like parallelogram of forces, triangle of forces and polygon of forces by universal force table
- To perform the practical giving basic understanding to fundamental application of mechanics like screw jack, winchcrab and simple wheel and axle

Course Content: List of Experiments

1. Verification of law of parallelogram of forces.
2. Verification of law of triangle of forces.
3. Verification of law of polygon of forces by universal force table.
4. Verification of law of moment by parallel forces apparatus.
5. Practical verification of forces in the member of jib crane.
6. Practical verification of forces in the member of the truss.
7. Determination of coefficient of friction between two given surfaces by inclined plane method.
8. Determination of efficiency of simple screw jack.
9. Determination of efficiency of single purchase winch crab.
10. Determination of efficiency of double purchase winch crab.
11. Determination of efficiency of simple wheel and axle.

Course Outcome: At the end of the course students will be able to:

1. Verify the fundamental principles of mechanics like parallelogram of forces, triangle of forces and polygon of forces by universal force table
2. Analyze the friction coefficient between two surfaces
3. Calculate the efficiency of screw jack, winch crab and wheel and axle

Course Outcomes and their mapping with Programme Outcomes: ENGINEERING MECHANICS LABORATORY (CEUBLE1)

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1						1	1		1	1	2	
CO2	3	2					1		1	1		1	1	2	
CO3	3	2	1				1		1	1		1	1	2	

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUCTT1	Strength of Materials	3	1	0	10	30	60	100	4

Course Objective:
The objective of this Course is to:

- To understand the nature of stresses induced in material under different loads
- To plot construct the shear force and bending moments diagrams in determinate beams under gravity loads.
- To study the stress variation in beams subjected to bending and shear.
- To understand the elastic behavior of beams using conceptual theories.
- To study the theory of torsion in solid and hollow circular shafts and stresses developed in cylindrical shells.

Course Content:

Unit 1 : Simple Stress - Strain and Compound Stresses: Types of stress and strains, Mechanicals properties, Hooke's law, stress– strain curve for mild & cast iron, and HYSD. Relation between the elastic moduli & Poisson's ratio, Bars subjected to varying loads, Temperature stresses in composite bars, Elongation of bars of prismatic and non prismatic sections.
Plane Stresses: Stress at a point. Components of stress in rectangular coordinates, Stresses on an inclined plane, Principal stresses & Principle plane, Mohr's circle of stresses.

Unit 2 : Shear Force - Bending Moment: Shear Force & Bending Moment diagrams in statically determinate beams loaded with different load combination, Relationship between Load intensity-Shear Force -Bending Moment, Thrust diagram, Point of contra flexure, loading diagram & Bending moment diagram from shear force diagram, beam with internal hinge.

Unit 3 : Bending Stress : Theory of simple bending, Assumptions, Bending equation, Neutral axis, Determination of bending stresses – section modulus of sections, Combine Bending and Direct Stress.
Shear Stress: Derivation of Shear Stress formula, assumptions, Shear stresses in symmetrical elastic beam with different sections. Shear Centre.

Unit 4 : Slope and Deflections of simple Beams: Derivation of differential equation for deflection, Slope & Deflection of Beams by Double integration method, Macaulay's method & Moment area method for Simply supported, Cantilever beam subjected to point load, UDL, UVL.

Unit 5 : Torsion: Equation of Pure Torsion, Assumptions, and Power transmitted, Stiffness of Shafts, Comparison of Solid & Hollow shaft, Strain energy in Torsion.
Cylindrical Shells: Type of Loads in pressure vessels, Stress Distribution in thin cylinder, Spherical vessels.

Text Books:

1) Strength of Materials – R.K. Rajput (S. Chand & Co.)
2) Strength of Materials – R.K. Bansal (Laxmi Publication)

3) Strength of Materials– S.S Ratnam (Tata McGrawHill)

Reference Books:

1) Strength of Materials – Timoshenko, S. & Gere (CBSPublishers)
2) Introductions to Solid Mechanics –Shames &Pitarresi (Prentice Hall of India)
3) Strength of Materials–S.Ramamurtham (DhanpatRai Publications)

Course Outcomes-
At the end of the course the students will be able to:

CO1 : Determine compound stresses and strains in material under different loads.
CO2 : Draw the shear force and bending moment diagrams for the beam subjected to different loading conditions.
CO3 : Evaluate stresses induced in different cross-sectional members subjected to bending and shear.
CO4 : Evaluate the deflections in beams subjected to different loading conditions.
CO5 : Estimate torsional stress in solid and hollow circular shaft and stresses variation in cylindrical shells.

CO_s	PO_s												PSO_s		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1			1	1						3		2
CO2	3	2	2	1		1							3	1	2
CO3	3	2	2	1									3	1	2
CO4	3	2	2	1									3		
CO5	3	2	2	1									3	1	2

Course Code	Subject	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUCTT2	Fluid Mechanics-I	3	0	0	10	30	60	100	3

Course Objectives:

- To introduce and give explanation of fundamentals of Fluid Mechanics and give fundamental knowledge of fluid with its properties, behaviour, forces on various surfaces and stability of submerged and floating body.
- To develop understanding about Kinematics of fluid flow.
- To imbibe basic law of energy and equation used for analysis of dynamic fluids.
- To introduce the importance of fluid Flow in Pipes and determine the losses in a flow system.
- To develop understanding about flow through mouthpieces and orifice

Course Content:

UNIT-1: **Introduction:** Fluid, physical properties of fluids ideal and real fluid, Newtonian and Non-Newtonian Fluid Statics: Pressure density height relationship, pressure measurement by Manometers, Pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, metacentric height.

UNIT-2: **Kinematics of fluid flow:** Steady and unsteady flow, uniform and non-uniform flow, laminar and turbulent flow, one, two and three dimensional flow, streamlines and path lines, rotational and irrotational flow, continuity equation, three dimensional continuity equation. Velocity potential and stream function.

UNIT-3:**Dynamics of fluid flow:** Euler's equation of motion along a streamline and its integration, Bernoulli's equation and its applications – Pitot tube, Venturimeter, orificemeter, and problems related to application of momentum equations.

UNIT-4: **Flow in Pipes:** Major and minor losses in pipe lines, loss due to sudden contraction & expansion, Pipes in series and parallel Flow in open Channel: Comparison between open channel and pipe flow, definition of uniform and non-uniform flow, Chezy's and Manning's Formula, Hydraulically efficient channel section of rectangular, trapezoidal.

UNIT -5: **Flow through mouthpieces and orifices:** Hydraulic coefficients of orifice, flow through large rectangular orifice, mouthpieces, Borda's mouthpieces. Notches and Weirs: Rectangular, triangular and trapezoidal notches and weir, cippoletti and broad crested weir.

Text Books:

1) Fluid Mechanics and Machines – Dr. A.K. Jain (Khanna Publications)
2) Fluid Mechanics and Machines – Dr. R.K. Bansal (Laxmi Publications)
3) Fluid Mechanics & Hydraulic Machines – Dr. P. N. Modi & S. M. Seth, (Narosa Publishing House)

Reference Books:

1) Mechanics of Fluid – Irving H. Shames (McGraw Hill)

2) Introduction to Fluid Mechanics – James A. Fay (Prentice Hall India)
3) Fluid Mechanics – R.J. Garde (New Age International Publication)
4) Fluid Mechanics – Streeter V.L. & Wylie E.B. (Tata McGraw Hills)
5) Fluid Mechanics – John F Douglas (Pearson Publication)
6) Introduction to Fluid Mechanics Fox, R.W. and McDonald, A.T., John Wiley & Sons.
7) Fluid Mechanics", Streeter, V.L. and Benjamin, W.E., "McGraw-Hill.
8) Fluid Mechanics and Fluid Mechanics Som, S.K. and Biswas, G., Tata McGraw Hill.
9) Introduction to Fluid Mechanics, Fox, R. W. and A. T. McDonald, 6th ed., John Wiley, New York, (2004)

Course Outcomes: At the end of the course students will be able to

CO1 Define fluid properties and state the Newton's law of viscosity with explain the mechanics of fluid at rest .
CO2 Describe the Kinematics of fluid flow.
CO3 Employ Bernoulli's equation for ideal and real fluid flow and deduce expressions for Venturimeter, orifice meter and pitot tube.
CO4 Explain the concept of Flow in Pipes and types of losses in pipe flow.
CO5 Describe Flow through mouthpieces & orifices and distinguish it.

Course Outcomes and their mapping with Programme Outcomes Fluid Mechanics- I (CE203TPC02)

CO_s	PO_s												PSO_s		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2									3	2	2
CO2	3	2	1	2	2								3	2	2
CO3	3	2	1	3									3	2	3
CO4	3	2	2	2	3								3	2	2
CO5	3	2	1	3	2								3	2	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUCTT3	Surveying & Geomatics	3	0	0	10	30	60	100	3

Course Objectives:

- To understand the Concepts of surveying & levelling &its application on the field.
- To learn about the concepts of theodolites, tacheometry & triangulation.
- To understand subsidiary surveying like photographic & hydrographic surveying.
- To learn to apply advanced application of surveying like Remote sensing, EDM.

Course Content:

Unit 1: Introduction to Surveying- Basic Principles, Objectives & Classification of surveying, Survey lines- ranging.
Compass Surveying: Bearing of survey lines (QB & WCB), Local attraction, Dip & Declination.
Levelling: Principles of levelling- Dumpy level, booking and reducing levels, Methods- simple, differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in leveling.

Unit 2: Theodolite and Tacheometry: Vernier theodolites, Temporary and permanent adjustments, Requirements of nonadjustable parts, Measurement of horizontal angle by repetition and reiteration method, Measurement of vertical angles.
Tacheometery: Definitions, Principles of stadia systems, Instrument constants, Substance and Tangential Systems, Construction and use of Reduction Tacheometers.

Unit 3: Triangulation: Triangulation figures, Triangulation stations, Inter visibility of stations, Satellite Stations and reduction to centre.
Theory of Errors – Types, theory of least squares, Weighting of observations, Most probable value, Computation of indirectly observed quantities - method of normal equations.

Unit 4: Photogrammetry: Phototheodolite, principle of the method of terrestrial photogrammetry. Aerial Surveying: scale and distortion of the vertical and tilted photograph.

Unit 5: Principle of Electronic Distance Measurement: Principle, Type, Use, Measurement: Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications.
Remote Sensing: Introduction– Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors. Introduction to GPS.

Text/Reference Books:

1. B.C. Punamia, A. K Jain, SurveyingVol.1&2, Laxmi Publications.
2. Madhu, N, Sathikumar, Rand Satheesh Gobi, Advanced Surveying: TotalStation, GIS and Remote Sensing, Pearson India, 2006.
3. Bhavikatti ,S. S. ,Surveying and Levelling, Vol. I and II,I.K.International,2010
4. Manoj.K.AroraandBadjatia,GeomaticsEngineering,NemChand&Bros,2011

Course Outcomes-

At the end of the course students will be able to:

CO1: Remember& Understand the principle & classifications of surveying & Apply concepts &techniques of compass surveying & levelling.
CO2: Understand the working of theodolite & apply the concepts of tacheometery.
CO3: Apply the concepts of triangulation & Photogrammetry & Analyze the computations of surveying using theory of errors.
CO4: Employ surveying techniques using advanced surveying equipments & Techniques like EDM's & Remote sensing.

Course Outcomes and their mapping with Programme Outcomes: Surveying & Geomatics (CE23DC303)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		2								3	3	3
CO2	2	1	2	1					1				2	2	3
CO3	3		3	2	3							2	2	3	1
CO4	3	3	3	2								2	2	3	2
CO5															

Weightage:1-Sightly;2-Moderately;3-Strongly

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUCTP1	Building Materials & Construction	3	0	0	10	30	60	100	3

Course Objectives:

- To introduce the basic engineering properties of building materials like brick, stones, timber, ceramics,plastics, etc.
- To understand the elementary characteristics of construction materials like cement aggregates, concrete,steel, etc.
- To understand the types of foundations, functions, types of masonry, lintels, etc.
- To learn the structure supporting method like Shoring, Underpinning, and other advanced constructionmaterials & Techniques.

Course Content:

UNIT-1: Bricks, Tiles, Timber; Properties, Classification & application in Construction.

UNIT-2: Miscellaneous Engineering Materials; Ceramics & Glass; Polymers in construction; Plastics & Rubber; Paints & Paint admixtures, Varnishes andDistempers; Composite materials; Adhesives; Thermal Electrical & Sound Insulators.
Other materials for construction; Cost effective materials, industrial byproducts, agricultural byproducts Construction & demolition waste, Introduction to new materials (Survey and study), and locally available materials.

UNIT 3: Cement, Mortar, Aggregate, Admixtures, Concrete and Steel; classification, properties & uses.

UNIT-4: Foundations, Masonry, Arches & Lintels, Door & Window, Sill, Stairs case; Classification Requirements, Uses & Construction, Joints; Construction, Contraction and Expansion Joints in buildings.

UNIT-5: Shoring, Underpinning, Formwork, Scaffolding, Slip form; Types and Construction Practice Advanced Construction Materials & Techniques, Low Cost housing techniques, Damp Proofing, Sound Proofing, and Fire Proofing Construction Practice.
The relevant IS Codes for all the materials and NBC.

Name of Text Books:

1) Building Materials – S.K. Duggal (New Age Publication)
2) Building Materials – S. C. Rangwala (Charotar Publication)
3) Building Construction by S.G. Rangwala, Charter Publishing House, Anand, India.
4) Building Construction by Sushil Kumar, Standard Publ. and Distributors, New Delhi
5) Building Construction by Punmia B.C., Lakshmi Publications, New Delhi.
6) Advanced Building Materials and Construction by Mohan Rai and Jai Sing, CBRI Publication Roorkee
7) Concrete Technology – A.M. Neville & J.J. Brooks (Pearson Education)

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8) Concrete Technology – M.S. Shetty (S. Chand & Co.)
9) Engineering Materials – Surendra Singh (Laxmi Publication)
10) Construction Engineering and Management – S. Seetharaman (Umesh Publication)
11) Building Materials – Gurucharan Singh (Standard Publishers, Delhi

Course Outcomes:

At the end of the course the students shall be able

CO1 To compare the properties of most common and advanced building materials.
CO2 To understand the typical and potential applications of these materials
CO3 To select the appropriate building material for building construction
CO4 To identify the different components of a building and differentiate various types of foundations, masonry, arches and lintels
CO5 To select the appropriate supporting structure for strengthening of the building

Course Outcomes and their mapping with Programme Outcomes: Building Materials & Construction (CE23DE301)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1		1			1		1	2		
CO2	3	2			1	1	1					1	1	1	
CO3	3	1					1			1			2		
CO4	3	2				1	1						2		
CO5	2	1			1	1	1			1			1		

Weight age: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUCTP2	Engineering Geology	3	0	0	10	30	60	100	3

COURSE OBJECTIVES

To describe weathering process and mass movements

- To gain knowledge about various properties of minerals and their engineering significance.
- To acquire knowledge of various classification of rocks.
- To interpret the importance of different geological features and their effects.
- To apply the principles of geological investigations in civil engineering structures.

Course Content:

UNIT I: PHYSICAL GEOLOGY Geology in civil engineering – branches of geology; structure of earth and its composition; weathering of rocks – scale of weathering; soils landforms and processes associated with river, wind, groundwater and sea; relevance to civil engineering; Plate tectonics.

UNIT II: MINEROLOGY Physical properties of minerals – Quartz group, Feldspar group; Pyroxene - hypersthene and augite, Amphibole, hornblende; Mica – muscovite and biotite, Calcite, Gypsum and Clay minerals.

UNIT III: PETROLOGY Classification of rocks - distinction between Igneous, Sedimentary and Metamorphic rocks; Engineering properties of rocks-Description, occurrence, engineering properties, distribution and uses of Granite, Dolerite, Basalt, Sandstone, Limestone, Laterite, Shale, Quartzite, Marble, Slate, Gneiss and Schist.

UNIT IV: STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD - Geological maps – attitude of beds, study of structures; folds, faults and joints – relevance to civil engineering; Geophysical methods – Seismic and electrical methods for subsurface investigations.

UNIT V: GEOLOGICAL INVESTIGATION - Remote sensing for civil engineering applications; Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels, and Road cuttings; Coastal protection structures; Investigation of Landslides and earthquakes - causes and mitigation; seismic zonation – seismic zones of India.

TEXT BOOKS :-

1) Parbin Singh, "Engineering and General Geology", S.K. Kataria & Sons, 2008.
2) Venkatareddy. D. Engineering Geology, Vikas Publishing House Pvt. Ltd. 2010.

REFERENCES :-

1) Muthiayya, V.D. (1969), "A Text of Geology", Oxford IBH Publications, Calcutta.

2) Blyth F.G.H. and de Freitas M.H., Geology for Engineers, Edward Arnold, London, 2010.
3) F.G. Bell. Fundamentals of Engineering Geology, B.S. Publications. Hyderabad 2011.
4) Dobrin, M.B An introduction to geophysical prospecting, McGraw-Hill, New Delhi, 1988
5) Varghese, P.C., Engineering Geology for Civil Engineering PHI Learning Private Limited, New Delhi, 2012.
6) MarlandP.Billings, "Structural Geology", PHI Learing Pvt. Ltd. New Delhi, 2012

WEB LINKS :

i. http://studentsuvidha.com/forum/Forum-Engineering-Geology-btech-Notes-study-material
ii. https://www.examrace.com/IES/IES-Free-Study-Material/Civil-Engineering/Engineering-Geology

COURSE OUTCOMES:-

The end of this course, students will be able to :

CO1- Classify the various geological agents and processes involved.
CO2- Identify the available minerals by their properties and behavior.
CO3- Classify and identify the available rock in the construction site.
CO4- Interpret the different geological features and their engineering importance.
CO5- Apply the geological concepts in civil engineering projects.

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2					2	2						2		
CO2	2			2	2				2				2		
CO3	2	2	1	2					2				2		
CO4	2	2		2	2	2	2	2			2	2	2		
CO5			2	2		2	2	2	2		2	2	2		

Weight age: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUCLT1	Survey Lab	0	0	2		25	25	50	1

Course Objectives:
The Lab sessions would help in learning:

- Applications of chains & compass in surveying.
- Various Applications of levelling process.
- Use of Plane table surveying in preparing of maps of a location
- Tacheometry & its applications.
- Relative adjustment of non- accessible stations
- Principle & operation of Total Station.

Course Content:
List of experiments:

1. Linear measurement, offsetting using metric chain.
2. Determination of the area of the given field by cross staff survey &metric chain.
3. Compass Open Traversing using prismatic compass and elimination of local attraction.
4. Compass Close Traversing using prismatic compass and elimination of local attraction
5. To find the difference in elevation between the two non-invisible stations by the method of differential levelling.
6. To draw longitudinal profile of the road by the method of profile levelling.
7. To draw Cross-Sectional profile of the road by the method of profile levelling
8. Measurement of horizontal angle by repetition & reiteration method using theodolite.
9. Measurement of vertical angle by using theodolite
10. Determination of Tachometric constants (K & C).
11. Determination of elevation and height by tangential method when both angles are angles of elevation & angles of Depression.
12. Determination of elevation and distance by Stadia Hair method when line of sight inclined Upward & Downward
13. To perform the experiment for reduction to center from different positions of a satellite station when: (i) Satellite station in north position, (ii) Satellite station in left position
14. To perform the experiment for reduction to Centre from different positions of a satellite station when: (i) Satellite station in south position, (ii) Satellite station in right position
15. Traversing of the given area by radiation & intersection method using plane table survey.
16. Find the plane table instrument station using Resection method (Two-point problem & three-point problem)
17. Study of total station

Text Book:

1) Surveying and Levelling. N.N.Basak, 1st Edition, Tata McGraw Hill
2) Surveying (Vol. I & II) – Punmia, B.C. (Laxmi Publications, New Delhi, 1996)
3) Surveying (Vol. I & II) – Kanetkar (Pune VidyarthiGrihaPrakashan, Pune)

Reference Books:

1) Surveying (Vol. II & III) – Agor, R (Khanna publications, Delhi, 1995)
2) Surveying (Vol. II & III) – Arora, K.R. (Standard Book House, Delhi, 1993)
3) Surveying (Vol. I & II) – S.K. Duggal (Tata McGraw Hill)

Course Outcomes-
On completion of the course, the students will be able to:

CO1 Remember about conventional surveying tools such as chain/tape, compass, plane table, levels, Theodolite & Tachometer in the field of civil engineering applications such as structural plotting and highway profiling.

CO2 Understand & apply the concepts of Traversing, Plane Table Surveying & Levelling in the surveying field.

CO3 Understand & apply the concepts of Tacheometery & Triangulation in the surveying field.

Course Outcomes and their mapping with Programme Outcomes: Survey Lab (CE23LB301

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	3								3	3	1
CO2	2	1	2	3	2								2	3	2
CO3	3	2	3	3	2							2	2	1	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUCLT2	Fluid Mechanics Lab	0	0	2		25	25	50	1

Course Objectives:

- To understand the verification of Bernoulli's equation.
- Determination of Meta centric height of ship model
- Calibration of flow measuring devices as Venturimeter
- Calibration of flow measuring devices as Orificemeter.
- Demonstrate and find out co-efficient of velocity for orifice and Mouthpiece.
- Demonstrate and find out co-efficient of discharge for various types notches.
- Determination of friction factor for pipes
- Determination of critical velocity in pipe
- Determination of the co-efficient of pitot tube.
- Determination of coefficient of impact for vanes
- To plot velocity profile across the cross section of pipe
- Determine the Reynold's Number in pipe.
- To learn the Calibration of rectangular sharp cornered weir and to study the pressure distribution on the upstream face of the weir.
- To learn the Calibration of rectangular streamlined weir and to study the pressure distribution on the upstream face of the weir.

Course Content:

List of experiments:

1) To calculate the total energy at different points and plot the graph between total energy vs. distance. (Verification of Bernoulli's equation)
2) To determine the Meta centric height with angle of ship model.
3) To determine the co-efficient of Discharge Cd for Venturimeter
4) To determine the co-efficient of Discharge Cd for Orificemeter.
5) To determine the co-efficient of discharge and the co-efficient of velocity for Orifice.
6) To determine the co-efficient of discharge and the co-efficient of velocity for Mouthpiece.
7) To determine the coefficient of discharge Cd of Rectangular Notch.
8) To determine the coefficient of discharge Cd V Notch - 45 0
9) To determine the coefficient of discharge Cd V Notch - 60 0
10) To determine the friction factor for Darcy-Weisbach equation
11) Experimental determination of critical velocity in pipe.
12) To determine the coefficient of impact for vanes
13) To find the co-efficient of pitot tube
14) To plot velocity profile across the cross section of pipe
15) To determine the Reynold's Number in pipe
16) Calibration of rectangular sharp cornered weir and to study the pressure distribution on the upstream face of the weir.
17) Calibration of rectangular streamlined weir and to study the pressure distribution on the upstream face of the weir.

Course Outcomes-At the end of the course students will be able to

CO1 Verify the basic energy principles (Bernoulli's equation).
CO2 Utilize the basic measurement techniques of fluid flow in Venturimeter.
CO3 Utilize the basic measurement techniques of fluid flow in Orificemeter.
CO4 Gain knowledge to calculate co-efficient of velocity for orifice and Mouthpiece
CO5 Gain knowledge to calculate co-efficient of discharge for various types notches
CO6 Determine the critical velocity in pipe.
CO7 Understand the pipe flow systems and its losses.
CO8 Determine the coefficient of impact for vanes.
CO9 Determine co-efficient of discharge for pitot tube
CO10 Plot velocity profile across the cross section of pipe
CO11 Determine the Reynold's Number in pipe
CO12 Calibrate the rectangular sharp cornered weir and to study the pressure distribution on the upstream face of the weir.
CO13 Calibrate the rectangular streamlined weir and to study the pressure distribution on the upstream face of the weir.

Course Outcomes and their mapping with Programme Outcomes: Fluid Mechanics Lab (CE203PPC02)

COs	POs												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	1								3	2	2
CO2	3	3	3	2	1								3	2	2
CO3	3	3	2	2	1								3	2	2
CO4	3	3	2	2	1								3	2	2
CO5	3	3	2	2	1								3	2	2
CO6	3	3	3	2	1								3	2	2
CO7	3	3	3	2	1								3	2	2
CO8	3	3	2	2	1								3	2	2
CO9	3	3	3	2	1								3	2	2
CO10	3	3	2	2	1								3	2	2
CO11	3	3	3	2	1								3	2	2
CO12	3	3	2	2	1								3	2	2
CO13	2	2	3	2	1								3	2	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUDTT1	Structural Analysis-I	3	1	0	10	30	60	100	4

Course Objectives:

To study the strain energy principles and their application tobeams and pin joint plane frames
To learn about analysis of arches &cables.
To know how to construct the influence line diagrams for determinate beams and its application to estimate the maximum shear force, bending moment at a section and absolute maximum bending moment in the beams.
To study the construction of influence lines for determinate trusses and three hinged arches and its applications.
To learn about the static indeterminacy of structures and methods of analysis, application of three momenttheorem to beams

Course Content:

UNIT 1: Principle of superposition, virtual work principle, Maxwell reciprocal theorem, deflection of beams using conjugate beam method. Deflection of beams and truss using energy method (Castiglianotheorem), Analysis of plane truss using tension coefficient method (determinate).

UNIT 2: Three-hinged Arches: Bending Moment, Shear force, axial force for three-hinged arches, Analysis ofSuspension Bridge without stiffening girders.

UNIT 3: Influence Lines: Basic concept of moving load and influence line; influence lines for reactions, Shearforce and bending moment for determinate beams; absolute maximum shearing force and bending moment.

UNIT4: Influence lines for three-hinged arches and stresses in simply supported plane determinate trusses.

UNIT 5: Static and kinematic indeterminacy of structure, Method of structural analysis, Analysis of fixed beam, continuous beam using Theorem of three moments, Effect of yielding of supports.

Reference Book:

1. Structural Analysis by Devdas Meenon
2. Fundamental of Structural Analysis by Lee.
3. Elementary structural Analysis by A.K. Jain
4. Advanced Structural Analysis by A. K. Jain
5. Structural Analysis (SI units) by R C hibbeler
6. Structural Analysis by L S nagi & R S Jangid

Course Outcomes:

At the end of the course the students will be able

CO1 To apply the concept of conjugate beam and strain energy methods to estimate the deflections ofdeterminate beams and trusses
CO2 To able to analysis three hinged arches and cables.
CO3 To construct and use the influence lines for estimation of different force functions in

determinatebeams
CO4 To able to draw the ILDs for reactions and internal forces in three hinged arches and determinatetrusses and find their values
CO5 To differentiate the determinate and indeterminate structures and apply the three-moment area theoremfor the analysis of continuous beams and fixed beams

Course Outcomes and their mapping with Programme Outcomes: Structural Analysis-I (CE23TDC401)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	2							3	1	1	
CO 2	3	3	3	1	2							3	2	1	
CO 3	3	3	2	2	3							3	2	1	
CO 4	3	3	2	2	3							3	2	1	
CO 5	3	3	2	1	2							3	2	1	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUDTT2	Fluid Mechanics-II	3	0	0	10	30	60	100	3

Course Objectives:

To introduce and give explanation of fundamentals of turbulent flow in pipe.
To develop understanding about Boundary layer Analysis.
To develop understanding about non-uniform flow in open channel.
To introduce the importance of Compressibility effect in pipe flow.
To develop understanding about Hydraulic Machines.

Course Content:

UNIT 1: Non-uniform flow in open channel: Specific energy, critical flow, analysis of flow over hump and transition, equation of gradually varied flow, hydraulic jump and evaluation of its elements in rectangular channel.

UNIT 2: Boundary layer Analysis: Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, turbulent boundary layer, and laminar sub layer, Application of momentum equation, local and average friction coefficient. Fluid flow past submerged bodies. Drag and lift, drag on sphere and cylinder Magnus effect.

UNIT 3: Turbulent flow in pipe: Nature of turbulence, free and wall turbulence, turbulent flow in pipes, equation for velocity distribution over smooth and rough surfaces, Colebrook-White equation, Moody's diagram, Explicit equation for friction factors.

UNIT 4: Compressibility effect in pipe flow: Transmission of pressure waves in rigid and elastic pipes, water hammer Dimensional analysis and Hydraulic similitude. Dimensional analysis, Buckingham's theorem, important dimensionless numbers and their significances, geometric, kinematics and dynamicssimilarity, model study.

UNIT 5: Hydraulic Machines: Turbines: Classification of turbines, draft tube, specific speed, unit quantities, and characteristics curves of turbines, and governing of turbine. Pump: Introduction, Centrifugal pumps, efficiencies, specific speed, cavitations, slip, percentage slip.

Name of Text Books:

1. Fluid Mechanics and Machines – Dr. A.K. Jain (Khanna Publications)
2. Fluid Mechanics and Machines – Dr. R.K. Bansal (Laxmi Publications)
3. Fluid Mechanics – Dr. P.N. Modi (Standard Book House)
4. Mechanics of Fluid – Irving H. Shames (McGraw Hill)
5. Introduction to Fluid Mechanics – James A. Fay (Prentice Hall India) Name of

Reference Books:

1. Fluid Machines – Dr. Jagdish Lal (Metropolitan Book Company Private Ltd.)2. Fluid Machines – John P. Douglas (Pearson Publication)

Course Outcomes: At the end of the course students will be able to

CO1 Define Turbulent flow in pipe and velocity equations for smooth and rough boundary of pipe.
CO2 Describe the Boundary layer theory and drag and lift.
CO3 Explain the concept of non-uniform flow in open channel
CO4 Explain the concept of Compressibility effect in pipe flow
CO5 Describe the concept of Hydraulic Machines.

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	2							3	3	2
CO2	3	3	2	2	2	3							3	2	2
CO3	3	3	3	2	3	2							3	2	2
CO4	3	3	2	3	2								3	2	2
CO5	3	2	2	3	3								3	2	3

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUDTT3	Concrete Technology	3	0	0	10	30	60	100	3

Course Objectives:

To learn about various ingredients materials of concrete, like cement aggregates, water, etc
To understand the role of various Admixtures added to concrete mixes
To design various grades of concrete as per IS method.
To understand the various testing methods for fresh & hardened properties of concrete.
To learn about various special application concretes.

Course Content:

Unit1: Constituent Material: Cement-Types-Chemical composition and Properties-Tests on cement - IS Specifications- Aggregates-Classification-Mechanical properties and tests as per BIS grading requirements-Water- Quality of water for use in concrete.

Unit 2: Chemical and Mineral Admixtures: Accelerators-Retarders- Plasticizers- Super plasticizers-Water proofers – Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaolin-Their effects on concrete properties

Unit 3: Proportioning of Concrete Mix: Principles of Mix Proportioning-Properties of concrete related to Mix Design Physical properties of materials required for Mix Design – Design Mix and Nominal Mix-BIS Method of Mix Design – Mix Design Examples

Unit4: Fresh and Hardened Properties of Concrete: Workability-TestsforworkabilityofconcreteSlumpTestandCompactingfactorTest-Segregation and Bleeding-Determination of Compressive and Flexural strength as per BIS – Properties of Hardened Concrete-Determination of Compressive and Flexural Strength-Stress-strain curve for concrete Determination of Young's Modulus.

Unit 5: Special Concretes: Light weight concretes – High strength concrete – Fibre reinforced concrete –Ferrocement–Ready mix concrete–Slurry in filtrated fibrous concrete (IFCON)-Shotcrete–Polymer concrete – High performance concrete- Geopolymer Concrete.

Text Books:

1. Gupta. B.L., Amit Gupta, "ConcreteTechnology",JainBookAgency,2010.
2. Shetty,M.S,"ConcreteTechnology",S.ChandandCompanyLtd,NewDelhi,2003
3. Santha kumar, A.R; "Concrete Technology", Oxford University Press, New Delhi,2007

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4. Neville, A.M; "Properties ofConcrete", Pitman Publishing Limited, London,1995
5. Gambir, M.L; "ConcreteTechnology",3rd Edition, Tata McGraw Hill Publishing Co Ltd, NewDelhi,2007
6. IS10262-1982Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 1998.

Course Outcomes:

At the end of the course students will be able to:

CO1 Remember & understand properties and role of ingredients like cement, aggregate, admixtures etc. to produce better quality concrete.

CO2 Understand various classification & role of admixtures on properties of concrete.

CO3 Apply design concepts (as per IS method) to design various grades of concrete as per requirement.CO4 Demonstrate destructive, semi-destructive and non-destructive tests for concrete.

CO5 Understand about various special application concretes.

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			3	2		3	2		3	2		3		2
CO2	1			3	3		3	3		3	3		3		1
CO3	2	2		3			1			3			3		2
CO4				3	2			2	2		3		2	3	2
CO5	2			1	3	3	3	1					3	2	1

Weightage:1-Sigtly;2-Moderately;3-Strongly

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUDTP1	Estimation and Costing	3	0	0	10	30	60	100	3

Course Objectives:

The objective of this Course is

1. To able prepare detailed and abstract estimation for the building and other structure.
2. To prepare bill of quantity and schedule of rate for various item of work.
3. To able to value the existing building and property.

UNIT-I
ESTIMATION OF BUILDING

Types of estimates – Units of measurements – Methods of estimates – Advantages. Quantity estimate for load bearing and framed structures - brick work and RCC works only, Steel requirement and Bar bending schedule - Calculation of quantities of earth work excavation, brickwork, PCC, RCC, Plastering, white washing, colour washing and painting/varnishing for shops and residential building with flat roof.

UNIT-II
ESTIMATE OF OTHER STRUCTURES

Estimating of septic tank, soak pit – sanitary and water supply installations – water supply pipe line – sewer line– estimate of bituminous and cement concrete roads

UNIT-III
ANALYSIS OF RATES AND SPECIFICATIONS

Data – Schedule of rates – Analysis of rates – Specifications – sources – General and Detailed Specifications-Material Calculations for each work. - Material cost

UNIT-IV
CONTRACTS AND TENDER

UNIT-V
REPORT WRITING OF PROJECT

Principles for report preparation – report on estimate of residential and industrial building –Roads – Water supply and sanitary installations. Introduction to Value Engineering: Cash flow and cost control. Systems of cost control based on accounting details of spends and periodicity of cost comparison

TEXTBOOKS

1. Dutta. B.N" Estimation and Costing in civil Engineering,27th Edition -2011.
2. Chackraborti .M 'Estimation and Costing Specification and valuation in civil Engineering,24th edition 2010.
3. Rangalwala S C Estimation costing and valuation, Charotar Publishing House"2008
4. Kohli D.D and Kohli. R. C" a TEXT BOOK OF Estimating and Costing,2013.
5. Estimating and Costing: Including Quantity Surveying, Tendering and Evaluation Kataria & Sons, 2010.

