KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE- 638 060

MINUTES OF THE MEETING OF BOARD OF STUDIES IN CIVIL ENGINEERING

MEETING No. 21

DATE : 19-06-2021

TIME : 10.00 AM (Online)

Google Meet Id: https://meet.google.com/atw-ftaq-qgt

The following members were present for the meeting:

1.	Dr.P.S.Kothai, Head of the Department, Department of Civil Engineering, Kongu Engineering College, Perundurai – 638060.	Chairman
2.	Dr.P.Vincent @ Venkatesan Senior Professor, Department of Civil Engineering, Mepco Schlenk Engineering College, Sivakasi - 626005.	University Nominee
3.	Dr. A. Murugappan, Professor, Department Of Civil Engineering, Annamalai University, Chidambaram — 608002.	Academic Council Nominee
4.	Dr.S.S.Chandrasekar, Professor, Department of Civil Engineering, Vellore Institute of Technology, Vellore – 632014.	Academic Council Nominee
5.	Mr. V.R. Ramkumar, Scientist — Ministry of Environmental Forest Science/GOI, IPIRTI. HMT Link Road, Tumkur Road Bangalore — 560022	Alumni Representative
6.	Mr. S.Veeramani, General manager, L & T Constructions, ECC, AR Centre, Mount Ponnamalle High Rd, Manapakkam. Chennai – 600089	Industry Representative
7.	Dr.S.Anandakumar	Internal Member
8.	Dr.K.Nirmalkumar	Internal Member
9.	Dr.S.Krishnamoorthi	Internal Member
10.	Dr.P.Chandrasekaran	Internal Member
11.	Dr.S.Balaji	Internal Member

12.	Dr.K.Arumugam	Internal Member
13.	Dr.S.Suchithra	Internal Member
14.	Dr.T.Pradeep	Internal Member
15.	Dr.G.S.Rampradheep	Internal Member
16.	Dr.D.Ambika	Internal Member
17.	Dr. S.Karthikeyan	Internal Member
18.	S.Venkatachalam	Internal Member
19.	Dr.A.R.Krishnaraja	Internal Member
20.	M.P.Thiyaneswaran	Internal Member
21.	P.Ravichandran	Internal Member
22.	S.Vijayanand	Internal Member
23.	K.Vishnuvardhan	Internal Member
24.	T.Ravi Prakash	Internal Member
25.	P.Dinesh Kumar	Internal Member
26.	R.K.Sangeetha	Internal Member
27.	M.Arun Kumar	Internal Member
28.	N.Nandhini	Internal Member
29.	T.jeevitha	Internal Member
30.	S.Vijayashanthy	Internal Member
31.	T.Karthika	Internal Member
32.	K.Sampath Kumar	Internal Member
33.	K.S.Navaneethan	Internal Member
34.	A.Sivakumar	Internal Member

35.	P.Kulanthaivel	Internal Member
36.	S.Vinodhkumar	Internal Member
37.	S.Manoj	Internal Member
38.	V.Sampathkumar	Internal Member
39.	V.Naveenraj	Internal Member
40.	K.Raja	Internal Member
41.	K.Santhosh Kumaar	Internal Member

Meeting of the Civil Engineering Board:

Chairman/BoS welcomed the members and briefed on the rules and regulations governing the autonomous scheme and presented the agenda points including the draft syllabi from 3rd semester to final semester under Regulation 2020 of UG Programme.

The board discussed and approved the following points as per the agenda:

Item No. 21.1: Confirmation of Minutes of the previous Board of Studies meeting

Resolved to confirm the minutes of the previous Board of Studies Meeting held on 29.08.2020.

Item No. 21.2: Ratification of the following items under R2014 & R2018 as given in Appendix-I.

One/two credit courses

The following one/two credit courses and their syllabus content were approved

S. No.	Course Code	Course Title	Credits
1.	18VAC17	Interior Design	2
2.	18VAC18	Wind Load Analysis of Structure	1
3.	18VAC19	Ocean and Coastal Engineering	1

It is resolved to ratify the one/two credit courses and their syllabus content as given in Appendix – I.

Item No. 21.3. Approval of the Syllabi from 3rd semester to 8th semester BE (Civil Engineering) under R2020 as given in Annexure-II

The members discussed the syllabi from third semester to eighth semester BE (Civil Engineering) under R2020 as given in Annexure – II and approved the same.

Item No. 21.4. Approval for one credit courses, on-line courses with syllabi, Transfer of credits from UGC & AICTE approved institutions and Credit transfer from foreign universities under R2018 & R2020 as given in Annexure-III.

The members discussed the one credit courses, on-line courses with syllabi, Transfer of credits from UGC and AICTE approved institutions including NPTEL, SWAYAM, etc., and Credit transfer from foreign universities under R2018 & R2020 (from the year 2021-22 onwards) as given in Annexure – III and approved the same.

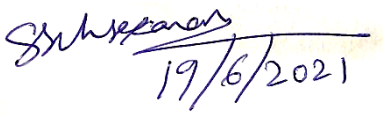
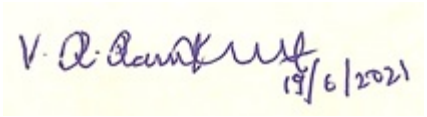
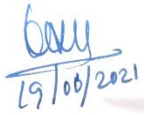
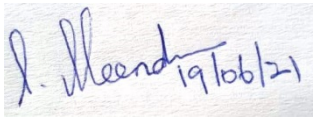
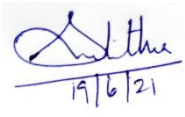
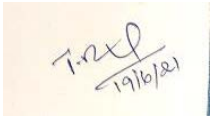
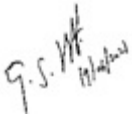
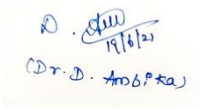
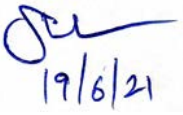
Item No. 21.5. Approval of Syllabus for PhD courses under R2020 as given in Annexure-IV.

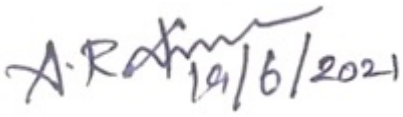
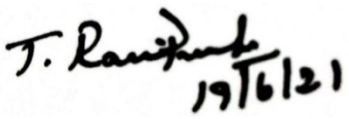
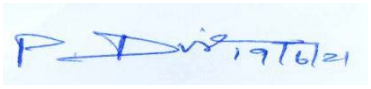
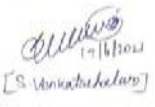
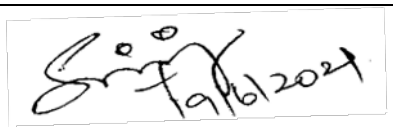
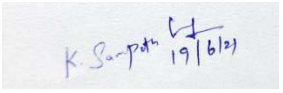
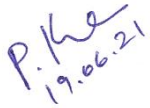
NIL

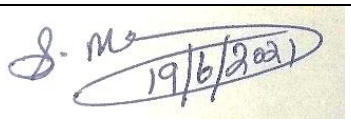
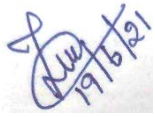
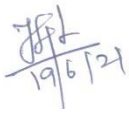
Item No. 21.6. To recommend the online examination system to be followed for the April/May 2021 End Semester Examinations as given in Annexure-V.

The members discussed recommend the online examination system to be followed for the April/May 2021 End Semester Examinations as given in Annexure-V

The meeting was concluded with a vote of thanks to the members.

 Name & Signature Dr. P. Vincent @ Venkatesan	 Name & Signature Dr. A. Murugappan
 Name & Signature Dr.S.S.Chandrasekar	 Name & Signature Dr. V. R. Ramkumar
 Name & Signature Mr.S.Veeramani	 Name & Signature Dr.S.Anandakumar
 Name & Signature Dr.K.Nirmalkumar	 Name & Signature Dr.S.Krishnamoorthi
 Name & Signature Dr.P.Chandrasekaran	 Name & Signature Dr.S.Balaji
 Name & Signature Dr. S. Suchithra	 Name & Signature Dr.K.Arumugam
 Name & Signature Dr. T. Pradeep	 Name & Signature Dr. G. S. Rampradheep
 Name & Signature Dr.D.Ambika	 Name & Signature Dr. S.Karthikeyan

 Name & Signature Dr. A. R. Krishnaraja	 Name & Signature M.P.Thiyaneswaran
 Name & Signature S.Vijayanand	 Name & Signature K. Vishnuvardhan
 Name & Signature T.Ravi Prakash	 Name & Signature P.Dinesh Kumar
 Name & Signature R.K.Sangeetha	 Name & Signature . S.Venkatachalam
 Name & Signature P.Ravichandran	 Name & Signature S.VijayaShanthy
 Name & Signature M.Arun Kumar	 Name & Signature T.Karthika
 Name & Signature K.Sampath Kumar	 Name & Signature K.S.Navaneethan
 Name & Signature N. Nandhini	 Name & Signature A.Sivakumar
 Name & Signature P.Kulanthaivel	 Name & Signature S. Vinodhkumar

 Name & Signature S.Manoj	 Name & Signature T. Jeevitha
 Name & Signature K. Raja	 Name & Signature K. Santhosh Kumar
 Name & Signature V. Naveen Raj	 Name & Signature V. Sampath Kumar
	 Name & Signature Dr.P.S.Kothai Chairman/BoS

Annexure – I

Ratification items under R2014 & R2018 implemented during the last academic year 2020-21

One/two credit courses

The following one/two courses and their syllabus content were approved

S. No.	Course Code	Course Title	Credits
1	18VAC17	Interior Design	2
2	18VAC18	Wind Load Analysis of Structure	1
3	18VAC19	Ocean and Coastal Engineering	1

18VAC17- INTERIOR DESIGN

L	T	P	Credit
2	0	0	2

Preamble	This course equips the learner with various aspects of interior design.	
Unit - I	**INTRODUCTION TO INTERIOR DESIGN**	**6**
Definition and process of interior design- Role of professions of interior designer- interior design and furniture design- bringing out their origin, evolution and current scope of work. Introduction to the design of interior spaces as related to typology, function and themes.		
Unit - II	**FUNDAMENTALS OF INTERIOR DESIGN**	**8**
Introduction to space planning and furniture design as related to parameters such as human comfort and function (including anthropometrics and ergonomics), built in or freestanding, materials and methods of construction, innovations and design ideas - Study and exercise with representative examples.		
Unit - III	**TREATMENTS OF INTERIOR SPACE – I**	**8**
Psychology of interior treatment and finishes in the experience of interior spaces - Outline of the design of components such as floors, ceilings, walls, partitions, window treatments and accessories based on parameters such as context, function, ambience, materials, properties, methods of construction, color, texture - Study and exercise with representative examples.		
Unit - IV	**TREATMENTS OF INTERIOR SPACE – II**	**8**
Role of lighting and landscaping in the experience of interior spaces - Outline of different types of interior lighting systems and outline of interior landscaping elements such as rocks, plants, water, flowers, fountains, paving, etc., Study and exercise with representative examples.		

Total:30

REFERENCES:

1.	Francis D.K.Ching, 'Interior Design Illustrated', John Wiley & Sons, 2012.
2.	Joseph DeChiara, Julius Panero, Martin Zelnik, 'Time Saver's Standards for Interior Design', McGraw-Hill Professional, 2001
3.	Jan Pieper, George Michell, 'The Impulse to Adorn- Studies in Traditional Indian Architecture', Marg Publications, 1982.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the process and methodology used in interior design	Understanding (K2)
CO2	Summarize the fundamentals of interior design	Understanding (K2)
CO3	Apply the interior treatments for building components	Applying (K3)

CO4	Formulate the interior treatments for lighting and landscaping	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1			2	1					1	3	2
CO2	2	1				2	1					1	3	2
CO3	3	2	1			3	2					2	3	3
CO4	3	2	1			3	2					2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
Theoretical Exam	20	30	50				100
Case Studies and Presentation		50	50				100

18VAC18 WIND LOAD ANALYSIS OF STRUCTURES

L	T	P	Credit
2	0	2	1

Preamble	To perform wind analysis as per code of practice through manual calculations and STADD.Pro.	
Unit - I	**Introduction to Wind Analysis:**	**10**
Introduction –Basic Wind Speed - Design Wind Speed - Design Wind Pressure - Wind Pressures and Forces on Buildings - Pressure Coefficients.		
Unit - II	**Wind Force on Structures:**	**10**
Determination of Wind Loads – Wind Pressure and Forces on Flat Roof Buildings -Wind Pressure and Forces on Pitched Roof Buildings.		

List of Exercises / Experiments:

1.	Wind Load Analysis on 2D frame
2.	Wind Load Analysis on 3D frame
3.	Wind Load Analysis on Rectangular Buildings
4.	Wind Load Analysis on Trusses
5.	Wind Load Analysis on Pitched Roof Buildings

Lecture:20, Practical:10, Total:30

REFERENCES:

1.	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures – IS 875:1987 Part 3.
2.	An Explanatory Handbook on IS 875 Part 3 – Wind Loads on Buildings and Structures, IIT Kanpur

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	calculate basic wind speed and design wind pressure of buildings.	Apply (K3)
CO2	determine wind pressure coefficients of buildings	Analysis (K4)
CO3	analyse the structure for wind loads using STADD.Pro	Analysis (K4), Precision (S3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2			3						1	3	3
CO2	3	3	2			3						1	3	3
CO3	3	2	1	2	1	3			1	1		2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
Theoretical Exam (50 marks)*	10	10	20	60			100
Practical (50 marks)*	-	-	50	50			100

18VAC19 – OCEAN AND COASTAL ENGINEERING

L	T	P	Credit
1	0	0	1

Preamble	This course imparts knowledge about the physical properties and characteristics of the ocean water, generation of waves, coastal management, coastal sediment processes, coastal deformation, coastal protection measures and measurement of waves.	
Unit - I	**OCEAN ENGINEERING**	**10**
Introduction – Physical Properties of sea water – Ocean Currents – Forces acting on sea water - Generation of waves – Classification of waves – Refraction of waves – Reflection of waves - Waves breaking in shallow water.		
Unit - II	**COASTAL ENGINEERING**	**10**
Coastal Engineering – Coastal management – Current Challenges in coastal management - Coastal Sediment processes – Coastal Protection Measures – Breakwaters – Groynes – Sea walls – Revetments – Rock armour – Gabions – Cliff Stabilization – Entrance Training walls – Floodgates – sand bypassing – Beach nourishment - Monitoring coastal zones – Event Warning systems – Shoreline Mapping – shoreline indicator.		
Unit -III	**OCEAN MEASUREMENTS**	**10**
Measurement of waves – Soundings Equipments - Lunar Tides – Solar Tides – Mean sea level – Tsunami – Aerial Photographs – Historical maps – Delineation of shoreline – Beach profiling surveys.		