Course Outcomes:

After successful completion of this course, the students should be able to

CO1 Prepare detailed estimation and find out the quantity of various works involved in the building.
CO2 Estimate the quantity of works involved in road works, water supply and sanitary works and septic tank
CO3 Carry out analysis of rates and bill preparation using spreadsheets.
CO4 Able to value the building and calculate rent from building.
CO5 Estimate the value of buildings.

COs	POs												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CO1						3				3	3		3		2
CO2						3				3	3		3		1
CO3						3				3	3		3		1
CO4						3				3	3		3		1
CO5						3				3	3		3	2	

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUDTD1	Remote Sensing & GIS	3	0	0	10	30	60	100	3

Course Objectives:

- Apply the concepts of Photogrametry and its applications such as determination of heights of objects on terrain.
- Understand the basic concept of Remote Sensing and know about different types of satellite and sensors.
- Illustrate Energy interactions with atmosphere and with earth surface features, Interpretation of satellite and top sheet maps.
- Understand different components of GIS and Learning about map projection and coordinate system.
- Develop knowledge on conversion of data from analogue to digital and working with GIS software.

SYLLABUS:

UNIT – I: INTRODUCTION TO PHOTOGRAMMETRY Principles and types of aerial photographs, geometry of vertical and aerial photograph, Scale and Height measurement on single and vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of Stereoscopy, fiducial points, parallax measurement using fiducial line.

UNIT – II: REMOTE SENSING Basic concepts and foundation of Remote Sensing elements, Data information, Remote sensing data collection, Remote sensing advantages and Limitations, Remote sensing process. Electromagnetic spectrum, Energy interaction with atmosphere and with earth surface features (soil, water, and vegetation) Indian Satellites and Sensors characteristics, Map and Image false color composite, introduction to digital data, elements of visual interpretations techniques.

UNIT – III: GEOGRAPHIC INFORMATION SYSTEMS Introduction to GIS, Components of GIS, Geospatial data: Spatial Data – Attribute Data- Joining Spatial and Attribute Data, GIS Operations: Spatial Data input- Attribute Data Management-Data Display-Data Exploration-Data Analysis. **COORDINATE SYSTEMS:** Geographic Coordinate system; Approximation of Earth, Datum: Map Projections; Types of Map Projections-Map Projection Parameters-Commonly used Map Projections – Projected Coordinate Systems.

UNIT – IV: VECTOR DATA MODEL Representation of simple features- Topology and its importance: coverage and its data structure, shape file: data models for composite features Object Based Vector Data Model; Classes and their Relationships: The geo-based data model: Geometric representation of Spatial feature and data structure: Topology rules.

UNIT – V: RASTER DATA MODEL Elements of Raster data model: Types of Raster data: Raster data structure: Data conversion, Integration of Raster and Vector data. Data Input: Metadata: Conversion of Existing data, Creating new data, Remote sensing data, Field data, Digitizing, Scanning, on screen digitizing, importance of source map, Data Editing.

TEXT BOOKS:

1. Bhatta B (2008), Remote sensing and GIS", Oxford University Press
2. Lillesand, T.M, R.W. Kiefer and J.W. Chipman (2013) Remote Sensing and Image Interpretation", Wiley India Pvt. Ltd., New Delhi
3. Schowenger, R. A (2006) Remote Sensing, Elsevier publishers.

4. Parkinson, B. W., Spilker, J. J. (Jr.) (1996). Global Positioning System: Theory & Applications (Volume-I). AIAA, USA
5. Remote Sensing of the environment- An earth resource perspective- 2nd edition- by John R. Jensen, Pearson Education.
6. Introduction to geographic information system- kang – Tsung Chang, Tata McGraw- Hill Education Private Limited.
7. Concepts & Techniques of GIS by C.P. Lo Albert, K.W. Young, Prentice Hall (India) Publications. Remote Sensing and Geographical Information systems by M.Anji Reddy JNTU Hyderabad 2001, B.S. Publications.
8. Principals of Geo physical Information System- Peter A Burragh and Rachael A. Mc Donnell, Oxford Publishers 2004
9. Basics of Remote Sensing and GIS by S. Kumar, laxmi Publications.

REFERENCE BOOKS:

1. Fundamentals of Remote Sensing by George Joseph, Universities Press, 2013.
2. Fundamentals of Geographic Information Systems" by Demers, M.N, Wiley India Pvt. Ltd, 2013. 3. Jensen John R. Introduction to Digital Image Processing: A Remote Sensing Perspective Prentice hall, New Jersey
4. Paul Wolf, Elements of Photogrammetry, McGraw Hill.
5. Leick Alfred, 1995: GPS Satellite Surveying, Wiley Interscience
6. Burrough, P. P. &McDonnel, R. A. (1998). Principles of GIS. Oxford University Press

Course Outcomes:

After completing this course, the student will have acquired the ability on the following. 1. Understand the concepts of Photogrammetry and compute the heights of objects.

CO1 Understand the principles of aerial and satellite remote sensing, Able to comprehend the energy interactions with earth surface features, spectral properties of water bodies.
CO2 Understand the basic concept of GIS and its applications, know different types of data representation in GIS.
CO3 Understand and Develop models for GIS spatial Analysis and will be able to know what the questions that GIS can answer are.
CO4 Apply knowledge of GIS software and able to work with GIS software in various application fields.
CO5 Illustrate spatial and non-spatial data features in GIS and understand the map projections and coordinates systems.
CO6 Apply knowledge of GIS and understand the integration of Remote Sensing and GIS.

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3											3		2
CO2	3	2											3	2	
CO3				3			2						3	2	
CO4											2		2	3	
CO5			3	2						2			2	3	2

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUDLT1	Civil Engineering Drawing with Computer Applications	0	0	2		25	25	50	1

Course Objectives:

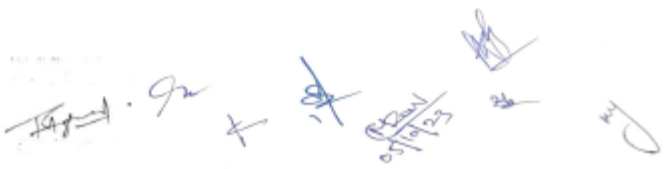
1. To introduce the fundamentals of Civil Engineering drawing.
2. To practice the understanding of the principles of planning.
3. To develop capability to understand and learn drafting of building drawings.
4. To impart knowledge on drafting software such as Auto CAD Course Content:

List of Experiments:

1. To draw various symbols used in building drawings & Learn Bye-Laws of the building drawing.
2. To draw the cross section of a wall (Load bearing & Framed Structures) and its foundation.
3. To draw the line plan of a single storey residential building.
4. To draw the ground floor plan of a residential building.
5. To draw the section for the above plan showing maximum details.
6. To draw the corresponding front elevation of the above residential building.
7. To draw the plan, Elevation and section of a primary school building.
8. To draw the plan, Elevation and section of a hostel building.
9. To draw the plan, Elevation and section of a Primary Health Center building
10. To draw elevation & section of flush shutter, paneled shutter doors and windows.
11. To draw section and elevation of fully glazed, half glazed, half glazed and half paneled doors and windows.
12. To draw Bar Bending Schedule of footing, Beams , Columns & Slab.
13. To draw different stair cases (RC/Steel).
14. To draw the elevations of various types of trusses.

Refrences:

1. National Building Code of India.
2. Building drawing with a ninety grated approach to built environment by M.Shah, C.Kale, S.Patki, Tata McGraw Hill Education; 4th edition.
3. Building Planning and Drawing by M.V. Chitawadagi S.S. Bhavikatti, Dreamtech Press.
4. Civil Engineering Drawing & House Planning: A TextBook by B.P. Verma, Khanna publishers.
5. Civil Engineering Drawing by Rangwala, Charotar Publishing House Pvt.Ltd.
6. Building Planning and Drawing by Dr. N. Kumara Swamy, A. Kameswara Rao, Charotar Publishing House Pvt. Ltd.
7. NKrishna Raju, Structural Design and Drawing, Second Edition, Universities Press (India),



Private Limited, Hyderabad.

Course Outcomes:

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

CO1 Remember & Understand Building Bye-Law & various symbols used for drawings of structures.

CO2 Apply drawing concepts to draw Plans Sections & Elevations for Various types of buildings.

CO3 Apply drawing concepts to draw Sections & Elevations for Various types of Doors, Windows, Staircases and Trusses.

Course Outcomes and their mapping with Programme Outcomes: Computer Aided Civil Engineering Drawing (CE23PLB401)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1		1	3	1							2	1	1
CO2	2	1								1			3	2	1
CO3	2	1				1				1			2	1	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUDLT2	Material Test Lab	0	0	2		25	25	50	1

Course Objectives:

- To Remember & understand various Properties of Cement & to learn testing methodology of eachproperties of cement.
- To learn to perform various experiments related to properties of Aggregates.
- To be able to examine the various properties of prefabricated bricks.
- To learn to perform various Destructive & non –destructive tests on concrete.

Course Content:

1.Normal Consistency, Fineness of Cement, Setting times of Cement
2.Specific Gravity of Cement
3.Soundness of Cement
4.Compressive strength of cement

Testing of aggregate:

5.Fineness modulus of Fine and Coarse aggregate
6.Bulk density of aggregate
7.Specific Gravity and Water Absorption of Aggregate
8.Bulking of Sand

Testing of bricks

9.Compressive strength, Water Absorption &Efflorescence of BricksTesting of concrete:
10. Workability of Concrete
11. Compressive strength
12. Modulus of Elasticity
13. Tensile Strength of Concrete
14. NDT Test of Concrete

Text Books / References:

1.Building Materials – S.K. Duggal (New Age Publication) 2. Building Materials – S. C. Rangwala (Charotar Publication)
3.Building Construction by S.G. Rangwala, Charter Publishing House, Anand, India

Course Outcomes: At the end of the course students will be able to:

CO1 Understand & demonstrate various tests on cement, Aggregates & Bricks.
CO2 Design Concrete for desired grade & test its various mechanical properties.
CO3 Demonstrate modern Non – Destructive method of concrete in-situ testing.

COs	POs												PSOs		
PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	1	3	1	2	2	1							2		3
CO2	2	2	3	3	2	1							2		2
CO3	1	3	1	3	2	2		2					2	3	2

Course Code	Subjects	Periods			Evaluation Scheme				Credits
		L	T	P	TA	IA	ESE	Total	
CEUDPT1	Mini Project	0	0	4	-	50	50	100	2

Course Outcomes:

After successful completion of this course, the students will be able to

CO1: prepare plan for various types of structures.
CO2: prepare the working and approval drawings for Civil engineering structures
CO3: prepare the project reports in the prescribed formats.
CO4: present project proposals efficiently. Pre-requisites: Nil Course Assessment methods:

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(SEMESTER V)

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205TPC09	L	T	P	CT-I	CT-II	TOTAL	70	100	04
Subject:	Design of Concrete Structures-I	3	1	0	15	15	30			

Course Learning Objectives:

1. To understand the various philosophies of design of concrete structures using IS Codes.
2. To understand the design beam for flexure, shear, bond and torsion
3. To know the design of slabs and staircase with their detailing.
4. To learn the design of axially and eccentrically loaded columns.
5. To know about different types of footings and their reinforcement detailing.

Course Content:

UNIT-1: Introduction to design of concrete structures-limit state analysis and design of beams for flexure, bond.

UNIT-2: Shear and torsion

UNIT-3: One way slabs, staircases, Two-way slabs

UNIT-4: Axially and eccentrically loaded columns. (Uniaxial only)

UNIT-5: Footings – different types of isolated footings, synthesis of limit state and working Stress methods.

Text Books:

1. Reinforced Concrete Design - S Unnikrishna Pillai &Devadas Menon
2. Limit State Design of Reinforced Concrete - P.C. Verghese
3. Design of Reinforced Concrete Structures - N Krishna Raju

Course Outcomes

After successful completion of this course, the students will be able

CO1: To adopt limit state design philosophy for deign of reinforced concrete.
CO2: To carry out the design of RC structural elements for flexure, bond, shear and torsion.
CO3: To implement the design slabs and staircases as per LSD.
CO4: To do the design of RC structural columns subjected to axial and eccentric loads.
CO5: To propose and design the type of footing for a RC structure.

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SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205TPC10	L	T	P	CT-I	CT-II	TOTAL	70	100	04
Subject:	Structural Analysis - II	3	1	0	15	15	30			

Course Learning Objectives:

The objective of this course is

1. To understand the principles of energy methods and their applications to indeterminate beams and plane frames
2. To know the principles and applications of slope deflection method to the indeterminate beams and rigid frames
3. To study the principles of moment distribution method and its applications to indeterminate beams and rigid joint plane frames
4. To study the principles of matrix methods and their applications to beams
5. To apply the Muller Breslau Principle for the construction of influence lines to indeterminate beams and two-hinged arches

Course Content:

UNIT-1: Analysis of indeterminate beams by Consistent Deformation methods, Analysis of indeterminate rigid plane frames and truss using energy method.

UNIT-2: Slop Deflection Method: Continuous beams and rigid joint plane frames by slope deflection method due to loads and yielding of supports.

UNIT-3: Moment-distribution method. Continuous beams and rigid joint plane frames by moment distribution method due to loads and yielding of supports.

UNIT-4: Introduction to Flexibility matrix and Stiffness Matrix methods: Applications of the methods to simple indeterminate beams.

UNIT-5: Analysis of symmetrical two hinge arches (parabolic and circular). Influence lines for propped cantilevers, continuous beams using Muller-Breslau's principle.

Text Books:

1. Structural Analysis –Devdas Meenon
2. Indeterminate Structural Analysis - C. K. Wang
3. Fundamental of Structural Analysis -Lee
4. Advanced Structural Analysis - A. K. Jain
5. Structural Analysis (SI units) - R C Hibbler
6. Structural Analysis - L S Nagi& R S Jangid

Course Outcomes

At the end of the course the students shall be able

CO1: To identify the suitable method of analysis for the analysis of indeterminate beams and trusses and analyse the same using consistent deformation method and energy method

CO2: To analyse the indeterminate beams and rigid joint plane frames by slope deflection method and moment distribution method

CO3: To analyse the indeterminate beams and rigid joint plane frames by moment distribution method

CO4: To apply and analyse the indeterminate beams using matrix methods

CO5: To construct the influence lines for stress resultants in indeterminate beams and two-hinged arches and analyse the same for moving loads

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SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205TPC11	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Transportation Engineering	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this Course is

1. To understand the importance of transportation and characteristics of highway transport
2. To study the geometric design of highway.
3. To understand the traffic characteristics
4. To know the pavement materials and pavement design
5. To explaindifferent parts of railway track, their functions geometric design of railway.

Course Content:

UNIT-1: Introduction: Importance of transportation, Modes of transportation, characteristics of highway transport.

Highway development & planning: Road development and planning in India, Roads classification, patterns, Planning surveys, Highway alignment and surveys, Highway drainage.

UNIT- 2: Geometric Design: Cross Section elements, Sight Distance, Design of horizontal and vertical Alignment.

UNIT -3: Traffic Engineering: Traffic characteristics, studies such as volume, density, Speed, 'O' and 'D' and their uses, Traffic control devices and road accidents.

UNIT-4: Pavement Materials: Behaviour of highway materials, properties of Subgrade materials and pavement component materials. Tests on subgrade soil, aggregate and bitumen.

Pavement Design: Design of flexible pavements and rigid pavements

UNIT- 5: Railway Engineering: Components of Railway Engineering: Permanent way components, Railway Track Gauge, Cross Section of Permanent Way, Functions of various Components like Rails, Sleepers and Ballast, Rail Fastenings. Geometric Design of Railway Track: Alignment, Engineering Surveys, Gradients, Grade Compensation, Cant and Negative Super elevation, Cant Deficiency, Compensation On Curves

Text Books:

1. Principle and Practices of Highway Engineering – Kadiyali& Lab (Khanna Publishers, Delhi)
2. Highway Engineering – S. K. Khanna& C.E.G. Justo (Khanna Publishers, Delhi)
3. Highway Engineering – Rangawala S.C. (Charotar Publishers)
4. A textbook of Transportation Engineering – S.P. Chandola (S. Chand)
5. Transportation Engineering – A.K. Upadhyay (S.K. Kataria& Sons)

Reference Book:

MoRTH (2013). "Specifications for Road and Bridge Works". Indian Roads Congress, New Delhi.

Course Outcomes

At the end of the course the studentsshall be able

CO1: To propose modes of transportation, transportation planning and survey.
CO2: To design cross section elements, sight distance, horizontal and vertical alignment.
CO3: To implement traffic studies, traffic regulations and carryout control and intersection designs.
CO4: To determine the properties of pavement materials and design flexible and rigid pavements as per IRC specification
CO5: To describe the components of Railway track, different Gauges and carryout geometric design.

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SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205TPC12	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Soil Mechanics - I	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this Course is:

1. To impart knowledge to classify the soil based on index properties and to assess their engineering properties based on the classification.
2. To familiarize the students about the fundamental concepts of compaction & flow through soils.
3. To impart knowledge to stress transformation and its distribution.
4. To develop the basic concept of shear strength of soils and its engineering aspects.
5. To learn about the significance of settlement of soils and calculations.

Course Content:

Unit 1: Introduction to Soil Mechanics and Geotechnical Engineering, Complexity of Soil Nature, Soil Formation and Soil Types. Index Properties of Soil: Basic Definitions, Phase Relationships, Classification of Soils-The Unified Soil Classification System and Indian Standard Soil Classification System, Soil Structure and Clay Minerals.

Unit 2: Soil Compaction: Definition and Compaction Theory, Laboratory Compaction Tests-Standard Proctor Compaction Test & Modified Compaction Test, Factors Affecting Compaction, Effect of Compaction on Engineering Properties of Soil , Field Compaction and Controls.Principle of Effective Stress, Capillarity and Permeability.Principle of Effective Stress, Capillarity in Soils, Effective Stress under Different Field Conditions, Seepage Pressure, Quick Sand Condition, Permeability, Darcy's Law, Determination of Permeability, Permeability of Stratified Soils, Absolute Co-efficient of Permeability, Factors Affecting Permeability , Seepage through Soils-Laplace's Equation, Flow Nets.

Unit 3: Vertical Stresses below Applied Loads: Stresses due to Applied Loads, Boussinessq and Westergaard Theories for Vertical Stresses under Concentrated Loads, Uniformly Loaded Circular and Rectangular Areas, Pressure Bulb, Variation of Vertical Stress under Point Load along the Vertical and Horizontal Planes, Newmark's influence chart.

Stability of Soil Slopes: Introduction, Types of Slope Failures, Slip Circle Method, Determination of Centre of Most Critical Slip Circle, Taylor's Stability Charts, Stabilization of Soil Slopes.

Unit 4: Shear Strength:Introduction, Stress at a Point and Mohr's Stress Circle, Normal and Shear Stresses on a Plane, Mohr-Coulomb Failure Criterion, Laboratory Tests for Shear Strength Determination, Shear Strength Parameters, Direct shear test, Triaxial shear test, Unconfined Compression Test and Vane Shear test, Shear Strength Characteristics of Normally Consolidated and Reconsolidated Clays, Factors Affecting Shear Strength.

Unit 5: Compressibility: Introduction to Compressibility, Consolidation, Effects of Soil Type, Stress History and Effective Stress on Compressibility , Factors Affecting Consolidation and Compressibility Parameters, Normally Consolidated and Over Consolidated Soils, Types of Consolidation, Terzaghi's Theory of 1-D Consolidation and Time Rate of Consolidation.

Text Books:

1. Basic and Applied Soil Mechanics by GopalRanjan and A.S.R. Rao, New Age Int.(P) Ltd., Pub., New Delhi.
2. Soil Mech. and Foundation Engg.Geotech. Engg. Series (PB 2018) by V. N. S. Murthy, CBS Pub., New Delhi.
3. Soil Mech. and Foundations by Dr.BC.Punmia, Ashok Kr. Jain &Arun Kr. Jain, Laxmi Pub. (P) Ltd, New Delhi.
4. Soil Mechanics by Robert V. Whitman & T. William Lambe, Wiley India Pvt Ltd. New Delhi.
5. Soil Mechanics and Foundation Engineering by Purushotama Raj, Pearson Publications, New Delhi.
6. Soil Mechanics and Foundation Engineering (Geotechnical Engineering) by Dr. P. N. Modi, Standard Book House (Rajsons Publications Pvt Ltd) New Delhi-110002.
7. Essentials of Soil Mechanics and Foundations by McCarthy, D.F. Prentice-Hall, 2006.
8. Geotechnical Engineering – Principles and Practices by Coduto, D.P. PHI.Pvt.Ltd. New Delhi, 2010.

Course Outcomes

On completion of the course, the student is expected to be able

CO1: To identify various types of soils and its properties, formulate and solve engg. problems
CO2: To determine compaction as well as flow through soil medium and its impact in Engineering application.
CO3: To solve engineering problems by drawing stress diagramwith the understanding of stress distribution in loaded soil medium.
CO4: To calculate the shear strength of soils and use it forthe design of foundations.
CO5: To evaluate settlement due to consolidation of soil.

DEPARTMENT OF CIVIL ENGINEERING B.TECH. THIRD YEAR SYLLABUS W.E.F 2022-23

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205TPC14	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Estimation and Costing	3	0	0	15	15	30			

Course Objective
To introduce students to the

- Classify Basic concepts, techniques and applications of Estimation and costing.
- Understand how to prepare a detailed estimate for a residential building and calculate the Quantities for various items of work like roads canals etc.
- Analyse the rates for various items of work and to prepare an abstract estimate
- Identify the preparation of bar bending schedule for reinforcement works and create various Tender documents for bidding purpose.
- Understand valuation and standard specification in construction.

Course Content:
UNIT – 1:
General items of work in buildings–Standard units – Principles of working out quantities for detailed and abstract estimates – Approximate method of estimating. Detailed estimates of buildings.
UNIT – 2:
Earthwork for Roads and Canals
UNIT – 3:
Rate Analysis - working out data for various items of work over head and contingent changes.
UNIT – 4:
Reinforcement bar Bending and bar requirement schedule; Contracts – Types of Contracts – Contract Documents – Conditions of Contract
UNIT – 5:
Valuation of Buildings, Standard specifications for different items of building construction
TEXTBOOKS:
1. Estimating and Costing by B. N. Dutta, UBS publishers, (2000).
2. Estimating and Costing by G. S. Birdie.
REFERENCE BOOKS:
1. Standard schedule of rates and standard data book by public works department.
2. I.S. 1200 (Parts I to XXV – 1974/method of measurement of building and Civil Engineering works – B.I.S)
3. Estimation, costing and specifications by M. Chakraborthi; laxmi publications.
4. National building code

Course Outcomes:
After completing this course the student must demonstrate the knowledge and ability to:

CO1: Understand the preparation of an Abstract Estimate for a Residential Building and demonstrate knowledge of professional and ethical responsibilities and the impact of engineering solutions on the society and also be aware of contemporary issues.
CO2: Demonstrate the calculation of earth work quantity for roads and canals and evaluate the rates for various items of work.
CO3: Analyse the units for various quantities of items of work.
CO4: Design and Prepare Bar bending schedule for reinforcement works and understand how to prepare a Notice inviting tender document for bidding.
CO5: Evaluate the valuation of building and preparation of standard specifications for different items of building construction and create new technologies to develop concrete estimating methods for more ethical and enhanced usage.

DEPARTMENT OF CIVIL ENGINEERING B.TECH. THIRD YEAR SYLLABUS W.E.F 2022-23

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205PPC04	L	T	P	CT-I	CT-II	TOTAL	20	50	1
Subject:	Transportation Engineering Lab	0	0	2	-	-	30			

Course Learning Objectives:

The objective of this course is

- To study the physical properties of road aggregate & their laboratory test.
- Determine the properties of bitumen.
- Determine the CBR value for subgrade soil.

Course Content:

Minimum 10 experiments to be performed

1. To determine the crushing value of the given aggregate sample.
2. To determine 10% finer value of the given aggregate sample.
3. To determine the abrasion value of the given aggregate sample by los angles apparatus.
4. To determine the impact value of the given aggregate sample.
5. To determine the elongation index of the given aggregate sample.
6. To determine the flakiness index of the given aggregate sample.
7. To determine the water absorption of the given coarse aggregate.
8. To determine the specific gravity of the given coarse aggregate.
9. To determine the penetration value of the given bitumen material.
10. To determine the softening point of the given bitumen material.
11. To determine the ductility of the given bitumen material.
12. To determine the viscosity of the given bitumen material
13. CBR Test

Course Outcomes

At the end of the course the studentsshall be able

CO1: To recognise the knowledge about different physical properties of aggregates by performing different test on road aggregates.
CO2: To determine the various properties of bitumen by performingvarious tests on it.
CO3: To compute the strength of subgrade soil by CBR test.

SYLLABUS	(SEMESTER-V)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE205PPC05	L	T	P	CT-I	CT-II	TOTAL	20	50	1
Subject:	Soil Mechanics Lab	0	0	2	-	-	30			

Course Learning Objectives:

The objective of this Course is:

- To learn the basic tests for classification of different soils.
- To conduct compaction tests for laboratory and in –situ.
- To learn the sampling of soil.

Course Content:

Minimum 10 experiments to be performed

Determination of Index Properties

1. To determine the specific gravity of soil sample by , a) Pycnometer Bottle Method., b) Density Bottle Method.
2. To determine the particle size distribution of a soil by a) by Mechanical Analysis/IS Sieve Method., b) by Hydrometer apparatus.
3. Liquid limit and Plastic limit Tests.
4. Shrinkage limit and Differential free swell test.

Determination of In -Situ Density and Compaction Characteristics

5. To determine the minimum moisture content (OMC) at maximum dry density (MDD) of soil by, a) Light weight Proctor Test, b) Heavy Weight Proctor Test.
6. To determine in situ dry density of soil by a) Core cutter method. b) Sand replacement method.

Determination of Engineering Properties- Part A

7. To determine the permeability of soil by a) Falling Head Methods, b) Constant Head Methods.
8. To determine the shear strength parameters a) Direct shear test in cohesionless soil., b) Unconfined compression test in cohesive soil

Determination of Engineering Properties- Part B

9. To determine the shear strength parameters for a) Tri-axial compression test in c-φ Soil (Demonstration only). b) One dimensional consolidation test (Determination of co-efficient of consolidation only), c) Laboratory vane shear test in cohesive soil.
10. California Bearing Ratio Test.

TextBooks:

1. Soil Engineering Laboratory Instruction Manual" published by Engineering College Co- operative Society, Anna University, Chennai, 2010.
2. "Saibaba Reddy, E. Ramasastri, K. "Measurement of Engineering Properties of Soils", New age International (P) limited publishers, New Delhi, 2008.
3. Lambe T.W., "Soil Testing for Engineers", John Wiley and Sons, New York, 1951. Digitized 2008.
4. IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi.
5. G.Venkatappa Rao and Gotham .K. Potable, "Geosynthetics Testing – A laboratory Manual", Sai Master Geoenvironmental Services Pvt. Ltd., 1st Edition 2008.
6. BrajaM.Das., "Soil Mechanics: Laboratory Manual", Oxford University Press, eighth edition, 2012

REFERENCES:

1. Basic and Applied Soil Mechanics by GopalRanjan and A.S.R. Rao, New Age International (P) Limited, Publishers, New Delhi-110002.
2. Soil Mechanics and Foundations by Dr. B. C. Punmia, Ashok Kr. Jain &Arun Kr. Jain, Laxmi Publications (P) Ltd, New Delhi-110002

Course Outcomes

On completion of the course, the student is expected to be able to:

CO1: Conduct tests to determine the index properties of soils
CO2: Determine the density and compaction characteristics in laboratory as well as in situ.
CO3: Conduct tests to find permeability and shear strength of soils (c & φ)
CO4: Understand various tests to find c & φ parameters, compressibility and CBR value.

(SEMESTER VI)

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TPC15	L	T	P	CT-I	CT-II	TOTAL	70	100	04
Subject:	Design of Steel Structures	3	1	0	15	15	30			

Course Learning Objectives:

The objective of this course is

1. To list mechanical properties of structural steel and outline general aspect of design philosophies.
2. To design and classify the use of steel fastener.
3. To determine tensile and compressive strength of structural steel member.
4. To understand design examples of Beam, Beam Column, Column Splices and Column Base
5. To introduce the design of eccentric connections, plate girders.

Course Content:

UNIT 1: Introduction: General, types of Steel, mechanical behaviour of steel, measures of Yielding, measures of Ductility, types of Structural system, Structural Steel Sections.Methods of Structural design: Introduction- Design Philosophies-Working Stress method-Ultimate Strength method-Load and Resistant factor- Limit State Method-Partial safety factor Load combinations-Classification of Cross sections- General aspects in the design.

UNIT 2: Design of Steel fasteners: Types of fasteners – Riveted connections- Bolted connections- Assumptions-Failure of bolted joints – Strength of bolted joints – Design examples – Design of Welded connections – Butt weld-fillet weld – Design examples.

UNIT 3: Design of Tension Members: General – Modes of Failure of Tension member- Analysis of Tension members- Example - Design steps – Design examples – Lug angles – Design.Design of Compression Members: General – Strength of Compression members- Design Compressive strength- Example on analysis of Compression members – Design of Angle struts – Design Examples- Built up Columns- Design of Lacing – Design of Battens-Design Examples- Design of Roof members.

UNIT 4: Design of Beams: General- Lateral Stability of Beams- Bending Strength of Beams – Plastic Section Modulus - Design Examples.Design of Beam Columns: Behaviour of members under combined loading – Modes of Failures – Design Examples.Design of Column Splices and Column Base: Design of Column Splice-Design Examples- Design of Column Base- Slab Base- Gusseted Base- Design Examples.

UNIT 5: Design of Eccentric Connections: Design of Brackets- Type-1 and Type 2 – Moment Resistant connections - Design Examples.Design of Plate Girder: General- Components of Plate Girder- Optimum depth – Bending Strength – Shear Strength – Shear Buckling- Simple Post critical method- Tension Field method- Stiffeners-Bearing-Transverse stiffeners - Design Examples.

Text Books:

1. Limit state Design of Steel Structures – S K Duggal.
2. Design of Steel structures: By Limit State Method– S. S. Bhavikatti.
3. Design of Steel Structures- K. S. Sai Ram
4. Design of Steel Structures-Limit States Method-N. Subramanian
5. Comprehensive Design of Steel Structures – Dr B.C.Punmia, Ashok Kr.Jain, Arun Kr. Jain
6. Design of Steel Structures- S. Ramamrutham
7. Fundamentals of Structural Steel Design – M. L. Gambhir
8. Limit state Design of Steel Structures – S Kanthimathinathan
9. Design of Steel Structure Volume-I- Ramchandra
10. Design of Steel Structure Volume-II- Ramchandra
11. Design and Analysis of Connections in Steel Structures-Fundamentals and examples-Alfredo Bcracchini
12. IS-800:2007- Indian Standard- General Construction in Steel-Code of Pr., & Steel Tables

Course Outcomes

At the end of the course the studentsshall be able

CO1: Define mechanical properties of structural steel and Implement the limit state design philosophy.
CO2: Design/Evaluate the riveted, bolted and welded connection in steel structure.
CO3: Design/Evaluate tension and compression members
CO4: Design/Evaluatebeam and column element.
CO5: Design/Evaluatean eccentric connection and a plate girder.

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TPC16	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Environmental Engineering - II	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this Course is

1. To help students develop the ability to apply basic understanding of physical, chemical, and biological phenomena in the sewage
2. To understand the concept successful design, operation and maintenance of sewage treatment plant
3. To study about the Aerobic Treatment units.
4. To learn about the Anaerobic Treatment units.
5. To study the various process performed with Municipal Solid Wastes.

Course Content:

UNIT 1: Objective, design period, Physical, Chemical and Biological characteristics. Waste water sampling, self-purification of natural streams, effluents Standards, Oxygen Sag Curve, sources of sewage. Design of sanitary sewers, minimum size of sewer, velocities in sewers and gradient of sewers. Sewer appurtenances viz. manholes, street inlets, flushing devices, Vent pipes etc.

UNIT 2: Waste Water primary Treatment: characteristics of wastewater. Effluent discharge standards. Primary, secondary and tertiary treatment of wastewater. Types of screens, design of screen chamber, sources of grit, design of grit chamber, disposal of grit, oil and grease removing skimming tanks, design of PST with inlet and outlet details, primary sludge and its disposal.

UNIT 3: Aerobic Treatment UNITs: Biological principle of ASP, SVI, sludge bulking and control; biological principle of Trickling filter, re-circulation, operational troubles; Rotating biological contactor. Low cost treatment methods: Principle of Oxidation pond, symbiosis, principle of Aerated Lagoons, aeration method, Principle of Oxidation Ditches, sewage farming, ground water recharge.

UNIT- 4: Anaerobic Treatment UNITs: Septic tanks, biological Principle, method of treatment and disposal of tank effluent. Anaerobic digester, principle of anaerobic digestion, Stages of digestion, bio-gas production. Sludge disposal methods, advantages and disadvantages, Design of STP.

UNIT 5: Municipal Solid Wastes: Characteristics, generation, collection & transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment & disposal), environmental & health implications, disposal of solid waste by land filling, composting and incineration methods. Hazardous waste management, environmental and health implications due to Exposure, incineration, landfill disposal, site remediation, disposal of refuse by Composting.

TEXT BOOKS:

1. Environmental Engineering – Peavy& Rowe (Tata McGraw Hill, New Delhi).
2. Waste Water Engineering – S.K. Garg (Khanna Publication).
3. Manual on sewerage & sewage Treatment published by Ministry of UrbanDev. GOI,Ministry of Urban development
4. Waste Water Engineering – Metcalf Eddy (Tata McGraw Hill, New Delhi).
5. Hazardous Waste management: M.D. LaGrega, P.L. Buckingham, J.C.Evans
6. Manual on Municipal Solid Waste Management: CPHEEO (Ministry of Urban Dev.)
7. Environmental Engineering-II P.Venugopala Rao Tata McGraw Hill
8. Water andWastewater Technology ,Hammer (PHI)

Course Outcomes:

At the end of the course the studentshall be able

CO1: To understand the basic phenomenon of Sewage and sewerage.
CO2: To estimate waste water quantity and can design the sewerage system.
CO3: To understand basic methodology for wastewater treatment (screening, grit chambers, sedimentation, biological treatment and chemical treatment) and to understand various processes of Aerobic & Anaerobic treatment units.
CO4: To design unit operations specific to wastewater treatment and to control & monitor wastewater treatment facilities.
CO5: To understand solid & hazardous wastes management, waste processing options and design

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TPC17	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Water Resources Engineering -I	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this Course is

1. To understand the need of Irrigation, types of irrigation systems and Methods of Irrigation.
2. To understand the Canal Irrigation systems and design of stable channels in alluvium.
3. To understand Water Logging and its Control.
4. To know the Riverbehaviour, control and training.
5. To know the Reservoir Planning, Hydrograph and Flood Routing and it principle.

Course Content:

UNIT 1: Introduction: Need for Irrigation, advantages and disadvantages of irrigation, types of irrigation systems – Flow irrigation, lift irrigation. Methods of Irrigation: Introduction, requirement of irrigation methods, surface and sub-surface irrigation. Water Requirement of crops: Introduction, water requirement of crop, crop season and crops of India, crop period and base period, delta, duty of water, relationship between delta, duty and base period, factors affecting duty.

UNIT 2: Canal Irrigation: Classification of canal, parts of canal irrigation system, canal alignment, typical canal cross section, command areas, losses in irrigation systems. Design of stable channels in alluvium: Introduction, Kennedy's silt theory, Lacey's Theory, Lacey's regime equation, Lacey's shock theory. Design of channels by Kennedy's and Lacey's theories, maintenance of irrigation channels.

UNIT 3: Water Logging and its Control: Causes and ill effects of water logging, prevention and control, reclamation of water logged lands, surface drainage. Design of Lined Channels: Introduction, benefits of lining, types of lining, economics of lining, procedure and design of lined canals.

UNIT 4: River behaviour, control and training: Objects, river characteristics, classification of river training works, methods of river training embankments, bank protection, cut-offs, meandering causes and parameters. Flood Control: Introduction, channel improvement, flood ways evacuation and flood plain zoning.

UNIT 5: Reservoir Planning: Introduction, type of reservoirs, investigation for reservoir planning, site selection, zonesin for reservoir, basic terms and definitions of reservoir, storage zones of a reservoir, mass curve and demand curve, determination of reservoir capacity, reservoir losses, reservoir sedimentation, factors affecting sedimentation, type of sediment load, life of reservoir, safe field. Applications of GIS in Reservoir Planning.

TEXT BOOKS:

1. Irrigation Engineering and Hydraulic Structures – S.K. Garg (Khanna Publications)
2. Irrigation Engineering – B.C. Punmia (Laxmi Publications)
3. Irrigation, Water Resources and Water Power Engineering – Dr. P.N. Modi (Standard Book House)
4. Theory and Design of Irrigation Structures (Volume – I & II) – Varshney (Nem Chand & Bros.)
5. Irrigation and Water resources Engineering – Asawa G.L. (New Age International Publications)
6. Fundamentals of Irrigation Engineering – Bharat Singh (Nem Chand & Bros)
7. Water Resources Engineering Larry -W. Mays (Wiley, John & Sons)

Course Outcomes:

At the end of the course the studentshall be able

CO1: To describe about the types of Irrigation systems, and methods of irrigation.
CO2: To design irrigation canals and canal network
CO3: To propose solutions regarding water logging and drainage.
CO4: To plan and design river training works and flood control of river.
CO5: To evaluate the capacity of reservoir and use Flood Routing principle for Reservoir Planning.

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TPC18	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Soil Mechanics - II	3	0	0	15	15	30			

Course Learning Objectives:

1. To impart knowledge of site investigation programme and to design samplers to obtain different soil samples.
2. To learn the basic concept of earth pressure & different theories of calculation of earth pressure.
3. To familiarize the students for the geotechnical design of different type of foundations and calculate the bearing capacity of soils.
4. To impart knowledge about deep foundations and it group efficiency of pile foundations.
5. To impart basic knowledge of well foundations.

Course Content:

Unit 1: Soil Exploration: Introduction, Different Phases of Soil Explorations, Methods of Subsurface Exploration- Trial Pits, Boring Methods, Sounding Test and Geophysical Explorations, Samples and Samplers, Soil Exploration Reports and Bore Log.

Unit 2: Earth Pressures: Introduction, Effect of Wall Movement on Earth Pressure, Earth Pressure at Rest, Rankine's Earth Pressure Theory and its Limitations, Coulomb's Theory of Earth Pressure, Culmann's Graphical Method, Additional Earth Pressure due to Surcharge.

Unit 3: Shallow foundations: Types of shallow foundations and choice, basic requirements, significance of these foundations. Bearing capacity of foundation: Introduction, Bearing Capacity and its Different Forms, Modes of Shear Failure, Evaluation of Bearing Capacity- Prandtl's Method, Terzaghi's Bearing Capacity, Skempton's Method, Meyerhof's Method ,Hansen's and Vesic's Assumptions and IS Code Recommendations, Estimation of Bearing Capacity Based on Field Methods-Standard Penetration Test, Static Penetrations Test and Plate Load Test, Settlement of Shallow Foundations.

Unit 4: Pile Foundation: Introduction, Classifications of Piles, Cast in Situ Pile Construction, Selection of Pile Type, and Pile Load Capacity in Compression- Static Pile Load Formulae, Pile Load Test, Dynamic Pile Formulae, Group Action of Piles, Negative Skin Friction, Group Efficiency of Piles and Settlements.

Unit 5:Well Foundation: Introduction, Types of Well or Caissons, Components of Well Foundation, Shapes of Wells, Depth of Well Foundation, Forces Acting on Well Foundation, Construction and Sinking of a Well.

Text Books:

1. Basic and Applied Soil Mechanics by GopalRanjan and A.S.R. Rao, New Age International (P) Limited, Publishers, New Delhi-110002.
2. Textbook of Soil Mechanics and Foundation Engineering Geotechnical Engineering Series (PB 2018) by V. N. S. Murthy , CBS Publication, New Delhi.
3. Soil Mechanics and Foundations by Dr. B. C. Punmia, Ashok Kr. Jain &Arun Kr. Jain, Laxmi Publications (P) Ltd, New Delhi-110002.
4. Foundation Engineering by B. C. Chattopadhay&JoyanataMaity,PHI Learning Private Limited, Delhi-110092.
5. Soil Mechanics by Robert V. Whitman & T. William Lambe, Wiley India Pvt Ltd. New Delhi.
6. Soil Mechanics And Foundation Engineering byP.Purushotama Raj, Pearson Publications, New Delhi.
7. Geotechnical Engineering by B. M. Das, Bharat Singh, SamsherAlam.
8. Soil Mechanics and Foundation Engineering (Geotechnical Engineering) by Dr. P. N. Modi, Standard Book House (Rajsons Publications Pvt Ltd) New Delhi-110002 .

Course Outcomes:

On completion of the course, the student is expected to be able

CO1: To demonstrate an ability to plan of site investigation to select geotechnical design parameters and type of foundation.
CO2: To demonstrate an ability to calculate earth pressure on retaining walls.
CO3: To demonstrate an ability to design shallow foundations (combined footings and raft footings), its component or process as per the needs and specifications.
CO4: To demonstrate an ability to find group efficiency of pile foundations.
CO5: To evaluate well foundations and its sinking problems.

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SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TPE01A	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Structural Analysis by Matrix Methods	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this course is

1. To understand the flexibility and stiffness matrices and their relationship between them
2. To understand the analysis of continuous beams by force (flexibility) and displacement (stiffness) methods
3. To understand the analysis of rigid and pin jointed plane frames by force and displacement methods
4. To differentiate the force and displacement methods

Course Content:

UNIT-1: Staticindeterminacy, kinematic indeterminacy;Matrix concepts and Matrix analysis of structures: Flexibility and Stiffness; Flexibility Matrix; Stiffness matrix; Relationship between Flexibility matrix and Stiffness matrix; Force displacement methods;Indeterminate Beams: Introduction; Analysis of indeterminate beams by flexibility and stiffness methods; Comparison of flexibility and stiffness methods;

UNIT-2: Rigid Joint Plane Frames: Introduction; Static indeterminacy; Analysis of rigid joint plane frames by flexibility method.

Unit-3: Rigid Joint Plane Frames: Introduction; Kinematic indeterminacy; Analysis of rigid joint plane frames by Stiffness matrix method.

UNIT-4: Pin-jointed Plane Frames (Trusses): Introduction; Static indeterminacy of pin joint truss; Analysis of pin joint plane frames (trusses) by flexibility method.

Unit-5: Introduction; Kinematic indeterminacy of a Pin-jointed plane frame; Analysis of pin joint plane frames (trusses) by stiffness method.

Text Books:

1. DevdasMenon, "Advanced Structural Analysis", Narosa Publishing House, 2009
2. AslamKassimali, "Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.
3. Weaver W. and Gere J. M., "Matrix Analysis of Framed Structure", CBS Publishers, Delhi.
4. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.
5. DevdasMenon, "Structural Analysis", Narosa Publishing House, 2008.
6. McGuire, W., Gallagher R. H. &Ziemian, R. D. "Matrix structure analysis", John Willey Publication
7. G S Pandit& S P gupta, "Structural Analysis-A Matrix Approach"

Course Outcomes:

At the end of the course the studentshall be able

CO1: To develop stiffness and flexibility matrix for prismatic members and analyses the indeterminate beams using the flexibility and the stiffness methods.
CO2: To apply and analyses the rigid joint plane frames by using the flexibility matrix method
CO3: To analyse the rigid joint plane frames using the stiffness matrix method
CO4: To compute the member forces in a plane truss using the flexibility matrix method.
CO5: To do the analysis of trusses by applying the stiffness matrix method

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TPE01C	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Advanced Concrete Design	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this course is

1. To understand the design procedures for combined footings.
2. To study the design of retaining walls
3. To know the design of different types of water tanks
4. To learn the design of flat slabs
5. To know the design of RCC chimneys

Course Content:

UNIT 1: Combined Footings: Simple Rectangular, trapezoidal footings (with and without central beam); Strap footing; raft foundation.

UNIT 2: Types of retaining walls: Cantilever Retaining wall design; Counterfort retaining wall (demonstration only)

UNIT 3: Water tanks resting on ground; Intze type water tank design.

UNIT 4: Large span concrete roofs: Introduction– classification- behaviour of flat slabs - direct design and equivalent frame method- Codal provisions - waffle slabs.

UNIT-5: Chimneys, analysis of stresses in concrete chimneys- uncracked and cracked sections- Codal provisions- design of chimney.

Text Books:

1. Purushothaman, P., Reinforced Concrete Structural Elements-, Tata McGraw Hill, 1986
2. Ashok K Jain, Reinforced Concrete –Nem Chand Bros. Roorkee , 1998
3. Jain and Jaikrishna, Plain and Reinforced Concrete – Vol I and II Nem Chand Bros., Roorkee, 2000.
4. Taylor C Pere, Reinforced Concrete Chimneys, Concrete publications, 1960
5. Design of deep girders, Concrete Association of India, 1960
6. Advanced Reinforced Concrete Design by N Krishna Raju
7. Mallick and Gupta, Reinforced Concrete, - Oxford and IBH, 1982
8. BIS codes (IS 456 , IS 2210, IS 4998, IS 3370, SP 16, SP 24, SP 34).
9. IRC Codes (IRC 5, IRC 6, IRC 21)
10. Reinforced Concrete Design by DevdasMenon and S U Pillai,

Course Outcomes:

At the end of the course the studentshall be able

CO1: To design different types of combined footings
CO2: To design cantilever retaining wall
CO3: To design Water tanks resting on ground and Intze tank with staging and foundation
CO4: To design flat slabs
CO5: To design RCC chimneys

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TPE01B	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Advanced Surveying	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this Course is

1. To understand about concepts of Astronomical Surveying.
2. To know the applications of cadastral surveying in different projects.
3. To be capable to compute the accuracy of observations made.
4. To learn the theory of triangulations surveying.
5. To learn about various advanced equipment of surveying

Course Content:

UNIT 1: Triangulation and Baseline Measurements: Triangulation figures or systems, station marks, signals, towers, baseline measurement by rigid bars, flexible apparatus, problems, satellite station and reduction to centre.

UNIT 2: Theory of Errors: Types and sources of errors, theory of least squares, method of weights, method of correlates, angle and station adjustment, figure adjustment. Land Surveys: Layouts, measurements.

UNIT 3: Aerial photogrammetry : Introduction, Principle, Uses, Aerial camera, Aerial 6 10 photographs, Definitions, Scale of vertical and tilted photograph, Ground Co-ordinates, Displacements and errors, Ground control, Procedure of aerial survey, Photomaps and mosaics, Stereoscopes, Parallax bar.

UNIT 4: Field Astronomy: Introduction, purposes, astronomical terms, determination of azimuth, latitude, longitude and time corrections to the observations.

UNIT 5: Remote Sensing Introduction, Principles of energy interaction in atmosphere and earth surface features, Image interpretation techniques, visual interpretation, Digital image processing, Global Positioning system.

Geographical Information System Definition of GIS, Key Components of GIS, Functions of GIS, Spatial data, spatial information system Geospatial analysis, Integration of Remote sensing and GIS and Applications in Civil Engineering.

Text Books:

1. Borden D. Dent, Jeffrey Trogusson, Thomas W. Hodler, Cartography: Thematic Map Design, McGraw-Hill Higher Education, 2008.
2. Gopi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education India, 2007.
3. Hoffmann.B, H.Lichtenegga and J.Collins, Global Positioning System - Theory and Practice, Springer -Verlag Publishers, 2001.
4. Punmia B. C, Ashok K. Jain, Arun K. Jain, Higher Surveying, Laxmi Publications, 2005.
5. Surveying Vol. I, II and III by Dr. B.C. Punamia, Laxmi Publishers. New Delhi
6. Surveying and Levelling Vol. I and II by T.P Kanetkar and S.V Kulkarni, Pune VidhyarthiGruh
7. Surveying Vol. I, II and III by Dr. K.R. Arora, Standard Book House. New Delhi
8. Surveying Vol. I and II by S. K. Duggal, Tata Mcgraw Hill, New Delhi
9. Surveying and Levelling by N.N. Basak, Tata Mcgraw Hill, New Delhi
10. Surveying and Levelling by R. Agor, Khanna Publishers, New Delhi
11. Advanced Surveying by R. Agor, Khanna Publishers, New Delhi
12. Fundamentals of Surveying by Roy, S.K., Prentice Hall India, New Delhi
13. Surveying and Leveling by Subramanian, R., Oxford University Press, New Delhi
14. Remote Sensing and GIS by B Bhatia, Oxford University Press, New Delhi.
15. Remote sensing and Image interpretation by T.M Lillesand,. R.W Kiefer,. and J.W Chipman, 5th edition, John Wiley and Sons India
16. Surveying theory and practice 7th Edition by James M Anderson and Edward M Mikhail Tata McGraw Hill Publication.

Course Outcomes

At the end of the course the students shall be able

CO1: To implement the concept of triangulation surveying used in geodetic surveying.
CO2: To adopt the concept of Field Astrononykeeping in view its importance.
CO3: To use Remote sensing & GIS in advance methods of surveying.
CO4: To apply the corrections in observations knowing the theory of errors.
CO5: To analyse aerial photographs for the calculation of various surveying parameters.

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TPE01E	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Basics of Computational Hydraulics	3	0	0	15	15	30			

Course Learning Objectives:

The objective of this Course is to

1. Provide knowledge on application of computational fluid mechanics to different Civil of engineering problems.
2. Provide knowledge on conservation law and the numerical approach to solve by converting different form of partial differential equations.
3. Provide some experience in the software engineering skills associated with the implementation of MATLAB computer programming and use of Computational Fluid Dynamics (CFD)software.
4. To study the analysis of Open Channel Flow
5. To learn about water surface profiles.

Course Content:

Unit1: Introduction, significance of computational hydraulics, discrete forms of the laws of conservation of mass, momentum and energy,examples of free surface flows.

Unit2: Continuous forms of the conservation laws, lateral inflow's 1-D expansions and contractions, homogeneous and stratified fluid flows.

Unit3: Introduction to computer programming and computation with MATLAB and using of Computational Fluid Dynamics (CFD)software.

Unit4: Pipe flow analysis, Open channel flow: Types of Open Channel Flow, Estimation of normal and critical depth, uniform flow computations

Unit5: Computation of water surface profile (WSP) gradually varied flow estimation using direct step methods.

Text Books:

1. SreenivasJayanti,Computational Fluid Dynamics for Engineers and Scientists, Springer, 2018.
2. J.D. Hoffman, Numerical Methods for Engineers and Scientists, CRC Press, Special Indian Edition, 2011.
3. K. A Hoffmann, Computational Fluid Dynamics, Engineering Education System, 2000.
4. M.H. Choudhary, Applied Hydraulic Transients, Van Nostrand Reinhold, New York, 1997.
5. M.B. Abbot & A.W. Minns, Computational Hydraulics, Ashgate Publication, 1994.
6. J.D. Anderson, Computational Fluid Dynamics, McGraw Hill, 1995.
7. C.B. Vreugdenhill, Computational Hydraulics: An Introduction, Springer-Verlag, Berlin, 1989.
8. M.B. Abbott & J.A. Gunga, Engineering Applications of Computational Hydraulics –Pitman Books Ltd., 1982.

Course Outcomes:

At the end of the course the students shall be able

CO1: To evaluate the governing equations based on conservation principals in fluid flow problems.
CO2: To apply finite difference method to the fluid flow problems.
CO3: To evaluate the output from numerical method as compared to the observed data
CO4: To analyse and model fluid dynamics using Matlab andCFD software.
CO5: To apply the computational methods in open channel flow.

SYLLABUS	(SEMESTER-VI)							
Subject Code:	CE206TOE01	CREDITS:3			SESSIONAL - TA			ESE
Subject:	Open Elective	L	T	P	CT-I	CT-II	TOTAL	
		3	-	-	15	15	30	70
CE06TOE01		Metro Systems and Engineering						

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206TOE01	L	T	P	CT-I	CT-II	TOTAL			
Subject:	Metro Systems and Engineering	3	0	0	15	15	30	70	100	03

Course Learning Objectives:

1. To introduce concepts of different types of mode of transportation and associated facilities.
2. To understand the concept of urban transport scenario, traffic characteristics and transport development.
3. To study the Intelligence Transport System
4. To understand ITS user services and its components.
5. To understand the approach and utility of Environmental Impact Assessment for the urban infrastructural measures.

Course Content:

Unit 1: Modes of Transportation:Transportation parameters- Traffic and Transport Problems of a city, Mass transport system, Modes of transportation & characteristics, Public transport system, public private transport system, Advantages and disadvantages of Public transport system. Role of transportation in mass transportation, advanced modes.

Transportation Infrastructure- Green bays, control stations, mitigation buildings, separator lanes and safety islands.

Unit 2: Urban Public Transport SystemRapid transit systems: BRTS, Bus Lane system, Advantages and limitations in Indian Scenario, Rail System. Types of rail system, advantages and disadvantages of rail system, sky walk and under bridge and its advantages. Advances in infrastructure.Urban Pedestrian Safety- Skyways, Intersection subways, halt stations, crossing measures, flexibility in accessibility.

Unit 3: ITS Background and Telametic systems:Definitions, features and objectives of ITS, History of ITS and its development over the world, telametric concept, transport telemetric, telemetric structure, ITS taxonomy, ITS application areas, uses, and application overview, ITS implication through AI, ITS based regression models.

Unit 4:ITS components, tools and strategies:Components of user services; advanced traffic management system, advanced traveller information systems, advanced vehicle control system, commercial vehicle operational management, advanced public transportation system, electronic payment system, advanced rural transportation, security and safety systems, urban traffic control, benefits and limitations, traffic calming systems, freight management by ITS.

Unit 5: Environmental ImpactAssessment: Description of proposed activity, structural audits, analysis of site selection procedure, baseline conditions / major concerns, green building and its advantages, description of potential positive and negative environmental, social, economic and cultural impacts including cumulative, regional, temporal and spatial considerations, significance of mitigation plans and monitoring plans (impacts and mitigation efforts)

Text Books:

1. Kadialy L.R., " Traffic Engg. and Transport Planning", 8th edition, Khanna Publishers, 2011.
2. O. Flaherty C.A., "Traffic Engineering and Transport Planning", 2006.
3. AUSTROADS, The Implication of Intelligent Transport Systems for Road Safety, Austroads Incorporated, 1999.
4. Bob Williams, Intelligent Transport Systems Standards, Artech House Publishers, 2008.
5. Chowdhury, M. A. and Sadek, A, Fundamentals of Intelligent Transp. Sys. Planning, Artech House, 2003.
6. E. Bekiaris and Y.J. Nakanishi, Economic Impacts of Intelligent Transportation Systems: Innovations and Case Studies, Elsevier/JAI, 2004.
7. IET Intelligent Transport Systems and 15th International IEEE Conference on Intelligent Transportation Systems (ITSC), 16-19 September, 2012. (http://digital-library.theiet.org/content/journals/iet-its)
8. J.M. Sussman, Perspectives on Intelligent Transportation Systems (ITS), Springer, 2005
9. L. Vlacic, M. Parent, F. Harashima, Intelligent Vehicle Tech. – Theory and Appl., Butterworth-Heinemann, 2010.
10. M.A. Chowdhury and A. Sadek, Fundamentals of Intelligent Transport. Systems Planning, Artech House, 2010.

11. R. Stough, Intelligent Transport Systems: Cases and Policies, Edward Elgar, 2001, Artificial Intelligence and Intelligent Transportation Systems, National Academy Press, 2010.
12. Gonzalez R. C. and Woods R. C., "Digital Image Processing", 2nd Ed., Pearson Education, 2007.
13. Jain A. K, "Fundamentals of Digital Image Processing", Prentice Hall, 2007.
14. R.R. Barthwal "Environmental Impact Assessment" New Age International, January 2012.
15. A.R. Gajbhiye& S.R. Khandeilwar N.S. Raman, "Environmental Impact Assessment", I.K. International, 2014

Course Outcomes: At the end of the course, students will be able

CO1: To implement the concept of urban transport scenario, traffic characteristics and transport development.
CO2: To adopt the concepts of different mode of transportation and associated facilitieswith advanced system.
CO3: To Identify and differentiate ITS user services and its components.
CO4: To plan and design appropriate ITS technology to solve real-life traffic problems.
CO5: To propose the mitigation plan for the EIA for the urban infrastructure.

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)	ESE	Grand Total	Credits
Subject Code:	CE206PPC06	L	T	P	IA	20	50	1
Subject:	Environmental Engineering Lab	0	0	2	30			

Course Learning Objectives:

The objective of this Course is

1. To understand about the equipment used to conduct the test procedures and Perform the experiments in the lab.
2. To determine the physical, chemical and biological characteristics of water and waste water through practical tests.
3. To determine optimum dosage of coagulant and other critical tests to find the quality of water.
4. To examine and Estimate water, waste water and create Develop a report on the quality aspect of the environment.
5. To compare the water with prescribed standards set by the local governments.

Course Content:

1. Determination of the following Parameters in the given Water Sample:
2. Turbidity by Nephelometer.
3. TDS and fixed solids by Gravimetric method.
4. pH using pH-meter.
5. Carbonate, Bi-Carbonate & Hydroxide Alkalinity.
6. Dissolved Oxygen [DO] using DO meter.
7. Concentration of Chlorides.
8. Optimum coagulant dose for coagulation by Jar test apparatus.
9. Chlorine Demand of Water.
10. Total Hardness and Calcium Hardness.
11. Study of Weather Monitoring Station.
12. Study of Sound Level Meter.

Course Outcomes:

Students will be able:

CO1: To know about the equipment used to conduct the test procedures and perform the experiments in the lab.
CO2: To determine the physical, chemical and biological characteristics of water and waste water through practical tests.
CO3: To determine optimum dosage of coagulant and other critical tests to find the quality of water.
CO4: To Examine and Estimate water, wastewater and create Develop a report on the quality aspect of the environment.
CO5: To compare the water with prescribed standards set by the local governments.

SYLLABUS	(SEMESTER-VI)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE206PPC07	L	T	P	CT-I	CT-II	TOTAL	20	50	1
Subject:	Computer Applications in Civil Engg. Lab	0	0	2	-	-	30			

Course Learning Objectives:

The objective of this Course is

1. To understand the need for software tools for analysis and design of Civil Engineering Structures.
2. To use the software tools for Modelling, Analysis and Design of Civil Engineering Structures

Course Content:

Minimum 10 problems to be solved either by using STAAD Pro/Excel Programming

USING MS EXCEL Programs

1. Analysis of simple beams
2. Design of simply supported RCC beams
3. Design of columns
4. Design of isolated footing (Flat, stepped and sloped)
5. Design of combined footings
6. Design of cantilever retaining walls
7. Design of slabs (one way and Two way)

USING STAAD Pro

8. Analysis of simple beams and Frames (2-D)
9. Analysis of multi storey frames for DL and LL
10. Analysis of multi storey frames for DL, LL, WL/EQL
11. Design of structural elements
12. Analysis and design of combined footing
13. Analysis and design of roof truss
14. Analysis of simple beams for rolling loads

Course Outcomes:

At the end of the course the studentshall be able

CO1: To analyse 2D and 3D frames using MS EXCEL
CO2: To design RCC beams, columns, footing, cantilever retaining walls and slabs using MS EXCEL
CO3: To analyse beams and frames (2-D),multi storey frames for DL, LL, WL/EQL using STAAD Pro
CO4: To design various RCC components of buildings using STAAD Pro
CO5: To analyse and design roof truss and simple beams for rolling loads using STAAD Pro

SEMESTER VII

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPC19	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Pre-stressed Concrete	3	0	0	15	15	30			

Course Learning Objectives:

- To introduce fundamental of pre stressing and develop understanding of pre stressing system.
- To determine loss of pre stress in pre tensioned and post tensioned members as per IS Code provision.
- To analyze simple and composite section in flexure.
- To evaluate deflection in beam and design simply supported beams as per IS Code provision.
- To design the members for shear reinforcement, Ultimate Shear Strength and end block design.

Course Content:

UNIT 1: Introduction: Fundamentals of Prestressing - Classification and types of Prestressing- Concrete Strength and strain characteristics - Steel mechanical properties - Auxiliary Materials like duct formers.

UNIT 2: Prestressing Systems: Principles of pretensioning and post tensioning - study of common systems of prestressing for wires strands and bars. Losses of Prestress: Losses of prestress in pre tensioned and post tensioned members - I.S. code provisions.

UNIT 3: Analysis of Sections: In flexure, simple sections in flexure, kern distance - cable profile - limiting zones - composite sections cracking moment of rectangular sections.

UNIT 4: Deflection of Beams: Long term and Short term deflectionand Design of Simply Supported Beams, Allowable stress as per I.S. 1343 - elastic design of rectangular and I-sections.

UNIT 5: Shear and Bond: Shear and bond in prestressed concrete beams - conventional design of shear reinforcement - Ultimate shear strength of a section - Prestress transfer in pretensioned beams-Principles of end block design.

Text Books:

1. Krishna Raju. N "Prestressed Concrete", Tata Mc Graw Hill.
2. Lin.T.Y, "Prestressed concrete", Mc Graw Hill Pub. Co.
3. Rajagopalan, "Prestressed concrete", Narosa Publishing House.

Course Outcomes:-

On completion of this course the student will be able

CO1: Describe mechanical properties of pre stressed concrete, types of pre stressing and its system.

CO2: Calculate losses in pre-tensioned and post tensioned members.

CO3: Analyze pre-stressed concrete members for flexure, shear and cracking moment.

CO4: Design pre stressed concrete beams of rectangular and I section and compute deflection.

CO5: Explain principle of end block design, pre stress transfer, shear and bond.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPC20	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Water Resources Engineering-II	3	0	0	15	15	30			

Course Learning Objectives:

- Introduce the types of dams and its failure criteria for structural stability
- Introduce the concepts of spillways and energy dissipaters
- Discuss the concept of diversion Head-works and understand design theory of seepage flow
- Introduce the concepts of regulation works, falls and hydraulic gates of spillways
- Know the concepts and design principles of Cross Drainage Works

Course Content:

UNIT 1: Dams: Types of Dams, Forces, failure of dams and criteria for structural stability, principle and shear stress, stability analysis, Elementary profile of a gravity dam, Profile from practical considerations, Openings in dams.

UNIT 2: Spillways and Energy Dissipaters: Introduction, essential requirements of a spillway, spillway capacity, components, Types of spillways, Ogee Spillway, Energy Dissipation below spillways, Types of Energy dissipator, USBR and Indian stilling basins.

UNIT 3: Diversion Head-works: Introduction, Types of diversion works, location and components, Weir and Barrage, Effect of construction of weir on the river regime, Bligh's creep theory, Theory of seepage flow, Khosla's theory, Vertical drop Weir.

UNIT 4: Regulation Works: Introduction, Definition of falls, necessity and location of falls, comparative study of the main types of falls. Hydraulic Gates: Spillway gates, types, tainter gates, Roller gates.

UNIT 5: Cross Drainage Works: Introduction, suitability, various types of C-D Works, Design principles of C-D Works

Text Books:

1. Irrigation Engineering and Hydraulic Structures – S.K. Garg (Khanna Publications)
2. Irrigation Engineering – B.C. Punmia (Laxmi Publications)
3. Irrigation, Water Resources and Water Power Engineering – Dr. P.N. Modi (Standard Book House)

Course Outcome

On completion of this course the student will be able:

CO1: Explain the various forces acting on gravity dam and its stability analysis

CO2: Design of ogee spillway and getting concept of energy dissipation

CO3: Explain the diversion head-works and the theory of seepage flow

CO4: Demonstrate the concept of regulation works, falls and spillways gates

CO5: Apply the basic design principles of Cross Drainage Works

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE02A	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Environmental Geo-technology	3	0	0	15	15	30			

Course Learning Objectives:

- Learning various soil engineering for land reclamation purposes, conversion of degraded waste land in new land use.
- Understanding land degradation and soil pollution and their restoration.
- Integration of engineering techniques with ecological process for restoration of productivity.

Course Content:

UNIT-1 Soil and ground water pollutants - their sources, nature, composition and polluting effects. The physico-chemical aspects of soils contaminated by various pollutants. Effects of environment and wastes on the properties of soils.
UNIT–2 Solid and liquid wastes disposal method and management. land treatment systems.
UNIT-3 Man made changes in geotechnical environment - mining, embankments, pumping, reservoir, land fills and reclamation effects and control.
UNIT- 4 Control of contamination with use of clay barriers, geosynthetics, cut-off walls, leachate collection systems.
UNIT- 5 Stabilization - different materials and techniques in control of ground pollution and treatment.

Text Books:

1. D.E.Daniel, Geotechnical Practice for Waste Disposal, Chaman & Hall, London, 1993
2. Hsai_Yang Fang and Daniels, J.L. Introductory Geotechnical Engineering an Environmental Perspective, Taylor & Francis, Oxon., 2006.
3. Lakshmi N. Reddy, Hilary. I. Inyang – Geo-Environmental Engineering – Principles and Applications – Makcel Dekker Ink. 2000
4. Mitchell, J.K. and Soga, K., Fundamentals of Soil Behaviour, John Wiley & Sons, Inc., New Jersey., 2005.
5. Mohamed, A.M.O. and Antia, H.E., Geo-environmental Engineering, Elsevier, Netherlands, 1998.
6. Reddy, L.N. and Inyang, H. I., Geo-environmental Engineering –Principles and Applications, Marcel Dekker, Inc., New York., 2000.
7. Yong, R. N., Geo-environmental Engineering: Contaminated Soils, Pollutant Fate and Mitigation", CRC press LLC, Florida., 2001.

Course Outcomes-

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

CO1: Understanding causes of soil pollution.

CO2: Understand the fundamentals of soil behavior under varied environmental conditions.

CO3: Identify contaminant transport mechanisms in soils.

CO4: Specify site investigation techniques in the characterization of the contaminated site

CO5: Understand remediation techniques to reclaim degraded land for conversion in to various land uses.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE02B	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Air and Noise Pollution and Control	3	0	0	15	15	30			

Course Learning Objectives:

- To comprehend the essential concepts of Air and Noise pollution Learning
- To understand, measure and evaluate the character &behaviour of air and noise pollutants
- To understand the measurement techniques and strategies to control their presence in the ambient atmosphere.

Course Content:

Unit I: Air pollution: composition and structure of atmosphere, global implications of air pollution. classification of air pollutants: particulates, hydrocarbon, carbon monoxide, oxides of sulphur, oxides of nitrogen and photochemical oxidants. Indoor air pollution. Effects of air pollutants on humans, animals, property and plants.

Unit II: Air pollution chemistry, meteorological aspects of air pollution dispersion; temperature lapse rate and stability; wind velocity and turbulence, plume behaviour, dispersion of air pollutants, the Gaussian Plume Model, stack height and dispersion.

Unit III: Ambient air quality and standards, air sampling and measurements; Ambient air sampling, collection of gaseous air pollutants, collection of particulate air pollutants, stack sampling. Control devices for particulate contaminants: gravitational settling chambers, cyclone separators, wet collectors, fabric filters (Bag-house filter), electrostatic precipitators (ESP).

Unit IV: Control of gaseous contaminants: Absorption, Adsorption, Condensation and Combustion, Control of sulphur oxides, nitrogen oxides, carbon monoxide, and hydrocarbons. Automotive emission control, catalytic converter, Euro-I, Euro-II and Euro-III specifications, Indian specifications.

Unit V NOISE POLLUTION: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psycho-acoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infra-sound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices.