Total: 30

REFERENCES:

1.	John Fenton, 'Coastal and Ocean Engineering', Course Material, TU Wien, Institute for Wasserbau und Ingenieurhydrologie, Karlsplatz, Wien, 2017.
2.	Balaji R & Behera M. R, 'Coastal Processes and Modelling', Course Material, Continuing Education & Quality Improvement Programme, Indian Institute of Technology Bombay, Mumbai, 2014.
3.	Balaji R & Behera M. R, 'Coastal Engineering: Basics, Design and Application', Course Material, Continuing Education & Quality Improvement Programme, Indian Institute of Technology Bombay, Mumbai, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Explain the properties of sea water, generation of waves	K1
CO2	Describe the coastal engineering and management, coastal protection and breakwaters	K3

CO3	Describe the measurement of waves and process of Tsunami	K2

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2					2							
CO2	2	2					2							
CO3	2	2					2							
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
Assessment1 (100 marks)*	50	30	20				45
Assessment2 (100 marks)*	50	30	20				45
Assignment (10 marks)*		50	50				10
Total							100

* As per the approval

Annexure - II

Syllabi from 3rd semester to 8th semester BE/BTech (Civil Engineering Branch) under R2020

20CET31 MECHANICS OF MATERIALS

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Engineering Mechanics	III	ES	3	1	0	4

Preamble	This course imparts knowledge about stresses, strains, shear force, bending moment, slope and deflection in beams, concept of torsion in circular shaft and theory of columns.	
Unit - I	**Stresses and Strain**	**9+3**
Introduction – Types of loads – Stability - Stresses & strains – Stress & strain diagram for steel – Elastic limit - Hooke's law – Poisson's ratio – Elastic constants – Young's modulus – Shear modulus – Bulk modulus - Thermal stresses – Temperature Strain – Factor of Safety - Deformation of simple and compound bars.		
Unit - II	**Shear Force & Bending Moments in Beams**	**9+3**
Types of beams – Types of supports and loads – Plane bending – Oblique bending – Bending moment & Shear force – Sign conventions - Point of contraflexure – Clockwise and anti-clockwise moments – Shear force & bending moment diagrams for concentrated load, uniformly distributed load, uniformly varying load & Couples.		
Unit - III	**Stresses in Beams**	**9+3**
Simple Bending - Bending stress – Assumptions – Theory of simple bending and bending equation – Complimentary shear – Load Carrying capacity -– Application's of bending equation - Shear stress distribution in beam.		
Unit - IV	**Deflection of Beams &Thin Cylinder**	**9+3**
Beam Deflection – Slope - Sign conventions - Double integration method –Macaulay's Method - Moment area method – Mohr's Theorems - Conjugate beam theorems - Conjugate beam method. Thin cylinder – Circumferential stress – Longitudinal stress – Maximum shear stress – Change in dimension of thin cylinder.		
Unit - V	**Theory of column** & **Torsion**	**9+3**
Column & strut – Classification of columns - Slenderness ratio – Buckling factor - Effective length – Various end conditions - Euler's theory, assumptions, formula & limitations - Rankine's formula – Crippling load & Safe load. Simple torsion – Torsional loads – Torsion equation for circular shafts & hollow circular shafts – Assumptions – Torsional rigidity - Power transmission – Modulus of rupture.		

Lecture: 45, Tutorial:15, Total:60

TEXT BOOK:

1. Rajput. R. K, Strength of Materials, 7th Edition, S. Chand & Company Ltd, New Delhi, 2018.

REFERENCES:

1. Subramanian R., Strength of Materials, 2nd Edition, Oxford University Press, 2014.
2. Ferdinand Pierre Beer, Elwood Russell Johnston, John T. De Wolf and David Francis Mazurek, Mechanics of Materials, 7th Edition, McGraw-Hill Education, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	determine the various types of stresses and strain	K3 (Applying)
CO2	draw the shear force and bending moment diagram for beams under various loading conditions	K3 (Applying)
CO3	analyse the bending and shear stresses in beams	K4 (Analyzing)
CO4	asses the slope and deflection in beams	K4 (Analyzing)
CO5	analyse the torsional behaviour and compute the critical load on columns	K4 (Analyzing)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1			3						1	3	3
CO2	3	3	2			3				1		1	3	3
CO3	3	3	2			3						1	3	3
CO4	3	3	2			3						1	3	3
CO5	3	3	2			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	20	70				100
CAT2	10	10	40	40			100
CAT3	10	10	30	50			100
ESE	10	10	30	50			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CET32 WATER RESOURCES AND IRRIGATION ENGINEERING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	III	PC	3	0	0	3

Preamble	This course aims to expose the civil engineering students with the clear knowledge on Water Resources, Irrigation Engineering concepts and National Water Policy. Further they will be imparted required knowledge on Reservoir management and Irrigation management practices.	
Unit - I	**Water Resources:**	**9**
Need for water resources – Water resources of Tamil Nadu and India– Planning of water resources – Assessment of water requirement for drinking and irrigation purposes – Reservoirs – Single and multipurpose reservoir – Multi objective –Storage capacity of reservoirs – Reservoir operation strategies – Design flood level – levees and flood walls.		
Unit - II	**Water Resource Management:**	**9**
Financial aspects of water resources planning – National Water Policy – Consumptive and non – consumptive water use – Water quality – Scope and aims of master plan – Idea of basin as a unit for development – Water budget – Conjunctive use of surface and ground water.		
Unit - III	**Irrigation Engineering:**	**9**
Need – Advantages and Disadvantages – Connection between Duty, Delta and Base period – Causes affecting duty– Problems – Irrigation efficiencies – problems – Seasonal crops of India – Crop water Requirement – Evaluation of Consumptive use of water.		
Unit - IV	**Canal Irrigation:**	**9**
Types of impounding structures: Gravity dam – Diversion Head works – Canal drop – Cross drainage works – Canal regulations – Canal outlets – Canal classifications – Alignment of canals – River Training works – Kennedy's and Lacey's Regime theory.		
Unit - V	**Irrigation Methods and Management:**	**9**
Types of Irrigation – Lift irrigation – Tank irrigation – Well irrigation – Irrigation methods: Surface and Sub – Surface and Micro irrigation – Merits and demerits – Irrigation scheduling – Water distribution – Participatory irrigation management with a case study – On farm development works– Participatory irrigation management – Case study.		

Lecture: 45, Total: 45

TEXT BOOK:

1. Asawa G.L., "Irrigation and Water Resources Engineering", 1st Edition, New Age International Publishers, New Delhi, 2005.

REFERENCES:

1. Garg S.K., "Water Resources Engineering Vol. II Irrigation Engineering & Hydraulic Structures" – 34th Edition, Khanna Publishers, New Delhi, 2016.
2. Suresh Ukarande., "Irrigation Engineering and Hydraulic Structures", 3rd Edition, Ane Books Pvt. Ltd., New Delhi – 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify the components of water storage structures along with its functions	Understanding (K2)
CO2	infer the importance of water resource management	Understanding (K2)
CO3	compute the delta, duty relationship and irrigation efficiency	Applying (K3)
CO4	identify the types of canal irrigation and analyze the functions of diversion head works	Applying (K3)
CO5	apply participatory irrigation management and infer the types of irrigation methods	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1			3						1	3	3
CO2	2	1				3							3	2
CO3	3	2	1			3						1	3	3
CO4	3	2	1			3						1	3	3
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	50	30				100
CAT2	15	55	30				100
CAT3	10	50	40				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CET33 SOIL MECHANICS

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	III	PC	3	0	0	3

Preamble	This course imparts basic knowledge on the index properties, engineering properties and classification of soil particles. This course also deals with the various concepts such as permeability, stress distribution, settlement, shear strength and slope stability	
Unit - I	**Soil Classification and Compaction:**	**9**
Formation of soil - Soil description – Particle behavior –Soil structure – Phase relationship – Index properties – Significance – Indian Standard Classification system – Unified classification systems – Compaction of Soils – Theory and Factors influencing compaction of Soils – Field Compaction methods		
Unit - II	**Permeability and Effective Stress:**	**9**
Flow of water through soils – Capillary phenomena - Darcy 's law – permeability – Factors affecting permeability – coefficient of permeability – Effective stress concepts in soils – quick sand conditions – Seepage – seepage velocity- discharge velocity – Introduction to flow nets – uplift pressure – properties and uses		
Unit - III	**Stress Distribution and Settlement:**	**9**
Stress distribution in homogeneous and isotropic medium – Boussinesq theory – Westergaard's theory – Use of New marks influence chart – Components of settlement – Immediate and consolidation settlement – Terzaghi's one dimensional consolidation theory – Computation of rate of settlement. - √t and log t methods– e-log p relationship		
Unit - IV	**Shear Strength:**	**9**
Shear strength of cohesive and cohesion less soils – Mohr-Coulomb failure theory – Measurement of shear strength - Direct shear test, Triaxial compression test, Unconfined compression test and Vane shear test -Factors influences shear strength of soil		
Unit - V	**Slope Stability:**	**9**
Stability Analysis - Infinite slopes and finite slopes – Total stress analysis for saturated clay – Friction circle method – Use of stability number – Method of slices –Mechanism of landslides and remedial measures - soil nailing – Methods of slope protection		

Lecture: 45

TEXT BOOK:

1.	Gopal Ranjan and Rao A.S.R., "Basic and Applied Soil Mechanics",3rd edition, New Age International Pvt. Ltd, 2020

REFERENCES:

1.	Arora K.R., "Soil Mechanics and Foundation Engineering", 7th Edition, Standard Publishers and Distributors, New Delhi, 2019
2.	Punmia B.C., —Soil Mechanics and Foundation Engineering, 17th Edition, Laxmi Publications, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	classify the soil and solve three phase system problems	Understanding (K2)
CO2	solve the problems related to effective stress, permeability and seepage	Applying (K3)
CO3	determine vertical stress distribution and settlement in soil	Applying (K3)
CO4	calculate the shear strength parameters for various soil conditions	Analyzing (K4)
CO5	analyse the stability of slopes	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				3						1	3	2
CO2	3	2	1			3						1	3	3
CO3	3	2	1			3						1	3	3
CO4	3	3	2			3						1	3	3
CO5	3	3	2			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	40				100
CAT2	15	40	45				100
CAT3	10	40	35	15			100
ESE	10	35	40	15			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CET34 CONCRETE TECHNOLOGY
(IS 10262: 2019 (Page No: 1 to 23) & IS 456: 2000 Code Books are Permitted)

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Construction Materials and Practices	III	PC	3	0	0	3

Preamble	This course imparts knowledge about the various ingredients and properties of concrete along with mix proportioning of concrete.	
Unit - I	**Ingredients of Concrete:**	**9**
Cement - ASTM classification of cement - Chemical composition - Hydration of cement - Field and laboratory tests for Cement. Aggregates: Coarse and Fine Aggregates – Tests for Aggregates - Importance of grading -Standard Grading Curve - Interfacial Transition Zone. Water: Quality of water for use in concrete - Use of sea water and its effects in concrete.		
Unit - II	**Concrete Mix Design:**	**9**
Statistical Quality Control of Concrete- Methods of Mix design - IS method of mix design for normal and high strength concrete - Sampling and Acceptance Criteria.		
Unit - III	**Fresh and Hardened Concrete Properties:**	**9**
Workability - Tests for workability of concrete - Determination of density, air content and temperature of fresh concrete - Segregation and Bleeding -Strength Properties of Hardened concrete - Elasticity - Creep, Shrinkage and temperature effects- Gain of strength with age - Stress and Strain characteristics of concrete- Non-Destructive Tests for concrete.		
Unit - IV	**Durability Properties of Concrete:**	**9**
Durability of concrete – Tests for durability - Strength and durability relationship - Factors affecting durability of concrete- Permeability- RCPT- Sorptivity - Alkali Aggregate Reaction - Chemical attack - Corrosion tests- Cracks in Concrete- Performance based durability design.		
Unit - V	**Special Concretes:**	**9**
Light Weight Concrete – Foam concrete – Self Compacting Concrete – Vacuum Concrete – Bacterial Concrete – Fiber Reinforced Concrete – Ferrocement – HVFA Concrete - SIFCON- SIMCON - Shotcrete - Basalt Fiber Concrete- Ready Mix Concrete – Reactive Powder Concrete– Geo-Polymer Concrete– Roller Compacted Concrete - Smart Concrete-Stamped Concrete- ECC - Sustainability of concrete.		

Lecture: 45

TEXT BOOK:

1.	Shetty M.S., “Concrete Technology Theory and Practice”, 8th Edition, S.Chand & Company Ltd., New Delhi, 2018.

REFERENCES:

1.	Neville A.M, “Concrete Technology”, 27th Edition, Pearson India Education Services, 2019.
2.	Santhakumar A.R., “Concrete Technology”, 2nd Edition, Oxford University Press India, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the properties of various ingredients of concrete	Understanding (K2)
CO2	perform mix design as per IS codal provisions	Applying (K3)
CO3	assess the fresh and hardened properties of concrete	Understanding (K2)
CO4	assess the durability performance of concrete	Understanding (K2)
CO5	infer the types of special concrete with its features and applications	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2						1	3	2
CO2	3	2	1			3	2					2	3	2
CO3	2	1				2						1	3	2
CO4	2	1				3	1					1	3	2
CO5	2	1				3						1	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	60	20				100
CAT2	10	40	50				100
CAT3	30	70					100
ESE	20	30	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEL31 STRENGTH OF MATERIALS LAB

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Mechanics of materials	3	PC	0	0	2	1
Preamble	This course illustrates the test methods to determine the various behaviours of materials used in construction						

List of Exercises / Experiments:

1.	Tension test on metal specimens.
2.	Compression test on wooden specimen.
3.	Shear test on metal specimens
4.	Torsion test on metal specimen
5.	Impact tests on metal specimens
6.	Hardness tests on metal specimens
7.	Bending test -I –Verification of Maxwell‘s reciprocal theorem
8.	Bending test -II – Determination of Young’s modulus and flexural rigidity
9.	Tests on open coil helical springs
10.	Tests on closed coil helical springs
11.	Study on mechanical and electrical strain gauges
12.	Study on fatigue test

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	IS 432-1 (1982) and IS 1810-38 (1984)

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Determine the behavior of materials under tension, compression, shear and torsion	Analyzing (K4) Manipulation (S2)
CO2	examine the impact strength and hardness of the material	Analyzing (K4) Manipulation (S2)
CO3	Investigate the strength of materials under bending and stiffness	Analyzing (K4) Manipulation (S2)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

20CEL32 CONCRETE TECHNOLOGY LAB

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Construction Materials and Practices	3	PC	0	0	2	1
Preamble	This course demonstrates how to determine the properties of materials used for concrete and the properties of fresh and hardened concrete.						