Text Books:

1. Peavy, Rowe and Tchobanoglous: Environmental Engineering.
2. Martin Crawford: Air Pollution Control Theory.
3. Wark and Warner: Air Pollution: Its Origin and Control.
4. M.N.Rao& HVN Rao, Air Pollution, Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Environmental Pollution Control Engineering- CS Rao, Wiley Eastern Ltd., New Delhi, 1996.
6. Environmental Noise Pollution – PE Cunniff, McGraw Hill, New York, 1987
7. Mycock, McKenna and Theodore: Handbook of Air Pollution Control Engineering and Technology.
8. Suess and Craxford: W.H.O. Manual on Urban Air Quality Management

Course Outcomes-

After studying the course, the students will be able to

CO1: Identify the major sources, effects and monitoring of air and noise pollutants.
CO2: Understand the key transformations and meteorological influence on air and noise.
CO3: Understand the behaviour of air pollutants in atmosphere.
CO4: Relate and analyse the pollution regulation on its scientific basis.
CO5: Application of various control equipment's for the abatement of air and noise.
CO6: Evaluate the engineering solutions for industrial and vehicular air & noise pollution problems.

Syllabus	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE02C	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Solid and Hazardous Waste Management	3	0	0	15	15	30			

Course Learning Objectives:

- To define and characterize municipal solid wastes from technical and regulatory points of view.
- To provide comprehensive ways of collection, transportation and management of different types of solid wastes.
- To classify the waste and remove hazardous wastes; apply different methods of management.
- .To introduce the most common techniques for hazardous waste disposal.
- To use laboratorial tests in sampling & characterization of solid wastes.

Course Content:

UNIT-1:Municipal Solid Waste Management
Legal and Organizational foundation: Definition of Solid Waste, Waste Generation Technological Society, Major Legislation, Monitoring Responsibilities, Sources and Types of Solid Waste, Sampling and Characterization – Determination of Composition of MSW, Storage and Handling of Solid Waste ,Future Changes in Waste Composition.

UNIT-2:Collection and Transport of Solid Waste
Collection of Solid Waste: Type of Waste Collection Systems, Analysis of Collection System, Alternative Techniques for Collection System, Separation, Processing and Transformation of Solid Waste: UNIT Operations User for Separation and Processing, Materials Recovery Facilities, Waste Transformation through Combustion and Aerobic Composting, Anaerobic Methods for Materials Recovery and Treatment, Energy Recovery.
Incinerators Transfer and Transport
Need for Transfer Operation, Transport Means and Methods, Transfer Station Types and Design Requirements, Landfills, Site Selection, Design and Operation, drainage and Leachate Collection Systems , Requirements and Technical solution, Designated Waste Landfill Remediation, Integrated Waste Management Facilities.
UNIT-3:Hazardous Waste Management
Definition and Identification of Hazardous Waste-Sources and Characteristics, Hazardous Wastes in Municipal Waste ,Hazardous Wastes Regulations ,Minimization of Hazardous Waste-Compatibility, Handling and Storage of Hazardous Waste-Collection and Transport, e-waste Sources, Collection, Treatment and Reuse Management.

UNIT-4:Hazardous waste treatment and Design
Hazardous Waste Treatment Technologies, Design and Operation , Facilities for Physical, Chemical and Thermal Treatment of Hazardous Waste –,Solidification, Chemical Fixation and Encapsulation, Incineration, Hazardous Waste landfills: Site Selection, Design and Operation, Remediation of Hazardous Waste Disposal Sites.

UNIT-5:Laboratory Practice: Sampling and Characterization of Solid Wastes; TCLP Tests and Leachate Studies.

Text Books:
1) Integrated Solid Waste Management by George Techobanoglous et al, McGraw-Hill Publication, 1993.
2) Hazardous Waste Management by Charles A. Wentz, McGraw Hill Publication, 1995.

Reference Books:
1) Solid and Hazardous Waste Management by S.C. Bhatia,Atlantic Publishers; Edition (1 December 2007).
2) Solid and Hazardous Waste Management by M.N Rao & Razia Sultana,BS Publications, Second Edition (2020)

Course Outcomes:- At the end of the course completion, the students shall be able to:

CO1: Ability to characterize municipal solid wastes from technical view.
CO2: Learn ways of collection, transportation and management of different types of solid wastes.
CO3: Apply different methods of managements for hazardous wastes.
CO4: Develop most suitable techniques for disposal of hazardous wastes.
CO5: Learn different laboratorial tests for solid wastes.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE02D	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Urban Hydrology and Hydraulics	3	0	0	15	15	30			

Course Learning Objectives:

- To describe physical properties of urban area.
- To understand the elements of drainage systems.
- To study about urban water supply
- To know about the measures to control storm water pollution
- To learn urban watershed software.

Course Content:

UNIT 1: Urbanisation: Process of urbanisation, Trends of urbanisation and industrialisation, influence on hydrologic cycle, effects and consequences for drainage, Rainfall analysis in urban environment, design storm. Urban Runoff computations: Empirical, Time-area and unit hydrograph approaches. Urban storm water runoff: overland flow.

UNIT 2: Design of drainage system elements: Hydraulic fundamentals, infiltration and on-site detention of storm water, design of sewerage and drainage channels, design of appurtenances, road drainage, design of pumping stations

UNIT 3: Urban water supply: Estimate of demand, sources in surface and groundwater, Reservoir, capacity estimation.

UNIT 4: Control of storm water pollution: Pollution build-up and wash off process with reference to urban drainage systems. Source control in commercial and industrial complexes, storage options - dry and wet ponds, biological treatment of wastewater, chemical treatment of storm water

UNIT 5: Introduction to urban watershed software - Hydrologic Cistern, water conservation and ecological aspects, Water harvesting

TEXT BOOKS:

1. Chow V T, Handbook of Applied Hydrology: A Compendium of Water resources technology, McGraw Hill, New York, 1964.
2. Gupta R S, Hydrology and Hydraulic Systems, Prentice Hall Publishers, New Jersey, 1989.
3. Geiger W F, Marsalek J Z, and Rawls G J, Manual on Drainage in Urban Areas, 2 Volumes, UNESCO, Paris, 1987
4. Hall M J, Urban Hydrology, Elsevier Applied Science Publishers, New York, 1984.
5. Stahre P, and Urbonas B, Stormwater Detention for Drainage, water quality and CSO Management, Prentice Hall Publishers, New Jersey, 1983.
6. Wanielista M P, and Yousef Y A, Stormwater Management, JohnWiley and Sons, New York, 1993.

Course Outcome: At the end of the course students shall be able to:

CO1: Understand and explain the effects of urbanization on rainfall and runoff.

CO2: Design various urban drainage system elements.

CO3: Estimate the demand of urban areas

CO4: Identify and apply the control required for storm water pollution

CO5: Use urban watershed software for simulation purpose.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE02E	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Environmental Impact Assessment and Life Cycle Analysis	3	0	0	15	15	30			

Course Learning Objectives:

- Identify environmental attributes for the EIA study.
- Identify methodology and prepare EIA reports.
- Specify methods for prediction of the impacts.
- Formulate environmental management plans.
- Understand the concept of life cycle analysis (LCA) and the basic principles.

Course Content:

UNIT-1: 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

UNIT–2: 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 modelling 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.

UNIT-3: Environmental Management Plan: 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.

UNIT- 4: An Introduction to Sustainability Concepts and Life Cycle Analysis (Introduction, Material flow and waste management, What it all means for an engineer? Water energy and food nexus). Risk and Life Cycle Framework for Sustainability (Introduction, Risk, Environmental Risk Assessment, Example Chemicals and Health Effects, Character of Environmental Problems)

UNIT- 5: Environmental Data Collection and LCA Methodology (Environmental Data Collection Issues, Statistical Analysis of Environmental Data, Common Analytical Instruments, Overview of LCA Methodology - Goal Definition, Life Cycle Inventory, Life Cycle Impact Assessment, Life Cycle Interpretation, LCA Software tools). Life Cycle Assessment – Detailed Methodology and ISO Framework (Detailed Example on LCA Comparisons, LCA Benefits and Drawbacks, Historical Development and LCA Steps from ISO Framework)

Text Books:

1) Anjaneyulu.Y., and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007
2) Canter, L.W., Environmental Impact Assessment, McGraw Hill Pub. Co., New York. 1997
3) David P. Lawrence, Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley & Sons, 2003
4) Environmental Assessment, 2001. Ravi Jain, LV Urban, GS Stacey, H Balbach, McGraw-Hill.
5) Handbook on Life Cycle Assessment : Operational guide to the ISO standards, Kluwer Academic Publishers, 2004
6) Hosetti, B. B., Kumar A. Eds, Environmental Impact Assessment & Management, Daya Publishing House, 1998
7) Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Inter science, New Jersey, 2003.
8) Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science, London, 1999.

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

CO1: Identify environmental attributes for the EIA study.
CO2: Identify methodology and prepare EIA reports.
CO3: Specify methods for prediction of the impacts.
CO4: Understand EIA tools & methodologies, auditing and documentation of EIA
CO5: Formulate environmental management plans
CO6: Perform life cycle inventory analysis of products.
CO7: Develop strategies to bring energy efficiency in all stages of the product development cycle.
CO8: Formulate plans for comprehensive environmental protection, in order to comply with environmental laws

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE03A	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Engineering Hydrology	3	0	0	15	15	30			

Course Learning Objectives:

- To develop the fundamentals of hydrology and Precipitation.
- To study various abstractions of precipitation.
- To understand the concepts of Rainfall-Runoff correlations
- To learn about the importance of Hydrographs and the basics of the flood.
- To understand the fundamentals of groundwater hydrology

Course Content:

UNIT-1 Introduction Description of Hydrologic Cycle, Overview of the applications of hydrology in engineering. Forms of precipitation, measurement, depth-area-duration, and intensity-duration frequency relations.

UNIT–2Abstraction from Precipitation Evaporation | process, measurement, and estimation, Evapotranspiration measurement and estimation Infiltration process, measurement, and estimation.

UNIT-3 Runoff Surface Runoff and Stream Flow Measurements, Rainfall-Runoff relations.

UNIT- 4 Hydrograph Factors affecting flow hydrograph, Unit hydrograph, its analysis, and S-curve hydrograph, Synthetic and instantaneous unit hydrographs. Basics of Flood and Flood Routing.

UNIT- 5 Groundwater Occurrence of groundwater, types of aquifers, aquifer properties, Darcy's law, Conductivity and Transmissivity, the yield from a well under steady-state conditions, Laboratory and field measurement of permeability.

Text Books:

1. Engineering Hydrology K.Subramanya, Tata McGraw-HillEducation
2. Hydrology Principles, Analysis and Design H.M.Raghunath, New AgeInternational
3. Hand BookofAppliedhydrologyV.T.Chow, McGraw-Hill Inc
4. ViessmanWandLewisGL(2008)"IntroductiontoHydrology" PrenticeHallofIndia
5. Ojha,C.S.P. , Bhunya, P. and Berndtsson, R.- Engineering Hydrology, Oxford University PressCanada.
6. K. C. Patra, Hydrology and Water Resources Engg., Narosa Publishing house, New Delhi.
7. D. K. Todd, Groundwater Hydrology, John Wiley and Sons

Course Outcomes-Upon completion of this course students shall be able to

CO1: Describe the basic concepts of hydrology and precipitation to integrate them with the physical hydrological processes.

CO2: Understand and Explain the various process, measurements, and estimations of hydrological components

CO3: Formulate the rainfall-runoff relationship and apply it to engineering practices.

CO4: Explain and use the hydrographs for practical purposes and investigations.

CO5: Understand and explain the basics of groundwater hydrology.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE03B	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Structural Dynamics	3	0	0	15	15	30			

Course Learning Objectives:

- To Introduce fundamentals of vibrations of SDOF system
- To Impart damped and undamped system
- To Present free and forced vibration
- To Acquaint with free and forced vibration of MDOF system
- To Present free and forced vibration of continuous system

Course Content:

UNIT- 1: INTRODUCTION: Comparison between static and dynamic analysis; Degrees of freedom; Undamped system; Newton's law of motion; 'D' Alembert's principle; Solution of the differential equation of motion.

UNIT-2: FREE VIBATION OF SINGLE DEGREE - OF - FREEDOM SYSTEM: Equation of motion for single degree - of - freedom system; free undamped vibration of the SDOF system; Damped single degree - of - freedom system -Viscous damping, Equation of motion, critically damped system, Over- damped system. Under-damped system and Logarithmic decrement.

UNIT-3: RESPONSE OF SDOF SYSTEM TO HARMONIC LOADING: Undamped harmonic excitation; Damped harmonic excitation; Evaluation of damping at resonance; Response to support motion; Force transmitted to the foundation. Response of SDOF system to general dynamic loading: Impulsive loading and Duhamel's integral; Numerical evaluation of Duhamel's integral — Undamped system;Numerical evaluation of Duhamel's integral -Damped system.

UNIT-4: GENERALIZED COORDINATES AND RAYLEIGH'S METHOD: Principle of virtual work; Generalized SDOF system - Rigid body; Generalized SDOF system - Distributed elasticity; Rayleigh's method; Improved Rayleigh's method.

UNIT-5: STRUCTURES MODELED AS SHEAR BUILDINGS: Stiffness equations for the shear building; Flexibility equations for the shear building; Free vibration of a shear building (Single bay two Storeyed) - Natural frequencies and normal modes. Forced motion of shear buildings (Two Storeyed): Modal superposition method; Response of a shear building to base motion; Harmonic forced excitation.

Text Books/Reference Books:

1. Dynamics of Structures by A.K.Chopra, Second edition (2001), Prentice Hall India Private Ltd
2. Dynamics of Structures by Clough, R.W. &Penzin, J., McGraw Hill, 1993.
3. Earthquake Resistant Design of Structures by Pankaj Agarwal, Manish Shrikhande , 1st edition (2006), Prentice Hall of India Private Ltd., New Delhi .
4. Dynamics of Structures by Humar, J.L., Prentice Hall, 1990.
5. Structural Dynamics by Mario, Paz, CBS Publ. New-Delhi, 1995.
6. Advanced Dynamics by Timoshenko, S., McGraw Hill Book Co, NY, 1948.
7. Elements of Vibration Analysis by Meirovitch, L., 2nd Edi. McGraw Hill Intr. Edi.,Singapore, 1986.
8. Introduction of Structural Dynamics, Biggs, J.M., McGraw Hill, NY, 1964
9. Principles and techniques of vibrations by L Meirovich, 1997, Prentice Hall, NJ.
10. Analytical methods in vibrations by L Meirovich, 1967, Macmillan, NY.
11. Theory of vibrations by W T Thompson, 1983, Prentice hall, New Delhi
12. Vibration: fundamentals and practice by C W de Silva, 1999, CRC Press, Boca Raton.
13. Mechanical Vibrations by S S Rao, 2004, 4th Edition, Pearson Education, New Delhi.

Course Outcomes:

On the completion of this course, the student will be able to

CO1: Convert a physical structure into SDOF system/model
CO2: Find response of free and force vibration (harmonic, periodic and transient) of SDOF system
CO3: Calculate natural frequency and mode shapes of MDOF system
CO4: Carry out modal analysis of MDOF system
CO5: Get the Response of structures by performing experiments and/or by computer simulation.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE03C	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Foundation Engineering	3	0	0	15	15	30			

Course Learning Objectives:

- To introduction of different methods of soil exploration.
- To provide comprehensive studies of shallow foundation and calculate settlements.
- To analyze various types of footings & rafts.
- To introduction of various types of piles foundations and to calculate bearing capacity.
- To introduce Comprehensive studies of Retaining walls and determine stability.

Course Content:

UNIT-1 Site Investigation And Selection Of Foundation: Scope and Objectives, Methods of Exploration ,Augering and Boring ,Wash Boring and Rotary Drilling ,Depth and Spacing of Bore Holes ,Soil Samples ,Representative and Undisturbed, Sampling Methods Split Spoon Sampler, Thin Wall Sampler, Stationary Piston Sampler ,Penetration Tests (SPT and SCPT) ,Data Interpretation ,Strength Parameters ,Bore Log Report and Selection of Foundation.

UNIT–2 Shallow Foundation: Location and Depth of foundation, Codal Provisions, Bearing Capacity of Shallow Foundation onHomogeneous Deposits ,Terzaghi's Formula and BIS formula ,Factors Affecting Bearing Capacity Bearing Capacity from In-Situ Tests (SPT, SCPT and Plate Load) ,Allowable Bearing Pressure , Seismic Considerations in Bearing Capacity Evaluation, Determination of Settlement of Foundations on Granular and Clay Deposits ,Total and Differential Settlement , Allowable Settlements , Codal Provision , Methods of Minimizing Total and Differential Settlement.

UNIT-3 Footings And Rafts:: Types of Isolated Footing, Combined Footing, Mat Foundation, Contact Pressure and Settlement Distribution, Proportioning of Foundations for Conventional Rigid Behavior, Minimum Thickness for Rigid Behavior, Applications, Compensated Foundation, Codal Provisions.

UNIT- 4 Pile Foundation: Types of Piles and Functions ,Factors Influencing the Selection of Pile , Carrying Capacity of Single Pile in Granular and Cohesive Soil , Static Formula ,Dynamic Formulae (Engineering News and Hileys) ,Capacity from In-Situ Tests (SPT and SCPT) , Negative Skin Friction , Uplift Capacity, Group Capacity by Different Methods (Feld's rule, Converse — Labarre formula and Block Failure Criterion) ,Settlement of Pile Groups , Interpretation of Pile Load Test (Routine Test Only), Under Reamed Piles, Capacity under Compression and Uplift , Cohesive -Expansive ,Non Expansive — Cohesionless Soils , Codal Provisions.

UNIT- 5 Retaining Walls: Plastic Equilibrium in Soils ,Active and Passive States , Rankine's Theory for Cohesionless and Cohesive Soil ,Coulomb's Wedge Theory , Condition for Critical Failure Plane ,Earth Pressure on Retaining Walls of Simple Configurations , Culmann's Graphical method ,Pressure on the Wall due to Line Load ,Stability Analysis of Retaining Walls ,Codal Provisions.

Text Books::

1) Foundation Analysis and Design by J. E. Bowels, McGraw Hill. Companies, Inc. 6th Ed. 2001.
2) Principles of Foundation Engineering by B. M. Das, CENGAGE Learning, Seventh Edition.
3) Foundation Engineering Handbook by R. W. Day, McGraw Hill. ConstructionASCE Press. Ed. 2006.
4) Basic and Applied Soil Mechanics by Gopal Ranjan & A.S. R. Rao, New Age International (P) Limited Publishers, New Delhi-110002.
5) Textbook of Soil Mechanics and Foundation Engineering –Geotechnical Engineering Series (PB 2018) by V.N. S. Murthy, CBS Publications, New Delhi
6) Soil Mechanics by Robert V. Whitman & T. William Lambe, Wiley India Pvt Ltd., New Delhi.
7) Soil Mechanics and Foundation Engineering (Geotechnical Engineering) by Dr. P.N. Modi, Standard Book House(Rajsons Publications Pvt Ltd), New Delhi-110002

Course Outcomes:-At the end of the course completion, the students shall be able to:

CO1: Understand different methods of soil exploration.
CO2: Analyze various shallow foundations and calculate different types of settlements.
CO3: Understand various types of footings & rafts.
CO4: Analyze bearing capacity of piles with different methods
CO5: Design stability of Retaining walls.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE03D	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Rock Mechanics	3	0	0	15	15	30			

Course Learning Objectives:

- To understand the basics of rock mechanics and able to analysis stress.
- To calculate strain and determine physical properties of rocks.
- To determine mechanical properties of rocks by different methods.
- To analyse different models of stress–strain in rocks.
- To determine the static & dynamic elastic constants of rocks.

Course Content:

UNIT – 1: INTRODUCTION TO ROCK MECHANICS

Definition, Scope, Importance & Development, Application in Mining, Discontinuities; Description of Discontinuities, Introduction to Mapping and Hemispherical Projection of Discontinuities, Barton's Shear Strength of Joints.
Analysis of Stress: Introduction, Definition and Basic Concepts, Stress in a Plane(2-D), Mohr's Circle of Stress, Secondary Principal Stress, Equations of Equilibrium, Plane Stress Equations.

UNIT – 2: ANALYSIS OF STRAIN

Introduction, Definition and Basic Concepts, Strain in a Pane (2-D), Mohr's Circle of Strain, Equations of Compatibility, Stress-Strain Relationship, Basic Equations in Elastic Theory, Pain Strain Equations, Elasto Plastic Behaviour of Rocks, Stress – Strain Curves of Various Rocks.
Physical Properties: Definition and Determination of Density, Hardness, Porosity, Permeability, Moisture Content, Degree of Saturation, Electrical and Thermal Properties of Rocks.

UNIT – 3: MECHANICAL PROPERTIES

Definition and Determination of Compressive Strength, Tensile Strength, Shear Strength, Triaxial Testing, Time Dependent Properties, Scaling of Laboratory Data to In-Situ Values.
Rock Indices: Protodyakanov Strength Index, Point Load Strength Index, RQD; In-Situ Strength Properties of Rocks, Necessity and Requirement, Methods of In-Situ Stress Measurements, Plate Load Test, Cable Jack Test, Bore Hole Test, Dilatometer Test, Flat Jack Test, Hydraulic Fracture and Velocity Propagation.

UNIT – 4: RHEOLOGICAL MODELS

Relationship and Rate of Change of Stress-Strain for Idealizing Materials – Models Representing Elastic, Plastic, Viscous, Elasto-Plastic, Non-Elastic and Brittle Rock Properties.

UNIT – 5: STATIC AND DYNAMIC ELASTIC CONSTANTS OF ROCKS

Static Elastic Constants of Rocks: Introduction, Definition, Instrument, Measurement of Deformation, Mechanical, Optical, Electrical Gauges, LVDT, Calculation of Elastic Constants of Rocks.
Dynamic Elastic Constants of Rocks: Introduction, Elastic Wave, Calculation of Modulus of Elasticity.

TEXT BOOKS:

1) Rock Mechanics for Engineers - B. P. Varma, 2nd edition, Khanna Publishers, 1989.
2) Strata Mechanics in Coal Mining - Jeremic, K. L. Jeremic, Rotterdam, Balkema, 1985.
3) Fundamentals of Rock Mechanics - Jager & Cook, Methuen andco. London, 1969.
4) Handbook on Mechanical Properties of rocks - R.D. Lama, V. S. Vutukuri, Vol. I to IV, Transtech Publications,1978.
5) Rock Mechanics for Underground Mining - 2nd edition, Brady and Brown, Khuwar AcadamicPublishers, 1993.

Course Outcomes: At the end of the course completion, the students shall be able to:

CO1: Learn basics of rock mechanics and calculate stresses.
CO2: Determine physical properties of rocks and strain.
CO3: Evaluate mechanical properties of rocks.
CO4: Compare stress strain in rocks by different methods.
CO5: Determine the static & dynamic elastic constants of rocks.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE03E	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Water Resources Planning & Management	3	0	0	15	15	30			

Course Learning Objectives:

- To learn how to assess water resources
- To study how to develop suitable plans for water resources development and management
- To understand various types of water resources systems.
- To learn managing the water resources quality and quantity
- To understand water quantity and quality modelling.

Course Content:

UNIT 1: Introduction: Role of water in national development, assessment of water resources of country, scope of water resources development vis-a-vis environment, Irrigation development in India, utilisation of Irrigation potential.

UNIT 2: Planning: Water resources planning process; planning for single purpose and multipurpose projects, estimation of different water needs and project formulations, comparison of alternatives, cost-benefit analysis.

UNIT 3: Water Resources Systems: Definition, types of system, optimization techniques, system approach, system analysis, linear programming, and formulation of a linear programming problem, formulation with different types of constraints, graphical analysis, graphical solution, simplex method, optimization techniques and systems approach.

UNIT 4: Management: Evaluation and monitoring of water quantity and quality, managing water distribution networks for irrigation, flood control and power generation, inter-basin transfer of water, conjunctive use of surface and ground water.

UNIT 5: Modelling: Water quantity and quality modelling, evaluation of impacts of water resources projects on river regimes and environment, reservoir sedimentation and watershed management.

Text Books:

1. Principles of Water Resources Planning – Good Man, A.S., (Prentice Hall, Inc., Englewood Cliffs, N.J. 1984.)
2. Water Resources Systems -S Vedula and P P Mujumdar, Tata McGraw-Hill Education, 2005
3. James, L. Douglas, and Robert R. Lee, Economics of Water resources Planning, McGraw-Hill Book Company, 1971.
4. Quentin Grafton, R. and Karen Hussey, Water Resources Planning and Management, Cambridge University Press, 2011.
5. Water Resources System, Planning and Management – M.C. Chaturvedy (Tata McGraw Hill)
6. Water Resources System, Planning and Management – Halweg O.J. (John and Wiley & Sons)

Course Outcomes- after completion of the course the students shall be able to

CO1: Describe the potential of assessing water resources
CO2: Prepare master and strategic water resources planning
CO3: Apply the optimization techniques for water resources systems.
CO4: Exercise the management of water resources in different real life situations
CO5: Solve various water resources problems using modelling.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE04A	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Industrial Structures	3	0	0	15	15	30			

Course Learning Objectives:
The purpose of this course is to:

- Develop an in-depth knowledge in the area of design of industrial structure with the latest code of practice as per the Indian Standard.
- To introduce the students about planning & functional requirement of industries
- To analyse& design the industrial buildings, bunkers & Silos
- To understand the design concept of chimneys
- To understand the principles of cylindrical shells

Course Content:

UNIT: I Planning and functional requirements- classification of industries and industrial structures- planning for layout- requirements regarding lighting ventilation and fire safety- protection against noise and vibrations

UNIT-II Thin Walled / Cold Formed Steel Members: Definitions – Local Buckling of Thin-Elements-Post Buckling of Thin-Elements – Light Gauge Steel Columns and Compression Members – Form-Factor for Columns and Compression Members – Behaviour of Stiffened Elements Under Uniform Compression – Multiple Stiffened Compression Elements –Effective Length of Light Gauge Steel Compression Members – Light Gauge Steel Tension Members.

UNIT-III RC Bunkers & Silos: Introduction – Janssen's Theory – Airy's Theory – Design of Square, Rectangular and Circular Bunkers; Design of Silos.

UNIT-IV RC Chimneys: Introduction – Wind Pressure – Stresses in Chimney Shaft Due to Self-Weight and Wind – Stresses in Horizontal Reinforcement Due to Wind Shear – Stresses Due to Temperature Difference – Combined Effect of Self Load, Wind and Temperature – Temperature Stresses in Horizontal Reinforcement Problems.

UNIT-V Design Principles of Cylindrical Shells & Design Problems.

TEXT BOOKS

1) Advanced Reinforced Concrete Design, By N. Krishna Raju (CBS Publishers & Distributors) 2005
2) Design of Steel Structures, By Ram Chandra and Virendra Gehlot vol-II, 2007.
3) Design of Steel Structures, By Duggal - Tata McGraw-Hill publishers – 2010
4) Handbook on Machine Foundations by P. Srinivasulu and C. V. Vaidyanathan, Structural Engineering Research Center
5) Tall Chimneys- Design and Construction by S. N. Manohar Tata Mc Grawhill Publishing Company

REFERENCES:

1) Transmission Line Structures by S. S. Murthy and A. R. Santakumar McGraw Hill
2) SP 32: 1986, Handbook on functional requirements of Industrial buildings
3) Design of steel structures by N. Subramanian

Course Outcomes-
Course Outcomes: At the end of the course, the student will be able to -

CO1: Plan the functional requirements of structural systems for various industries.
CO2: Get an idea about the materials used and design of industrial structural elements.
CO3: Realize the basic concepts and design of power plant structures.
CO4: Design power transmission structures.
CO5: Possess the ability to understand the design concepts of Chimneys, bunkers and silos

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE04B	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Airport Planning and Design	3	0	0	15	15	30			

Course Learning Objectives:

- To familiarize students with of airport planning.
- To develop the knowledge for design and analysis of airport runway, taxiway and airport pavement crust.
- To understand air traffic control system.

Course Content:

UNIT-1 Airport Planning: Significance of transport, Different modes of transportation, Airport master plan-FAA recommendation, Regional planning, airport site selection, survey for site selection, Estimation of future air traffic, Characteristics of aircraft, Environmental consideration.

UNIT–2Runway Design: Orientation of runway , Basic runway length, Corrections for basic runway length, Runway geometric design.

UNIT-3 Taxiway Design: Controlling factors of taxiway, Geometric design for taxiway, Design for exit taxiways.

UNIT- 4 Airport Pavement Design: Design factors, Design of flexible pavement, Design of rigid pavement, design of overlay pavements.

UNIT- 5Air Traffic Control and Visual Aids: Air traffic control objectives, control system. Visual aids-airport markings and lighting.

Text Books:

1. Dr. S. K. Khanna, M.G. Arora and S.S. Jain, Airport Planning & Design, Nem Chand &Bros.,Roorkee
2. G.V. Rao Airport Engineering, Tata McGraw Hill Pub. Co., New Delhi
3. S.C. Rangwala and K.S, Rangwala, Airport Engineering, Charotar Publishing House Pvt. Ltd, Anand

Course Outcomes-

After learning the course the students should be able to:

CO1: Understand the fundamentals of airport planning.

CO2: Familiarize with design of runway.

CO3: Recognize design of taxiway

CO4: Understand airport pavement design

CO5: Analyse air traffic control system.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE04C	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Railway Engineering	3	0	0	15	15	30			

Course Learning Objectives:
The objective of this Course is

- Comprehend the history of indian railway and basic study required with respect to construction of railway track.
- To make aware of the different components of railway track and the recent updation in indian railway with respect to the components.
- Comprehensive understanding of the factors involved in designing of the various alignment elements.
- Explain essential features, requirements and components of different types of point, crossings, turnouts, switches, crossovers etc.
- Detailed study and uderstanding of the signalling and station yard system of railway.

Course Content:

UNIT 1: Introduction to Railways in India: Role of Indian Railways in National Development. Railways for Urban Transportation –LRT & MRTS. Alignment of Railway Lines: Engineering Surveys for Track Alignment. Permanent Way: Components and their Functions.

UNIT 2: Rails - Types of Rails, Length of rail, Weight of Rail, Rail Joints, Creep of rail, Buckling of rail, Kinks of Rail Fastenings, Coning of Wheels & tilting of rails.
Sleepers –Types, Functions, sleeper density.
Ballasts- Types, function, advantage & disadvantage of each type.

UNIT 3: Geometric Design of Railway Tracks: Gradients and Grade Compensation, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal Curves.

UNIT 4: Points and Crossings, Turnouts: Working Principles, Cross overs.

UNIT 5: Signalling: Types and their function. Station and Yards: Types, Requirements, factors for site selection.

Text Books:

1. Chandra S. and M.M. Agarwal, Railway Engineering, Oxford University Press, New Delhi, India, 2007.
2. Saxena, S.C. and S.P. Arora, Railway Engineering, Dhanpat Rai and Sons, New Delhi, India, 1997.
3. Agarwal, M.M., Indian Railway Track, Prabha and Co., New Delhi, India, 1988.
4. Rangwala, S.C., Principles of Railway Engineering, Charotar Publishing House, Anand, India, 1988.
5. J. S. Mundrey, "Railway Track Engineering", McGraw Hill Publishing Co., 2009

Course Outcomes

At the end of the course the students shall be able to:

CO1: The students are expected to prepare the detailed project report for the construction, design and operation of mass transit systems that use a fixed guide way.
CO2: The students understands the basic requirents of the components of the railway tracks and also got global updation about the railway track components.
CO3: The students are expected to handle the tasks that include determining horizontal alignment and vertical alignment design.
CO4: The students are able to design various components of point, crossing, turnouts etc.
CO5: The students understand the requirenmets and also diffentiate the signalling system for particular track. Also understand the basic factors and requirtamnet of station yards.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE04D	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Contracts Management	3	0	0	15	15	30			

Course Learning Objectives:

- To introduce about various Authorities, indulge in construction contract management.
- To impart knowledge on municipal bye-laws related to construction.
- To elaborate about construction contracts, arbitration, and litigation procedures

Course Content:

UNIT-1 Introduction and concepts of Construction law-public law-government departments and local authorities.

UNIT–2Private law-contracts-torts-property law and building law-concepts-salient features sections

UNIT-3 Construction contracts-contracts specifications-types of contract documents used for construction.

UNIT- 4 Contract procurement- selection of contractor-contract procedure-salient features.

UNIT- 5Arbitration and litigation procedure-preparation, settlement, evidence, price adjustment-need for the formulae-civil engineering and building formulae- practical implications.

Text Books:

1. Gajaria G. T., laws relating to building and engineering contracts in India, M. M Tripathi Private Ltd., Bombay, 1982.
2. Jimmie Hinze, construction contracts, 2nd edition. McGraw hill, 2001.
3. Joseph T. Bockrath, contracts and the legal environment for engineers and architects, 6th edition, McGraw Hill, 2000.

Course Outcomes-

CO1: To remember about various Authorities, indulge in construction contract management.

CO2: To understand about municipal bye-laws related to construction.

CO3: To remember & understand about various classifications of construction contacts.

CO4: To review about various steps of contract procurement in construction industry.

CO5: To evaluate the role of Arbitration and litigation procedure in settlement of contract related disputes.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE207TPE04E	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Construction Projects Planning & Systems	3	0	0	15	15	30			

Course Learning Objectives:

- To understand the project management and different scheduling techniques.
- To expertise in PERT network analysis.
- To learn CPM network analysis and compared with PERT.
- To understand time-cost analysis and resource scheduling.
- To understand the factor for equipment selection and cost of owing and operating and expertise in evaluation and analysis of different equipment life.

Course Content:

UNIT 1: Introduction: Objectives and functions of project management, project feasibility reports, Planning for construction projects: Steps, factors, advantages and disadvantages for different stake holder.

Scheduling: Scheduling Job layout and Line of balance, project management through networking, Bar Chart, Linked bar chart, Work-break down structures, Activity-on-arrow diagrams.

UNIT 2: PERT: Network analysis, critical path, probability of project.

UNIT3: CPM: Network analysis, Critical Path, Difference between CPM and PERT.

UNIT 4: Time-Cost Trade-off, Resource Scheduling

UNIT 5: Time and motion studies, Standard and special equipment, factors affecting selection of construction equipment, cost of owning and operating the construction Equipment, Equipment Life and Replacement Analysis

Text Books:

1. Chitkara, K.K. "Construction Project Management Planning", Scheduling and Control, Tata McGraw-Hill Publishing Co., New Delhi, 1998.
2. Srinath,L. S., "PERT and CPM Principles and Applications ", Affiliated East West Press, 2001
3. Chris Hendrickson and Tung Au, "ProjectManagement for Construction – Fundamentals Concepts for Owners", Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
4. Moder J., C.Phillips and Davis, "Project Management with CPM", PERT and Precedence Diagramming, Van Nostrand Reinhold Co., Third Edition, 1983.
5. Construction Planning and Equipment - R.L.Peurifoy - Tata McGraw Hill, New Delhi Willis., E.M., "Scheduling Construction projects", John Wiley and Sons 1986.
6. Halpin,D.W., "Financial and cost concepts for construction Management", John Wiley and Sons, New York, 1985.

Course Outcomes- At the end of the course students will be able to:

- **CO1**: To apply the knowledge in managing and handling of different civil engineering project and also able to schedule the project.
- **CO2**: To do PERT analysis and able to find the project completion time and its probability.
- **CO3**: To do CPM analysis and able to find the project completion time and compare with PERT analysis.
- **CO4**: To do cost and time analysis and also resource allocation, scheduling and crashing for different activities of the network.
- **CO5**: To apply the knowledge in equipment selection and able to find cost of owing and operating and able to find the equipment life, which help in comparisons of different equipments.

SYLLABUS	(SEMESTER VII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE07TOE02A	L	T	P	CT-I	CT-II	TOTAL	70	100	3
Subject:	Green Building and Sustainable Materials	3	0	0	15	15	30			

Course Learning Objectives:

- To understand the basics of Green Buildings.
- To learn the concept of site selection and planning.
- To study the use of efficient energies.
- To understand the types of sustainable building materials.
- To learn about maintenance of Indoor environmental quality.

Course Content:

UNIT-I
Green Buildings: Introduction, Definition, sustainable development, typicalfeatures of green buildings, benefits,key Requisites for Constructing a Green Building,Greenbuildingrating systems – GRIHA, IGBC and LEED.

UNIT- II
Site selection and building planning: Criteria for site selection, preservation of landscape, soil erosion control,minimizing urban heat island effect, maximize comfort by proper orientation of building facades, daylighting, ventilation, etc.
Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof,water demand, water efficient plumbing systems, water metering, waste water disposal, recycle and reuse systems.

UNIT-III
Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy,operationalenergy and life cycle energy; Methods to reduce operational energy: Energy efficientbuildingenvelopes, efficient lighting technologies, energy efficient appliances for heating and airconditioningsystems in buildings, zero ozone depleting potential (ODP) materials; wind and solarenergyharvesting,energy metering and monitoring, concept of net zero buildings; Optimum EnergyEfficiency, Typical Energy Saving Approach in Buildings Use of Renewable Energy Sources

UNIT-IV
Sustainable Building materials: local building materials, natural and renewable materials like bamboo, timber,

rammed earth, stabilized mud blocks, materials with recycled content such as blended cements, pozzolana cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. Reuse of waste and salvaged materials

UNIT-V
Indoor Environmental Quality for Occupant Comfort and Wellbeing: Daylighting, air ventilation,exhaust systems, low VOC paints, materials & adhesives, building acoustics. Codes related to greenbuildings: NBC, ECBC, ASHRAE, UPC etc.Rapidly renewable building materials and furniture; Environment Quality And Occupational Health: Air conditioning, air quality, Sick building syndrome, Tobacco smoke control, Minimum fresh air requirements avoid use of asbestos in the building, improved fresh air ventilation, Measure of IAQ, Reasons for poor IAQ, Measures to achieve Acceptable IAQ levels.

Text Book:
1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
3. Alternative building materials and technologies by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. Non-Conventional Energy Resources by G. D. Rai, Khanna Publishers.
5. Sustainable Building Design Manual, Vol.1 and 2, TERI, New Delhi 2004.
6. Mike Montoya, Green Building Fundamentals, Pearson, USA, 2010.
7. Charles J. Kibert, Sustainable Construction – Green Building Design and Delivery, John Wiley & Sons, New York, 2008.
8. Regina Leffers, Sustainable Construction and Design, Pearson / Prentice Hall, USA, 2009.

Course Outcomes:- At the end of the course students will be able to:

CO1: To apply the knowledge of Green Building in handling any physical projects.

CO2: To conduct a site selection process with respect to green buildings.

CO3: To make use of technologies with efficient energies.

CO4: To select and work with various sustainable materials.

CO5: To apply the knowledge in maintaining the indoor environmental quality.

SEMESTER VIII

SYLLABUS	(SEMESTER-VIII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE208TPC21	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Earthquake Resistant Design of Structures	3	0	0	15	15	30			

Course Learning Objectives:

- To introduce Engineering seismology and functional planning and the effects of configurations of buildings for earthquakes.
- To introduce the requirements for conceptual design for earthquake safety and the analysis methods.
- To acquaint with IS code-based design lateral forces for earthquake resistant design of structures.
- To identify the behavior of structural and nonstructural elements for seismic resistance and impart design of shear walls.
- Introduce Capacity Design as per IS 13920: 2016, Capacity Design for Beams, Columns, beam column joints and structure as a whole.

Course Content:

UNIT 1: Engineering Seismology: Earthquake phenomenon cause of earthquakes-Faults- Plate tectonics- Seismic waves- Terms associated with earthquakes-Magnitude/Intensity of an earthquake-scales-Energy released-Earthquake measuring instruments-Seismoscope, Seismograph, accelerograph-Characteristics of strong ground motions- Seismic zones of India. Introduction-Functional Planning-Continuous load path-Overall form-simplicity and symmetry-elongated shapes-stiffness and strength - Seismic design requirements-regular and irregular configurations-basic assumptions.

UNIT 2: Conceptual Design - Horizontal and Vertical Load Resisting Systems - System and Members for Lateral Loads and High Rise / Tall Structures. Twisting of Buildings – Flexible Building and Rigid Building Systems. Strength and Stiffness – Ductility – Definition – Ductility Relationships – Choice of construction Materials – Unconfined Concrete & Confined Concrete – Masonry, Steel Structures. Design Earthquake Loads – Basic Load Combinations – Permissible Stresses. Seismic Methods of Analysis – Static Method – Equivalent Lateral Force Method. Dynamic Analysis – Response Spectrum Method – Modal Analysis Torsion.

UNIT 3: Introduction to Earthquake Resistant Design – Seismic Design Requirements and Methods. RC Buildings – IS Code based Method. - Vertical Irregularities – Mass Irregularity Torsional Irregularity - Plan Configuration Problem - Design Lateral Force, Base Shear Evaluation – Lateral Distribution of Base Shear –.

UNIT 4: Structural Walls Strategies and the Location of Structural Walls – Sectional Shapes – Behaviour of Unreinforced and Reinforced Masonry Walls – Behaviour of Walls Box Action and Bands – Behaviour of infill Walls - Non Structural Elements – Failure Mechanism of Nonstructural Elements – Effects of Nonstructural Elements on Structural System – Analysis – Prevention of Damage to Nonstructural Elements – Isolation of Non-Structures, Design of Shear walls: Classification according to Behavior, Loads in Shear walls, Design of Rectangular and Flanged Shear walls.

UNIT 5: Ductility Considerations in Earthquake Resistant Design of RC Buildings: Introduction Impact of Ductility-Requirements for Ductility- Assessment of Ductility- Factors affecting Ductility- Ductile detailing considerations as per IS 13920. Behavior of beams, columns and joints in RC buildings during earthquakes-Vulnerability of open ground storey and short columns during earthquake- Seismic Evaluation and Retrofitting. Capacity Based Design: Introduction to Capacity Design, Capacity Design for Beams and Columns-Case studies.

Text Books/References:

1. Seismic Design of Reinforced Concrete and Masonry Building – T. Paulay and M.J.N. Priestly, John Wiley & Sons
2. Earthquake Resistant Design of structures – Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd
3. Earthquake Resistant Design for Engineers & Architects by Dowrick, D. J., John Willey & Sons, 2nd Edition; 1987.
4. Earthquake Resistant Design of structures by S. K. Duggal, Oxford University Press.
5. Concrete Structures in Earthquake Regions by Booth, E., Longman Higher Education, 1994.

6. Reinforced Concrete Structures by Park, R. &Paulay, T., John Willey & Sons, 2nd Edition; 1975.
7. Masonry and Timber structures including earthquake Resistant Design –Anand S.Arya, Nemchand& Bros.
8. Earthquake –Resistant Design of Masonry Building –Miha Tomazevic, Imperial College Press.
9. Design of Reinforced Concrete Structures by N. Subramanian, Oxford University Press.
10. Dynamics of Structures by A.K.Chopra, Second edition (2001), Prentice Hall India Private Ltd
11. Handbook on Seismic Analysis and Design of Structures by Farzad Naeim, Kluwer Academic Publisher, 2001.

Reference Codes:

1. IS 1893 (Part-1): 2016, "Criteria for Earthquake Resistant – Design of structures." B.I.S., New Delhi.
2. IS 4326: 2013, "Earthquake Resistant Design and Construction of Building", Code of Practice, B.I.S., New Delhi.
3. IS 13920: 2016, "Ductile design and detailing of reinforced concrete structures subjected to seismic forces" – Code of practice, B.I.S., New Delhi.

Course Outcomes:

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

CO1: Identify the causes of earthquakes, its propagation, and measurement and can quantify the hazard at the location of the structure and quantify the forces based on the source.

CO2: Adopt a suitable structural system to resist earthquake forces considering safe behavior of structural and nonstructural elements with different material properties and load combinations.

CO3: Design seismically safe structures in accordance with the provisions of Indian code IS 1893.

CO4: Implement design of shear wall elements for earthquake safety of structures.

CO5: Design or retrofitting of structures by detailing the elements, beams, columns, beam-column joints as per capacity-based design adopting ductility provisions as per IS 1893, IS 13920, to mitigate the vulnerability of earthquake damages of elements and structures.

SYLLABUS	(SEMESTER-VIII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE208TPE05A	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Offshore Engineering	3	0	0	15	15	30			

Course Objective:

- To introduce basics of offshore structures and its historical development.
- To characterize static and dynamic loads coming on offshore structure.
- To study about general layout consideration of deck and oil & gas processing system.
- To understand method involving platform installation.
- To learn about material used in design and construction of offshore structure.

Course Content:

UNIT I HISTORICAL DEVELOPMENT OF OFFSHORE STRUCTURES: Introduction – Definition of Offshore Structures – Historical Developments – Deep water challenges, Functions of Offshore Structures, selection of Offshore Structure and its Configurations, Bottom Supported Fixed Structures, Compliant Structures, Floating Structures – Novel offshore design – Field development concepts.

UNIT 2 LOAD AND RESPONSES: Introduction, Gravity Load, Hydrostatic Loads, Resistance Loads, Current loads on Structures, Current Drag and Lift Force, Steady and Dynamic Wind Loads on Structures, Wave Loads on Structures, Varying Wind Load, Impulse loads and Introduction to design.

UNIT 3TOPSIDE FACILITIES AND LAYOUT: Introduction - General layout Considerations - Areas and Equipment - Deck Impact Loads - Deck Placement and Configuration - Float over Deck Installation - Helipad - Platform Crane - Living quarters - Oil and gas treatment - Oil and gas storage, offloading and export - Utility and process support systems - Drilling facilities

UNIT 4 OFFSHORE INSTALLATION: Introduction – Installation of Fixed Platform Substructures - Floating Structures – Foundations - Subsea Templates – load outs - transportation - Platform Installation Methods and installation criteria – Installation of Pipelines and Risers.

UNIT 5: MATERIALS FOR OFFSHORE APPLICATIONS: Material for Construction-Structural Steel, Topside Materials, Advanced Composite materials, Corrosion Control, Material Reliability and Monitoring and Fracture Control.

Textbooks:

1. Dawson, T.H., "Offshore Structural Engineering", Prentice Hall, 1983
2. B.C Gerwick, Jr. "Construction of Marine and Offshore Structures", CRC Press, Florida, 2000.
3. Subrata K Chakrabarti, "Handbook of Offshore Engineering", Vol 1, Vol 2, Elsevier Publishers, 1 st edition, 2005.

Reference Books:

1. API RP 2A., "Planning Designing and Constructing Fixed Offshore Platforms", API
2. McClelland, B &Reifel, M.D., "Planning & Design of fixed Offshore Platforms", VanNostrand, 1986
3. Graff, W.J., "Introduction to Offshore Structures", Gulf Publ. Co. 1981.
4. Reddy, D.V &Arockiasamy, M., "Offshore Structure" Vol.1 & 2,

Course Outcomes:

CO1: To classify types of offshore structure and know its basic fundamental knowledge.
CO2: To analyze various loads and their response on the structure.
CO3: To describe process involving deck layout and oil & gas treatment.
CO4: To outline key feature of platform, foundation and pipelines installation.
CO5: To identify and select appropriate material for construction.

SYLLABUS	(SEMESTER-VIII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credit
Subject Code:	CE208TPE05B	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Surface Hydrology	3	0	0	15	15	30			

Course Learning Objectives:

- To understand the fundamentals of hydrology and concepts of watershed
- To study the analysis of rainfall and its components.
- To understand the estimation techniques of evapo-transpiration and infiltration
- To learn various types of Hydrographs and its uses.
- To know the Flood estimation and Flood routing methods

Course Content:

UNIT 1: Introduction: Scope and importance of hydrology, Hydrologic cycle, Global and India's Water resources, Applications of hydrology, Formation of precipitation, Climate and Weather seasons in India. Watershed concept and modeling: Catchment-topographic and ground water divide, Description of the catchment, catchment processes, demarking a catchment, stream patterns.

UNIT 2: Location of rain-gauges and optimum number of rain-gauges, Analysis of rainfall data, Rainfall mass curve and hyetograph, Intensity-Duration analysis, Intensity-Frequency-Duration analysis, Depth-Area-Duration analysis, Double mass curve. Abstractions from precipitation: Evaporation-Process, measurement, empirical equations and Estimation by water budget method and Energy budget method.

UNIT 3: Evapo-transpiration-AET & PET, Estimation by Penman's equation, Reference Crop Evapo-transpiration by Blaney Criddle formula, Infiltration-Process, Factor affecting infiltration, Measurement, Horton's equation and Philip's equation. Infiltration indices, Probability and Statistics-Introduction, Probability and Random variables, PDF and CDF, Distribution functions, Selection of distribution function and its parameter estimation.

UNIT 4: Hydrograph and its features, Unit hydrograph and its derivation, Unit hydrographs from complex storms and for various durations, S-curve hydrograph and its uses, Synthetic unit hydrograph.

UNIT 5: Flood: Design flood and its estimation- Rational method, Frequency analysis Gumbel's and Log-Pearson's type III distribution, Selection of design return period. Flood routing- Reservoir routing: Channel routing- Prism and Wedge storage, Muskingum method. Flood control: Structural and Non-structural measures.

Text Books:

1. Engineering Hydrology K.Subramanya, Tata McGraw-HillEducation
2. Hydrology Principles, Analysis and Design H.M.Raghunath, New AgeInternational
3. Hand BookofAppliedHydrologyV.T.Chow, McGraw-Hill Inc
4. ViessmanWandLewisGL(2008)"IntroductiontoHydrology" PrenticeHallofIndia
5. Ojha,C.S.P. Bhunya, P. and Berndtsson, R.- Engineering Hydrology, Oxford University PressCanada.
6. K. C. Patra, Hydrology and Water Resources Engg., Narosa Publishing house, New Delhi.

Course Outcomes-Upon completion of this course, students shall be able to:

CO1: Describe the basic concepts of hydrology and watershed to incorporate into physical hydrological processes.

CO2: Relate and analyze the various components involved in rainfall analysis.

CO3: Explain the various process, measurement, and estimation of hydrological components

CO4: Formulate the hydrograph's estimation and apply into engineering practices.

SYLLABUS	(SEMESTER-VIII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE208TPE05C	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Bridge Engineering	3	0	0	15	15	30			

Course Learning Objectives:

- To understand the IRC Loadings and Standards for bridge design and to know the important hydrological parameters necessary for bridge design
- To learn the design of slab bridges under various IRC loading cases
- To understand the behaviour of T-beam slab bridge and the design of T-beam bridges
- To evaluate the stresses due to various loads and design of RCC box-culverts
- To study the various forces acting on bridge piers and abutments and the design of abutment and bridge piers

Course Content:

UNIT-1: Brief historical review, Different types of Bridges and span range, Bridge codes, Importance of hydrologic factors in bridge design, Hydraulic geometry, linear water ways, economic span, afflux and scour.

UNIT-2: Design of Reinforced concrete deck slab bridges.

UNIT-3: Design of Reinforced Concrete Tee beam bridges.

UNIT-4: Design of Box culverts.

UNIT-5: Design of Piers and Abutments.

Text Books:

1. Xanthakos, P. P. (1993) Reinforced Concrete Bridges, in Theory and Design of Bridges, John Wiley & Sons, Inc., Hoboken, NJ, USA. doi: 10.1002/9780470172889.ch3
2. Design of Bridge Structures by M A Jayaram, Prentice-Hall Of India Pvt. Limited, 01-Aug-2004 - Bridges - 292 pages
3. Design of Bridges by N. Krishna raju , Oxford and IBH Publishing, ISBN 8120417410, 9788120417410
4. Essentials Of Bridge Engineering, 6/E, Victor , Oxford and IBH Publishing, 2007, ISBN 8120417178, 9788120417175

Course Outcome: At the end of the course the students will be able:

CO1: To explain and apply various IRC loadings as per the IRC standards in the design of bridges and also explain the importance of hydrological parameters in bridge design

CO2: To design the slab bridges under various IRC loadings

CO3: To analyse and design the T-beam girder bridges

CO4: To explain the behaviour and design the box-culverts

CO5: To describe the various forces to be considered on pier and abutment and design the bridge abutments and piers

SYLLABUS	(SEMESTER-VIII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE208TPE05D	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Traffic Engineering	3	0	0	15	15	30			

Course Objectives:

- To develop the basic knowledge of Traffic Engineering.
- To define Traffic flow characteristic.
- To develop knowledge about traffic control system.
- To understand the parking and highway lighting
- To develop the knowledge of different pollution occurring and its remedial measures.

Course Content:

UNIT 1: Introduction To Traffic Engineering-Definition and Scope of Traffic Engineering. Functions, Organization and Importance of Traffic Engineering. Elements of Traffic Engineering: Vehicular, Driver and Road Characteristics.

UNIT 2: Traffic Flow Parameters -Traffic flow parameters: volume, density, speed and related terms, Relationship between various parameters, Study and analysis of vehicle arrivals, headways, and gap acceptance in traffic flow. Highway Capacity and Level of Service.

UNIT 3: Traffic Control-Definition, functions and importance of traffic control. Methods of traffic control: Traffic signs, Road Markings, and other traffic controls aids. Traffic Regulation. Intersection control and design of traffic signals.

UNIT 4: Parking- Parking survey, types of parking, design of parking places. Lighting-Lumen arrangement, Types of lamp

UNIT 5: Traffic and Environment- Pollution problems of cities, Detrimental effects of traffic on environment, Noise pollution, Air pollution, Vibration, Environmental Impact Assessment.

Text Books:

1. Kadialy L.R., "Traffic Engg. and Transport Planning", 8th edition, Khanna Publishers.
2. Parthachakrobarty&Animesh Das, "Principles of Transportation Engineering", PHI.
3. C. JotinKhisty, B. Kent Lal, "Transportation Engineering – An Introduction", PHI.

Course Outcomes:

At the end of this course the student will be able to

CO1: Estimate the basic characteristics of traffic stream

CO2: Conduct traffic flow studies and analyze traffic data

CO3: Design traffic signal systems

CO4: Analyse the parking and highway lighting

CO5: Manage controlling the different pollution occurring in road.

SYLLABUS	(SEMESTER-VIII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE208TPE05E	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Construction Equipment & Automation	3	0	0	15	15	30			

Course Learning Objectives:

- To understand the factor for equipment selection and cost of owning and operating.
- To expertise in evaluation and analysis of different equipment life.
- To learn the engineering fundamentals of excavating equipments.
- To learn fundamentals of the pile driving and lifting equipments.
- To understand the concreting equipments and techniques and the advanced instruments like GIS etc. In construction.

Course Content:

UNIT 1: Introduction to course & Planning Process of Equipment Factors affecting equipment selection.Cost of Owning and Operating Construction Equipment Elements of ownership cost, Depreciation accounting methods, Cost Estimation using Average Annual Investment method. Use of compounding factors in Equipment cost estimation based on time value method, Operating cost components, Caterpillar method and Peurifoymethod.

UNIT 2: Equipment life and replacement analysis determination of economic life of equipment. Minimum cost method, Maximum profit method, Time value concept

UNIT3: Engineering Fundamentals of Moving Earth Machine Performance-Required power, Available power, Usable power, Performance chart.
Earthmoving and Excavating equipment Bull Dozers, Scrapers, Front end loaders, Excavators, Trucks, Productivity estimation and balancing of interdependant machines

UNIT 4 Piles and Pile driving equipment Pile types, pile hammers, principle of pile hammer, factors affecting pile hammer selection, Types of pile hammer: Drop hammer, Single acting and double acting steam hammers, Diesel hammers, Vibratory pile drivers.
Lifting equipment Cranes, Principles of lifting mechanism of crane, types of cranes-lattice boom crawler crane, lattice boom truck mounted cranes, telescopic boom crane, Tower cranes, Factors affecting lifting capacity of crane, Range diagram.

UNIT 5 Concreting equipment Steps in concrete making process, types of concrete mixer machines, Methods of handling and transporting concrete, Consolidation of concrete, Methods of finishing and curing of concrete.
Aerial and Satellite Surveying: GIS and GPS in Construction; use of Drones for spread out sites; Use of robots for repetitive activities.

Reference Books:

1. Construction Planning and Equipment - R.L.Peurifoy - Tata McGraw Hill, New Delhi
2. Construction Equipment & Planning and Application. - Mahesh VermaArtec Publication.
3. GPS satellite surveying- Alfred Leick, Wiley

Course Outcomes- At the end of the course students will be able to:

CO1: To apply the knowledge in equipment selection and able to find cost of owning and operating.
CO2: To find the equipment life, which help in comparisons of different equipments.
CO3: To select the earth excavating equipment on the basis of output and different selection factors.
CO4: To decide the pile driving equipment and lifting equipment based on safe working load determination
CO5: To decide the concreting equipment based on the construction project and relate the knowledge on Surveying to the new frontiers of science like GIS, GPS and Remote Sensing.

SYLLABUS	(SEMESTER-VIII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE208TPE06A	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Low Cost Housing Techniques	3	0	0	15	15	30			

Course Learning Objectives:

- To introduce various housing technique adopted in different zones in country.
- To study various uses of cost effective Technologies.
- To learn needs and innovations of building techniques for low cost construction.
- To learn space norms for low cost construction.
- To learn about building materials and costing of low cost construction.

Course Content:

UNIT-1An introduction to the subject to understand the various building techniques adopted in different climatic zones of the country, which resulting in varied vernacular expressions.

UNIT–2Use of cost effective technologies through the use of local materials, up gradation of traditional technologies, prefabrication etc.

UNIT-3 Need for low cost construction, both in the rural and the urban sectors. Innovations of building techniques for low cost construction.

UNIT- 4 Analysis of space norms for low cost buildings. Study of usages pattern of low cost buildings by the habitants.

UNIT- 5Comparative analysis of building materials and costing.Works of Laurie Baker, Hassan Fathy and other prominent architects.

Text Books:

1. "Building Systems for Low Income Housing", Ashok Kumar Jain; Management Publishing House, 1992
2. "Low Cost Housing in Developing Countries", Guru Charan Mathur; For Centre for Science & Technology of the Non-Aligned and Other Developing Countries, Oxford & IBH Publishing Company, 1993

Course outcomes:

Upon completion of this course students will be able to

CO1: To classify various housing techniques adopted in different zones in country.

CO2: To identify various uses of cost effective Technologies.

CO3: To understand needs and develop innovations of building techniques for low cost construction.

CO4: To explain space norms for low cost construction.

CO5: To analysis about building materials and costing of low cost construction.

SYLLABUS	(SEMESTER-VIII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE20STPE06B	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Water and Air Quality Modelling	3	0	0	15	15	30			

Course Objectives:

- Understand the idea, methodology and basic tools of water and air quality modelling
- Understand the different modelling approaches, their scope and limitations.
- Understand the fate and transport of pollutants in different water bodies and ambient air.
- Become mindful of a wide range of applications of modelling for the water quality and air pollution.
- Understand Water quality indexing parameters and its application.

COURSE CONTENT:

UNIT I MODELING CONCEPTS: Causal and statistical models-Characteristics- Steps in model development - Importance of model building. - conservation of mass and mass balance – calibration and verification of models; Transport phenomena – Advection, diffusion, dispersion, simple transport models; chemical reaction kinetics – Law of mass action, Rate constants, reaction order, types of reactions, equilibrium principles.

UNIT II WATER QUALITY MODELING: Water quality models – Historical development – Mass balance equation – Streeter - Phelps Equation – Modification to Streeter – Phelps Equation – Waste load allocations – Dissolved oxygen in Rivers and estuaries; Lake Water Quality Models; Models for Nitrogen, Bacteria, Phosphate and toxicants - Ground Water Quality Modeling - Contaminant solute transport equation, Numerical methods.

UNIT III AIR POLLUTION MODELING: Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution – Transport of air Pollutants - Meteorological settling for disperal of air pollutants – Vertical structure of temperature and stability, atmospheric motions, Wind and shear, self-cleaning of atmosphere; transport and diffusion of stack emissions – atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics.

UNIT IV AIR QUALITY MODELS: Types of modeling technique, modeling for non-reactive pollutants, single source, short term impact, multiple sources and area sources, Fixed box models- diffusion models – Gaussian plume derivation-modifications of Gaussian plume equation- long term average-multiple cell model- receptor oriented and source-oriented air pollution model performance, accuracy and utilization.

UNIT V Water Quality Index: Categories of water quality index. Determination of water quality index (WQI): Industrial and municipal effluent index, ambient water quality index, combined water quality index and Delphi method. Air Quality Index: Categories of air quality index. Determination of air quality index (AQI): National AQI, Extreme value indices, regional indices.

Reference Books:

1. Arthur C. Stern, Air Pollution, Air Pollutants, their transformation and Transport, (Ed.), (Third Ed.) Volume I , Academic Press, 2006.
2. Chapra, S.C. Surface Water-Quality Modelling, McGraw-Hill, International Edition, 2008
3. Deaton and Wine Brake, Dynamic Modeling of Environmental Systems, Wiley & Sons, 2002
4. E.V. Thomson, Principles of Surface Water Quality Modeling and Control, Happer and Row Publishers New York, 1987.
5. Hadlock, C.R., Mathematical Modelling in the Environment. The Mathematical Association of America.
6. Rastogi A.K. (2008) Numerical Groundwater Hydrology, Penram International Publishing Pvt. Ltd., Bombay.
7. Steven C. Chapra, Surface Water Quality Modeling, Tata McGraw-Hill Companies, Inc., New Delhi, 1997.
8. Wainwright, J and Mulligan, M., Environmental Modelling Finding simplicity in complexity, John Wiley and Sons Inc., New York, 2013.

Course outcomes:

CO1: To provide basic knowledge on mathematical and statistical concepts required for mode development.
CO2: To Develop models based on the mass-balance approach
CO3: To Perform data exploration and visualization
CO4: To Predict the impact of the of external waste loading on different water bodies
CO5: To Design and model of air & water quality and its applicability in the Control of pollution
CO6: To Determine and evaluate the water quality index

SYLLABUS	(SEMESTER-VIII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE208TPE06C	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Repair and Rehabilitation of Structures	3	0	0	15	15	30			

Course learning objectives:

- To learn about various distress and damages in concrete and steel structures.
- To learn about assess the damage to structures using various methods.
- To study the various methods of rehabilitation.
- To study the various methods of repairs of structures.
- To learn importance of repair and maintenance of structures.

Course Content:

UNIT 1: Aging of structures – performance of structures – need for rehabilitation. Distress in concrete / steel structures – damage – source – cause – effects – case studies.

UNIT 2: Damage assessment and Evaluation models – Damage testing methods – NDT – Core samples.

UNIT 3: Rehabilitation methods – grouting – detailing – imbalance of structural stability – case studies.

UNIT 4: Methods of repairs – shotcreting – guniting – epoxy – cement mortar injection – crack ceiling.

UNIT 5: Repair and maintenance of buildings – IS standards – Bridge repairs – Seismic strengthening.

Reading/Textbooks:

1. Diagnosis and treatment of Structures in Distress – R.N Raikar.
2. Bridge Rehabilitation – V K Raina.
3. Building Failures – Diagnosis and Avoidance – W H Ranson.
4. Forensic Engineering – Kennethe and Carper.

Course outcomes:

Upon completion of this course students will be able to:

CO1: Analyze distress and damages in concrete and steel structures.

CO2: Understand about assess the damage to structures using various methods.

CO3: Classify the various methods of rehabilitation.

CO4: Classify the various methods of repairs of structures.

CO5: Understand the importance of repair and maintenance of structures.

SYLLABUS	(SEMESTER-VIII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE208TPE06D	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Finite Element Analysis	3	0	0	15	15	30			

Course Objectives:

- To introduce the fundamentals of FEM,
- Understand how it works,
- Implement (code) the method,
- Understand the capabilities of FEM

Course Content:

UNIT 1: Matrix Methods of Structural Analysis – Review of concepts – Actions and displacements – compatibility – indeterminacy – Member and joint loads – Flexibility Matrix formulation - Stiffness Matrix formulation.

UNIT 2: Analysis of Beams- Finite Element formulation and Analysis of beams by Finite Element method.

UNIT 3: Analysis of Rigid Jointed Plane Frame- Finite Element formulation and Analysis of rigid jointed plane frame by Finite Element method.

UNIT 4: Analysis of Pin Jointed Plane Frame- Finite Element formulation and Analysis of pin jointed plane frame by Finite Element method.

UNIT 5: Introduction to Plate and Shell Elements:- Analysis of plane stress / strain and ax symmetric solids- triangular, quadrilateral and isoperimetric elements, Analysis of plate bending, basic equations of thin plate theory, Reissinner-Mindlin theory, plate elements and applications. Analysis of shells, degenerated shell elements.

Text Books:

1. Chandrupatla T.R., Belegundu A.D., Introduction to Finite Elements in Engineering, Prentice Hall of India Private Limited, New Delhi.
2. Desai C.S., Abel J.F., Introduction to the Finite Element Method, CBS Publishers & Distributors, Delhi.

Reference Books:

1. Krishnamurthy, C.S., Finite Element Analysis – Theory and Programming, Tata McGraw Hill Publishing Company Limited, New Delhi.
2. Finite Element Analysis – Theory and Programming by Cook R.D. et.al., Concepts and Applications of Finite Element Analysis, John Wile

Course outcomes:

Upon successful completion of this course, you should be able to:

CO1: Understand the concepts behind formulation methods in FEM.

CO2: Identify the application and characteristics of FEA elements such as bars, beams, plane.

CO3: Analyze the rigid and pin jointed plane frame using finite element method.

SYLLABUS	(SEMESTER-VIII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE208TPE06E	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Design of Hydraulic Structures	3	0	0	15	15	30			

Course Learning Objectives:

- Recognise the different types of dams, identify its purpose and function and to select the most appropriate dam.
- To introduce and give explanation the Principles of Design of Hydraulic Structures.
- To develop understanding for Analysis of gravity dam.
- To develop understanding about Earth dam and stability analysis.
- To introduce the importance of Spillways and energy dissipation systems.

Course Content:

UNIT 1: Introduction - Classification of dams, Gravity dams, Earth dams, Arch dam, Buttress dam, Steel dams, Timber dams, selection of site for dam, selection of type of dam, investigations of dam sites, Engineering surveys, Geological investigations, Types of hydropower plants, site selection for power plant, General arrangement of a hydropower project.

UNIT 2: Principles of Design of Hydraulic Structures - Hydraulic structures on permeable foundations, Theories of subsurface floor, Khosla's method of independent variables, Exit gradient, Location of Hydraulic jump, water surface profiles, scour due to subsurface flow, Design Principles, Energy dissipation principles.

UNIT 3: Gravity Dams - Types of storage head works, Forces acting on gravity dams, Analysis of gravity dams, Profile of a gravity dam, Finite Element Method, Design of gravity dam, joints in gravity dam, Galleries in gravity dam, Adits and shafts, Construction of gravity dam, Foundation Grouting, Instrumentation of gravity dams.

UNIT 4: Earth dams - Types of earth dams, Causes of failure of earth dams, Seepage analysis, phreatic line, flow net construction, criteria for safe design of gravity dams, typical cross sections of earth dams, Stability analysis, Seepage control, and design of filters.

UNIT 5: Spillways and energy dissipation systems - Essential requirements of spillways, Required spillway capacity, component parts of spillway, Types of spillways, Design of Ogee spillway, Design of shaft spillway, Design of siphon spillway, Design of stilling basins. Hydropower structures - Storage power plant, Runoff River plant, Pumped storage plant, Water conveyance systems, Tunnels and Penstocks, Gates, Surge tanks, Power house layout.

Text Books:

1. Golze, A. R., Handbook of Dam Engineering, Von Rostrand Reinhold Co., 1977
2. Sharma, H.D., Concrete Dams, CBIP Publication, 1998.
3. Siddiqui, I H, Dams and Reservoirs: Planning, Engineering, Oxford University Press, USA, 2009.
4. Novak, P., Moffat, A. I. B., Nalluri, C and Narayan, R., Hydraulic Structures, Taylor & Francis, 2006.
5. Modi P.M., Irrigation Water Resources and Hydropower Engineering, Standard Publishing Company, New Delhi, 2000.
6. Arora K.L. Irrigation Water Resources Engineering, Standard Book Publishing Co., Delhi, 1996.

Course Outcomes-

CO1: Define different types of dams.
CO2: Describe the Principles of Design of Hydraulic Structures.
CO3: Explain the concept of Gravity Dams.
CO4: Explain the concept of Earth dams and its stability analysis.
CO5: Describe the concept of spillways and energy dissipation systems.