List of Exercises / Experiments:

1.	Specific gravity of Cement and Aggregates
2.	Fineness Modulus of Aggregates - Sieve Analysis
3.	Fineness and Soundness test on cement
4.	Consistency, Initial and Final setting time of cement
5.	Compressive Strength of Cement
6.	Workability of fresh concrete -Slump Value, Compaction factor and Vee Bee Consistometer
7.	Compressive Strength of Concrete
8.	Split Tensile Strength of Concrete
9.	Flexural Strength of Concrete
10.	Tests on Concrete Blocks (Hollow blocks & Paver blocks)
11.	NDT on Concrete (Rebound Hammer and UPV test)
12.	Durability on Concrete - Permeability and RCPT (Demo only)

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	Gambhir M.L “Concrete Testing Manual” Dhanpat Rai & Sons, New Delhi,2010

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	test the properties of materials used in concrete	Applying(K3) Manipulation (S2)
CO2	determine the mechanical properties of hardened concrete	Applying (K3) Manipulation (S2)
CO3	conduct non-destructive testing to analyze the quality of concrete	Analyzing (K4) Manipulation (S2)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

20CET41 FOUNDATION ENGINEERING

(IS6403-1981 code is permitted)

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Soil Mechanics	4	PC	3	0	0	3

Preamble	This course facilitates the students to understand the behaviour of foundations for engineering structures and to gain knowledge of the design methods that can be applied to practical problems	
Unit - I	**Soil Exploration and Foundation Systems:**	**9**
Soil exploration – planning – test pits – boring – sampling – standard penetration test – static and dynamic cone penetration tests – geophysical methods (seismic, electrical resistivity and ground penetrating radar) – preparation of soil investigation report. Types of foundation – Choice of foundations based on soil profile.		
Unit - II	**Bearing Capacity and Settlement Analysis:**	**9**
Terms and definitions – types of bearing capacity failure – Terzaghi's method Meyerhoff's method– IS code method – Teng's method. Causes of settlement – Elastic settlement– primary settlement– differential settlement – estimation of settlement from SPT – codal provisions – methods of minimizing settlement – plate load test for bearing capacity and settlement analysis.		
Unit - III	**Design of Shallow Foundation:**	**9**
Design principles of isolated and spread footing – combined rectangular and trapezoidal footing – design aspects of strap footings and mat foundation - Concept of Beams on elastic foundation – proportioning of footing for equal settlement – contact pressure under footings.		
Unit - IV	**Deep Foundation**	**9**
Classifications – construction of piles - load carrying capacity – static and dynamic analysis – Pile load tests – negative skin friction - Pile under laterally loading. Group action of piles – load carrying capacity of pile groups– Settlement of pile groups – pile caps-Introduction to combined piled-raft foundation		
Unit - V	**Earth Pressure Analysis:**	**9**
Introduction- Plastic equilibrium in soils – active and passive earth pressure – Rankine's theory – Coulomb's wedge theory – Graphical method (Rebhann and Culmann).		

Lecture:45, Total:45

TEXT BOOK:

1. Arora K.R., "Soil Mechanics and Foundation Engineering", 7th Edition, Standard Publishers and Distributors, New Delhi, 2019

REFERENCES:

1. Varghese P.C., "Foundation Engineering", 2nd Edition, PHI Learning, New Delhi. 2011.
2. Das B.M., "Principles of Foundation Engineering", 5th Edition, Thomson Books, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	summarize soil exploration techniques and foundation systems	K2 (Understanding)
CO2	determine bearing capacity and settlement of shallow foundations	K3 (Applying)
CO3	design shallow foundations	K3 (Applying)
CO4	calculate the load carrying capacity and settlement of pile foundation	K3 (Applying)
CO5	analyse the earth retaining structures	K4 (Analyzing)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70				100
CAT2	10	30	60				100
CAT3	10	20	40	30			100
ESE	10	20	50	20			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CET42 FLUID MECHANICS AND HYDRAULICS ENGINEERING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Applied Physics	IV	PC	3	1	0	4

Preamble	This course provides knowledge about fluid properties, fluid statics, kinematics and dynamics. It provides an understanding of flow through pipes and open channel. This course also enhances the knowledge on flow hydraulics.	
Unit - I	**Fluid Properties, Statics and Kinematics:**	**9+3**
Properties of fluids – Types of fluids- Hydrostatic law – Pascal's law- Types and measurement of pressure – Hydrostatic pressure on plane and curved surfaces -Total pressure - Centre of pressure – Buoyancy – Metacentre – Equilibrium conditions of floating and submerged bodies.		
Unit - II	**Fluid Dynamics:**	**9+3**
Classification and types of flow –flow lines and Path lines – Stream tube - Continuity equation – Velocity potential function and Stream function– Flow net - Euler's equation of motion - Bernoulli's equation and its applications – Darcy Weisbach's formula – Flow through pipes– Hagen Poiseuille's' equation - Moody diagram.		
Unit - III	**Open Channel Flow:**	**9+3**
Types of flow- Specific energy – Energy- depth relationship - Critical flow – Velocity measurements by Manning's and Chezy' formula -Most economical sections (Rectangular, Trapezoidal and Circular sections).		
Unit - IV	**Flow through Pipes & Boundary Layer:**	**9+3**
Characteristics and types of flow profiles- back water and draw down curves – surface profile calculations- Hydraulic Jumps – Surges. Boundary layer concept, thickness and classification.		
Unit - V	**Dimensional and Model Analysis:**	**9+3**
Dimensional analysis - Dimensional parameters – Rayleigh's method and Buckingham's Pi theorem -Model analysis - Hydraulic Similitude- Scale effect – Distorted and undistorted models.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1. Bansal R.K., "A Textbook of Fluid Mechanics and Hydraulic Machines", 10th Edition, Laxmi Publications, 2018.

REFERENCES:

1. Douglas J.F., Gasirock J.M. and Swaffield J.A., "Fluid Mechanics", 14th Edition, Pearson Education Publishers, 2002.
2. Victor L. Streeter, Benjamin E. Wylie and Bedford K.W., "Fluid Mechanics", 9th Edition, McGraw-Hill, India, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	predict the properties and characteristics of fluids	Applying (K3)
CO2	classify different types of flow and compute the components related to various flows.	Applying (K3)
CO3	design economical sections for open channel flow	Applying (K3)
CO4	classify the various flow profiles and calculate the boundary layer thickness	Applying (K3)
CO5	evaluate the dimensional and model parameters to solve complex fluid problems	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1			3						1	3	3
CO2	3	2	1			3						1	3	3
CO3	3	2	1			3						1	3	3
CO4	3	3	2			3						1	3	3
CO5	3	3	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	20	70				100
CAT2	10	30	60				100
CAT3	10	20	40	30			100
ESE	10	20	50	20			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CET43 STRUCTURAL ANALYSIS

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Mechanics of Materials	IV	PC	3	1	0	4

Preamble	This course offers the various methods for the analysis of indeterminate structures. It aims at the determination of end moments and constructing shear force and bending moment diagrams for the continuous beams and portal frames. It also involves the structures for moving loads.	
Unit - I	**Energy methods**	**9+3**
Basic energy concepts – Strain energy – Linear system – Load potential energy – Energy principles based on displacement field – Castigliano's theorem (I & II) – Stiffness coefficients – Energy principles based on force field – Flexibility coefficients – Theorem of least work.		
Unit - II	**Slope Deflection and Moment Distribution Methods**	**9+3**
Introduction to displacement method of analysis – Slope deflection equations – Analysis of continuous beams and frames – Introduction to moment distribution method – Stiffness factor – Carryover factor and distribution Factor – Analysis of beams – Sinking of supports – Analysis of non-sway frames – Analysis of sway frames.		
Unit – III	**Flexibility Matrix Method**	**9+3**
Introduction – Static and kinematic indeterminacy – Equilibrium and computability conditions – Primary structure – Element and global flexibility matrix – Applications – Analysis of indeterminate beams, frames and trusses (Redundancy restricted to two).		
Unit – IV	**Stiffness Matrix Method**	**9+3**
Introduction – Displacement and force transformation matrices – Element and global flexibility matrix – Applications – Analysis of indeterminate beams, frames and trusses (Redundancy restricted to two).		
Unit – V	**Moving Loads and Influence Lines**	**9+3**
Influence Lines for reactions in statically determinate structures – Influence lines for member forces in pin-jointed frames – Influence lines for shear force and bending moment in beam sections – Muller Breslau's principle – Influence lines for continuous beams (2-degree redundant structures)		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Devdas Menon, Structural Analysis, 2nd Edition, Narosa Publishing House, New Delhi, 2018.

REFERENCES:

1. Hibbeler, R.C, Structural Analysis, 10th Edition, Pearson India, Bengaluru, 2018.
2. Punmia.B.C, Ashok K.Jain, ArunK.Jain, Theory Of Structures, 13th Edition, Laxmi Publications, New Delhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	analyse the structural elements using energy methods	Analyzing (K4)
CO2	calculate shear force and bending moment for beams and rigid frames using slope defection method and moment distribution method	Analyzing (K4)
CO3	determine the bending moment using flexibility matrix method	Analyzing (K4)
CO4	determine the bending moment using stiffness matrix methods	Analyzing (K4)
CO5	analyse the beams subjected to moving loads	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2			3				1		2	3	3
CO2	3	3	2			3				1		2	3	3
CO3	3	3	2			3				1		2	3	3
CO4	3	3	2			3				1		2	3	3
CO5	3	3	2			3				1		2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	10	20	60			100
CAT2	10	10	20	60			100
CAT3	10	10	20	60			100
ESE	10	10	20	60			100

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

20CEL41 – GEOTECHNICAL ENGINEERING LABORATORY

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Soil Mechanics	IV	PC	0	0	2	1
Preamble	This laboratory course deals with the determination of various index and engineering properties of soil. With the knowledge of these properties, students will able to classify the soil, utilize the soil as a suitable construction material and design suitable foundation for the structure.						

List of Exercises / Experiments:

1.	Determination of Specific Gravity for coarse grained and fine grained soil
2.	Grain size distribution – Sieve analysis
3.	Determination of consistency limits
4.	Determination of differential free swell index of cohesive soil
5.	Determination of field density by a. sand replacement method b. core cutter method
6.	Determination of moisture – density relationship using Standard Proctor Method
7.	Determination of relative density of cohesionless soil
8.	Determination of coefficient of permeability by constant head and falling head method
9.	Determination of coefficient of consolidation by one dimensional consolidation test
10.	Determination of shear parameters by direct shear test in cohesionless soil
11.	Determination of shear parameters by unconfined compression test in cohesive soil
12.	Study on shear parameters of soil by Triaxial test

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	Braja M. Das, “Soil Mechanics Laboratory Manual”, 7th Edition, Oxford University Press, 2015

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	characterize the given soil based on the index properties	Analyzing (K4), Manipulation (S2)
CO2	determine the drainage characteristics and rate of consolidation	Applying (K3), Manipulation (S2)
CO3	evaluate the shear strength parameters of cohesive and cohesionless soil	Analyzing (K4), Manipulation (S2)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

20CEL42 FLUID MECHANICS LABORATORYRY

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	**Physics**	**4**	**PC**	**0**	**0**	**2**	**1**
Preamble	This course helps the students to determine various flow and hydraulic machine characteristics.						

List of Exercises / Experiments:

1.	Determination of co-efficient of discharge through orifice and mouthpiece
2.	Determination of co-efficient of discharge of rectangular and triangular notches
3.	Determination of co-efficient of discharge of venturimeter through Bernoulli's equation
4.	Determination of co-efficient of discharge of orificemeter through Bernoulli's equation
5.	Impact of jet on vanes - Efficiency determination
6.	Determination of friction loss in pipes
7.	Determination of various types of minor losses in pipes
8.	Evaluation of the performance characteristics of Pelton turbine
9.	Evaluation of the performance characteristics of Francis turbine
10.	Evaluation of the performance characteristics of centrifugal pump
11.	Evaluation of the performance characteristics of reciprocating pump
12.	Evaluation of the performance characteristics of submersible pump

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	determine the rate of flow under different flow characteristics	Applying(K3), Manipulation (S2)
CO2	compute the major and minor losses in pipe flow	Applying (K3), Manipulation (S2)
CO3	determine the performance characteristic of pumps and turbines	Analyzing (K4), Manipulation (S2)

Mapping of Cos with Pos and PSOs														
Cos/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	2		3			1			2	3	3
CO2	3	2	1	2		3			1			2	3	3
CO3	3	3	2	2		3			1			2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20CET51 ENVIRONMENTAL ENGINEERING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	V	PC	3	0	0	3

Preamble	The course aims to impart knowledge on water and sewage occurrence, distribution, treatment and disposal techniques.	
Unit – I	**Water Supply, Source and Conveyance:**	**9**
Objectives and Factors influencing Public Water Supply systems – Sources of water – Population Forecasts – Water quality parameters and standards – Intake Structures – Laying, Jointing and Testing of pipelines – Pipe Appurtenances.		
Unit – II	**Principles of Treatment:**	**9**
Basic principles of water treatment – Unit processes and operations – Screens –Grit chamber – Design of sedimentation tanks – Principles of flash mixers & Flocculators – Design of Filters – Disinfection methods – Water Softening Methods.		
Unit – III	**Collection and Conveyance of Water and Wastewater:**	**9**
Pipes and channels for transmitting water – Pumps and pumping stations – Analysis of distribution networks – Layout of Distribution Networks – Sources and characteristics of wastewater – Fluctuations in flow pattern – Storm runoff estimation – Minimum and Maximum velocity – Laying, jointing and testing of sewers – Layout of Sewage treatment plant – Sewer appurtenances.		
Unit – IV	**Principles of Sewage Treatment:**	**9**
Basic principles of biological treatment – Trickling filter – Principles and operation of standard and High-rate filters – Activated sludge process and its modifications – Aeration process and types – Oxidation ditch – Waste stabilization ponds – Principles and Design of septic tanks.		
Unit – V	**Sewage Disposal and Rural Sanitation:**	**9**
Objectives of sludge treatment – Properties of sludge – Digesters and lagoons – Dilution – Oxygen sag curve – Eutrophication – Sewage farming practices – Sanitary fixtures – One pipe and two pipe systems – Rural sanitation system – Environmental Protection Acts.		

Lecture: 45, Total: 45

TEXT BOOK:

1. Garg S.K., “Environmental Engineering (Vol. I)”, 33rd Edition, Khanna Publishers, New Delhi, 2010. (Unit (I, II & III)
2. Garg S.K., “Environmental Engineering (Vol. II)”, 39th Edition, Khanna Publishers, New Delhi, 2019. (Unit (IV & V)

REFERENCES:

1. Metcalf and Eddy, " Waste Water Engineering: Treatment and Reuse", 4th Edition, McGraw-Hill, New Delhi, 2017.
2. Myer Kutz, “Handbook of Environmental Engineering”, 1st Edition, Wiley Publishers, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	predictand estimate the population and water demand	Applying (K3)
CO2	Identify and design suitable the water treatment method	Applying (K3)
CO3	calculate the quantity of waste water generated from various sources	Applying (K3)
CO4	design the principal components of sewage treatment plant	Applying (K3)
CO5	explain appropriate sludge treatment methods and sanitary fixtures	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1			3	2					2	2	2
CO2	3	2	1			3	2					2	3	3
CO3	3	2	1			3	2					2	3	3
CO4	3	2	1			3	2					2	3	3
CO5	2	1				2	2					2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	40				100
CAT2	15	45	40				100
CAT3	10	40	50				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CET52 – TRANSPORTATION ENGINEERING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	NIL	5	PC	3	0	0	3

Preamble	To impart knowledge on highway and railway geometric designs, construction and maintenance of highway and railways	
Unit – I	**Highway - Geometric Design:**	**9**
Scope of Transportation Engineering - Highway alignment - Engineering surveys for Highway location - Highway cross sectional elements of Urban and Rural Roads - Sight distance - Horizontal alignment - horizontal curves, camber, super elevation, widening of curves, transition curves, set-back distance - Design of Vertical alignment - gradients, grade compensation, vertical curves		
Unit – II	**Highway – Pavement design:**	**9**
Highway Materials - Design factors - Design of bituminous paving mixes - flexible pavement design as per IRC. Rigid Pavements - stresses in rigid pavements – Types of Joints - design of joints, dowel bar, tie bar - IRC method of design of concrete pavements		
Unit – III	**Highway - Construction and Maintenance:**	**9**
Types - Standard construction practice for WBM and WMM, Bituminous and Cement concrete roads - Maintenance of Highways – Pavement Failures - Pavement Evaluation - Highway drainage - Surface Drainage- Subsurface drainage		
Unit – IV	**Railway Planning:**	**9**
Importance of Railway - Engineering Surveys for Track alignment - Permanent way - Elements and functions - Geometric design of railway track – Gradient - horizontal curves, super elevation, widening of gauges on curves, transition curves – summit and valley curve – Points and Crossings - Turnouts - Working principle - Signaling, interlocking and track circuiting		
Unit – V	**Railway Infrastructure, Construction and Maintenance:**	**9**
Earthwork – Stabilization of track on poor soil – Track drainage– Calculation of Materials required for track laying – Construction and maintenance of tracks –Modern methods of construction & maintenance - Railway stations and yards and passenger amenities - Modern Transit Facilities - Railway Track – Transfer Station – Structures – Bridges – Tunnels –Planning and Design aspects		

Lecture: 45, Total:45

TEXT BOOK:

1. Subramanian, K.P. "Highway, Railway, Airport and Harbour Engineering", Scitech publications (India) Pvt. Ltd, Chennai, 2nd Edition, 2016.

REFERENCES:

1. Kadiyali, L.R. and Lai, N.B. "Highway Engineering (Including Expressways and Airport Engineering)", Khanna Publishers, New Delhi, 5th edition, 2013.
2. Khanna, S.K., Justo C.E.G. and Veeraragavan, A. "Highway Engineering", New Chand and Brothers, Roorkee, 10th edition, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	design the cross-section elements, sight distance, horizontal and vertical alignments for highways	Applying (K3)
CO2	design flexible and rigid pavements as per IRC	Applying (K3)
CO3	suggest suitable materials and construction methodology based on pavement type and failures in pavement	Understanding (K2)
CO4	design the geometric elements of railways	Applying (K3)
CO5	infer the modern facilities of the railway infrastructure and explain the material requirement, construction and maintenance works	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1			3						1	3	3
CO2	3	2	1			3						1	3	3
CO3	2	1				3						1	3	2
CO4	3	2	1			3						1	3	3
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	20	60				100
CAT2	20	30	50				100
CAT3	20	30	50				100
ESE	20	30	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CET53 DESIGN OF RC ELEMENTS

(IS 456 -2000 & SP 16 codes are permitted)

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Engineering Mechanics, Mechanics of Materials, Concrete Technology	v	PC	3	1	0	4

Preamble	This course gives the detailed design philosophies for reinforcement concrete design, design of different types of conventional slabs, determinate beams for various forces, short columns, long columns and isolated Footing.	
UNIT – I	**Fundamental Concepts:**	**9+3**
Objective of structural design – Grades of concrete – Type of Loads on Structures and Load combinations –Basic structural elements – Steps in RCC Structural Design Process – Design considerations – Code of practices and Specifications – Cover requirements - Stress–Strain curve for concrete in compression – Types and grades of reinforcement – Stress – Strain curve for reinforcing steel.– Concept of Working Stress Method (WSD), Ultimate Load Method (ULD) and Limit State Method (LSD) – Advantages of Limit State Method over other methods – Permissible stress – Characteristic strength and Characteristic load – Factor of safety and Partial safety factors – Various limit states		
Unit - II	**Limit State Design of Slabs:**	**9+3**
Types of slabs – Behaviour of one-way slab – Design considerations – Design of one-way slab – cantilever, simply supported and continuous. Behaviour of two-way slab – Design of two-way slab – restrained, non-restrained and continuous. Types of staircases – design of dog-legged staircase.		
Unit - III	**Limit State Design of Beams:**	**9+3**
Assumptions – Design of singly and doubly reinforced rectangular and flanged beams for flexure, shear and combined bending, shear and torsion – Design of shear reinforcement – Design requirement for bond and anchorage as per IS code		
Unit - IV	**Limit state design of Columns**:	**9+3**
Classification of columns – Assumptions – Unsupported and effective length of a column – Failure of columns – Codal specifications on slenderness limits, Minimum eccentricities and reinforcement – Design of short rectangular, square and circular columns subjected to axial, uni-axial and bi-axial bending - Design of slender columns subjected to bi-axial bending.		
Unit - V	**Limit state design of Footings:**	**9+3**
Types of footings – Soil pressure under footings – Design considerations – Design of axially and eccentrically loaded square and rectangular footings – design principles of combined rectangular footings for two columns – Introduction to strap footing and raft/mat foundation.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Unnikrishna Pillai S. and Devdas Menon, Reinforced Concrete Design, 3rd Edition, Tata McGraw-Hill, New Delhi, 2009

REFERENCES:

1. Subramanian N., Design of Reinforced Concrete Structures, 1st Edition, Oxford University Press, 2014
2. Varghese P.C., Limit State Design of Reinforced Concrete, 2nd Edition, Prentice Hall of India, New Delhi, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the basic concept of design philosophies	Understanding (K2)
CO2	design different types of slabs and dog-legged staircase	Applying (K3)
CO3	design beams for flexure, shear & torsion	Applying (K3)
CO4	categorize the column and apply the appropriate design procedure	Applying (K3)
CO5	design axially and eccentrically loaded isolated footing	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	3	2	1			3				1		2	3	3
CO3	3	2	1			3				1		2	3	3
CO4	3	2	1			3				1		2	3	3
CO5	3	2	1			3				1		2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy														

20CEL51 ENVIRONMENTAL ENGINEERING LABORATORY

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	**Nil**	**5**	**PC**	**0**	**0**	**2**	**1**
Preamble	This course imparts knowledge on determination of various water quality parameters.						

List of Exercises / Experiments:

1.	Introduction to sampling and preservation methods of water and wastewater
2.	Determination of pH, turbidity and hardness
3.	Determination of acidity and alkalinity
4.	Determination of chlorides
5.	Determination of sulphates
6.	Calculate the optimum coagulant dosage
7.	Determine the available chlorine in bleaching powder
8.	Determination of dissolved oxygen
9.	Determination of total dissolved solids and suspended solids
10.	Determination of B.O.D
11.	Determination of C.O.D
12.	Determination of amount of iron and fluoride in given water sample

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	Garg S.K., " Environmental Engineering (Vol. I) & (Vol. II)", 33rd & 39th Edition, Khanna Publishers, New Delhi, 2010 & 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	determine the physio-chemical parameters present in water	Analyzing (K4) Manipulation (S2)
CO2	determine the amount of oxygen required for self-purification of a stream	Analyzing (K4) Manipulation (S2)
CO3	Estimate the quantity of chlorine and coagulants required for public water supply	Analyzing (K4) Manipulation (S2)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

20CEL52 - TRANSPORTATION ENGINEERING LABORATORY

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Transportation Engineering	5	PC	0	0	2	1
Preamble	To impart knowledge about properties of materials used in highway construction						

List of Exercises / Experiments:

1.	Water absorption and specific gravity test on aggregates and Bitumen
2.	Gradation of coarse aggregates
3.	Aggregate impact value test and crushing value test
4.	Attrition and abrasion test on aggregates
5.	Flakiness and elongation test on aggregates
6.	Penetration and specific gravity test on Bitumen
7.	Viscosity test on bitumen
8.	Softening point test on bitumen and stripping test on bituminous mixes
9.	Ductility test on bitumen
10.	Marshall stability test on bituminous mixes
11.	Skid resistance test
12.	CBR test on sub-grade soil

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	Methods of Test for Bitumen and Tar Materials, IS 1201-1978 to IS 1220-1978, Bureau of Indian Standards, Reaffirmed 2004
3.	Khanna S.K., Justo C.E.G. and Veeraragavan A., “Highway Materials and Pavement Testing”, 5th Edition, New Chand and Brothers, Roorkee, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	determine the physical properties of aggregates and bitumen	Analyzing (K4), Manipulation (S2)
CO2	design a mix ratio for required grade of bitumen	Analyzing (K4), Manipulation (S2)
CO3	determine the sub grade strength of the soil and to assess the surface condition of the pavement	Analyzing (K4), Manipulation (S2)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

20CEL53 COMPUTER AIDED BUILDING DRAWING LAB

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Engineering Drawing	5	PC	0	0	2	1
Preamble	This course imparts knowledge about how to plan and draw the different views of components of the various buildings as per specifications.						

List of Exercises / Experiments:

1.	Building planning, specifications and bye-laws
2.	Introduction about AutoCAD and basic drafting tools/commands
3.	Drawing the cross section details of foundation with masonry wall & Isolated RCC column footing
4.	Drawing the different types of bonds in brick masonry
5.	Drawing the plan and sectional elevation of dog legged staircase
6.	Draw plan and cross-section of septic tank
7.	Drawing the plan and cross-section of rain water harvesting layout
8.	Drawing the elevation of the steel roof truss
9.	Drawing the plan, elevation and section of a residential building
10.	Drawing the plan, elevation and section of a school Building
11.	Drawing the plan, elevation and section of a hospital Building

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Reference Manual for AutoCAD
2.	Sikka V.B., A Course in Civil Engineering Drawing, 4 th Edition, S.K.Kataria and Sons, 2015.
3.	Chitawadagi. M.V , Bhavikatti, S.S., Building Planning and Drawing, I.K International Publishing House Pvt. Ltd, New Delhi,2019

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	draw the various components of a building	Applying (K3), Manipulation (S2)
CO2	prepare detailed drawing for septic tank, rainwater harvesting and roof truss	Analyzing (K4), Manipulation (S2)
CO3	prepare the plan, elevation and section for various types of building for approval	Analyzing (K4), Manipulation (S2)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

20CET61 DESIGN OF STEEL STRUCTURES

(IS 800:2007, Steel Tables, IS 875 (Part-3) and SP 06 are permitted)

Prog. & Branch	B.E & Civil Engineering	Sem.	Category	L	T	P	Credit
Pre requisite	Mechanics of Materials and Structural Analysis	6	PC	3	0	0	3

Preamble	This course offers the design of steel structures as per limit state method. This course follows the recommendation of IS: 800 – 2007. It aims at determination of safe as well as economical steel section for various industrial and framed structures	
Unit - I	**Introduction:**	**9**
Structural form: Classification of structures based on function, material and shape - different structural systems – Load combinations – Concepts of Working Stress Method and Limit State Method of Design - load and resistance factor design - Material - properties of steel - behavior - partial safety for materials - load safety. Other properties: durability - fatigue - fire protection.		
Unit - II	**Connections:**	**9**
Metal joining methods using welding, bolting - Design of bolted and welded joints — weld symbols - strength of fillet and butt welds - Efficiency of joints – High Tension bolts.		
Unit - III	**Tension Members:**	**9**
Types of sections – Net area – Net effective sections for angle and Tee in tension – Design of connections in tension members – Design of tension splice – Concept of shear lag – Use of lug angles		
Unit - IV	**Compression members:**	**9**
Types of compression members – Theory of columns – Buckling class - Slenderness ratio – Strength of simple compression member - Design of built-up compression members – Design of laced columns - Design procedure of battened column		
Unit - V	**Beams:**	**9**
Classification of sections - simple and compound sections – calculation of plastic modulus of section –flexural strength of beams - design considerations – behavior of web under shear – shear check – deflection check- bearing strength of web –buckling strength of web - web buckling –web crippling.		

Lecture:45, Total:45

TEXT BOOK:

1. Subramanian N., “Design of Steel Structures Limit States Method”, 2nd Edition, Oxford University Press, New Delhi, 2016.

REFERENCES:

1. Bhavikatti S.S., “Design of Steel Structures”, 5th Edition, I.K. International Publishing House Pvt. Ltd., New Delhi, 2017.
2. Duggal S., “Design of Steel Structures”, 3rd Edition, McGraw Hill Education, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	discriminate the various connection methods	Analysing (K4)
CO2	analyse and design the various profiles of tension members	Analysing (K4)
CO3	analyse and design the forms of compression members	Analysing (K4)
CO4	discriminate and design the flexural members	Analysing (K4)
CO5	examine and design the roof truss	Analysing (K4)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2			3						1	3	3
CO2	3	3	2			3				1		2	3	3
CO3	3	3	2			3				1		2	3	3
CO4	3	3	2			3				1		2	3	3
CO5	3	3	2			3				1		2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	20	30	40	-	-	100
CAT2	-	15	35	50	-	-	100
CAT3	-	15	40	45	-	-	100
ESE	10	20	30	40	-	-	100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CET62 - ADVANCED REINFORCED CONCRETE DESIGN

(IS 456 -2000, SP16, IS 3370 – 2009 (Part-I, II & IV) and IS1893-2002 (Part-I) are permitted)

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Structural Analysis and Design of RC Elements	6	PC	3	0	0	3

Preamble	This course enhances the knowledge of students in the design of retaining walls, flat slab, water tank, shear wall and corbels	
UNIT – I	**Design of Water Tank**	**9**
Design of circular and rectangular water tanks resting on ground - Design principles for elevated water tank.		
Unit - II	**Design of RC and Shear Wall**	**9**
Introduction – Design of RC wall – Types and use of Shear walls – Design of shear wall with boundary elements		
Unit - III	**Design of Retaining Wall**	**9**
Introduction – Earth pressure theories – Types of retaining wall – Design and detailing of cantilever and counter fort retaining wall.		
Unit - IV	**Design of Flat Slabs and Yield Line Theory**	**9**
Introduction – Design of flat slab (IS Code Method). Yield Line Theory – Equilibrium and virtual work method – Analysis and design of simply supported square, rectangular and circular slabs.		
Unit - V	**Design of Special RC Elements**	**9**
Design and detailing of corbels (IS code method) – Design of pile caps –Design principles of bunkers and silos.		

Lecture:45, Total:45

1.	Subramanian N., Design of Reinforced Concrete Structures, 1st Edition, Oxford University Press, 2014.

REFERENCES:

1.	Varghese P.C., Advanced Reinforced Concrete Design, 2nd Edition, Prentice Hall of India, New Delhi, 2013
2.	Unnikrishna Pillai S. and Devdas Menon, Reinforced Concrete Design, 3rd Edition, Tata McGraw-Hill, New Delhi, 2011

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	design the water tank with appropriate design procedure	Applying (K3)
CO2	design RC wall and shear wall under various loading conditions	Applying (K3)
CO3	design the retaining wall and perform the stability check	Applying (K3)
CO4	analyse and design different types of slabs	Applying (K3)
CO5	design the corbel and pile cap	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1			3				1		2	3	3
CO2	3	2	1			3				1		2	3	3
CO3	3	2	1			3				1		2	3	3
CO4	3	2	1			3				1		2	3	3
CO5	3	2	1			3				1		2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	15	75				100
CAT2	10	15	75				100
CAT3	10	15	75				100
ESE	10	15	75				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CET63 – ESTIMATION AND QUANTITY SURVEYING
(PWD Schedule of rates are permitted)

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Construction Material & Practices, Computer Aided Building Drawing Laboratory	6	PC	3	0	0	3

Preamble	To estimate the quantities and rate analysis for the various types of structures.	
Unit - I	**Estimation of Buildings:**	**9**
Types of estimates - Units of measurements - Methods of estimates - Load bearing and framed structures - Calculation of quantities of various items for residential building with flat roof - Steel requirement and bar bending schedule – Types of arches - Calculation of brick work in arches.		
Unit - II	**Estimation of other Structures and Specifications:**	**9**
Doors and windows (panelled and glazed) - septic tank - soak pit - bituminous and cement concrete roads – retaining walls – culverts - Specifications – sources – Detailed and general specifications – Measurement book.		
Unit - III	**Analysis of Rates:**	**9**
Rate for material and labour - Rate analysis for Stone masonry, Brick masonry, concreting, plastering, painting and Tiles laying, PWD Schedule of rates.		
Unit - IV	**Valuation:**	**9**
Basics of valuation – Capitalized value – Factors affecting the value of plot and building - depreciation - Valuation of residential building – Escalation – Calculation of standard rent – Mortgage – Lease.		
Unit - V	**Tenders and Report Preparation:**	**9**
Tenders – e-Tendering - Contracts – Types of contracts – Arbitration and legal requirements- Principles for report preparation – report on estimate of residential building, culvert, roads, water supply and sanitary installations.		