SYLLABUS	(SEMESTER-VIII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE208TOE03	L	T	P	CT-I	CT-II	TOTAL	70	100	03
Subject:	Infrastructure Planning and Management	3	0	0	15	15	30			

Course Learning Objectives:

The students will be able to:

- Understand and explain concepts of infrastructure
- Understand private involvement in infrastructure
- Learn about challenges to successful infrastructure planning and implementation
- Study strategies for successful infrastructure project implementation
- Understand sustainable development of infrastructure

Course Content:

UNIT I AN OVERVIEW OF BASIC CONCEPTS RELATED TO INFRASTRUCTURE: Introduction to Infrastructure, an overview with regards to Indian sectors(i) Power Sector , (ii) Water Supply and Sanitation Sector in India., (iii) Road, Rail, Air and Port Transportation Sectors, (iv) Telecommunications , (v) Urban Infrastructure ,(vi) Rural Infrastructure.

An Introduction to Special Economic Zones, Organizations and layers in the field of Infrastructure, The Stages of an Infrastructure Project Lifecycle.

UNIT II PRIVATE INVOLVEMENT IN INFRASTRUCTURE: A Historical Overview of Infrastructure Privatization. The Benefits of Infrastructure Privatization, Problems with Infrastructure Privatization, Challenges in Privatization of Water Supply, Privatization of Infrastructure in India.

UNIT III CHALLENGES TO SUCCESSFUL INFRASTRUCTURE PLANNING AND IMPLEMENTATION: Mapping and Facing the Landscape of Risks in Infrastructure Projects, Economic and Demand Risks, Socio-Environmental Risks, Cultural Risks in International Infrastructure Projects, Legal and Contractual Issues in Infrastructure, Challenges in Construction and Maintenance of Infrastructure.

UNIT IV STRATEGIES FOR SUCCESSFUL INFRASTRUCTURE PROJECT IMPLEMENTATION: Risk Management Framework for Infrastructure Projects, Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Introduction to Fair Process and Negotiation, Negotiating with multiple Stakeholders on Infrastructure Projects.

UNIT V SUSTAINABLE DEVELOPMENT OF INFRASTRUCTURE: Information Technology and Systems for Successful Infrastructure Management, - Innovative Design and Maintenance of Infrastructure Facilities, Infrastructure Modeling and Life Cycle Analysis Techniques, Capacity Building and Improving the

Government Role in Infrastructure Implementation, An Integrated Framework for Successful Infrastructure Planning and Management - Infrastructure Management Systems and Future Directions.

TEXT BOOKS

1. Grigg, Neil, Infrastructure engineering and management, Wiley, (1988).

2. Haas, Hudson, Zaniewski, Modern Pavement Management, Krieger, Malabar, (1994).

3. Hudson, Haas, Uddin, Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation, McGraw Hill, (1997).

Course Outcomes:-

After course completion the students shall be able to:

CO1: Explain the basic concepts related to Infrastructure Projects
CO2: Explain the role of private sector in infrastructure growth.
CO3: Describe the strategies for successful Infrastructure Project implementation.
CO4: Develop Infrastructure modeling and Life Cycle Analysis Techniques.
CO5: Explain Sustainable development of Infrastructure

SYLLABUS	(SEMESTER-VIII)	Periods/ Week			Internal Assessment (IA)			ESE	Grand Total	Credits
Subject Code:	CE208PPC12	L	T	P	CT-I	CT-II	TOTAL	20	50	1
Subject:	Structural Detailing Lab	0	0	2	-	-	30			

Course Learning Objective:

- To learn detailing of structural steel members (tension & compression member, steel connection)
- To study in detail and draw components of industrial building.
- To understand reinforcement detailing of RCC beams and column footings.
- To know about distribution of reinforcement in slab, stair case, water tank and retaining wall.

Course Content:

Part A: (Steel Structures)

1. Detailing of Tension Members.
2. Detailing of Built-up Compression Members.
3. Detailing of Column Bases.
4. Detailing of connections.
5. Detailing of an Industrial shed.
6. Detailing of a Plate girder/Gantry girder.

Part B: (Reinforced Concrete Structures)

1. Details of reinforcement in RCC Continuous Beams.
2. Details of reinforcement for RCC column with isolated footings.
3. Details of reinforcement in a one way/two-way slabs.
4. Details of reinforcement in staircases.
5. Detailing of Combined footings.
6. Detailing of Retaining walls/Water Tanks.

Course Outcome:

CO1: To sketch detailed drawing of structural steel beams, columns and connections.

CO2: To understand design components of industrial shed and gantry girder.

CO3: To sketch reinforcement detailing of RCC member as per IS code provision.

CO4: To draw accurate arrangement of reinforcement in slab, staircase, water tank and retaining wall.

M. Tech. Structural Engineering

Semester-I

Subject: **Advanced Structural Analysis**

Type: Core-I

Teaching Scheme: Lectures: 3 hours/week

Credits			
L	T	P	Total
3	0	0	3

Course Objectives: **The course is aimed**

1 To impart knowledge on the analysis of structures by stiffness analysis.

2 To introduce the limitations of direct stiffness method.

Course outcomes: **At the end of the course, students will be able to**

1 Analyze the skeleton structures using stiffness analysis code.

2 Use direct stiffness method understanding its limitations

Syllabus Contents:

- Influence Coefficients: Physical Significance, Effects of Settlements, Temperature Change and Lack of Fit, Member Approach and Structure Approach.
- Stiffness Method applied to Large Frames: Local Coordinates and Global Coordinates.
- Stiffness Matrix Assembly of Structures: Stiffness Matrix in Global Coordinates, Boundary Conditions, Solution of Stiffness Matrix Equations, Calculation of Reactions and Member Forces.
- Applications to Simple Problems: Beams, Plane Trusses, Plane Rigid Jointed Frames and Grids by Structure Approach and Member Approach.
- Boundary Value Problems (BVP): Approximate Solution of Boundary Value Problems, Modified Galerkin Method for One-Dimensional BVP, Matrix Formulation ofthe Modified Galerkin Method.
- Linear Element: Shape Functions, Solution for Poisson's Equation, General One Dimensional Equilibrium Problem.

References:

- Matrix Analysis of Framed Structures, Weaver and Gere.
- The Finite Element Method, Lewis P. E. and WardJ. P., Addison-Wesley Publication Co.
- Computer Methods in Structural Analysis, MeekJ. L., E and FN, Span Publication.
- The Finite Element Method, Desai and Abla, CBS Publication.

Subject:	Advanced Solid Mechanics	Credits			
Type:	Core-II	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce the basic concepts and problems of elasticity and plasticity.

2 To Emphasize on numerical methods to solve continuum problems

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

1 Solve simple problems of elasticity and plasticity understanding the basic concepts.

2 Apply numerical methods to solve continuum problems

Syllabus Contents:

- Introduction to Elasticity: Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity.
- Strain and Stress Field: Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components.
- Equations of Elasticity: Equations of Equilibrium, Stress- Strain relations, Strain Displacement and Compatibility Relations, Boundary Value Problems, Co-axiality of the Principal Directions.
- Two-Dimensional Problems of Elasticity: Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.
- Torsion of Prismatic Bars: Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes.
- Plastic Deformation: Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.

References:

- Theory of Elasticity, Timoshenko S. and Goodier J. N., McGraw Hill, 1961.
- Elasticity, Sadd M. H. Elsevier, 2005.
- Engineering Solid Mechanics, Ragab A. R., Bayoumi S.E., CRC Press, 1999.
- Computational Elasticity, Ameen M., Narosa, 2005.
- Solid Mechanics, Kazimi S. M. A., Tata McGraw Hill, 1994.
- Advanced Mechanics of Solids, Srinath L.S., Tata McGraw Hill, 2000.

Subject: **Theory of Thin Plates and Shells**

	Credits			
	L	T	P	Total
Type: Program Elective (I)				
Teaching Scheme: Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To learn the analysis of thin plates and shells.

2 To introduce the numerical techniques for analysis of complex problems in thin plates and shells.

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

1 Use analytical methods for the solution of thin plates.

2 Use analytical methods for the solution of shells

3 Apply the numerical techniques and tools for the complex problems in thin plates.

4 Apply the numerical techniques and tools for the complex problems in shells.

Syllabus Contents:

- Introduction: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions.
- Static Analysis of Plates: Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.
- Circular Plates: Analysis under Axi- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates, Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.
- Static Analysis of Shells: Membrane Theory of Shells - Cylindrical, Conical and Spherical Shells.
- Shells of Revolution: with Bending Resistance - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels.
- Thermal Stresses in Plate/ Shell

References:

- Theory of Plates and Shells, Timoshenko S. and Krieger W., McGraw Hill.
- Stresses in Plates and Shells, Ugural Ansel C., McGraw Hill.
- Thin Elastic Shells, Kraus H., John Wiley and Sons.
- Theory of Plates, Chandrashekhara K., Universities Press.
- Design and Construction of Concrete Shells, Ramaswamy G.S.

Subject:	Theory and Applications of Cement Composites	Credits			
Type:	Program Elective (I)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: **The course is aimed**

1 To introduce the constitutive behaviour of composite materials and enable the student for its classification.

2 To emphasize the theories applicable to composite materials.

3 To impart the analysis and design of structural elements made of cement composites.

Course outcomes: **At the end of the course, students will be able to**

1 Formulate constitutive behaviour of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete - by understanding their strain- stress behaviour.

2 Classify the materials as per orthotropic and anisotropic behaviour.

3 Estimate strain constants using theories applicable to composite materials.

4 Analyse and design structural elements made of cement composites.

Syllabus Contents:

- Introduction: Classification and Characteristics of Composite Materials- Basic Terminology, Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.
- Mechanical Behaviour: Mechanics of Materials Approach to Stiffness- Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness.
- Cement Composites: Types of Cement Composites, Terminology, Constituent Materials and their Properties, Construction Techniques for Fibre Reinforced Concrete - Ferrocement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing.
- Mechanical Properties of Cement Composites: Behavior of Ferrocement, Fiber Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.
- Application of Cement Composites: FRC and Ferrocement- Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behaviour, Constitutive relationship, Elastic Constants.
- Analysis and Design of Cement Composite Structural Elements - Ferrocement, SIFCON and Fibre Reinforced Concrete.

References:

- Mechanics of Composite Materials, Jones R. M., 2nd Ed., Taylor and Francis,BSP Books, 1998.
- Ferrocement – Theory and Applications, Pama R. P., IFIC, 1980.
- New Concrete Materials, Swamy R.N., 1stEd., Blackie, Academic and Professional, Chapman & Hall, 1983.

Subject:	Theory of Structural Stability	Credits			
Type:	Program Elective (I)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: **The course is aimed**

1 To learn the concepts to evaluate stability of columns, frames, beams and plates

2 To emphasize the stability criteria for discrete and continuous systems

Course outcomes: **At the end of the course, students will be able to**

1 Determine stability of columns and frames

2 Determine stability of beams and plates

3 Use stability criteria and concepts for analysing discrete and continuous systems

Syllabus Contents:

- Criteria for Design of Structures: Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, Linear and nonlinear behaviour.
- Stability of Columns: Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling.
- Stability of Frames: Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members.
- Stability of Beams: lateral torsion buckling.
- Stability of Plates: axial flexural buckling, shear flexural buckling, buckling under combined loads.
- Introduction to Inelastic Buckling and Dynamic Stability.

References:

- Theory of elastic stability, Timoshenko and Gere, Tata Mc Graw Hill,1981
- Principles of Structural Stability Theory, Alexander Chajes, Prentice Hall, New Jersey.
- Structural Stability of columns and plates, Iyengar, N. G. R., Eastern west press Pvt. Ltd.
- Strength of Metal Structures, Bleich F. Bucking, Tata McGraw Hill, New York

Subject:	Structural Optimization	Credits			
Type:	Program Elective (II)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To formulate structural optimization problems in the framework of calculus of variations as well as finite-variable optimization

2 To become familiar with principles of structural optimization and be able to solve them analytically when it is possible and computationally in most cases.

3 To learn the contemporary literature on structural optimization in general and topology optimization in particular.

Course Outcomes: At the end of the course, students will be able to

1 Use Variational principle for optimization

2 Apply optimization techniques to structural steel and concrete members.

3 Design using frequency constraint.

Syllabus Contents:

- Introduction: Simultaneous Failure Mode and Design, Classical External Problems.
- Calculus of Variation: Variational Principles with Constraints.
- Linear Programming, Integer Programming, Nonlinear Programming, Dynamic Programming.
- Geometric Programming and Stochastic Programming.
- Applications: Structural Steel and Concrete Members, Trusses and Frames.
- Design: Frequency Constraint, Design of Layouts.

References:

- Variational methods for Structural optimization, Cherkaev Andrej, Springer.
- Haftka, R. T. and Gurdal, Z., "Elements of Structural Optimization," Kluwer Academic Publishers, 1992.
- Bendsoe, M. P. and Sigmund, O., "Topology Optimization: Theory, Methods, and Applications," Springer, 2003.
- Haug, E. J., Choi, K. K., and Komkov, V., "Design Sensitivity Analysis of Structural Systems," Academic Press, 1986.
- NPTEL MOOC: https://nptel.ac.in/courses/112/108/112108201

Subject:	Advance Concrete Technology	Credits			
Type:	Program Elective (II)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To make students understand concrete admixtures, non-destructive testing, semi-destructive testing, special concrete.

2 To familiarize students with structure of hydrated cement paste, types of cement, cement production quality control.

3 To make students learn transition zone in concrete, measurement of workability, properties of concrete, concrete mix design

4 To make students understand causes of concrete deterioration, permeability of concrete, durability of concrete, alkali aggregation reaction.

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

1 To understand concrete technology, admixtures, non-destructive testing, semi destructive testing, special concrete.

2 To be familiar with structure of hydrated cement paste, types of cement, cement production quality control.

3 To learn transition zone in concrete, measurement of workability, properties of concrete, rheological behaviour of concrete, economic concrete mix design

4 To be exposed to strength-porosity relationship, failure modes in concrete, elastic behaviour in concrete, ageing properties and long term behaviour

5 To better understand the causes of concrete deterioration, permeability of concrete, durability of concrete, alkali aggregation reaction.

Syllabus Contents:

Introduction to concrete – Mineral and chemical admixtures – Structure of hydrated cement paste – Calcium Aluminate Cement – Cement Production quality control - Transition zone in concrete – measurement of workability by quantitative empirical methods – concrete properties: setting and hardening.
Concrete Design mix for higher grades. Strength-Porosity relationship – Failure modes in concrete – plastic and thermal cracking – maturity concept to estimate curing duration - Elastic behavior in concrete- Creep, shrinkage and thermal properties of concrete.
Classification of causes of concrete deterioration – Permeability of concrete – durability concept: pore structure and transport process - Alkali-aggregate reactivity.
Non-Destructive testing methods - Semi-destructive testing methods. Concreting under special circumstances – Special materials in construction – Concreting machinery and equipment – Sustainability in concrete - Future trends in concrete technology

References:

- P. Kumar Metha and Paulo J. M. Monteiro., Concrete: Microstructure, Properties and Materials, Mc Graw Hill, Fourth Edition, 2014.
- John Newman and Ban Seng Choo, Advanced Concrete Technology Part 1 to 4, utterworth-

Subject:	Advanced Steel Design	Credits			
Type:	Program Elective (III)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: **The course is aimed**

1 To recognize limit states and failure modes in structural steel members and systems

2 To study the design specification and codes for steel structures, and understand their basis in mechanics, testing, and analysis.

3 To learn the design of steel and composite members and connections with an understanding of their limit states / failure modes and current design specifications / codes.

Course outcomes: **At the end of the course, students will be able to**

1 Design steel structures/ components by different design processes

2 Analyze and design beams and columns for stability and strength, and drift.

3 Design welded and bolted connections

Syllabus Contents:

- Properties of Steel: Mechanical Properties, Hysteresis, Ductility. Hot Rolled Sections: compactness and non-compactness, slenderness, residual stresses.
- Design of Steel Structures: Inelastic Bending Curvature, Plastic Moments, Design Criteria Stability, Strength, Drift.
- Stability of Beams: Local Buckling of Compression Flange & Web, Lateral Torsional Buckling.
- Stability of Columns: Slenderness Ratio, Local Buckling of Flanges and Web, Bracing of Column about Weak Axis.
- Method of Designs: Allowable Stress Design, Plastic Design, Load and Resistance Factor Design.
- Strength Criteria: Beams - Flexure, Shear, Torsion, Columns - Moment Magnification Factor, Effective Length, PM Interaction, Biaxial Bending, Joint Panel Zones.
- Drift Criteria: P Effect, Deformation Based Design.
- Connections: Welded, Bolted, Location Beam Column, Column Foundation, Splices.

References:

- Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
- Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee.
- The Steel Skeleton- Vol. II, Plastic Behaviour and Design - Baker J. F., Horne M. R., Heyman J., ELBS.
- Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London.
- IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.
- SP – 6 - Handbook of Structural Steel Detailing, BIS,1987

Subject: **Design of Formwork**

Type:	Program Elective (III)	Credits L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: **The course is aimed**

1 To study the various form work materials.

2 To introduce the concepts of design of various form works.

3 To learn the failure case studies of form work.

Course outcomes: **At the end of the course, students will be able to**

1 Select proper formwork, accessories and material.

2 Design the form work for Beams, Slabs, columns, Walls and Foundations.

3 Design the form work for Special Structures.

4 Understand the working of flying formwork

5 Judge the formwork failures through case studies.

Syllabus Contents:

- Introduction: Requirements and Selection of Formwork.
- Formwork Materials- Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork Supports.
- Formwork Design: Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.
- Formwork Design for Special Structures: Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.
- Flying Formwork: Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre- and Post-Award.
- Formwork Failures: Causes and Case studies in Formwork Failure, Formwork Issues in Multi-Story Building Construction

References:

- Formwork for Concrete Structures, Peurify, Mc Graw Hill India, 2015.
- Formwork for Concrete Structures, Kumar Neeraj Jha, Tata McGraw Hill Education, 2012.
- IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.

Subject: **Design of High Rise Structures**

Credits			
L	T	P	Total
3	0	0	3

Type: Program Elective (III)

Teaching Scheme: Lectures: 3 hours/week

Course Objectives: **The course is aimed**

1 To Introduce the design of Transmissions towers, masts.

2 To study the design of RC and/or Steel Chimneys.

3 To learn the analysis and design of tall buildings.

Course outcomes: **At the end of the course, students will be able to**

1 Analyse, design and detail Transmission/ TV tower, Mast and Trestles with different loading conditions.

2 Analyse, design and detail the RC and Steel Chimney.

3 Analyse, design and detail the tall buildings subjected to different loading conditions using relevant codes.

Syllabus Contents:

- Design of transmission/ TV tower, Mast and trestles: Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.
- Analysis and Design of RC and Steel Chimney, Foundation design for varied soil strata.
- Tall Buildings: Structural Concept, Configurations, various systems, Wind and Seismic loads.
- Dynamic approach, structural design considerations and IS code provisions. Firefighting design provisions.
- Application of software in analysis and design.

References:

- Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., SouthAsian Publishers, New Delhi, 2002.
- Structural Analysis and Design of Tall Buildings, Taranath B. S., Mc Graw Hill, 1988.
- Illustrated Design of Reinforced Concrete Buildings (GF+3storeyed), Shah V. L. & Karve S. R., Structures Publications, Pune, 2013.
- Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976.
- Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India. 1991.
- High Rise Building Structures, Wolfgang Schueller, Wiley. 1971.
- Tall Chimneys, Manohar S. N., Tata Mc Graw Hill Publishing Company, New Delhi

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Subject: **Advance Concrete Lab**

Credits			
L	T	P	Total
0	0	4	2

Type: Core Lab (I)

Teaching Scheme: Lectures: 2 hours/week

Course Objectives: **The course is aimed**

1 To learn the design of high grade concrete and study the parameters affecting its performance.

2 To conduct Non Destructive Tests on existing concrete structures.

3 To understand behavior of structural/ elements.

Course outcomes: **At the end of the Lab, students will be able to**

1 Design high grade concrete and study the parameters affecting its performance.

2 Conduct Non Destructive Tests on existing concrete structures.

3 Apply engineering principles to understand behavior of structural/ elements.

List of Experiments/Assignments:

- 1. Study of stress-strain curve of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
- 2. Effect of cyclic loading on steel.
- 3. Non-Destructive testing of existing concrete members.
- 4. Behavior of Beams under flexure, Shear and Torsion.

References:

- Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
- Concrete Technology, Shetty M. S., S. Chand and Co., 2006.

Semester-II

Subject: Finite Element Method in Structural Engg.

Type:	Core (III)
Teaching Scheme:	Lectures: 3 hours/week

Credits			
L	T	P	Total
3	0	0	3

Course Objectives: The course is aimed

1 To introduce the Finite Element Method for structural analysis.

2 To practice the Finite Element Program/ Software

3 To study the solutions for continuum problems using finite element analysis.

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

1 Use Finite Element Method for structural analysis.

2 Execute the Finite Element Program/ Software

3 Solve continuum problems using finite element analysis.

Syllabus Contents:

- Introduction: History and Applications, Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.
- Beam Elements: Flexure Element, Element Stiffness Matrix, Element Load Vector.
- Method of Weighted Residuals: Galerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.
- Types: Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoparametric Formulation, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature.
- Application to Solid Mechanics: Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations.
- Computer Implementation of FEM procedure, Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software.

References:

- Finite Element Analysis, Seshu P., Prentice-Hall of India, 2005.
- Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995.
- Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004.
- Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995.
- Finite Element Method, Ziemkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier, 2000.
- Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R., Prentice Hall India, 1991.

Subject: **Structural Dynamics**

Credits			
L	T	P	Total
3	0	0	3

Type: Core (IV)

Teaching Scheme: Lectures: 3 hours/week

Course Objectives: **The course is aimed**

1 To study the analysis of dynamics response of single degree freedom system using fundamental Theory and equation of motion.

2 To analyze and study the dynamics response of Multi degree freedom system using fundamental theory and equation of motion.

3 To study the use of the available software for dynamic analysis.

Course outcomes: **At the end of the course, students will be able to**

1 Analyze and study dynamics response of single degree freedom system using fundamental Theory and equation of motion.

2 Analyze and study dynamics response of Multi degree freedom system using fundamental theory and equation of motion.

3 Use the available software for dynamic analysis.

Syllabus Contents:

- Introduction: Objectives, Importance of Vibration Analysis, Nature of Exciting Forces, Mathematical Modeling of Dynamic Systems.
- Single Degree of Freedom System: Free andF orced Vibration with and without Damping, Response to Harmonic Loading, Response to General Dynamic Loading using Duhamel's Integral, Fourier Analysis for Periodic Loading, State Space Solution for Response.
- Numerical Solution to Response using Newmark Method and Wilson Method, Numerical Solution for State Space Response using Direct Integration.
- Multiple Degree of Freedom System (Lumped parameter): Two Degree of Freedom System, Multiple Degree of Freedom System, Inverse Iteration Method for Determination of Natural Frequencies and Mode Shapes, Dynamic Response by Modal Superposition Method, Direct Integration of Equation of Motion.
- Multiple Degree of Freedom System (Distributed Mass and Load): Single Span Beams, Free and Forced Vibration, Generalized Single Degree of Freedom System.
- Special Topics in Structural Dynamics(Concepts only): Dynamic Effects of Wind Loading, Moving Loads, Vibrations caused by Traffic, Blasting and Pile Driving, Foundations for Industrial Machinery, Base Isolation.

References:

- Dynamics of Structures, Clough R. W. and Penzien J., Mc Graw Hill.
- Structural Dynamics and Introduction to Earthquake Engineering, Chopra A. K.
- Vibration of Structures - Application in Civil Engineering Design, Smith J. W., Chapman and Hall.
- Dynamics of Structures, Humar J. L., Prentice Hall.
- Structural Dynamics - Theory and Computation, Paz Mario, CBS Publication.
- Dynamics of Structures, Hart and Wong.

Subject: **Design of Advanced Concrete Structures**

Type:	Program Elective (IV)	Credits L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: **The course is aimed**

1 To study the analysis of the special structures by understanding their behaviour.

2 To learn the Design and prepare detail structural drawings for execution citing relevant IS codes.

Course outcomes: **At the end of the course, students will be able to**

1 Analyse and design of the special structures by understanding their behaviour.

2 Design and prepare detail structural drawings for execution citing relevant IS codes.

Syllabus Contents:

Introduction review of basic concepts -Behaviour and Design of Reinforced Concrete members considering flexure, Torsion, combined with flexure and flexural shear, axial compression, deflection and crackwidth as per IS-456-2000 - Comparative study with BS 8110 and ACI - 318.
Design of special R.C. elements - behaviour and Design of Slender Columns - Design of R.C.Walls - Ordinary and Shear walls - Design of Corbels - Deep beams and grid floors.
Limit Analysis of Concrete beams - moment - rotation curves - moment redistribution in continuous beams - Baker's method of plastic design - Design of cast in - situ frames.
Flat slabs and flat plates - Design of flat slabs and flat plate - According to ACI method - Design of shear - Reinforcement and Edge (Spandrel) beams - yield line theory & Hiller borg method of design of slabs.
Design and detailing of structures - Detailing for ductility - Fire Resistance of buildings - Field control of concrete - Strengthening of existing structures - Design and detailing of structures according to different codes

References:

- Reinforced Concrete Design, Pillai S. U. and Menon D., Tata McGraw-Hill, 3rd Ed, 1999.
- Reinforced Concrete Structures, Park R. and Paulay T., John Wiley & Sons, 1995.
- Advanced Reinforced Concrete Design, Varghese P. C., Prentice Hall of India, New Delhi.
- Unified Theory of Concrete Structures, Hsu T. T. C. and Mo Y. L., John Wiley & Sons, 2010.

Subject: **Advanced Design of Foundations**

Credits			
L	T	P	Total
3	0	0	3

Type: Program Elective (IV)

Teaching Scheme: Lectures: 3 hours/week

Course Objectives: The course is aimed

1 To learn the suitability of soil strata for different projects.

2 To study the designs of shallow foundations deciding the bearing capacity of soil.

3 To introduce the Analysis and design of pile foundation, well foundations.

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

1 Decide the suitability of soil strata for different projects.

2 Design shallow foundations deciding the bearing capacity of soil.

3 Analyze and design the pile foundation

4 Understand analysis methods for well foundation.

Syllabus Contents:

- Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings along with Various Penetration Tests.
- Shallow Foundations, Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Law's.
- Pile Foundations, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behavior of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles.
- Well Foundation, IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods.
- Tunnels and Arching in Soils, Pressure Computations around Tunnels, Open Cuts, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.
- Coffer Dams, Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structure interaction

References:

- Design of foundation system, N.P. Kurian, Narosa Publishing House
- Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York
- Analysis and Design of Substructures, Swami Saran, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi..

Subject: **Soil Structure Interaction**

Credits			
L	T	P	Total
3	0	0	3

Type: Program Elective (IV)

Teaching Scheme: Lectures: 3 hours/week

Course Objectives: The course is aimed

1 To study the soil structure interaction and the computer programs for interaction problems

2 To learn the analysis of different types of frame structure and evaluate the action of group piles considering stress-strain characteristics of soils.

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

1 Understand soil structure interaction concept and complexities involved to evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics

2 Prepare comprehensive design oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.

3 Analyze different types of frame structure founded on stratified natural deposits with linear and non-linear stress-strain characteristics.

4 Evaluate action of group of piles considering stress-strain characteristics of real soils.

Syllabus Contents:

- Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction.
- Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method.
- Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics.
- Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems.
- Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts, Etc.
- Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics.
- Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles Considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance.

References:

- Analytical and Computer Methods in Foundation, Bowels J.E., McGraw Hill Book Co., New York, 1974.
- Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw Hill Book Co., New York.
- Soil Structure Interaction - The real behaviour of structures, Institution of Structural Engineers.
- Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol-17, Elsevier Scientific Publishing Company.
- Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific Publishing Company.
- Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd.
- Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing

Subject: **Design of Industrial Structures**

Type:	Program Elective (IV)	Credits			
		L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: **The course is aimed**

1 To introduce the designs of Steel Gantry Girders, Steel Portal and Gable Frames

2 To tudy the designs of Steel Bunkers and Silos, Chimneys and Water Tanks.

Course outcomes: **At the end of the course, students will be able to**

1 Design Steel Gantry Girders.

2 Design Steel Portal, Gable Frames.

3 Design Steel Bunkers and Silos.

4 Design Chimneys and Water Tanks.

Syllabus Contents:

- Steel Gantry Girders: Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure.
- Portal Frames: Design of portal frame with hinge base, design of portal frame with fixed base - Gable Structures, Lightweight Structures
- Steel Bunkers and Silos: Design of square bunker, Jansen's and Airy's theories, IS Code provisions, Design of side plates, Stiffeners, Hooper, Longitudinal beams Design of cylindrical silo, Side plates, Ring girder, stiffeners.
- Chimneys: Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.
- Water Tanks: Design of rectangular riveted steel water tank, Tee covers, Plates, Stays, Longitudinal and transverse beams, Design of staging, Base plates,, Foundation and anchor bolts.
- Design of pressed steel water tank: Design of stays, Joints, Design of hemispherical bottom water tank, side plates, Bottom plates, joints, Ring girder, Design of staging and foundation.

References:

- Subramanian. N, "Design of Steel Structures: Theory and Practice", Oxford university Press, U.S.A, Third Edition, 2011.
- Duggal.S.K, "Design of Steel Structures", McGraw Hill New Delhi, 2010.
- Dayaratnam. P, "Design of Steel Structures," Chand. S, Limited, New Delhi. 2008.
- John. E, Lothers, "Structural Design in Steel", Prentice Hall, 1999.
- Neal. B.G, "Plastic Method of Structural Analysis", Taylor & Francis, Third Edition, 1985.
- Edwin .H, Gaylord, Charles .N, Gaylord, James .E, Stallmeyer, "Steel Structures", McGraw Hill, New Delhi, 1980.
- Ramchandra, "Design of Steel Structures", Vol I & II Standard Book House, Delhi, 1975.
- Arya.S and Ajmani. J.L, "Design of Steel Structures", Nem Chand & Bros, Roorkee.

Subject: **Advanced Prestressed Concrete**

Type:	Program Elective (V)	Credits L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the understanding of properties and behavior of Prestressing material.

2 To learn the analysis and design of Prestressed structure and superstructure.

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

1 To have an overall understanding of properties and behavior of Prestressing material.

2 Ability to analyse and design and the prestressed structure and prestressed concrete superstructure.

Syllabus Contents:

Need for prestressing; Materials used; Pretensioning and Post-tensioning methods; Systems of prestressing. Behaviour of prestressed concrete beams; Loss of prestress; bursting forces in anchorage zone. Design methods; Partial prestressing. Analysis and design of continuous beams. Need of composite construction; Design methods for composite beams, slabs, columns and box -girders. Prestressed concrete water tanks. Prestressed concrete superstructures. Statically determinate PSC beams: design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.

References:

- Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.
- Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.
- Limited State Design of Prestressed Concrete, Guyan Y., Applied Science Publishers, 1972.
- IS: 1343- Code of Practice for Prestressed Concrete
- IRC: 112

Subject: **Analysis of Laminated Composite Plates**

Type:	Program Elective (V)	Credits L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the analysis of rectangular composite plates using the analytical methods.

2 To understand the analysis of the composite plates using advanced finite element method.

3 To learn the computer programs for the analysis of composite plates.

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

1 Analyse the rectangular composite plates using the analytical methods.

2 Analyse the composite plates using advanced finite element method.

3 Develop the computer programs for the analysis of composite plates.

Syllabus Contents:

- Introduction: Displacement Field Approximations for Classical Laminated Plate Theory (CLPT) and First Order Shear Deformation Theory (FSDT), Analytical Solutions for Bending of Rectangular Laminated Plates using CLPT.
- Governing Equations, Navier Solutions of Cross-Ply and Angle-Ply Laminated SimplySupported Plates, Determination of Stresses. Levy Solutions for Plates with Other Boundary Conditions, Analytical Solutions for Bending of Rectangular Laminated Plates Using FSDT.
- Finite Element Solutions for Bending of Rectangular Laminated Plates using CLPT.
- Introduction to Finite Element Method, Rectangular Elements, Formation of Stiffness Matrix, Formation of Load Vector, Numerical Integration, Post Computation of Stresses.
- Finite Element Solutions for Bending of Rectangular Laminated Plates using FSDT. Finite Element Model, C0 Element Formulation, Post Computation of Stresses.
- Analysis of Rectangular Composite Plates using Analytical Methods

References:

- Mechanics of Laminated Composites Plates and Shells, Reddy J. N., CRC Press

Subject: **Fracture Mechanics of Concrete Structures**

Type:	Program Elective (V)	L	T	P	Credits Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: **The course is aimed**

1 To study the Identification and the classification of cracking of concrete structures based on fracture mechanics.

2 To study the Implementation of stress intensity factor for notched members

3 To introduce the application of fracture mechanics models to high strength concrete and FRC structures.

Course outcomes: **At the end of the course, students will be able to**

1 Identify and classify cracking of concrete structures based on fracture mechanics.

2 Implement stress intensity factor for notched members

3 Apply fracture mechanics models to high strength concrete and FRC structures.

4 Compute J-integral for various sections understanding the concepts of LEFM.

Syllabus Contents:

Review of theory of elasticity: Body and surface forces, strain and strain tensors, equilibrium equation, compatibility condition, plane stress, plane strain, Airy stress function, polar coordinate system.

Basic modes of fracture, an atomic view of fracture, stress concentration effect of flaws, Griffith theory of brittle fracture, Irwin's modifications for elastic-plastic materials, dimensional analysis of fracture mechanics.

Theories of linear elastic fracture mechanics, stress intensity factors, Fracture toughness, Energy release rate, Critical Energy release rate, Crack mouth opening displacement, R-Curve and J integral.

Tensile Behavior of Concrete, Strain localization effect, Fracture process zone, Nonlinear behavior of concrete, softening function of concrete, Fracture energy.

Definition and brief introduction of fracture parameters of various nonlinear concrete fracture models: cohesive crack model (CCM) or fictitious crack model (FCM), crack band model (CBM), two parameter fracture model (TPFM), size effect model (SEM), effective crack model (ECM), double-K fracture model (DKFM) and double-G fracture model (DGFM).