Lecture:45, Total:45

TEXT BOOK:

1. Dutta B.N., "Estimating and Costing in Civil Engineering", 28th Edition, UBS Publishers & Distributors Pvt. Ltd., Chennai, 2016.

REFERENCES:

1. Upadhyay A.K., “Civil Estimating & Costing: Including Quality Surveying, Tendering and Valuation”, S K Kataria and Sons, New Delhi, 2013.
2. Kohli D.D., &Kohli R.C., “A Textbook of Estimating and Costing (Civil)”, 13th Edition, S Chand Publishing, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	compute quantities of various items for load bearing and framed structures	Applying (K3)
CO2	calculate the quantities of various items for other structures	Applying (K3)
CO3	calculate the rates for various items of works	Applying (K3)
CO4	prepare valuation report for plots and buildings	Applying (K3)
CO5	prepare tenders, contract documents and reports as per norms	Analyzing (K4)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	50				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	10	20	50	20			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEL61 COMPUTER AIDED BUILDING INFORMATION MODELLING LAB

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Computer aided building drawing laboratory	6	PC	0	0	2	1
Preamble	This course imparts knowledge about how to develop models of different views of various types of buildings using BIM software.						

List of Exercises / Experiments:

1.	Introduction to BIM software tools
2.	Creation of wall and wall editing tools
3.	Fixing of doors, windows and customization
4.	Creation of floors, roofs, staircase and editing
5.	Creating structural plan using grid, beam and column tools
6.	Creating a 3D model of a single storied building
7.	Creating a 3D model of a multi storied building
8.	Creating a walkthrough model of a building
9.	Documentation and quantity take off for single storied building
10.	Documentation and quantity take off for multi storied building

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	REVIT Architecture
3.	MS Project

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	choose the building components effectively in 3D modelling for a building system	Creating (K6), Manipulation (S2)
CO2	prepare a 3-D floor plan and elevation for a building system	Creating (K6), Manipulation (S2)
CO3	estimate the quantity of materials and duration of construction	Analyzing (K4), Manipulation (S2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	2	2	3			1	2		2	3	3
CO2	3	3	2	2	2	3			1	2		2	3	3
CO3	3	3	2	2	2	3			1	2		2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

20CEL62 STRUCTURAL ENGINEERING LABORATORY

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Concrete Technology Laboratory	6	PC	0	0	2	1
Preamble	This course demonstrates the test methods to study the behaviour of concrete with different proportions of ingredients and behaviour of beams under different loaded and environment conditions.						

List of Exercises / Experiments:

1.	Determine the workability of Self Compacting Concrete
2.	Determine the effect of water/cement ratio on workability and strength of concrete
3.	Determine the effect of fine aggregate-coarse aggregate ratio on strength of concrete
4.	Determine the stress - strain relationship for concrete
5.	Determine the correlation between cube strength& cylinder strength
6.	Determine the rate of corrosion of steel in concrete
7.	Determine the behaviour of steel beam under flexure
8.	Determine the behaviour of reinforced concrete beam under flexure
9.	Study on behaviour of beams under shear
10.	Study on behaviour of under reinforced and over reinforced beams

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	determine the fresh and hardened properties of concrete	Applying (K3), Manipulation (S2)
CO2	relate the strength parameters of concrete	Analyzing (K4), Manipulation (S2)
CO3	analyse the behaviour of beams under flexure and shear	Analyzing (K4), Manipulation (S2)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s Taxonomy

20CEL63 Computer Aided Structural Design & Detailing Lab
(Use of IS 456:2000, IS 3370:2009, SP 16, SP 34, IS 800:2007, Steel Tables, IS 875 and SP 38 code books are permitted)

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Structural Analysis, Design of RC Elements & Design of Steel Structures	6	PC	0	0	2	1
Preamble	This course gives knowledge about how to design and detailing the various components of the different types of the structure using STAAD Pro software						

List of Exercises / Experiments:

1.	Introduction to structural analysis software
2.	Design and detailing of one-way continuous slab
3.	Design and detailing of two-way continuous slab
4.	Design and detailing of beams and columns
5.	Design and detailing of isolated and combined footing
6.	Design and detailing of a dog-legged staircase
7.	Analysis and design of a steel structure
8.	Analysis and design of a commercial building / public building
9.	Analysis and design of a water tank
10.	Analysis and design of a shear wall

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	STAAD. Pro V8i
2.	Krishnaraju N., Structural Design & Drawing - Reinforced Concrete and Steelll, 3 rd Edition, University Press (India) Ltd., Hyderabad, 2014.
3.	Punmia B.C., Jain, Ashok Kumar and Jain, Arun Kumar, Comprehensive Design of Steel Structures, 2 nd Edition, Laxmi Publications Pvt. Ltd., 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	analyze and design the structural elements	Analyzing (K4), Manipulation (S2)
CO2	prepare bar bending schedule and calculate the quantity take-off	Analyzing (K4), Manipulation (S2)
CO3	analyze and design the residential / industrial / public building	Analyzing (K4), Manipulation (S2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2	3			1	1		2	3	3
CO2	3	3	2	2	2	3			1	1		2	3	3
CO3	3	3	2	2	2	3			1	1		2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

PROFESSIONAL ELECTIVES

20CEE01 ADVANCED STRUCTURAL ANALYSIS

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Structural Analysis	V	PE	3	0	0	3

Preamble	This course offers the various plastic and elastic methods of analysis for structures. It also aims at analysis of special structures like suspension cables, space structures arches and shells.	
Unit – I	**Plastic Analysis of Structures**	**9**
Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – Plastic analysis of indeterminate beams and portal frames – Upper and lower bound theorems.		
Unit – II	**Force methods**	**9**
Introduction – Choice of redundants – Method of consistent deformation – Applications – Statically indeterminate beams – Pin jointed plane frames – Statically indeterminate rigid jointed plane frames – System with elastic supports – Three moment equation.		
Unit - III	**Space and Cable Structures**	**9**
Analysis of space trusses using method of tension coefficients – Beams curved in plan – Suspension Cables – Cables with two and three hinged stiffening girders – Analysis of Portal frames by Substitute frame method.		
Unit – IV	**Arches**	**9**
Arches as structural forms – Arch structures – Arch action – Types of arches – Parabolic and circular arches – Analysis of three hinged and two hinged arches – Settlement and temperature effects.		
Unit – V	**Shells**	**9**
Introduction – Classification of shells – Structural action – Membrane theory – Analysis of spherical domes – Analysis of cylindrical shells – Introduction to folded plates.		

Lecture:45, Total:45

TEXT BOOK:

1. Devdas Menon, Structural Analysis, 2nd Edition, Narosa Publishing House, New Delhi, 2018.

REFERENCES:

1. Hibbeler, R.C, Structural Analysis, 10th Edition, Pearson India, Bengaluru, 2018.
2. Stephen Timoshenko, Theory of Plates & Shells, 2nd Edition, Tata MCgraw Hill Education, Noida, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	determine the plastic moment capacity of structures	Analyzing (K4)
CO2	analyse the structural elements using force method	Analyzing (K4)
CO3	determine the forces acting in space and cable structures	Analyzing (K4)
CO4	analyse the behaviour of various types of arches	Analyzing (K4)
CO5	analyse the behaviour of dome and shell structures	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2			3				1		2	3	3
CO2	3	3	2			3				1		2	3	3
CO3	3	3	2			3				1		2	3	3
CO4	3	3	2			3				1		2	3	3
CO5	3	3	2			3				1		2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	10	20	60			100
CAT2	10	10	20	60			100
CAT3	10	10	20	60			100
ESE	10	10	20	60			100

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

20CEE02 CONSTRUCTION ENGINEERING AND MANAGEMENT

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	V	PC	3	0	0	3

Preamble	This course imparts knowledge on Construction Engineering and Management principles necessary for execution of projects efficiently which deals with quality, cost control and safety aspects in construction industry.	
Unit - I	**Planning, Scheduling and Organizing:**	**9**
Planning for Construction projects – objectives - principles – stages of planning, Scheduling - Methods - Project management through networks – CPM & PERT - Job lay-out-Work breakdown structure –Types of Construction organization.		
Unit - II	**Resource Management:**	**9**
Types of resources- Estimating resource requirements- Material management-Effective utilization of resources - Depreciation of construction equipment -Manpower planning- Resource levelling- Resource smoothing.		
Unit - III	**Quality Control:**	**9**
Quality control in construction-Importance-Elements-Quality control methods- ISO 9000 family of standards-Statistical methods- Sampling by attributes-Sampling by variables-Techniques and needs of QC.		
Unit - IV	**Schedule and Cost Control:**	**9**
Schedule variance – Cost variance – Cost and schedule relationship – Budgeted cost - Cost control in construction – Objectives - Cost control systems - Direct and indirect cost control – Time-cost trade off - Risk cost management.		
Unit - V	**Safety Management:**	**9**
Safety in construction projects – Importance of safety - Elements of safety programme – Jobsite safety assessment – Site accidents – Causes – Classification - Safety measures - Approaches to improve safety in construction - Safety codes and OSHA standards.		

Lecture:45, Total:45

TEXT BOOK:

1. Seetharaman. S, "Construction Engineering and Management", 5th Edition, Umesh Publishing, 2019

REFERENCES:

1. S.C. Sharma, S.V. Deodhar “Construction Engineering and Management”, 1st Edition, Khanna Publishing House, 2017.
2. Garold D. Oberlender,"Project Management for Engineering and Construction", 3rd Edition, McGraw-Hill Education, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret the importance of planning and scheduling in construction projects	Understanding (K2)
CO2	estimate the resource requirement for construction projects	Applying (K3)
CO3	assess quality elements and its importance for construction materials	Applying (K3)
CO4	prepare schedule and budgeted cost associated with construction activities	Applying(K3)
CO5	apply the safety codes and standards to improvise the safety culture at job site	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2				1	1		3	2
CO2	3	2	1			3					2	1	3	3
CO3	3	2	1			3					2	1	3	3
CO4	3	2	1			3					2	1	3	3
CO5	3	2	1			3					2	1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	35	45				100
CAT2	25	40	35				100
CAT3	20	40	40				100
ESE	20	35	45				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE03 SOLID AND HAZARDOUS WASTE MANAGEMENT

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Environmental Engineering	V	PE	3	0	0	3

Preamble	This course helps to interpret the nature and characteristics of solid and hazardous wastes for providing appropriate treatment method.	
Unit - I	**Solid Waste and Its Perspectives:**	**9**
Sources – Types – Composition – Properties – Characteristics – Quantities – Generation rates – Types of Sampling – Functional elements – Legislative measures – 3R concept – Participatory waste management.		
Unit - II	**On-Site and Off-Site Processing:**	**9**
Importance of onsite and offsite handling- storage methods – Effect of storage methods at site and offsite – materials used for containers – waste segregation and storage – Offsite processing techniques and equipment – Types of composting – Incineration – Pyrolysis.		
Unit - III	**Collection and Transfer:**	**9**
Collection services – Classification of container systems – Analysis of collection system – Collection routes – Guidelines – Transfer station –Site selection – Types – Manpower requirement.		
Unit - IV	**Hazardous Wastes:**	**9**
Sources and Impacts – Classification – Handling of wastes – Selection and design of storage facilities – Physical, Chemical and Biological treatment technologies – Federal and State Legislations – International treaties and their significance.		
Unit - V	**Disposal of Solid and Hazardous Wastes:**	**9**
Design configurations and site selection of sanitary landfills – Merits and demerits – Classification – Leachate control methods – Principles and design of hazardous waste landfills – Bioremediation processes – Monitoring of disposal sites – Case studies.		

Lecture: 45, Total: 45

TEXT BOOK:

1. G. Tchobanoglous, Frank Kreith, "Hand Book of Solid Waste Management", 2nd Edition, McGraw-Hill, Inc., 2002.

REFERENCES:

1. “Manual on Municipal Solid Waste Management”, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2016.
2. Freeman, H. M., “Standard Handbook of Hazardous Waste Treatment and Disposal”, 2nd Edition, McGraw-Hill, Inc., 1997.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	illustrate the sources, types and characteristics of solid waste	Understanding (K2)
CO2	Identify and suggest suitable on-site and offsite processing methods	Understanding (K2)
CO3	explain the collection and conveyance approaches available in solid waste sector	Applying (K3)
CO4	Interpret the causes and effects of hazardous wastes with treatment techniques	Applying (K3)
CO5	Identify and suggest appropriate disposal methods for solid and hazardous wastes	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				3	1						3	2
CO2	2	1				3	1						3	2
CO3	3	2	1			3	1					1	3	3
CO4	3	2	1			3	1					1	3	3
CO5	2	1				3	1						3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	25	75					100
CAT2	20	40	40				100
CAT3	20	50	30				100
ESE	20	60	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE04 AIRPORT, DOCK AND HARBOUR ENGINEERING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Transportation Engineering	V	PE	3	0	0	3

Preamble	To impart a detailed knowledge about the planning & design of Airport, Docks and Harbour Engineering	
Unit - I	**Airport Planning and Design**	**9**
Introduction - Merits and demerits - Aircraft characteristics - Airport planning - Site selection - Airport obstructions - Runway design - Orientation - Wind Rose Diagram - Corrections to basic runway length - Airport capacity and configuration - Taxiway design - Exit taxiways.		
Unit - II	**Airport Terminal Design and Passenger Facilities:**	**9**
Function of airport passenger terminal and cargo terminal – Design of air freight terminals – Airport access – Airport landside planning – Capacity – Parking and circulation area – Airport zones – Passenger facilities and services - Airport drainage.		
Unit - III	**Airport Layout and Visual Aids:**	**9**
Typical airport layouts - Airport marking and lighting - Air Traffic Control - Instrument Landing System – Navigational aids – lighting, sign, markings - Ground based systems - Satellite based systems		
Unit - IV	**Dock and Harbour:**	**9**
Growth and regulation of ports - Various components of maritime systems, including shorefront and inland infrastructure - Docks and repair facilities - Concepts of port and marine terminal design – Cargo handling equipment and intermodal transportation networks		
Unit - V	**Harbour Dredging:**	**9**
Dredging equipment - Dredging for navigation improvement – Pipelines and cables – Soil replacement - Potential effects of dredging on environment, environmental factors – Functional design of the various components of ports and marine terminals, including steel, concrete, timber, and stone structures - Design procedures for breakwaters, bulkheads, wharves, dolphins, piers, fender and mooring systems and revetments		

Lecture:45, Total:45

TEXT BOOK:

1. Subramanian, K.P. “Railways, Airport and Harbour Engineering”, Scitech publications (India) pvt. Ltd, Chennai, 2nd edition, 2018.