References:

- David Broek, Elementary Engineering Fracture Mechanics, Sijthoff and Noordhaff, Alphen Aan Den Rijn, The Netherlands, 2001.
- Analysis of Concrete Structure by Fracture Mechanics, Ed L. Elfgren and S.P. Shah, Proc of Rilem Workshop, Chapman and Hall, London, 2001.
- Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New
- Delhi, India, 2009. K. Ramesh, e-Book on Engineering Fracture Mechanics, IIT Madras, 2007.
- Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, Wiley, India, 5th Edition, 2014.
- Anderson, : Fracture Mechanics: Fundamentals and Applications, CRC press, 3rd Ed., 2005
- Kumar S, Barai SV (2011) Concrete Fracture Models and Applications. ISBN 9783642167638 (Hard Cover), Springer.

Subject: **Design of Plates and Shells**

Credits			
L	T	P	Total
3	0	0	3

Type: Program Elective (V)

Teaching Scheme: Lectures: 3 hours/week

Course Objectives: The course is aimed

1 To introduce the analysis and design of prismatic folded plate systems.

2 To study the analysis and design of shells using approximate solutions

3 To learn the analysis and design of cylindrical shells and doubly curved shells

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

1 Analyse and design prismatic folded plate systems.

2 Analyse and design shells using approximate solutions

3 Analyse and Design Cylindrical Shells

4 Design Doubly Curved Shells using Approximate Solutions.

Syllabus Contents:

- Prismatic folded Plate Systems
- Shell Equations
- Approximate Solutions
- Analysis and Design of Cylindrical Shells
- Approximate Design methods for Doubly Curved Shells.

References:

- Theory of Plates and Shells, Timoshenko and Woinowsky-Krieger S., Tata Mc Graw Hill Edition, 2010.
- Design and Construction of Concrete Shell Roofs, Ramaswamy G. S., 1st Edition, 2005.
- Design of Reinforced Concrete Shells & Folded Plate, Varghese P. C., 1st Edition, PHI.
- Design of Plate and Shell Structures, Jawad Maan H., Springer Science.

Subject: **Computer Applications Lab**

Credits			
L	T	P	Total
0	0	4	2

Type: Core Lab I(II)

Teaching Scheme: Lectures: 2 hours/week

Course Objectives: The course is aimed

1 To introduce the practical development of computer programs for the analysis of structural elements based on FEM

2 To introduce the use of software for the design of multi-storey building

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

1 Develop the computer programs for analysis of structural elements based on FEM

2 Use the design software for the design of multi-storey buildings

Syllabus Contents:

To develop the MATLAB applications for Finite Element Method on structural analysis

- Static and Dynamic Analysis of Beam, rigid frame and truss, 3-D Analysis of simple building
- Analysis, Design and Detail complete Multi-Storey Framed Buildings using STAAD Pro/ETABs.

Subject: **Mini Project**

Credits			
L	T	P	Total
0	0	4	2

Type: Core

Teaching Scheme: Practice 4 hours//week (Contact: 2 hours/week)

Course Objectives: The Mini Project is aimed

1 To Identify structural engineering problems reviewing available literature.

2 To Study different techniques used to analyze complex structural systems.

3 Work on the solutions given and present solution by using his/her technique applying Engineering principles.

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

1 Identify methods for structural engineering problems reviewing available literature.

2 Adopt different techniques used to analyze complex structural systems.

3 Propose solutions, or give solutions or present a solution by using his/her technique applying Engineering principles.

Syllabus Content:

- Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.
- Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee.

Semester-III

Subject: **Dissertation I**

Credits			
L	T	P	Total
0	0	28	14

Type: Core

Teaching Scheme: Practice hours: 28 hours/week (contact-3 hours/week)

Course Objectives: The course is aimed

1 To inculcate the reviewing available research literature for Identifying the complex Civil Engineering problems.

2 To practice the applications of appropriate techniques to analyze complex Civil Engineering problems.

3 To adopt the engineering and management principles through efficient handling of the projects

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

1 Identify complex Civil Engineering problems reviewing available literature.

2 Identify appropriate techniques to analyze complex Civil Engineering problems.

3 Apply engineering and management principles through efficient handling of project

Syllabus Contents:

- Dissertation-I will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution.
- Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem. and End Sem. will be monitored by the departmental committee.

Semester-IV

Subject:	Dissertation-II	Credits			
Type:	Core	L	T	P	Total
Teaching Scheme:	Practice hours: 32 hours/week (contact-3 hours/week)	0	0	32	16

Course Objectives: The dissertation is aimed

1 To introduce the problem solving skills related to the complex Civil Engineering problems by applying appropriate techniques and tools.

2 To necessitate the exhibition of good communication skill to the engineering community and society.

3 To crop out and demonstrate the promotion of professional ethics and work culture.

Course outcomes: At the end of the Dissertation, students will be able to

1 Solve complex Civil Engineering problems by applying appropriate techniques and tools.

2 Exhibit good communication skill to the engineering community and society.

3 Demonstrate professional ethics and work culture.

Syllabus Contents:

- Dissertation – II will be extension of the work on the topic identified in Dissertation – I.
- Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be pre-submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.

PRE-Ph.D. COURSE WORK

Course Code	Subject	Credits
ETPHDT00	RESEARCH METHODOLOGY IN ENGINEERING	3-1-0: 4

Course Learning Objectives:

The objective of this Course is

1. To demonstrate the ability to choose an appropriate methodology to research aims and objectives
2. To assess the types of data and techniques for collecting various types of data collection of particular research
3. To develop skills in qualitative and quantitative data analysis and presentation
4. To Develop skills and knowledge related to conducting research and effectively communicating the findings through written reports.
5. To develop a comprehensive understanding of ethics, research integrity, scientific misconduct, publication ethics, and intellectual property rights

Course Outcomes:

At the end of the course, the students shall be able

1. To demonstrate the ability to select an appropriate research methodology that aligns with the aims and objectives of a study.
2. To assess the types of data and techniques required for collecting various forms of data in specific research contexts.
3. To develop skills in qualitative and quantitative data analysis and presentation.
4. To develop skills and knowledge related to conducting research and effectively communicating the findings through written reports.
5. To integrate a comprehensive understanding of ethics, research integrity, scientific misconduct, publication ethics, and intellectual property rights.

Module 1: Introduction and Design of research: Meaning, objectives and significance of research, types and parameters of research, research process, identification and definition of the research problem, definition of construct and variables, pure and applied research design, exploratory and descriptive design methodology, qualitative vs. quantitative research methodology, field studies, field experiments vs. laboratory experiments, research design in social and physical sciences.

Module 2: Data and Methods of Data Collection: Survey, assessment and analysis: data collection, primary and secondary sources of data, Collection of primary data through questionnaire and schedules. Collection of secondary data, processing and analysis of data. Sample survey, simple random sampling, stratified random sampling, systematic sampling, cluster sampling, area sampling and multistage sampling. Pilot survey, scaling techniques, validity & reliability.

Module 3: Data Analysis and Interpretation: Procedure for testing of hypothesis, the null hypothesis, determining levels of significance, Testing of hypothesis, type i and ii errors, grouped data distribution, measures of central tendency, measures of spread/dispersion, normal distribution, analysis of variance: one way, two-way, chi square test, z test and its application, student's 'T' distribution, Univariate and Bivariate analysis, regression analysis.

Module 4: Report writing and presentation: Review of literature: historical survey and its necessity, layout of research plan, meaning, techniques and precautions of interpretation, types of report: technical report, popular report, report writing – layout of research report, mechanics of writing a research report. Writing bibliography and references.

Module 5: Research ethics, IPR and scholarly publishing: Ethics: Definition, moral philosophy, nature of moral judgments and reactions, Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP). Redundant publication duplicates and overlapping publications, salami slicing, Selective reporting and misrepresentation of data, Publication ethics: definition, introduction and importance, Publication's misconduct: definition, concept, problems that lead to unethical behavior and vice versa, Patents, Designs, Trade and Copyright. Process of Patenting and Development.

Reference Books:

1. Research in education, By J W Best and J V Kahn, Pearson/ Allyn and Bacon.
2. Research Methodology – Methods and Techniques, C K Kothari, New Age International.
3. Design and Analysis of Experiments, D C Montgomery, Wiley.
4. Applied Statistics & Probability for Engineers, D C Montgomery & G C Runger, Wiley.
5. Management Research Methodology: Integration of Principles, Methods and Techniques, K N Krishnaswamy, A I Sivakumar and M Mathiranjan, Pearson Education.
6. Research Methodology- Methods & Tec., CR Kothri CR (1990), Vishva Prakashan, NDL.

7. Research Methodology & Statistical Techniques, S Gupta (1999) Deep & Deep Publications, New Delhi.
8. Research Methodology for Biological Sciences, N Gurumani (2007), MJP Publishers, Chennai.
9. Research Design: Qualitative, Quantitative &Mixed Method Approaches, John W. Creswell (2009), Sage Publication, USA

Course Outcomes and their mapping with Programme Outcomes: RESEARCH METHODOLOGY IN ENGINEERING (ETPHDT00)

CO	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	3				3				1	2	2
CO2	3	3	1	2	3			3					2	3	2
CO3	3	3	1	2	3			3		3			2	3	2
CO4	3	3	1	2	3			3		3			2	3	2
CO5	2	2	2	1	1			3	3				2	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

LIST OF ELECTIVES

S.N.	SUBJECT CODE	TITLE OF THE SUBJECT
ELECTIVE-I & II		
1	CEPHDT01	OPTIMIZATION TECHNIQUES
2	CEPHDT02	FINITE ELEMENT METHOD
3	CEPHDT03	STRUCTURAL DYNAMICS
4	CEPHDT04	ADVANCED CONCRETE TECHNOLOGY
5	CEPHDT05	CONCRETE FRACTURE MECHANICS
6	CEPHDT06	SPECIAL CONCRETES
7	CEPHDT07	MULTIMODAL TRANSPORTATION SYSTEM
8	CEPHDT08	DESIGN AND CONSTRUCTION OF RURAL ROADS
9	CEPHDT09	ADVANCED PAVEMENT MATERIALS
10	CEPHDT10	TRANSPORTATION GEOTECHNICS
11	CEPHDT11	GEO-ENVIRONMENTAL ENGINEERING
12	CEPHDT12	RIVER HYDRAULICS
13	CEPHDT13	IRRIGATION TECHNOLOGY AND IRRIGATION WATER MANAGEMENT
14	CEPHDT14	OPEN CHANNEL HYDRAULICS
15	CEPHDT15	EARTHQUAKE ENGINEERING

16	CEPHDT16	TRANSPORTATION SYSTEM DESIGN AND AND MANAGEMENT
17	CEPHDT17	ADVANCE SOIL MECHANICS
18	CEPHDT18	ENVIRONMENTAL GEOTECHNICS
19	CEPHDT19	PRINCIPLES OF GROUND MODIFICATION
20	CEPHDT20	SOIL REMEDIATION

Course Code	Subject	Credits
CEPHDT01	OPTIMIZATION TECHNIQUES	3-1-0: 4

Course Objectives:

1. To develop the knowledge about formulation of structural optimization problem.
2. To define linear programming.
3. To understand application of nonlinear programming.
4. To understand the optimal control and optimality criteria methods.
5. To develop the knowledge of modern methods of optimization.

Unit-I: Formulation of structural optimization Problem: Design Vector, Design Constraints, Constraint Surface, Objective Function, Objective Function Surfaces, Classification of Optimization Problems, Single-Variable Optimization, Multivariable Optimization with No Constraints, with Equality Constraints and with Inequality Constraints

Unit-II: Linear Programming: Simplex Method, Application to structural optimization.

Unit-III: Nonlinear Programming: One-Dimensional Minimization Methods, Unconstrained Optimization Techniques, Constrained Optimization Techniques.

Unit-IV: Optimal Control and Optimality Criteria Methods: Calculus of Variations, Optimal Control Theory, Optimality Criteria Methods, optimization of sections, steel and concrete structures, framed structures, bridge structures.

Unit-V: Modern Methods of Optimization: Genetic Algorithms, Simulated Annealing, Particle Swarm Optimization, Ant Colony Optimization, Optimization of Fuzzy Systems.

Artificial Intelligence and Artificial Neural Networks based approaches for structural optimization problems.

References

1. J.S. Arora, introduction | to Optimum Design, Elsevier, 2nd Edition, 2004.
2. K. Deb, Optimization for Engineering. Design: Algorithms & Examples, Prentice Hall India, 2006
3. S.S. Rao, Engineering Optimization: Theory & Practice, New Age International (P) Ltd, 3rd Edition,1996, Reprint: June, 2008
4. K. Deb, Multi-Objective Optimization Using Evolutionary Algorithms, John Wiley, 2003

Course Outcomes:

At the end of this course the students will be able to

1. Design formulation of structural optimization problem.
2. Apply the linear programming methods.
3. Apply the nonlinear programming methods.
4. Implement the optimal control and optimality criteria methods.
5. Analysis the modern methods of optimization.

Course Outcomes and their mapping with Programme Outcomes: OPTIMIZATION TECHNIQUES (CEPHDT01)

CO	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										3	2	1
CO2	3	2	2	1									3	2	1
CO3	3	2	2	1	1								3	2	1
CO4	3	2	1	1	1								3	2	1
CO5	3	2	2	1	2								3	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT02	**FINITE ELEMENT METHODS**	**3-1-0: 4**

Course objective: The course is aimed

1. To introduce the Finite Element Method for structural analysis.
2. To practice the Finite Element Program/ Software
3. To study the solutions for continuum problems using finite element analysis.

Course Content

Differential equilibrium equations - strain displacement relation - linear constitutive relation - special cases - Principle of stationary potential energy - application to finite element methods. Some numerical techniques in finite element analysis- calculus of variation, the Rayleigh-Ritz and Galerkin methods.

Displacement models - convergence requirements. Natural coordinate systems - Shape function. Interpolation function - Linear and quadratic elements - Lagrange and Serendipity elements - Strain displacement matrix - element stiffness matrix and nodal load vector.

Two dimensional iso-parametric elements - Four node quadrilateral elements - triangular elements - Computation of stiffness matrix for iso-parametric elements - numerical integration (Gauss quadrature) – Mess refinement - Convergence criteria for iso-parametric elements.

Assemblage of elements – Direct stiffness method - Special characteristics of stiffness matrix - Boundary condition and reaction - Gauss elimination and LDLT decomposition - Basic steps in finite element analysis.

Analysis of framed Structures - 2D truss element - 2D beam element. Analysis of plate bending: Basic theory of plate bending - displacement functions - plate bending Elements. Plane stress and plane strain analysis: Triangular elements - rectangular elements, Eigen value and time dependent problems - discussion about pre-processors, postprocessors and finite element packages.

Reference Books

1. Krishnamoorthy, C. S, Finite Element Analysis - Theory and Programming, McGraw - Hill, 1995.

2. R. T. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements in Engineering, PHI Learning Pvt Ltd, New Delhi, 1997.
3. S. S. Bhavikatti, Finite Element Analysis, New Age Publishers, 2007.
4. David Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.
5. Chennakesava R. Alavala Finite Element Methods: Basic Concepts and Applications, Prentice Hall Inc., 2010.
6. J. N. Reddy, An introduction to the Finite Element Method, McGraw-Hill, New York, 2006
7. R. D. Cook, D. S. Malkus and M. E. Plesha, Concepts and Applications of Finite Element Analysis, Fourth Edition, Wiley, India, 2003.
8. K. J. Bathe, Finite Element Procedures in Engineering Analysis, Prentice-Hall, Englewood Cliffs, NJ, 1996
9. Fish and Belytschko, A First Course in Finite Elements, John Wiley, 2007.

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

1 Use Finite Element Method for structural analysis.

2 Execute the Finite Element Program/ Software

3 Solve continuum problems using finite element analysis.

Course Outcomes and their mapping with Programme Outcomes: FINITE ELEMENT METHODS (CEPHDT02)

CO	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		2							2	3		2
CO2	2	2	2		3							3	3		1
CO3	3	1	1		2							1	3		3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT03	STRUCTURAL DYNAMICS	3-1-0: 4

Course Objectives: The course is aimed

1 To Introduction the dynamic analysis of SDOF for blast and earthquake loads

2 To evaluate the structural property matrices, natural vibration and solution of eigen value problems.

3 To carryout deterministic analysis of earthquake response - lumped SDOF system, evaluate beam flexure including shear deformation and ductile design and detailing of buildings. .

Course Content

Unit-I: Introduction to Dynamic analysis - Elements of vibratory systems and simple Harmonic Motion - Mathematical models of SDOF systems - Principle of Virtual displacements - Evaluation of damping resonance.

Unit-II: Fourier series expression for loading - (blast or earthquake) - Duhamel's integral - Numerical methods - Expression for generalized system properties - vibration analysis - Rayleigh's method - Rayleigh-Ritz method.

Unit-III: Evaluation of structural property matrices - Natural vibration - Solution of the Eigen value problem - Iteration due to Holzer and Stodola.

Unit-IV: Idealization of multi-storeyed frames - analysis to blast loading - Deterministic analysis of earthquake response - lumped SDOF system.

Unit-V: Differential equation of motion - Beam flexure including shear deformation.

Basics of Earthquake Engineering Indian standards, Response Spectrum Concepts, Different analysis methods, Ductile detailing of buildings, Examples

Reference Books

1. Mario Paz, and William Leigh, Structural Dynamics, CBS, Publishers, 1987.
2. Roy R Craig, Jr., Structural Dynamics, John Wiley and Sons, 1981.
3. A. K. Chopra "Dynamics of Structures Theory and Application to Earthquake Engineering" Pearson Education, 2001.
4. Clough and Penzien, Dynamics of Structures, McGraw Hill, 5 th Edition, 1975.
5. Srinivasan Chandrasekaran, Dynamic Analysis and Design of Ocean Structures, Springer, 2015

Course Outcomes:

On the completion of this course, the student will be able to

1 To carry out the dynamic analysis of SDOF for blast and earthquake loads

2 To determine the structural property matrices and evaluate natural vibration and solution of eigen value problems.

3 To perform deterministic analysis of earthquake response - lumped SDOF system, and evaluate beam flexure including shear deformation and ductile design and detailing of buildings. .

Course Outcomes and their mapping with Programme Outcomes: STRUCTURAL DYNAMICS (CEPHDT03)

CO	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1					1	3	2	1
CO2	3	3	3	1	2	1	1					1	3	2	1
CO3	3	3	3	1	2	1	1					1	3	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT04	ADVANCED CONCRETE TECHNOLOGY	3-1-0: 4

Course Content

Unit I: Structure of hydrated cement paste, Micro structure, air & void ratio, mechanical strength of cement gel, water held in hydrated paste and heat of hydration, pore structure and transport process. Transition zone in concrete, Concrete: segregation, bleeding, Effect of water quality.

Unit II: Concrete quality control, Green Concrete, Concrete properties, Factors affecting Workability, Performance of concrete in hardened state, Strength-Porosity relationship, maturity concept for curing duration, Behaviour of Concrete under different stress Conditions. Mix Design for High Strength Concrete.

Unit III: Concrete deterioration, Strength properties, Elastic Modulus, Permeability, shrinkage, creep, plastic & thermal cracking, corrosion, carbonation, freezing-thawing. Alkali-aggregate reactivity, Durability, Self-healing concrete.

Unit IV: Fibre reinforced concrete: Types & Mechanism, Aspect ratio, Fibres: Types, Volume & orientation, balling effect, properties & applications of fibre reinforced concrete. Ready mix concrete: Concept, plants, use of admixtures in RMC, quality control aspects.

Unit V: Recycled aggregates and recycled aggregate concrete properties. Concrete from Industrial wastes: Blast furnace slag cement concrete; Fly-ash concrete and. Silica fume concrete

References

1. A.M. Neville, J.J. Brooks, Concrete Technology, Low Priced Edition, Pearson Education, 2015.
2. M.S. Shetty, Concrete Technology- Theory & Practice, S. Chand & Comp., 2015
3. N. Krishna Raju, Design of Concrete Mixes, CBS Publishers & distributers
4. Irving Kett, Engineered Concrete: Mix Design & Test Methods, CRC press, Taylor & Francis group, 2010
5. P. Mehta and P.J.M. Monteiro, Concrete: Microstructure, Properties and Materials, Mc Graw Hill, 2001
6. Kumar Mehta. P, Paul J.N. Monterio: Microstructure, Properties & Materials, Tata McGraw Hill

7. Chakradhara Rao, M, Bhattacharyya SK and Barai SV. A Systematic approach of characterisation and behaviour of recycled aggregate concrete. Springer Nature, 2019.
8. Jongjin Li, Advanced Concrete Technology, John Wiley & Sons, Inc, 201.

Course outcomes:

At the end of the course, students will be able to:

1. To understand concrete technology, admixtures, non-destructive testing, semi destructive testing, special concrete.
2. To be familiar with structure of hydrated cement paste, types of cement, cement production quality control.
3. To learn transition zone in concrete, measurement of workability, properties of concrete, rheological behaviour of concrete, economic concrete mix design.
4. To be exposed to strength-porosity relationship, failure modes in concrete, elastic behaviour in concrete, ageing properties and long-term behavior
5. To better understand the causes of concrete deterioration, permeability of concrete, durability of concrete, alkali aggregation reaction.

Course Outcomes and their mapping with Programme Outcomes: ADVANCED CONCRETE TECHNOLOGY (CEPHDT04)

CO	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	1	1	1	-	-	-	3	3	2
CO2	3	2	2	3	1	1	1	1	-	-	-	-	3	2	1
CO3	3	3	2	3	2	2	1	1	1	-	-	-	2	3	2
CO4	3	3	2	2	2	2	1	1	1	-	-	-	3	3	2
CO5	3	3	2	2	2	2	1	1	1	-	-	-	3	2	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

6.

Course Code	Subject	Credits
CEPHDT05	**CONCRETE FRACTURE MECHANICS**	**3-1-0: 4**

Course Objectives: **The course is aimed**

1 To study the Identification and the classification of cracking of concrete structures based onfracture mechanics.

2 To study the Implementation of stress intensity factor for notched members

3 To introduce the application of fracture mechanics models to high strength concrete andFRC structures.

Course Content

Unit I: Review of theory of elasticity: Body and surface forces, strain and strain tensors, equilibrium equation, compatibility condition, plane stress, plane strain, Airy stress function, polar coordinate system.

Unit II: Basic modes of fracture, an atomic view of fracture, stress concentration effect of flaws, Griffith theory of brittle fracture, Irwin's modifications for elastic-plastic materials, dimensional analysis of fracture mechanics.

Unit III: Theories of linear elastic fracture mechanics, stress intensity factors, Fracture toughness, Energy release rate, Critical Energy release rate, Crack mouth opening displacement, R-Curve and J integral.

Unit IV: Tensile Behavior of Concrete, Strain localization effect, Fracture process zone, nonlinear behavior of concrete, softening function of concrete, Fracture energy.

Unit V: Definition and brief introduction of fracture parameters of various nonlinear concrete fracture models: cohesive crack model (CCM) or fictitious crack model (FCM), crack band model (CBM), two parameter fracture model (TPFM), size effect model (SEM), effective crack model (ECM), double-K fracture model (DKFM) and double-G fracture model (DGFM).

Reference Books

1. David Broek, Elementary Engineering Fracture Mechanics, Sijthoff and Noordhaff, Alphen Aan Den Rijn, The Netherlands, 2001.
2. Ed L. Elfgren and S.P. Shah, Analysis of Concrete Structure by Fracture Mechanics, , Proc of Rilem Workshop, Chapman and Hall, London, 2001.
3. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New
4. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, Wiley, India, 5th Edition, 2014.
5. Anderson: Fracture Mechanics: Fundamentals and Applications, CRC press, 3rd Ed., 2005
6. Kumar S and Barai SV (2011) Concrete Fracture Models and Applications. ISBN 9783642167638 (Hard Cover), Springer.
7. Bazant ZP, Planas J (1998) Fracture and size effect in concrete and other quasibrittle materials, Florida, CRC Press.
8. Surendra P. Shah, Stuart E. Swartz, Chengsheng Ouyang. Fracture Mechanics of Concrete: Applications of Fracture Mechanics to Concrete, Rock and Other Quasi-Brittle Materials. John Wiley & Sons.

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

1 Identify and classify cracking of concrete structures based on fracture mechanics.

2 Implement stress intensity factor for notched members

3 Apply fracture mechanics models to high strength concrete and FRC structures.

4 Compute J-integral for various sections understanding the concepts of LEFM.

Course Outcomes and their mapping with Programme Outcomes: CONCRETE FRACTURE MECHANICS (CEPHDT05)

CO	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	-	-	-	-	3	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	-	2	2	1
CO3	3	3	3	3	2	1	-	-	-	-	-	-	3	2	2
CO4	3	2	2	2	1	1	-	-	-	-	-	-	2	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT06	**SPECIAL CONCRETES**	**3-1-0: 4**

Course Objective:

1. To impart the knowledge of various method for manufacturing and the mechanical properties of High Performance Concrete.
2. To make aware with durability properties of High Performance Concrete.
3. To familiarize the mix design of High Performance Concrete using different methods.
4. Explain the performance of High Performance Concrete under various conditions in which it is used.
5. To impart the knowledge of method of manufacturing, properties, mix design and behavior/performance under various working condition of Self-Compacting Concrete.

Course Content

Unit-I: High Performance Concrete (HPC) - Introduction – Principles of HPC – Ingredients used for HPC – Production of HPC – Curing of HPC – Mechanism of HPC – Properties of HPC during the fresh and hardened state.

Unit-II: Durability of HPC - Acid Attack – Permeability – Scaling resistance – Chloride penetration – Resistance to sea water – sulphate attack – Alkali-aggregate reaction – Fire resistance

Unit-III: Mix design methods of HPC.

Unit-IV: Ultra-High-Performance Concrete - Air-entrained HPC – Light-weight HPC – Heavy weight HPC – Fibre reinforced HPC – Confined HPC – Roller Compacted HPC – Ultra High-Performance Concrete – Reactive powder Concrete - Bio concrete - Geopolymer concrete.

Unit-V: Self-Compacting Concrete - Introduction – Principles of SCC – Ingredients used for SCC – Mix design methods – Production and curing of SCC – Behaviour of SCC under fresh and hardened state. Various Case Histories on HPC and SCC.

Reference Books

1. P. C. Aitcin, High Performance Concrete, E & FN SPON, 1998.
2. E. G. Nawy, Fundamentals of High-Performance Concrete, John Wiley and Sons., 2nd Edition, 2000.

3. High Performance Concrete Structural Designers Guide published by FHWA, USA, 2005.
4. Geert De Schutter, Peter J. M. Bartos, Peter Domone, John Gibbs, Self-Compacting Concrete, Whittles Publishing, 2008.
5. Shetty M. S., Concrete Technology, S. Chand and Company Ltd. Delhi, 2003.

Course outcomes:

At the end of the course, students will be able to:

1. Apply various method for manufacturing of High Performance Concrete and analyze the mechanical properties of High Performance Concrete.
2. Familiar with durability properties of High Performance Concrete.
3. Mix design High Performance Concrete using different methods.
4. Understand the performance of High Performance Concrete under various conditions in which it is used.
5. Understand method of manufacturing, properties, mix design and behavior/performance under various working condition of Self-Compacting Concrete.

Course Outcomes and their mapping with Programme Outcomes: SPECIAL CONCRETES (CEPHDT06)

CO	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										2	3	3	
CO2	3	2		2	2							2	3	3	
CO3	3		3									2	3	3	
CO4	3			2								2	3	3	
CO5	3	2	3	2								2	3	3	

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT07	MULTIMODAL TRANSPORTATION SYSTEM	3-1-0: 4

Course Objectives:

1. To develop the basic knowledge about role of Artificial Intelligence in optimization of Transportation system.
2. To define role of GIS in Transportation system.
3. To understand Application of Image Processing in Urban Transportation Systems.
4. To understand the planning of Non-Motorized Transportation (NMT) Systems.
5. To develop the knowledge of Urban Pedestrian Safety.

Course Content

Unit-I: Artificial Intelligence based Transportation System: Urbanization and transportation, Travel demand impacts of urbanization, Modal share, Motorization, Introduction to AI, components of transportation system that require optimization, role of AI in optimization of these components, congestion control, accident avoidance, active alert system design

Unit-II: Geographic information system-based transportation system: Introduction to GIS, sources of GIS, role of GIS in transportation, assessment of roads, and railways using GIS, case study of smart city GIS

Unit-III: Introduction of signal processing: Overview of Signal processing, Fundamentals of Image processing; Fundamental signals (1-D, 2-D and 3-D); Classification of systems; Characteristics of LTI/LSI systems. Application of Image Processing in Urban Transportation Systems

Unit-IV: Non-Motorized Transportation (NMT) Systems: Components of NMT, categories of NMT, planning smart cities to facilitate NMT, effect of NMT planning on healthcare

Unit-V: Pedestrian Safety: Urban Pedestrian Safety- Skyways, Intersection subways, halt stations, crossing measures, flexibility in accessibility, design of collision control systems for intersections to improve pedestrian safety

Reference Books

1. O. Flaherty C.A., “Traffic Engineering and Transport Planning”, Butterworth Heinemann, Elsevier, Burlington, MA 2006.

2. M.A. Chowdhury and A. Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, 2010.
3. Gonzalez R. C. and Woods R. C., "Digital Image Processing", 2nd Ed., Pearson Education, 2007.
4. Jain A. K, "Fundamentals of Digital Image Processing", Prentice Hall, 2007.

Course Outcomes:

At the end of this course the students will be able to

1. Design the artificial intelligence-based transportation system.
2. Analysis the geographic information system-based transportation system.
3. Implement the application of image processing in urban transportation systems.
4. Design and planning of non-motorized transportation Systems.
5. Analysis the urban pedestrian safety.

Course Outcomes and their mapping with Programme Outcomes: MULTIMODAL TRANSPORTATION SYSTEM (CEPHDT07)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1								3	2	1
CO2	3	2		1									3	3	1
CO3	3	2	1	1	1								3	2	1
CO4	3	2	2	1									2	1	1
CO5	3	2											3	1	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT08	DESIGN AND CONSTRUCTION OF RURAL ROADS	3-1-0: 4

Course Objectives:

1. To develop the basic knowledge of rural roads.
2. To understand geometric design and road materials.
3. To understand construction of rural roads.
4. To understand use of recycle or waste material in rural roads.
5. To develop the knowledge of quality control and maintenance of rural roads.

Course Content

Unit-I: Introduction about Rural Roads and Planning and Alignment: Importance of Rural roads, Classification of rural roads, Terrain classification, Socio-economic impact of rural roads. Data base for master plan, Concept of network planning, Rural Roads plan, Road alignment, Governing factors for route selection, Factors controlling alignment, Special considerations while aligning hill roads, Surveys, Detailed project report, Environmental issues.

Unit-II: Geometric Design and Road Materials: Introduction, Design speed, Basic principles of geometric design, Elements, Horizontal and vertical alignment, Alignment compatibility, Lateral and vertical clearances. General, Soil and material surveys, Soil as road construction material, Aggregates for pavement courses, Materials for bituminous construction, Materials for semi-rigid and rigid pavement, Materials for special pavements Climatic suitability of concrete materials

Unit-III: Pavement Design, Specifications and Construction of Rural Roads: Introduction, Design parameters, Pavement components, Design of flexible pavement, Design of semi-rigid pavement, Design of rigid pavement, Drainage and Shoulders. General, Selection of construction materials and methodology, Earthwork, Sub-base, Base course, Bituminous constructions, Semi-rigid pavement construction, Concrete pavements, Equipment required for different operations.

Unit-IV: Use of Waste Materials in Rural Road Construction: Introduction, Significance of green roads, fly ash for road construction, Iron & steel and copper slags, Recycled concrete aggregate, other waste materials.

Unit-V: Quality Control Tests & Maintenance: General, Pre-requisite, Specifications and codes of practice, Quality control tests during pavement construction. Distresses/defects in pavements, Types of maintenance, Classification of maintenance activities, Maintenance norms of maintenance cost.

References:

1. Rural Roads Manual, IRC: SP 20-2002
2. Guidelines for the design of flexible pavements for low volume rural roads, IRC: SP: 72-2007
3. Geometric design standards for Rural (Non-Urban) Highways, IRC: 73-1980.
4. Guidelines for quality systems for road construction, IRC: SP: 57-2000.

Course Outcomes:

At the end of this course the students will be able to

1. Estimate the planning and alignment of rural roads.
2. Apply the knowledge of the geometric design and road materials.
3. Pavement design, specification and construction of rural roads.
4. Plan use of recycle or waste material in rural roads.
5. Analysis quality control and maintenance of rural roads.

Course Outcomes and their mapping with Programme Outcomes: DESIGN AND CONSTRUCTION OF RURAL ROADS (CEPHDT08)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										2	2	1
CO2	3	2	2	1									3	2	1
CO3	3	2	2	1	1								3	2	1
CO4	3	2											2	2	1
CO5	3	2											3	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT09	ADVANCED PAVEMENT MATERIALS	3-1-0: 4

Course Learning Objective:

1. To develop knowledge of different type of materials used in different layers of pavement.
2. To define natural materials used in pavement.
3. To understand the pavement plastics and geosynthetic materials.

To understand recycled waste materials in pavement.

Course Content

Unit-I: Aggregate: Nature and properties – aggregate requirements – types and processing – aggregates for pavement base – aggregate for bituminous mixture – aggregate for Portland Cement Concrete – lightweight aggregate – tests on aggregate – specification.

Unit-II: Bituminous Materials: conventional and modified binders – production – types and grade – physical and chemical properties and uses – types of asphalt pavement construction – principles of bituminous pavement construction – tests on bituminous materials. Bituminous Mix design – modified mixtures – temperature susceptibility and performance.

Unit-III: Cement /concrete-based materials: Cement – properties – PCC mix design and properties – modified PCC – Mix Design – Behaviour – Performance – Tests on Cement and Concrete mixes. High Performance Concrete – low shrinkage – increased strength. Composites,

Unit-IV: Plastics and Geosynthetics: Plastics and polymerization process – properties – durability and chemical composition – Reinforced Polymer Composites – Geosynthetics – Dry Powdered Polymers – Enzymes.

Unit-V: Reclaimed / Recycled Waste Products: Reclaimed Materials – waste products in highway engineering and its applications – effect of waste products on materials, structure and properties – self healing and smart materials – locally available materials.

References:

1. P. T. Sherwood, Alternative Materials in Road Construction, Thomas Telford Publication, London,1997.

2. RRL, DSIR, Soil Mechanics for Road Engineers, HMSO, London, 1995
3. Koerner, R. M. Designing with Geosynthetics, Prentice Hall, Englewood Cliffs, New Jersey, U.S.A.
4. Shan Somayaji, Civil Engineering Materials, second edition, Prentice Hall Inc., 2001.