REFERENCES:

1. Khanna , Arora, “Airport,Planning & design”, Nem chand & Bros,Roorkee,6th Edition,2018.
2. Subramanian, K.P. “Highway, Railway, Airport and Harbour Engineering”, Scitech publications (India) pvt. Ltd, Chennai, 2nd edition, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the concepts of airport planning and the components with its functions	K2 (Understanding)
CO2	design terminal facility and explain passenger facilities	K3 (Applying)
CO3	Infer the process of landing system and explain the components of navigational aids	K3 (Applying)
CO4	explain the layout and components of docks with its functions	K2 (Understanding)
CO5	Infer the process of dredging and explain the components of port terminal	K3 (Applying)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				3							3	2
CO2	3	2	1			3						1	3	3
CO3	3	2	1			3						1	3	3
CO4	2	1				3							3	2
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	60					100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	20	60	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE05 GROUND IMPROVEMENT TECHNIQUES

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Soil Mechanics and Foundation Engineering	V	PE	3	0	0	3

Preamble	Course consists of various problems associated with soil deposits and different techniques used to improve the characteristics of problematic soil as well as design techniques required to implement ground improvement methods.	
Unit - I	**Problematic Soil and Improvement Techniques:**	**9**
Role of ground improvement in foundation engineering – Methods of ground improvement – Geotechnical problems in alluvial, lateritic and black cotton soils – Selection of suitable ground improvement techniques based on soil conditions.		
Unit - II	**Dewatering:**	**9**
Dewatering Techniques - Well points – Vacuum and electro-osmotic methods – Seepage analysis for two-dimensional flow for fully and partially penetrated slots in homogeneous deposits – Design for simple cases.		
Unit - III	**In-situ Treatment of Cohesionless and Cohesive Soils:**	**9**
In-situ densification of cohesionless soils - Dynamic compaction –Vibro-flotation, Sand compaction piles and deep compaction - Consolidation of cohesionless soils - Preloading with sand drains and fabric drains - Stabilization of soft clay ground using stone columns and lime piles-Installation techniques –Relative merits of above methods and their limitations.		
Unit - IV	**Earth Reinforcement:**	**9**
Concept of reinforcement – Types of reinforcement material – Soil nailing - Reinforced earth wall – Mechanism – Simple design - Applications of reinforced earth - Functions of Geotextiles in filtration, drainage, separation, road works and containment applications.		
Unit - V	**Grouting Techniques:**	**9**
Types of grouts – Grouting equipment and machinery – Injection methods – Grout monitoring – Stabilization with cement, lime and chemicals – Stabilization of expansive soil.		

Lecture:45, Total:45

TEXT BOOK:

1. Purushothama Raj. P, “Ground Improvement Techniques”, 2nd Edition, Laxmi Publications (P) Ltd, 2016.

REFERENCES:

1. Koerner, R.M. “Construction and Geotechnical Methods in Foundation Engineering”, 2nd Edition McGraw Hill, 1994.
2. Das, B.M., “Principles of Foundation Engineering” 7th edition, Cengage learning, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify the geotechnical problems in various soil deposits	Applying (K3)
CO2	design and select suitable technique of dewatering	Applying (K3)
CO3	suggest suitable in-situ treatment for cohesive and cohesionless soils	Applying (K3)
CO4	recommend different soil reinforcement materials based on their application	Applying (K3)
CO5	select different types of grouting methods and stabilization techniques	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1			3						1	3	3
CO2	3	2	1			3						1	3	3
CO3	3	2	1			3						1	3	3
CO4	3	2	1			3						1	3	3
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	30	60				100
CAT2	10	30	60				100
CAT3	20	40	40				100
ESE	10	30	60				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE06 REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEMS

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	V	PE	3	0	0	3

Preamble	This course gives knowledge on remote sensing and its working principles. It also describes the image processing techniques using GIS for real time applications.	
Unit - I	**Principles of Remote Sensing:**	**9**
Definition – Components of Remote sensing – EMR Spectrum – EMR interactions with atmosphere – EMR interactions with Earth – Spectral signature curves of Earth surface features – Platforms and Sensors: Evolution of different types of satellites and their characteristics – Sensor types and properties – Resolution concepts.		
Unit - II	**Geographical Information System:**	**9**
Definition and Components of GIS – GIS Data types – Non spatial data: Field and statistical data, Spatial data: Maps and Map projection methods, Aerial photographs and satellite data – Vector and Raster data types – Merits and demerits- Open source software.		
Unit - III	**Image processing:**	**9**
Digital Image – Characteristics – Image pre-processing techniques – Image Enhancements techniques – Classification methods – Database concepts – Data structures: Run Length Encoding, Block encoding, Chain encoding and Quad tree, Topology – Data storage formats: BIL, BSQ and BIP, Topology – Data compression techniques – File formats - Image Interpretation: Visual Interpretation keys and techniques.		
Unit - IV	**Data Analysis and Interpretation:**	**9**
Data Retrieval: Querying – Raster data analysis: Spatial analysis – Reclassification – Vector data analysis: Overlay, Buffer and Network analysis – Modelling surfaces: TIN, DTM, DEM, Slope model: Slope, Aspect, Hill shades – Types of Data products.		
Unit - V	**Applications of Remote Sensing and GIS:**	**9**
LiDAR and Microwave Remote sensing with its applications, Basics of Hyper spectral Remote sensing – Concepts of Online GIS and Mobile GIS – Fields of Applications and case studies: LIS and Cadastral mapping – Urban and Regional planning – Natural resources management – Climate studies and Disaster monitoring – Ocean studies.		

Lecture:45 Total:45

TEXT BOOK:

1. Basudeb Bhatta, “Remote Sensing and GIS”, 2nd Edition, Oxford University Press, 2011.

REFERENCES:

1. M. Anji Reddy, ”Remote sensing and Geographical Information Systems”, 4th Edition, B S Publications, 2019.
2. Kang-Tsung Chang,” Introduction to Geographic Information Systems”, 2nd Edition, McGraw Hill Publishing, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	categories the earth features in a satellite imagery and the sensor properties for various applications of remote sensing	Applying (K3)
CO2	suggest suitable GIS elements for storing and analysing different remote sensing datasets	Applying (K3)
CO3	select suitable GIS database for different remote sensing imageries using pre-processing techniques	Applying (K3)
CO4	use raster and vector data analyses on different remote sensing images	Applying (K3)
CO5	explain the fields of applications of remote sensing and GIS with the recent advancement techniques	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1		1	3						1	3	3
CO2	3	2	1		1	3						1	3	3
CO3	3	2	1		1	3						1	3	3
CO4	3	2	1		1	3						1	3	3
CO5	2	1				2							3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	40	30				100
CAT2	30	40	30				100
CAT3	30	40	30				100
ESE	30	40	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20SEE07 DESIGN OF PRE-STRESSED CONCRETE STRUCTURES

(Use of IS 1343:2012, IS 2090-1983 & IS 3370 (Part III) 2009 are permitted)

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Structural Analysis and Design of Reinforced Concrete Structures	VI	PE	3	0	0	3

Preamble	This course gives knowledge on the prestressing principles and the methods of prestressing for real time applications.	
Unit - I	**Introduction:**	**9**
Concepts of Prestressing – Historical development – Requirements for high strength steel and concrete – Partial prestressing – Moderate prestressing – Bonded & unbounded prestressing - Terminology – Degree of prestressing - Advantages of Prestressed Concrete - Applications of prestressed concrete - Materials for prestressed concrete – Pre-tensioning systems – Post tensioning systems – Tensioning devices - Analysis of prestress and bending stresses – Effect of end eccentricity – Resultant stress distribution – Durability.		
Unit - II	**Loss of Prestress and Deflection of Prestressed Concrete Beams:**	**9**
Losses of Prestress – Types of losses - Deflections of Prestressed Concrete Members – Factors influencing deflection – Mohr's theorem - Factors Influencing Deflections – Short-Term Deflections of Uncracked Members – Prediction of Long Time Deflections - Flexural Strength of Prestressed Concrete Sections – Eccentricity - Types of Flexural Failure.		
Unit - III	**Design of Prestressed Concrete Elements:**	**9**
Design of Sections for Flexure – Critical combinations - Design of Sections for Axial Tension- Design of sections for compression and bending – Types of failures - Design of Prestressed Sections for Shear and Torsion (design concepts only) – Anchorage Zone - Guyon's theorem - Concept of Magnel's method - Assembly of prestressing and reinforcing steel - Instability during erection.		
Unit - IV	**Design of Composite Prestressed Concrete Elements:**	**9**
Composite structures – Advantages - Types of Composite Structures – Design procedure - Propped construction - Unpropped construction - Design of shear connector – Shrinkage Stresses – Stresses due to differential shrinkage – Design of shear connector – Estimation of ultimate shearing force – Calculation of horizontal shear stress.		
Unit - V	**Design of Circular Elements, Mast and Sleepers**	**9**
Circular prestressing – Types of pre-stressed concrete pipes - IS Codal provisions – Design of cylindrical pre-stressed concrete tanks - Design of pre-stressed pretensioned mast - Design of pre-stressed concrete sleepers.		

Lecture:45, Total:45

TEXT BOOK:

1. Krishna Raju, "Prestressed Concrete", 5th Edition, Tata McGraw Hill Publishing Co, India, 2012.

REFERENCES:

1. Praveen Nagarajan, "Prestressed Concrete", 1st Edition, Dorling Kindersley (I) Pvt. Ltd., 2011.
2. N.Rajagopalan, "Prestressed Concrete", 2nd Edition, Narosa Book Distributors, 2010

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	calculate the losses in prestress	Analyzing (K4)
CO2	calculate the deflections in prestressed concrete structural elements	Analyzing (K4)
CO3	design the prestressed concrete structural elements	Analyzing (K4)
CO4	design the shear connectors	Analyzing (K4)
CO5	design the prestressed circular tanks and concrete poles	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2			3				1		2	3	3
CO2	3	3	2			3				1		2	3	3
CO3	3	3	2			3				1		2	3	3
CO4	3	3	2			3				1		2	3	3
CO5	3	3	2			3				1		2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	14	28	48			100
CAT2	10	14	36	40			100
CAT3	14	14	36	36			100
ESE	14	18	38	30			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE08 CONTRACT MANAGEMENT

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	VI	PE	3	0	0	3

Preamble	This course create awareness on contracts for construction industry, impart knowledge on tender preparation, tendering process, arbitration procedure and laws, Legal requirements and Labour Regulations.	
Unit - I	**Contracts:**	**9**
Indian Contract Act – Need – Provisions - Scope for modifications / improvement - Contract Specifications - Types of contract documents used for construction - Contract procurement - Selecting a contractor - Introduction to BOT and BOOT projects - EPC contracts.		
Unit - II	**Tenders:**	**9**
Tender request For Proposals - Bids & Proposals - Bid Evaluation - Contract Conditions & Specifications - Critical /Red Flag conditions - Contract award & Notice to Proceed - Variations & Changes in Contracts - Differing site conditions - Cost escalation - Delays, Suspensions & Terminations - Wrong practices in contracting (Bid shopping, Bid fixing, Cartels).		
Unit - III	**Legal Requirements:**	**9**
Introduction –Intellectual property - Main forms of IP- Copyright - Trademarks, Patents and designs - Secrets - Law relating to copyright in India – Ownership of copyrights and assignment - Criteria of infringement - Piracy in internet – Remedies and procedures in India - Law relating to patents under patents act - Process of obtaining patent – Application, examination, opposition and sealing of patents.		
Unit - IV	**Arbitration:**	**9**
Arbitration and litigation procedure - preparation, settlement, evidence - Comparison of Actions and Laws – Agreements - Subject matter violations - Appointment of arbitrators - Conditions of arbitrations - Powers and duties of arbitrator - Enforcement of award – Costs - Arbitration and conciliation act 1996 - Case studies.		
Unit - V	**Laws applicable to Construction Industry:**	**9**
Industrial Disputes Act - Workmen's Compensation Act - Employer's Liability Act - Payment of Wages Act - Contract Labour Act - Minimum Wages Act - Inter-state Migrant Workmen Act - BOCW Act - other Acts introduced from time to time.		

Lecture:45

TEXT BOOK:

1. Gajaria G.T., “Laws Relating to Building and Engineering Contracts in India”, 4th Edition, M.M.Tripathi Pvt. Ltd., Bombay, 2000.

REFERENCES:

1. Joseph T. Bockrath, “Contracts and the Legal Environment for Engineers and Architects”, 7th Edition, McGraw-Hill, New York, 2010.
2. Jimmie Hinze, “Construction Contracts”, 3rd Edition, McGraw-Hill, New York, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	prepare contract documents including standard and international norms.	Applying (K3)
CO2	infer the procedures of bidding and accepting of tenders.	Understanding (K2)
CO3	explain the different types of property rights and patents	Understanding (K2)
CO4	summarize the duties and powers of arbitrators.	Understanding (K2)
CO5	choose the laws related to construction industry	Applying (K3)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	17	66	17	-	-	-	100
CAT2	50	50	-	-	-	-	100
CAT3	17	66	17	-	-	-	100
ESE	44	44	12	-	-	-	100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE09 ENVIRONMENTAL IMPACT ASSESSMENT

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Environmental Engineering	VI	PE	3	0	0	3

Preamble	This course imparts knowledge on EIA and to identify the impact of environmental attributes for sustainable development.	
Unit - I	**Introduction:**	**9**
Definition & concept- Hierarchy in EIA-Initial environmental examination (IEE)- Environmental Impact Statement (EIS) – Environmental appraisal - Rapid and Comprehensive EIA, EIS, FONSI and NDS-Need for EIA studies-Advantages and limitation of EIA.		
Unit - II	**Methodologies and clearance procedure:**	**9**
Application forms - category of projects-Formation of EIA study team Methods of EIA - Criteria for selection of EIA methodology-Check lists – Matrices-Networks-Overlay - Cost-benefit analysis –EIS format- Terms of Reference (ToR).		
Unit - III	**Assessment and Prediction:**	**9**
Baseline data-Assessment of Impact on land, water, air, noise, social, cultural, flora and fauna –Mathematical Models-Predictive measures- resettlement & rehabilitation-Public participation in EIA-EIA case studies for selected projects.		
Unit - IV	**Environmental Management Plan:**	**9**
Environmental audit- Types of audit-definitions and concepts-stage of environmental audit- compliance schedule-Contents of EA reports-preparation of audit report- Introduction to ISO 14000- Environmental monitoring plan.		
Unit - V	**Legislation:**	**9**
The Environmental Protection Act-The water Act- The Air (Prevention & Control of pollution Act)- Motor Act-Wild life Act- Case studies and preparation of environmental impact assessment statement for various Industries.		

Lecture: 45, Total: 45

TEXT BOOK:

1. Charles H. Eccleston., "Environmental Impact Assessment: A Guide to Best professional practices", 1st Edition, CRC Press., United States, 2017.

REFERENCES:

1. Y.Anjaneyulu and Valli Manikam, “Environmental Impact Assessment Methodologies”, 2nd Edition, B.S Publications., Hyderabad, 2011.
2. Barthwal R.R., “Environmental Impact Assessment”, 2nd Edition, New Age International Publishers, New Delhi, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	summarize the concept of EIA framework.	Understanding (K2)
CO2	suggest the methodologies and prepare EIA reports.	Understanding (K2)
CO3	interpret the importance of public participation in EIA studies.	Applying (K3)
CO4	illustrate the compliance schedule for the developmental projects.	Applying (K3)
CO5	discuss the key steps involved in the EIA legislations.	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2	1						3	2
CO2	2	1				2	1						3	2
CO3	3	2	1			3	1					1	3	3
CO4	3	2	1			3	1					1	3	3
CO5	2	1				2	1						3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	70		-	-	-	100
CAT2	20	40	40	-	-	-	100
CAT3	20	30	50	-	-	-	100
ESE	20	40	40	-	-	-	100

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

20CEE10 PUBLIC TRANSPORTATION SYSTEMS

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Transportation Engineering	VI	PE	3	0	0	3

Preamble	To impart knowledge on public transportation systems and planning	
Unit - I	**Introduction**:	**9**
Modes of public transport and comparison - Public transport travel characteristics - Prioritization of public transport - Technology of bus, rail, rapid transit systems – Transit classification – Right of way – Transit system performance – Transit capacity – Quality of service		
Unit - II	**Rail Transit System**	**9**
Rail transport – Types of rail transit - Suburban commuter rail - rapid rail transit – Light rail transit – Monorail system – Growth of rail based transit systems – Rail transit system development in Indian cities		
Unit - III	**Rail Transit Planning**	**9**
Transittystem operations – Para-Transit systems – Street transit systems – Rapid transit systems – Estimation of transit demand - Route development – Properties of routing stop location and stopping policy – Schedule		
Unit - IV	**Bus Transit Management**	**9**
Bus transport –Characteristics – Types of buses –Bus transit management – Estimation of the required fleet strength – Bus route planning - Expansion/Curtailment of services – Performance indicators – Fleet management – Methods of financing		
Unit - V	**Coordination of Public Transport & Parking**	**9**
Need for coordination – Selection of transit mode – Public transport financing – Transit fare structures – Transit marketing - Intermodal transfer – Parking problems – Impact of parking – Parking space requirements – Parking standards		

Lecture:45

TEXT BOOK:

1. L. R. Kadiyali, "Traffic Engineering and Transport Planning", Khanna Publishers, 9th Edition, 2018

REFERENCES:

1. G.V.Rao "Principles of Transportation and Highway Engineering" Tata McGraw-Hill Publishing Co. Ltd, 5th Edition,2012
2. P.Chakroborty & A. Das, Principles of Transportation Engineering , 6th Edition Prentice Hall India Learning Private Limited, 2nd Edition 2003

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	summarize different modes of public transport and its characteristics	Understanding (K2)
CO2	explain the types of rail transit system and its development in India	Understanding (K2)
CO3	illustrate rail transit planning system, routing and scheduling	Applying (K3)
CO4	infer the transit management techniques and finance	Understanding (K2)
CO5	interpret the coordination of public transport system and financing	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	2	1				2							3	2
CO3	3	2	1			3						1	3	3
CO4	2	1				2							3	2
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	80					100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	20	60	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE11 GEOENVIRONMENTAL ENGINEERING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Soil Mechanics	VI	PE	3	0	0	3

Preamble	To develop an understanding of the geotechnical aspects in the disposal of waste materials and the remediation of environmentally contaminated sites.	
Unit - I	**Fundamentals of Geo-environmental Engineering:**	**9**
Scope of geo-environmental engineering - Multiphase behaviour of soil – Role of soil in geo-environmental applications – Importance of soil physics, soil chemistry, hydrogeology, biological process – sources and type of ground contamination - impact of ground contamination on geo-environment - case histories on geo-environmental problems.		
Unit - II	**Contaminant transport and Site characterisation:**	**9**
Transport of contaminant in subsurface – advection, diffusion, dispersion – chemical process –biological process, sorption, desorption, precipitation, dissolution, oxidation, complexation, ion exchange, volatization, biodegradation – characterization of contaminated sites – soil and rock data – hydrological and chemical data – analysis and evaluation – risk assessment – case studies		
Unit - III	**Waste Containment System**	**9**
Insitu containment – vertical and horizontal barrier – surface cover – ground water pumping system on subsurface drain – soil remediation – soil vapour extraction, soil waste stabilization, solidification of soils, electrokinetic remediation, soil heating, vitrification, bio remediation, phytoremediation – ground water remediation – Insitu flushing, permeable reacting barrier, Insitu air sparging - case studies.		
Unit - IV	**Landfills**	**9**
Source and characteristics of waste - site selection for landfills – components of landfills – liner system – soil, geomembrane, geosynthetic clay, geocomposite liner system – leachate collection –final cover design – monitoring landfill.		
Unit - V	**Remediation of Contaminated soils:**	
Rational approach to evaluate and remediate contaminated sites – Monitored natural attenuation – Ex-situ and in-situ remediation – Solidification, Bio-remediation, incineration, soil washing, electro kinetics, soil heating, vitrification, bio-venting – Ground water remediation – Pump and treat, air sparging, reactive well –Case studies.		

Lecture:45, Total:45

TEXT BOOK:

1. Hsai-Yang Fang and Ronald C. Chaney., “Introduction to Environmental Geo-technology”, 2nd Edition, CRC Press., USA, 2016.

REFERENCES:

1. Sharma H.D. and Reddy K.R., "Geo-environmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies", 1st Edition, John Wiley & Sons, USA, 2004.
2. Reddi L.N. and Inyang, H. I., "Geo-environmental Engineering, Principles and Applications", 3rd Edition, Marcel Dekker, New York, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	discuss the importance, applications and case histories of geo-environmental engineering	Understanding (K2)
CO2	Identify the various methods of generation of wastes and asses the waste characterization	Understanding (K2)
CO3	select suitable treatment techniques based on waste containment system	Applying (K3)
CO4	design engineered land fill systems	Applying (K3)
CO5	choose suitable remediation techniques based on type of pollutant	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	2	1				2							3	2
CO3	3	2	1			3						1	3	3
CO4	3	2	1			3						1	3	3
CO5	2	1				2							3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	80					100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	10	50	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE12 ENGINEERING GEOLOGY

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	VI	PE	3	0	0	3

Preamble	This course imparts knowledge on geological process, classification, morphology of rocks and the importance of the study of geology for civil engineering practices with regard to the selection of appropriate site for their projects like dams, tunnels, buildings etc.,	
Unit - I	**Geomorphology:**	**9**
Internal structure of the earth – Weathering - Geological work of rivers - Wind — Groundwater – Hydrologic cycle – Origin and occurrence - Vertical distributions and types of aquifers.		
Unit - II	**Mineralogy:**	**9**
Elementary knowledge on symmetry elements of crystallographic systems (normal class) – Physical properties of minerals – Study of the rock forming minerals: Quartz family – Feldspar family – Mica minerals: Muscovite and Biotite – Augite – calcite - Fundamentals of ore mineral formation.		
Unit - III	**Rock studies:**	**9**
Rock cycle – Classification and distinction of rocks - Igneous rocks: granite, syenite, basalt and dolerite - Sedimentary rocks: Conglomerate, breccia, sandstone, shale and limestone - Metamorphic rocks: Gneiss, schist, quartzite, slate and marble.		
Unit - IV	**Structural features of rocks & investigations:**	**9**
Attitude of beds: Dip, strike, stratification and outcrops – Folds - Faults and Joints - causes and types – bearing on engineering construction – unconformities- Electrical and seismic methods – Geotechnical considerations for Dam and reservoir - Tunnels – Road cuts - Landslides.		
Unit - V	**Fundamental concepts of geo-tectonic:**	**9**
Plate tonics and continental drift – Earthquake- Causes –Seismic zones of India -dynamic evolution of continental and oceanic crust- tectonic framework of India.		

Lecture: 45, Total: 45

TEXT BOOK:

1. Duggal S.K., Pandey H.K., Rawal N., “Engineering Geology”, 5th Edition, McGraw Hill Education (India)Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1. Subinoy Gangopadhyay, “Engineering Geology”, 1st Edition, Oxford University Press India, 2012.
2. Marland P. Billings, “Structural Geology”, 3rd Edition, Pearson Education India, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identity different earth surface process	Understanding (K2)
CO2	classify the minerals with reference to their properties	Understanding (K2)
CO3	distinguish the different types of rocks	Analyzing (K4)
CO4	identify the geological structures of rocks and suggest suitable site investigation methods	Applying (K3)
CO5	summarize the concepts of geo-tectonic movements	Understanding (K2)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70					100
CAT2	10	30	30	30			100
CAT3	20	40	40				100
ESE	10	30	40	20			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE13 ADVANCED STEEL DESIGN
(IS 800:2007, Steel Tables, IS 875 (Part-3), IS 801: 1975, IS811:1987and SP 06 are permitted)

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Structural Analysis and Design of Steel Structures	VII	PE	3	0	0	3

Preamble	This course offers the design of steel structures as per limit state method. It aims at determination of safe as well as economical steel section for various industrial and framed structures.	
Unit - I	**Industrial buildings:**	**9**
Roof trusses - Roof and side coverings – Wind load calculation - Design of purlins – Design of truss under gravity load and wind load - Introduction to the design of steel structures for fire loads.		
Unit - II	**Design of Connections**:	**9**
Introduction – Bolted Flexural connections – Bolted Shear connections – Welded Flexural connections - Welded shear connections.		
Unit - III	**Light Gauge Steel Structures and Pre-Engineered Buildings:**	**9**
Types of cross sections - Local buckling - Design of compression members - Design of beams - General concept of pre-engineered buildings - Simple portal frame design concepts.		
Unit - IV	**Plate Girder**:	**9**
Introduction - Difference between beam and plate girder – Types of plate girders – Post buckling behavior of the web plate – Proportioning of the web plate and flanges – Design of welded plate girder.		
Unit - V	**Gantry girder:**	**9**
Introduction - Load considerations - Max load effects - Determination of maximum bending moment and shear force due to vertical component of crane wheel load - Horizontal component of crane wheel load - Longitudinal effect of wheel load - Design of gantry girder**.**		

Lecture:45, Total:45

TEXT BOOK:

1. Subramanian N., “Design of Steel Structures Limit States Method”, 2nd Edition, Oxford University Press, New Delhi, 2016.

REFERENCES:

1. Bhavikatti S.S., —Design of Steel Structures, 5th Edition, I.K. International Publishing House Pvt. Ltd., New Delhi, 2017.
2. Duggal S., “Design of Steel Structures”, 3rd Edition, McGraw Hill Education, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	analyze and design various components of truss	Analyzing (K4)
CO2	design welded and bolted connections	Analyzing (K4)
CO3	analyze and design the components of a pre-engineered steel building	Analyzing (K4)
CO4	design welded plate girder	Analyzing (K4)
CO5	analyze and design different gantry girders	Analyzing (K4)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2			3				1		2	3	3
CO2	3	3	2			3				1		2	3	3
CO3	3	3	2			3				1		2	3	3
CO4	3	3	2			3				1		2	3	3
CO5	3	3	2			3				1		2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	20	30	40	-	-	100
CAT2	10	20	30	40	-	-	100
CAT3	10	20	30	40	-	-	100
ESE	10	20	30	40	-	-	100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE14 ARCHITECTURE AND TOWN PLANNING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	VII	PE	3	0	0	3

Preamble	This course imparts knowledge on building standards, zone regulation, design of architectural elements in buildings and surveys related to site analysis.	
Unit - I	**Architectural Space Standards:**	**9**
Introduction to architectural design-aesthetics, concepts of space, form and function-Factors and concepts related to building design - climate, site characteristics, land form, visual elements, behavioural factors, space utilization.		
Unit - II	**Town Planning & Surveys:**	**9**
Evolution of planning- Objects of planning- Principles and necessity of planning- Town planning in ancient India- Types of survey - Uses of survey - Methods adopted to collect data - Aerial photo and remote sensing techniques in planning - Master plan-Concepts of smart cities.		
Unit - III	**Zoning:**	**9**
Principles of zoning- Advantages and importance of zoning- Economy of zoning- Housing- Slum - Parks and playgrounds- Industries- Public buildings-Urban roads - Traffic management.		
Unit - IV	**Climate and Environmental Responsive Design:**	**9**
Man and environment interaction with climatic factors– Characteristics of climate types – Design adopting different climatic conditions – Passive and active energy controls – Green building concept		
Unit - V	**Building Bye-laws:**	**9**
Objects - Importance - Functions of local Authority- Anthropometrics- Building rules and regulations- Set back - Light plane - Floor space Index- Off-street parking - Fire protection- Neighbourhood planning.		

Lecture:45

TEXT BOOK:

1. Rangwala. S., “Town Planning”, 29th Edition, Charotar Publishers, 2016.

REFERENCES:

1. Hiraskar. G. K., “Fundamentals of Town Planning”, 17th Edition, Dhanpat Rai Publications, 2017.
2. Francis D. K. Ching., “Architecture: Form, Space & Order”, 4th Edition, John Wiley & Sons, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Identify and design architectural elements in buildings by considering space standards	Understanding (K2)
CO2	identify the standards required for town planning	Understanding (K2)
CO3	classify the zoning along with its required standards	Understanding (K2)
CO4	apply green building concepts in the planning of buildings	Applying (K3)
CO5	prepare building plans as per standards and zoning regulations	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	2	1				2							3	2
CO3	2	1				2							3	2
CO4	3	2	1			3						1	3	3
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	80					100
CAT2	20	40	40				100
CAT3	15	35	50				100
ESE	20	30	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE15 AIR AND NOISE POLLUTION CONTROL ENGINEERING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Environmental Engineering	VII	PE	3	0	0	3

Preamble	To realize the importance of air and noise pollution measurement and its control strategies for maintaining environmental quality standards.	
Unit - I	**Sources and Effects of Air Pollutants:**	**9**
Classification of air pollutants -Sources of air pollution -Effects of air pollution on human beings, materials, vegetation, animals-global warming-ozone layer depletion-Basic Principles of Sampling-Source and ambient sampling-Analysis of pollutants.		
Unit - II	**Dispersion of Air Pollutants:**	**9**
Elements of atmosphere - Meteorological factors –source Monitoring of gaseous and particulate matter - Wind rose diagram - Lapse rate - Atmospheric stability and turbulence-Plume rise - Dispersion of pollutants - Dispersion models – Kyoto Protocol - Applications.		
Unit - III	**Air Pollution Control:**	**9**
Concepts of control - Principles and design of control measures - Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation - Selection criteria for equipment - gaseous pollutant control by adsorption, absorption, condensation, combustion - Pollution control for specific major industries.		
Unit - IV	**Noise Pollution:**	**9**
Sources – Noise scales – Decibels and Levels - Effects and occupational hazards of noise pollution- Assessment-Control methods-Noise Exposure Index-Prevention-Noise measurement strategies- Case studies.		
Unit - V	**Noise and Air Quality Management:**	**9**
Noise and Air quality standards - Quality monitoring - Preventive measures - Pollution control efforts – Noise and Air quality Zoning - Town planning regulation of new industries - Legislation and enforcement - Environmental Impact Assessment on Air and Noise quality.		