Course Outcomes:

At the end of this course the students will be able to

1. Estimate the basic characteristics of pavement materials.
2. Analysis the natural and basic materials used in pavement.
3. Implement the plastics and geosynthetic materials in pavement.
4. Analysis the recycled waste materials.

Course Outcomes and their mapping with Programme Outcomes: ADVANCED PAVEMENT MATERIALS (CEPHDT09)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3	2	1
CO2	3	2		1									3	2	1
CO3	3	2				1	1						3	2	1
CO4	3	2	1										2	1	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT10	TRANSPORTATION GEOTECHNICS	3-1-0: 4

Course Learning Objective:

1. To develop knowledge of different type of materials and technics for subgrade materials.
2. To define subgrade soil and ground improvement technics.
3. To understand the pavement design.
4. To understand subgrade improvement and strengthening.

Course Content

Subgrade Soil: Classification, desirable properties, determination of soil strength, Swelling and Shrinkage characteristics, Road aggregates: classification, properties of aggregates, design of aggregate gradation; Cyclic response of soils, resilient and plastic behaviour of soils and aggregates, Effects of traffic loads, natural forces, and material quality. Current design practices; Principles and theoretical concepts of rigid and flexible pavements for highways and airfields;

Ground Improvement technics: Need for ground improvement, column methods: sand, stone and lime columns, soil nailing: root piles, soil reinforcement, functions of geosynthetics in soil, soil grouting: electro-chemical stabilization

Pavement evaluation and performance; Utilization of recycled materials for sustainable pavements; Life cycle cost analysis. Highway embankments; Design and construction of embankments; Stage construction; Introduction to reinforced earth design and construction.

Subgrade Improvement and Strengthening

Objectives of Soil Stabilization, Characteristics of Stabilized Soils, Thick Granular Layers, Geotextiles and Geogrids, Admixture Stabilization, Soil Encapsulation, Light-weight Fill, Deep Foundations & Other Foundation Improvement Method

References:

1. Rajib B. Mallick, Tahar El-Korchi, Pavement Engineering: Principles and Practice. CRC Press, 2017.
2. Chakraborty P. and Das, A. Principles of Transportation Engg., PHI Publication, 1st Edition 2005
3. Papagiannakis A. T. and Masad, E. A. Pavement Design and Materials. Willey,2017

Course Outcomes:

At the end of this course the students will be able to

1. Estimate the basic characteristics of subgrade materials.
2. Analysis the subgrade soil characteristics.
3. Implement the ground improvement technics.
4. Design the different type of pavement.
5. Analysis the Subgrade Improvement and Strengthening.

Course Outcomes and their mapping with Programme Outcomes: TRANSPORTATION GEOTECHNICS (CEPHDT10)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										3	2	1
CO2	3	2											3	2	1
CO3	3	2	1	1									3	2	1
CO4	1	2	3	1									2	1	1
CO5	3	2											3	1	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT11	GEO-ENVIRONMENTAL ENGINEERING	3-1-0: 4

Course Learning Objective:

1. To develop knowledge role of soil in geo-environmental application in various field.
2. To define soil mineralogy and soil-water interaction.
3. To understand design of waste containment facilities.
4. To understand remediation methods for soil and groundwater.
5. To define advanced soil characterization.

Course Content

Unit-I: Fundamentals of Geoenviromental Engineering: Scope of geoenvironmental engineering - multiphase behaviour of soil – role of soil in geoenvironmental applications – importance of soil physics, soil chemistry, hydrogeology, biological process – sources and type of ground contamination – impact of ground contamination on geoenvironment - case histories on geoenvironmental problems.

Unit-II: Soil-Water-Contaminant Interaction: Soil mineralogy characterization and its significance in determining soil behaviour – soil-water interaction and concepts of double layer –forces of interaction between soil particles. Concepts of unsaturated soil–importance of unsaturated soil in geoenvironmental problems - measurement of soil suction - water retention curves - water flow in saturated and unsaturated zone. Soil-water-contaminant interactions and its implications – Factors effecting retention and transport of contaminants.

Unit-III: Waste Containment System: Evolution of waste containment facilities and disposal practices – Site selection based on environmental impact assessment –different role of soil in waste containment – different components of waste containment system and its stability issues – property evaluation for checking soil suitability for waste containment – design of waste containment facilities.

Unit-IV: Contaminant Site Remediation: Site characterization – risk assessment of contaminated site - remediation methods for soil and groundwater – selection and planning of remediation methods – some examples of in-situ remediation.

Unit-V: Advanced Soil Characterization: Contaminant analysis - water content and permeability measurements – electrical and thermal property evaluation – use of GPR for site evaluation - introduction to geotechnical centrifuge modeling.

References:

1. Rowe R.K., "Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
2. Sharma H.D. and Reddy K.R.,"Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
3. Yong, R. N.,"Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation" CRC Press, New York, 2001.
4. Alvarez-Benedi J. and Munoz-Carpena, R., "Soil-Water Solute Process Characterization: An Integrated Approach" CRC Press, New York, 2005.
5. Mitchell, J.K.,"Fundamentals of Soil Behavior" Wiley, 2005.

Course Outcomes:

At the end of this course the students will be able to

1. Importance of soil in geo-environmental application in various field.
2. Analysis soil mineralogy and soil-water interaction.
3. Design of waste containment facilities.
4. Analysis the remediation methods for soil and groundwater ground.
5. Analysis the advanced soil characterization.

Course Outcomes and their mapping with Programme Outcomes: GEO-ENVIRONMENTAL ENGINEERING (CEPHDT11)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2					1						3	2	1
CO2	3	2	1										3	2	1
CO3	3	2	1										3	2	1
CO4	2	2	1	1									2	1	1
CO5	3	2	1	1			1						3	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT12	RIVER HYDRAULICS	3-1-0: 4

Course Learning Objectives:

The objective of this Course is to

1. Understand the fundamental principles and concepts of river mechanics, including the mechanical properties of flow and the basic principles of free surface flow.
2. Learn the characteristics of flow profiles in steady gradually varied flow and apply appropriate computation methods.
3. Study hydraulic structures such as spillways, energy dissipaters, and channel transitions for steady and unsteady rapid varied flow conditions.
4. Understand the characteristics of river beds and sediments, including the initiation of motion and the different types of sediment loads.
5. Learn stable channels for different flow conditions, considering erosion and sediment transport, and apply similitude principles for model testing.

Course Content

Unit-1: Introduction to river mechanics, Mechanical properties of flow, Aggrading rivers, Degrading rivers, Meandering rivers, Basic concepts of free surface flow, Flow regimes, Velocity and Pressure distribution, Energy principles and its applications, Specific energy, Critical flow computations, Momentum equations and its applications, Specific force diagram.

Unit-2: Steady gradually varied flow, Dynamic equation, Characteristics of flow profile and methods of computation, Practical problems, gradually varied flow classification, analysis and computations

Unit-3: Steady rapid varied flow, Hydraulic jump analysis and location, Jump in sloping channels and Oblique jump, Surge analysis, Design of spillways, Energy dissipaters, Channel transitions. Unsteady rapidly varied flow, Dam break problem, Moving hydraulic jump, Positive and Negative surges.

Unit-4: Fluvial hydraulics, Basic characteristics of river beds and sediments, Initiation of motion, Bed load, suspended load, total load and sediment measurements, Regimes of flow, Plan form and stream bed variations of rivers, Sediment control.

Unit-5: Design of stable channels, Design of erodible and lined channels for clear and sediment – laden flows, Regime method, Tractive force methods, Reservoir sedimentation, Erosion and deposition, Sediment transport in pipes Similitude and models.

Reference Books

1. Chow V.T. "Open Channel Hydraulics", McGraw Hill, Inc. New York.
2. Henderson "Open channel flow", McMillan Pub. London
3. Subramanya K. "Flow in Open Channels", Tata McGraw Hill Pub.
4. Garde and Ranga Raju K.G. "Mechanics of sediment transportation and Alluvial Stream Problems", Wiley Eastern, New Delhi
5. Chaudhry M.H. "Open – Channel Flow", Prentice Hall of India, New Delhi
6. French R.H. "Open Channel Hydraulics", McGraw Hill Pub Co., New York

Course Outcomes:

At the end of the course the students shall be able to

1. Explain the concept of critical flow and apply the energy principles to analyze and compute specific energy in river systems.
2. Solve practical problems related to gradually varied flow, such as determining flow profiles and predicting flow behavior in river systems.
3. Apply the principles of hydraulic jump analysis and surge analysis to solve problems and design appropriate structures in river systems.
4. Analyze and predict stream bed variations and sediment transport regimes in rivers and propose strategies for sediment control.
5. Develop design solutions for erodible and lined channels that can handle both clear and sediment-laden flows, while considering sediment transport and similitude principles for model testing.

Course Outcomes and their mapping with Programme Outcomes: RIVER HYDRAULICS (CEPHDT12)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2										3	1	2
CO2	3	1	1			2							2	2	1
CO3	3	2		2									3	3	1
CO4	3		2	2									2	1	2

CO5	3	2	2	2									2	1	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT13	IRRIGATION TECHNOLOGY AND WATER MANAGEMENT	3-1-0: 4

Course Learning Objectives:

The objective of this Course is

1. To understand the Types & Techniques of Irrigation.
2. To develop the basic understanding of Soil and Land Management in Agriculture.
3. To understand the Crop requirements and irrigation scheduling.
4. To learn the Water conveyance and computing the capacity of canals.
5. To learn the Reclamation of Water Logged and Saline Soils.

Course Content

Unit-1

Introduction: Types & Techniques of Irrigation including advanced techniques, Present situation of irrigation in India Soil-Moisture Irrigation Relationship, Estimating depth and frequency of irrigation.

Unit-2

Soil and Land Management in Agriculture: classification and surveys-land capability farm development, grading-equipment, land management techniques.

Unit-3

Crop requirements and irrigation scheduling: Major Indian crops times of sowing and harvesting –critical periods of growth moisture stress, Duty & delta of crops, Irrigation scheduling, Consumptive use of Crop- Blanney-Criddle, Thornth wait penman, Christiansen methods, Water-use efficiency, scope of computerization in irrigation.

Unit-4

Water conveyance Computing the capacity of canals, Losses in water canals, Distribution of water into the fields through water courses, Lined canals.

Unit-5

Reclamation of Water Logged and Saline Soils: Glances of water logging- design of surface and subsurface drains, Saline and alkaline lands reclamation and management of Salt affected lands.

Reference Books

1. Modi. P. N., "Irrigation, Water Resources & Water Power Engineering", Standard Publishers, New Delhi.
2. Punmia B. C., Pande Ashok kumar and Jain Arun kumar, "Irrigation and water power engineering", Laxmi Publications Pvt. Ltd.
3. Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGraw Hill. NY.
4. Linsley, R. K.and Frazinini, J. B., "Water Resources Engineering", 2nd Ed. McGraw Hill, NY
5. James L.D and Lee R.R., "Economics of Water Resources Systems Planning, McGraw Hill. NY

Course Outcomes:

At the end of the course the students shall be able

1. To have an understanding about Types & Techniques of Irrigation
2. To have an understanding about Soil and Land Management in Agriculture.
3. To have an idea about Crop requirements and irrigation scheduling.
4. Ability to analyse and calculate the capacity of canals.
5. To have an idea Reclamation of Water Logged and Saline Soils.

Course Outcomes and their mapping with Programme Outcomes: IRRIGATION TECHNOLOGY AND WATER MANAGEMENT (CEPHDT13)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1									3	2	1
CO2	3	2	1	2									2	2	2
CO3	3	2	2	1									2	2	2
CO4	3	2	2	2									3	3	3
CO5	3	2	1	1									2	2	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT14	**OPEN CHANNEL HYDRAULICS**	**3-1-0: 4**

Course Learning Objectives:

The objective of this Course is

1. To understand the concepts of free surface flow and equations hydraulics to uniform and non-uniform open channel flows.
2. To develop the basic understanding for flow resistance and compound channel.
3. To learn to apply conservation laws to gradually varied and rapidly varied unsteady flows.
4. To analyse hydraulics of mobile bed channel.
5. To learn the significance of Bridge Hydraulics.

Course Content

Unit-1: Basic Concepts of Free Surface Flow, classification of flow, velocity & pressure distribution. Conservation laws, continuity equation, momentum equation, Specific energy, Application of momentum & energy equation, Channel transition, Hydraulic jump. Critical flow.

Unit-2: Uniform flow: flow resistance, equation of flow resistance, compound channel, Computation of normal flow depth.

Unit-3: Gradually varied flow, Governing equation, classification of water surface profiles, and computation of GVF. Unsteady Rapidly Varied Flow. Application of conservation laws. Spillways, Energy dissipaters. Critical slope and limit slope.

Unit-4: Initiation of Motion of sediment, Critical analysis of Shield's diagram, Bed forms, and Predication of bed form. Sediment load: Suspended load, Bed load, total bed material load, measurement and estimation of sediment load. Design of Stable Channels: Regime and Tractive force Methods.

Unit-5: Introduction to Bridge Hydraulics: Water ways, Afflux, Scour: Local scour, abutment scour, Indian practice of design for scour.

Books and References

1. Flow through Open Channel by Ranga Raju, K.G., Tata McGraw Hill, New Delhi.
2. Open Channel Hydraulics by Chow, V.T, McGraw Hill, New York.
3. Open Channel Flow by Hendersen, F.M., McGraw Hill, New York.
4. Open Channel Flow by Chaudhry, M. H., Prentice Hall of India.

5. River Behavior Management and Training, Vol. I & II by Central Board of Irrigation & Power (CBIP), New Delhi.
6. River processes: An Introduction to Alluvial dynamics by Andre Rober, ARNOLD, London.

Course Outcomes:

At the end of the course the students shall be able

1. Ability to apply continuity, momentum and energy equations to uniform and non-uniform open channel flows.
2. Ability to apply flow resistance equation for uniform flow in open channel and compound channel.
3. Ability to apply conservation laws to gradually varied and rapidly varied unsteady flows.
4. Ability to analyse hydraulics of bed load sediment in open channel.
5. To have an idea of bridge hydraulics

Course Outcomes and their mapping with Programme Outcomes: OPEN CHANNEL HYDRAULICS (CEPHDT14)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3									3	2	1
CO2	3	2	2	2									2	3	2
CO3	3	2	2	2									3	3	2
CO4	3	2	3	3									2	2	1
CO5	3	2	2	2									2	2	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT15	**EARTHQUAKE ENGINEERING**	**3-1-0: 4**

Course Objectives: The course is aimed

1 To Introduction the Seismology and Earthquakes, Strong Ground Motion, Seismic Hazard Analysis.

2 To study the Wave propagation and evaluate the Ground Response Analysis (1D, Linear Non-Linear) with Local site effects,

3 To introduce Liquefaction, Soil Improvement for Remediation of Seismic Hazards:

Unit-I: Seismology and Earthquakes; Introduction, Seismic Hazards, seismic waves, internal structure of earth, Continental drift and plate tectonics, faults, elastics rebound theory, geometric notations, location of earthquakes, size of earthquakes.

Strong Ground Motion: Strong ground motion measurement, ground motion parameters, estimation of ground motion parameters.

Unit-II: Seismic Hazard Analysis; Identification and Evaluation of Earthquake Sources, deterministic seismic hazard analysis, probabilistic seismic hazard analysis.

Unit-III: Wave propagation; Waves in unbounded media, waves in a semi – infinite body, waves in a layered media, attenuation of stress waves.

Unit-IV: Ground Response Analysis; One – Dimensional Ground response Analysis – Linear and Non-Linear Approaches.

Local Site Effects: Effect of local site conditions on ground motion, design parameters, development of design parameters.

Unit-V Liquefaction: Flow liquefaction, cyclic mobility, evaluation of liquefaction hazards, liquefaction susceptibility, initiation of liquefaction, effects of liquefaction.

Soil Improvement for Remediation of Seismic Hazards: Densification techniques, Reinforcement Techniques, Grouting and Mixing techniques, Drainage techniques.

TEXT BOOK:

1. Geotechnical Earthquake Engineering by Steven L. Kramer, prentice Hall, 1st edition, 1996.
2. Fundamentals of Earthquake Engineering: An Innovative Approach by Amr S. Elnashai and Luigi Di Sarno, Wiley–Blackwell,2008.

REFERENCE BOOK:

1. Geotechnical Earthquake Engineering Handbook by Robert W. Day, McGraw-Hill.2nd edition, 2010.
2. Earthquake Engineering: Theory and Implementation with the 2015 International Building Codeby by Nazzal Armouti,2015.

Course Outcomes:

On the completion of this course, the student will be able to

1	Implement the effects of Seismology and Earthquakes and use Strong Ground Motion for the Seismic Hazard Analysis.
2	Carryout the wave propagation and evaluate the Ground Response Analysis (1D, Linear Non-Linear) with Local site effects,
3	Evaluate the Liquefaction of soils and carryout the Soil Improvement for Remediation of Seismic Hazards:

Course Outcomes and their mapping with Programme Outcomes: EARTHQUAKE ENGINEERING (CEPHDT15)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	1					1	3	2	1
CO2	3	3	2	1	1	1	1					1	3	2	1
CO3	3	3	2	1	1	1	1					1	3	2	1

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT16	TRANSPORTATION SYSTEM DESIGN AND MANAGEMENT	3-1-0: 4

Course Learning Objectives:

- To provide a comprehensive scientific insight of transportation system planning.
- To learn travel survey and analysis using econometric methods.
- To learn various travel demand modelling.
- To understand the concepts of transportation system management.
- To understand the sustainability aspects of transport system design for green mobility.

Course Content:

UNIT-I

Introduction: Basic concepts in transportation planning; accessibility and mobility; Characteristics of travel and transport problems.

UNIT- II

Travel Survey and Analysis: Transportation survey and data collection; planning, design and Implementation, Econometric methods for transportation data analysis (Regression Analysis); travel analysis zone (TAZ) development.

UNIT-III

Travel Demand Modelling: Travel demand and supply analysis, Trip generation, Trip distribution (Spatial and Temporal), Mode choice, Traffic assignment.

UNIT-IV

Demand Management: Transportation demand management (TDM); Transportation system management (TSM), Transit-oriented development (TOD); pedestrian-oriented development, liveable street planning, Multimodal transportation planning; shared mobility concept; integrated transportation management and planning.

UNIT-V

Sustainability: Sustainable Transport Planning, Transportation and energy; climate change, fuel choice and green mobility.

Text Books:

1. Sarkar, P.K., Maitri, V., and Joshi, G.J. Transportation Planning, Principles, Practices and Policies, PHI Pvt. Ltd., 2016
2. Papacosta, C.S., and Prevedouros Transportation Engineering and Planning, PHI Pvt.Ltd.,2004

Reference Books:

1. De Dios Ortuzar, J., and Willumsen, L. G. Modelling transport. John Wiley & Sons., 2011
2. Hutchinson B.G; Principles of Urban Transport Systems Planning; McGraw-Hill Book Company, 1974.
3. Chakroborty, P. and Das, A. Principles of Transportation Engineering, PHI Pvt. Ltd., 2012
4. Train, K. E. Discrete choice methods with simulation. Cambridge university press, 2009
5. Kadiyali, L. R. Traffic Engineering and Transport Planning, Khanna Publishers, 20

Course Outcomes- At the end of the course students will be able to:

CO1: Develop an understanding of transportation planning to measure transportation demand.

CO2: Design various travel behavior surveys to collect transportation planning related data and analyze the data for calibration and validation of various types of models involved in the traditional four-step travel demand forecasting process.

CO3: Develop in-depth knowledge on the classic four stage demand models including: 1) trip generation, 2) trip distribution, 3) mode choice, and 4) trip assignment.

CO4: Able to understand econometric models and use statistical packages.

CO5: Learn the concepts of sustainable transportation planning and land-use transport.

Course Outcomes and their mapping with Programme Outcomes: TRANSPORTATION SYSTEM DESIGN AND MANAGEMENT (CEPHDT16)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3		2							3	1	1

CO2	3	3	2	2		2							2	3	2
CO3	3	2	3	2		1							3	3	2
CO4	3	2	3	3	2	1							2	3	1
CO5	3	2	2	2		2	3						2	2	2

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT17	**Advance Soil Mechanics**	**3-1-0: 4**

Course Learning Objectives:

The objective of this Course is

- To understand soil composition, index properties, and forces governing soil structure, fostering a comprehensive grasp of soil nature.
- To analyze dry soil behavior, shear strength, and stress-strain relationships for practical application in civil engineering projects and designs.
- To assess the principles of saturated soil behavior, including permeability, stress-strain characteristics, and stability analysis in diverse conditions.
- To analyze undrained shear behavior, consolidation, and stability under varying conditions for informed geotechnical design decisions.
- To Analyze and Design the Retaining Wall and Foundations with Different field Conditions

Module 1: Nature of Soil: Soil Problems in Civil Engineering, A Preview of Soil Behaviour, Conduct of the Subject. Soil Composition, Index Properties, Soil Classification, Soil Structure: Clay-Water Forces, Interparticle Forces: Normal Stresses and Shear Stresses, Soil Formation.

Module 2: Dry Soil: Stresses Within a Soil Mass: Geostatic Stress & Stresses due to applied load, Tests, to Measure Stress-Strain Properties, General Aspects of Stress-Strain Behaviour, Shear Strength of Cohesionless Soil, Stress-Strain Relationships.

Module 3: Saturated Soil (No or Steady State Flow): Effective Stress Principle, Capillarity, Soil Suction, One- and Two-Dimensional Flow, Coefficient of Permeability (Theory and Practice), Stress-Strain and Strength Behaviour of Clays, 1-D Behaviour

(Theory and Practice), Drained Shear Behaviour, Strength Principles, Lateral Earth Pressures, and Slope Stability.

Module 4: Saturated Soil (Transient Flow): Pore Pressure Parameters, Undrained Shear Behaviour of Clays, and Strength Principles, Consolidation of Cohesive Soils, Evaluation of Stability (Loading vs. Unloading and Undrained vs. Drained Conditions), Estimation of Undrained Strength for Design.

Module 5: Slopes and Foundations: Finite & Infinite Slopes, Rankine Earth Pressures, Retaining Walls: Analysis and Behaviour of Shallow Foundation: Analysis and Design, Settlement, Deep Foundations: Analysis and Design

Reference Books:

1. Lambe, T. W., & Whitman, R. V. (1991). Soil mechanics (Vol. 10). John Wiley & Sons.
2. Das, B. M. (2019). Advanced soil mechanics. CRC press.
3. Terzaghi, K., & Peck, R. B. (1948). Soil mechanics. Engineering Practice. John Wiley and Sons, Inc., New York.
4. Terzaghi, K., Peck, R. B., & Mesri, G. (1996). Soil mechanics in engineering practice. John Wiley & sons.
5. Mitchell, J. K., & Soga, K. (2005). Fundamentals of soil behavior (Vol. 3, p. USA). New York: John Wiley & Sons.

Course Outcomes:

At the end of the course, the students shall be able

CO1: To Characterize soil composition, index properties, and structure for engineering applications.

CO2: To Analyze dry soil properties to determine stress-strain behavior, shear strength, and stability in civil engineering applications.

CO3: To Apply principles of effective stress, capillarity, permeability, stress-strain, and strength behavior to assess and design for stability in saturated soil under no or steady-state flow conditions.

CO4: To Analyze pore pressure parameters, undrained shear behavior, consolidation, and stability to make informed engineering decisions in saturated soil under transient flow conditions.

CO5: To Analyze and Design the retaining wall and foundations for different field conditions.

Course Outcomes and their mapping with Programme Outcomes: Advance Soil Mechanics (CEPHDT17)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	3					2	3	2	3
CO2	3	3	3	3	3	3	3					3	3	2	3
CO3	3	3	3	2	3	3	3					2	3	2	3
CO4	3	3	3	3	3	3	3					3	3	2	3
CO5	3	3	3	3	3	3	3					3	3	2	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT18	**Environmental Geotechnics**	**3-1-0: 4**

Course Learning Objectives:

The objective of this Course is

- To develop an understanding of geoenvironmental engineering, emphasizing soil's multifaceted role in diverse applications and addressing contamination impact through case studies
- To explore soil-water-contaminant interactions, understanding factors influencing the retention and transport of contaminants in soil for geoenvironmental problem-solving.
- To evaluate soil properties for waste containment, ensuring stability and suitability, guiding the design of adequate waste containment facilities
- To develop skills for effective site characterization, risk assessment, and selection of remediation methods for contaminated sites.
- To enhance expertise in advanced soil characterization through contaminant analysis, property evaluation, and innovative geotechnical techniques like GPR and centrifuge modelling.

Module 1: Fundamentals of Environmental Geotechnics: Scope of geoenvironmental engineering- multiphase behaviour of soil – role of soil in geoenvironmental applications – importance of soil physics, soil chemistry, hydrogeology, biological process – sources and type of ground contamination – impact of ground contamination on geoenvironmental - case histories on geoenvironmental problems.

Module 2: Soil-Water-Contaminant Interaction: Soil mineralogy characterization and its significance in determining soil behaviour – soil-water interaction and concepts of double layer – forces of interaction between soil particles.

Concepts of unsaturated soil – the importance of unsaturated soil in geoenvironmental problems - measurement of soil suction - water retention curves - water flow in the saturated and unsaturated zone. Soil-water-contaminant interactions and its implications – Factors affecting retention and transport of contaminants.

Module 3: Waste Containment System: Evolution of waste containment facilities and disposal practices – Site selection based on environmental impact assessment –different role of soil in waste containment – different components of waste containment system and its stability issues – property evaluation for checking soil suitability for waste containment – design of waste containment facilities.

Module 4: Contaminant Site Remediation: Site characterization – risk assessment of contaminated site - remediation methods for soil and groundwater – selection and planning of remediation methods – some examples of in-situ remediation.

Module 5: Advanced Soil Characterization: Contaminant analysis - water content and permeability measurements – electrical and thermal property evaluation – use of GPR for site evaluation - introduction to geotechnical centrifuge modeling.

Reference Books:

1. Rowe, R. K. (Ed.). (2012). Geotechnical and geo-environmental engineering handbook. Springer Science & Business Media.
2. Reddi, L., & Inyang, H. I. (2000). Geo-environmental engineering: principles and applications. CRC Press.
3. Yong, R. N. (2000). Geo-environmental engineering: Contaminated soils, pollutant fate, and mitigation. CRC press.
4. Sharma, H. D., & Reddy, K. R. (2004). Geo-environmental engineering: site remediation, waste containment, and emerging waste management technologies. John Wiley & Sons.
5. Fredlund, D. G., & Rahardjo, H. (1993). Soil mechanics for unsaturated soils. John Wiley & Sons.

Course Outcomes:

At the end of the course, the students shall be able

CO1: To understand geo-environmental engineering, analyzing soil's multiphase behavior and its role in environmental applications, supported by case histories.

CO2: To comprehend soil-water-contaminant interactions, assessing implications, and factors affecting retention and transport of contaminants in geo-environmental scenarios.

CO3: To evaluate waste containment system stability, soil suitability, and design, considering environmental impact, evolving disposal practices, and facility components.

CO4: To develop expertise in assessing and planning contaminant site remediation, integrating site characterization, risk assessment, and remediation method selection.

CO5: To apply advanced techniques, including contaminant analysis, GPR, and geotechnical centrifuge modeling, for comprehensive soil characterization in practice.

Course Outcomes and their mapping with Programme Outcomes: Environmental Geotechnics (CEPHDT18)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3	3	3	2	3	3	3					2	3	2	3
CO2	3	3	3	3	3	3	3					3	3	2	3
CO3	3	3	3	2	3	3	3					2	3	2	3
CO4	3	3	3	3	3	3	3					3	3	2	3
CO5	3	3	3	3	3	3	3					3	3	2	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

Course Code	Subject	Credits
CEPHDT19	**Principles of Ground Modification**	**3-1-0: 4**

Course Learning Objectives:

The objective of this Course is

- To analyze ground modification methods, including recent trends and emerging developments in geotechnical engineering.
- To understand soil compaction principles for effective ground modification in engineering applications.
- To design and implement effective hydraulic modifications for soil dewatering, drainage, and seepage control.
- To apply chemical, thermal, and admixture methods for soil modification in geotechnical engineering practices.
- To understand soil reinforcement techniques, including geosynthetics and stone columns, for practical ground modification applications.

Module 1: Introduction to Engineering Ground Modification: The ground modification option in dealing with difficult soil, Recent forums, Traditional objectives, Emerging Trends, and Current and Future Developments.

Module 2: Mechanical modification: Analysis and Design: Mechanical Modification, Principles of Soil Densification, Properties of Compacted Soil, Compaction Control Tests, Specifications of Compaction Requirements and Design.

Module 3: Hydraulic Modifications: Introduction to Hydraulic Modification; Design of Dewatering System; Filtration, Drainage and Seepage Control with Geosynthetics; Analysis and Design: Preloading and Use of Vertical Drain; Electrokinetic Dewatering and Stabilization.

Module 4: Physical and Chemical Modification: Analysis and Design: Modifications by Admixtures; Modification at Depth by Grouting; Thermal Modifications.

Module 5: Modification by Inclusion and Confinement: Analysis and Design Using Soil Reinforcement; Mechanical Models of Soil Reinforcement, Flexible Geosynthetics Sheet reinforcement, Stone Columns; Encased Stone Columns; Soil Confinement by Formwork.

Reference Books:

6. Hausmann, M. R. (1990). Engineering principles of ground modification. McGraw Hill Education (India) Private Limited.
7. Han, J. (2015). Principles and practice of ground improvement. John Wiley & Sons.
8. Nicholson, P. G. (2014). Soil improvement and ground modification methods. Butterworth-Heinemann.
9. Moseley, M. P., & Kirsch, K. (Eds.). (2004). Ground improvement. CRC Press.
10. Datye, K. R. (1982). Simpler technique for ground improvements. Fourth IGS Annual Lectures, IGJ, 12, 1-82.
11. Chu, J. J., & Rujikiatkamjorn, C. (2005). Ground improvement: case histories. Elsevier.

Course Outcomes:

At the end of the course, the students shall be able

CO1: To recall and articulate the historical evolution and diverse objectives of ground modification practices.

CO2: To apply principles of soil densification, compaction control, and specifications for effective mechanical modification.

CO3: To design dewatering system, filtration, and drainage with geosynthetics for effective hydraulic modifications.

CO4: To design and implement effective ground modifications using admixtures, grouting, and thermal techniques at various depths.

CO5: To apply advanced soil reinforcement techniques, demonstrating expertise in inclusion and confinement methods for stabilization and their design.

Course Outcomes and their mapping with Programme Outcomes: Principles of Ground Modification (CEPHDT19)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	3	1	3					2	3	2	1
CO2	3	3	3	3	3	2	2					2	3	2	3
CO3	3	3	3	3	3	2	3					2	3	2	3
CO4	3	3	3	3	3	2	2					2	3	2	3
CO5	3	3	3	3	3	2	3					2	3	2	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

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Course Code	Subject	Credits
CEPHDT20	**Soil Remediation**	**3-1-0: 4**

Course Learning Objectives:

The objective of this Course is

- To analyze soil origin, constituents, properties, and degradation to comprehend soil dynamics and its environmental impact.
- To comprehend soil pollution sources, mechanisms, and effective monitoring strategies for sustainable environmental management.
- To master electrokinetic and thermal soil remediation principles, processes, and applications for effective environmental restoration.
- To understand and apply bioremediation principles and phytoremediation for effective soil pollutant removal.
- To apply spatial and mathematical models to understand fluid flow, enhancing proficiency in soil pollution prediction and management.

Module 1: Soil-Its Nature and Origin: Origin of Soil: Formation and Morphology, Soil Constituents: As Three Phase System, Organic Matter and Soil Organisms; Soil properties and Classification: Physical and Chemical Properties, Criteria of Soil Classification, Different system of classification along with FAO-UNESCO Soil Classification system; Soil Degradation.

Module 2: Soil Pollution and Monitoring: Major Types of Soil Pollutants, Source of Soil Pollution, Pollution Mechanism and Soil-Pollution Interaction, Pollutant's Alteration and Initiation of Chemical Change within Soil, Monitoring of Soil Pollution.

Module 3: Electrokinetic and Thermal Remediation: Electrokinetic Remediation: Introduction, Fundamentals, Important Processes and Case study; Thermal Remediation: Thermal processes, Fundamentals, Incineration, Thermal Desperation, Aqueous Oxidation and Case study.

Module 4: Bioremediation and Plant-Based Remediation: Overview of Phytoremediation, Phytoremediation of Metal-Contaminated, Lead-Contaminated, Heavy Metal Polluted and Salt Affected Soils, Phytoremediation Towards Future; Bioremediation: Introduction, Fundamentals, Important Processes and Case study.

Module 5: Modelling of Soil Pollution: Model and Their Construction, Types of Models: Space Analogue and Mathematical Modelling of Fluid Flow in Soil.

Reference Books:

1. Ibrahim, A.M. "Soil Pollution: Origin, Monitoring and Remediation" Springer New York, 2008.
2. Brian, J.A. and Jack, T.T. "Soil Remediation and Rehabilitation: Treatment of Contaminated and Disturbed land" Springer New York, 2013.
3. William, C.B. "Basic Hazardous Waste Management" Lewis Publishers, New York, 2001.

Course Outcomes:

At the end of the course, the students shall be able

CO1: To demonstrate a comprehensive understanding of soil science fundamentals and environmental implications.

CO2: To effectively monitor and mitigate soil pollution, demonstrating proficiency in pollutant identification and monitoring techniques.

CO3: To apply electrokinetic and thermal remediation principles to address soil contamination effectively in practice.

CO4: To apply bioremediation principles to design effective strategies for diverse soil contamination challenges.

CO5: To model soil pollution using space analogy and mathematical methods for practical environmental analysis.

Course Outcomes and their mapping with Programme Outcomes: Soil Remediation (CEPHDT20)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	3					2	3	2	3
CO2	3	3	3	2	3	3	3					2	3	2	3
CO3	3	3	2	3	2	3	3					2	3	2	3
CO4	3	3	3	2	3	3	3					2	3	2	3
CO5	3	3	3	2	3	3	3					2	3	2	3

Weightage: 1-Sightly; 2-Moderately; 3-Strongly