Lecture: 45, Total: 45

TEXT BOOK:

1. Rao M and Rao H.V.N., "Air Pollution Control", 1st Edition, Tata-McGraw-Hill., New Delhi, 2017.

REFERENCES:

1. Keshav Kant and Er.RajniKant., “Air Pollution and Control Engineering”, 1st Edition, Khanna Book Publishing., New Delhi,2019.
2. Eugene Roberto Nicchi., “Noise Pollution: sources, Effects on workplace Productivity and health Implications (Pollution Science, Technology and Abatement)”, 2nd Edition, Nova Science Publishers Inc., United Kingdom, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	identify the sources and impacts of air pollutants.	Understanding (K2)
CO2	sketch wind rose diagram based on the plume behaviour.	Applying (K3)
CO3	suggest air pollution control methods for different pollutants.	Applying (K3)
CO4	Select suitable control method for noise pollution.	Applying (K3)
CO5	apply air and noise quality standards.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2	1						3	2
CO2	3	2	1			3	1					1	3	3
CO3	3	2	1			3	1					1	3	3
CO4	3	2	1			3	1					1	3	3
CO5	3	2	1			3	1					1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	50	20	-	-	-	100
CAT2	20	60	20	-	-	-	100
CAT3	20	70	10	-	-	-	100
ESE	20	50	30	-	-	-	100

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

20CEE16 URBAN TRANSPORTATION PLANNING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Transportation Engineering	VII	PE	3	0	0	3

Preamble	This course imparts knowledge on the principles of urban transportation planning and its components	
Unit - I	**Urban Transportation Planning Process & Concepts:**	**9**
Role of transportation – Transportation problems – Urban travel characteristics – Evolution of transportation planning process - Concept of travel demand – Demand function - Independent variables – Travel attributes – Assumptions in demand estimation - Sequential, recursive and simultaneous processes.		
Unit - II	**Transportation Survey and Analysis:**	**9**
Definition of study area – Zoning – Types and sources of data – Road side interviews – Home interview surveys – Expansion factors – Accuracy check – Trip generation models - Zonal models – Category analysis – Household models – Trip attractions of work centers - Trip distribution models – Growth factor models – Uniform Factor Method – Average Factor Method – Disadvantage of Growth factor method – Case studies**.**		
Unit - III	**Design and Mode Split Analysis:**	**9**
Standards and guidelines – Transport policies – Mode choice behaviour, completing modes, mode split curves, probabilistic models – Route split analysis – Elements of transportation networks, coding – Minimum path trees, all-or-nothing assignment.		
Unit - IV	**Urban Goods Movement:**	**9**
Importance and characteristics of urban goods movement - Problems of urban goods movement - Goods traffic management in urban area - Urban Goods Movement planning process - Goods movement forecasting		
Unit - V	**Innovations in Urban Transportation:**	**9**
Need for innovative approaches–Classification of urban transportation innovations–Bus rapid transit (BRT)–Bus route rationalization–Geographic Information System (GIS)–Intelligent Transportation System (ITS)–Track Guided Bus–Duo Bus		

Lecture:45, Total:45

TEXT BOOK:

1. Khisty, C. J. and Iall, B. K., “Transportation Engineering - An Introduction”, Prentice Hall, 3rd Edition, India, 2002.

REFERENCES:

1. Papacostas, C S, and Prevedouros. P. D, “Transportation Engineering and Planning”, Prentice Hall, 3 rd Edition,2009.
2. Hutchinson B. G., “Principles of Urban Transportation System Planning”, McGraw Hill,1 st Edition 1974

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain urban transport planning and its concepts	Understanding(K2)
CO2	infer the transportation survey, trip attraction, generation and distribution	Applying(K3)
CO3	summarize the modal choice and the transportation network	Understanding(K2)
CO4	illustrate the characteristics, problems and management of urban goods movement	Applying(K3)
CO5	explain the advancement in urban transportation	Understanding(K2)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20				100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	20	50	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE17 ROCK MECHANICS

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	VII	PE	3	0	0	3

Preamble	To impart knowledge on fundamentals of rock mechanics and its applications in solving problems associated with rock slopes and underground openings.	
Unit - I	**Classification and index properties of rocks:**	**9**
Introduction – Scope of rock mechanics- Geological classification –Index properties of rock systems – Classification of rock masses for engineering purpose- Rock mass rating and Q System		
Unit - II	**Rock strength and failure criteria:**	**9**
Modes of rock failures – Strength of rock –Laboratory measurement of shear, tensile and compressive strength – Stress-strain behaviour of rock under hydrostatic compression and deviator loading – Mohr-Coulomb failure criteria.		
Unit - III	**Initial stresses and their measurements:**	**9**
Estimation of initial stresses in rocks –influence of joints and their orientation in distribution of stresses – measurement of in-situ stresses – Hydraulic fracturing –Flat jack method – Over coring method		
Unit - IV	**Application of rock mechanics in engineering:**	**9**
Simple engineering application – Underground openings –Rock slopes – Bolting – Anchoring -Foundations and mining subsidence		
Unit - V	**Rock stabilization:**	**9**
Rock support and Rock reinforcement -methods of excavation of tunnels - control and maintenance- tunnel ventilation - Grouting in rocks-Rock bolting-Rock anchors.		

Lecture:45, Total:45

TEXT BOOK:

1. Ramamurthy T. 'Engineering in Rocks for Slopes Foundations and Tunnels', PHI Learning Pvt. Ltd, 3rd Edition, 2014.

REFERENCES:

1. Debasis & Verma Abhiram Kumar, "Fundamentals and Applications of Rock Mechanics" 1st Edition, PHI Learning Pvt. Ltd, 2016.
2. Nagaratnam Sivakugan, Sanjay Kumar Shukla and Braja M. Das, 'Rock Mechanics An Introduction', CRC press, 1st edition, India, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	classify the rocks and explain the index properties of rock systems	Understanding (K2)
CO2	Interpret the modes of rock failure and the stress-strain characteristics	Applying (K3)
CO3	calculate the stresses in rocks	Applying (K3)
CO4	apply the methods to improve the stability of rocks	Applying (K3)
CO5	use a suitable method for rock stabilization	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	3	2	1			3						1	3	3
CO3	3	2	1			3						1	3	3
CO4	3	2	1			3						1	3	3
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	50	20				100
CAT2	10	40	50				100
CAT3	20	40	40				100
ESE	10	40	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE18 FINITE ELEMENT METHOD

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Structural Analysis	VII	PE	3	0	0	3

Preamble	This course deals with various modeling techniques and uses different numerical methods for solving a system of governing equations over the domain of a continuous physical system.	
Unit - I	**Introduction**	**9**
Historical Background-Mathematical Modeling of field problems in Engineering-Governing Equations - Stresses and equilibrium-boundary conditions-Strain displacement relations -potential energy and equilibrium - Variational method -Concepts of potential energy- Rayleigh Ritz method- weighted residual method- Point collocation method, Sub domain collocation method, Least squares method, Galerkin's method.		
Unit - II	**One Dimensional Problems**	**9**
Discretization of domain -Coordinate types, shape function using natural coordinates and generalized coordinates-stiffness matrix of a 1-D bar and beam element-Stiffness matrix and finite element equation for a two noded Truss element- Basic equations of heat transfer - Shape function and thermal stiffness matrix for 1-D heat conduction.		
Unit - III	**Two Dimensional Problems**	**9**
Derivation of shape functions for CST and LST triangular and rectangular elements-Stiffness matrices and force vectors for CST and LST triangular and rectangular elements- concept of plane stress and plain strain and axi-symmetry- Beam bending-Governing differential equation for beam bending- Two node beam element-Exact solution for uniform beams subjected to distributed loads using superposition.		
Unit - IV	**Analysis of Framed Structures**	**9**
Stiffness of Truss Member - Analysis of Truss - Stiffness of Beam Member - Finite Element Analysis of Continuous Beam - Plane Frame Analysis - Numerical Evaluation of Element Stiffness - Formulation for 3 Dimensional Elements - Solution for simple frames.		
Unit - V	**Iso-parametric Formulation**	**9**
Natural co-ordinate systems – Iso-parametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems – Matrix solution techniques – Solutions Techniques to Dynamic problems.		

Lecture:45,Total:45

TEXT BOOK:

1. J.N.Reddy, "An Introduction to the Finite Element Method", Third Edition, McGrawHill Mechanical Engineering, Reprint, 2015

REFERENCES:

1. Singuresu S. Rao, "Finite Element method in Engineering", Fourth edition, Elsevier Science & Technology Books, Reprint 2015.
2. Tirupathi R. Chandrupatla, Ashok D. Belagundu, "Introduction to Finite Elements in Engineering", Third Edition, Reprint, Prentice Hall, 2012

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Explain different approximation techniques	Understanding (K2)
CO2	Solve one-dimensional problems	Applying (K3)
CO3	solve two-dimensional problems	Applying (K3)
CO4	apply FEM concept in linear 2D structural beams and frames problems	Applying (K3)
CO5	explain iso-parametric elements and its formulations	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	3	2	1			3						1	3	3
CO3	3	2	1			3						1	3	3
CO4	3	2	1			3						1	3	3
CO5	2	1				2							3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	50	30				100
CAT2	20	40	40				100
CAT3	20	50	30				100
ESE	20	40	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE19 EARTHQUAKE ENGINEERING AND DESIGN

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	NIL	VII	PE	3	0	0	3

Preamble	This course imparts knowledge on earthquake-resistant design of structures in the field of engineering wherein many exciting developments are possible.	
Unit - I	**Elements of Seismology**	**9**
Interior of Earth, plate tectonics, faults, consequences of earthquake, Basic parameters of earthquake, magnitude & intensity, scales, Seismic zones of India, damages caused during past earthquakes		
Unit - II	**Basics & Causes of Earthquake**	**9**
Earthquake causes and its effect on built structures - EQ resistant provisions in masonry building - Single degree freedom system - Free and forced vibration - Forced vibration using Duhamel integral and Laplace transform - Multi degree of freedom system		
Unit - III	**Response Spectrum and Dynamic Analysis**	**9**
Response of structure subjected to Random vibrations - Seismic coefficient method and Dynamic analysis - Ductile detailing of reinforced concrete beams, Columns and shear wall - Design procedure on ductile detailing - Design concepts of non-structural members		
Unit - IV	**Design and Detailing**	**9**
Resistant design of RCC buildings – Material properties – lateral load analysis – Capacity based design and Detailing – Rigid frames – Shear walls.		
Unit - V	**Vibration Control Techniques**	**9**
Vibration control – Tuned mass dampers – principles and application, Basic concepts of Seismic base Isolation – various systems. Case studies of important structures.		

Lecture:45, Total:45

TEXT BOOK:

1. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", 2ndEdition, PHI Learning Private Ltd, New Delhi, 2013.

REFERENCES:

1. Ray W Clough & Joseph Penzien., "Dynamics of Structures",2ndEdition, CBS Publishers & Distributors Pvt. Ltd, New Delhi, 2019
2. Paz M. & Young Hoon Him, "Structural Dynamics –Theory & Computation", Springer International Publishing, 2018

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain various elements of seismology with some case studies	Understanding (K2)
CO2	interpret the causes and effects of vibration under earthquakes	Applying (K3)
CO3	interpret response spectrum presented in various formats	Applying (K3)
CO4	design the earthquake resistant rcc structures	Understanding (K2)
CO5	explain the concept of vibrational control techniques	Understanding (K2)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	75					100
CAT2	30	40	30				100
CAT3	30	60	10				100
ESE	30	50	20				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE20 SUSTAINABLE ENGINEERING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	VII	PE	3	0	0	3

Preamble	This course imparts knowledge on sustainable construction methods incorporating site and climatic zone-specific sustainability features	
Unit - I	**Introduction to Sustainable Engineering**:	**9**
Definitions of Sustainability - Need for Sustainability-Concept of sustainable development-three pillar basic model - Egg of sustainability model- Attkisson's Pyramid Model-Prism Model-Principles of sustainable development-Threats for sustainability		
Unit - II	**Environmental issues:**	**9**
Zero Waste Concept - 3R Concept- Waste to Energy Technology - Climate Change and Global Warming - Ozone Layer Depletion – Resource Degradation- Carbon Footprint		
Unit - III	**Tools for Sustainability:**	**9**
Environmental Management System (EMS)- Concept of IS0 14000 - Life Cycle Assessment (LCA)- Basic Concepts- EIA Process in India - Environmental Auditing- Case Studies		
Unit - IV	**Sustainable habitat:**	**9**
Introduction- Necessity - Concept of Green Building-Principles of Green Building-Green Building Certification and Rating-Sustainable Cities -Sustainable Transport-Sustainable Pavements-Case Studies		
Unit - V	**Sustainable industrialization and urbanization:**	**9**
Need-Pollution Prevention-Industrial Ecology-Green Business-Green Technology-Green Construction-Green Energy-Green Transportation		

Total:45

TEXT BOOK:

1.	R.L.Rag, "Introduction to sustainable engineering",1st Edition, PHI Learning Pvt. Ltd, New Delhi,2015

REFERENCES:

1.	Mohamed Salama, "Principles of Sustainable Project Management", 1st Edition, Goodfellow Publishers Ltd, Oxford,2018
2.	Rogers Peter P, "An Introduction to Sustainable Development", 1st Edition, Glen Educational Foundation Inc, USA,2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the concept of sustainability for future	Understanding (K2)
CO2	predict the local and global environmental issues to overcome the challenges in implementing sustainability	Applying (K3)
CO3	identify sustainable tools for construction	Understanding (K2)
CO4	apply green building practices in a building	Applying (K3)
CO5	illustrate sustainable industrialization and urbanization process	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	3	2	1			3						1	3	3
CO3	2	1				2							3	2
CO4	3	2	1			3						1	3	3
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	70	20				100
CAT2	10	20	70				100
CAT3	10	30	60				100
ESE	10	40	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE21 INDUSTRIAL WASTE MANAGEMENT

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Environmental Engineering	VII	PE	3	0	0	3

Preamble	This course imparts knowledge on the significance of industrial wastewater and solid waste treatment techniques for ensuring environmental sustainability.	
Unit - I	**Introduction:**	**9**
Industrial scenario in India -Uses of water by industry-Sources, characteristics and types of industrial wastewater-Industrial wastewater and environmental impacts-Industrial waste survey-Industrial Wastewater generation rates-Population Equivalent-Toxicity of Industrial effluents and Bioassay tests.		
Unit - II	**Industrial Pollution Prevention:**	**9**
Importance of prevention techniques - Significance of control measures -Benefits and Barriers - Source reduction techniques - Waste audit - Recycle, reuse and bye-product recovery - Applications.		
Unit - III	**Pollution from Major Industries:**	**9**
Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, Fertilizer, Thermal power plants - Wastewater reclamation concepts.		
Unit - IV	**Waste Treatment Methods:**	**9**
Equalization – Neutralization – Oil separation – Flotation – Precipitation – Heavy metal removal – Adsorption – Sequential batch reactor (SBR) – Handling and treatment of Solid waste management.		
Unit - V	**Wastewater Reuse and Residual Management:**	**9**
Zero effluent discharge Systems-Residue management - Quality requirements for wastewater reuse and industrial reuse-Disposal on water and land- Quantification and characteristics of sludge - Location, needs and flow sheet of operational sequences in CETPs.		

Lecture: 45, Total: 45

TEXT BOOK:

1. Rao M.N. and Datta A.K., "Wastewater Treatment", 3rd Edition, Oxford - IBH Publication, New Delhi, 2016

REFERENCES:

1. Stanley N Barton “Industrial Waste: Management, Assessment & Environmental Issues (Waste and Waste Management)”, 1 st Edition, Sara Books Pvt Ltd, New Delhi, 2016.
2. G N Pandey, “Environmental Management”, 1st Edition, Vikas Publishing, Noida, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the sources and effects of industrial contaminants.	Understanding (K2)
CO2	identify rigid preventive measures to overcome environmental pollution	Applying (K3)
CO3	identify the causes and effects of pollution from various industries	Applying (K3)
CO4	choose appropriate industrial waste treatment technique	Applying (K3)
CO5	Select suitable waste management technique	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	3	2	1			3						1	3	3
CO3	3	2	1			3						1	3	3
CO4	3	2	1			3						1	3	3
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	45	25				100
CAT2	25	45	30				100
CAT3	30	40	30				100
ESE	25	45	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE22 – TRAFFIC ENGINEERING & MANAGEMENT

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Transportation Engineering	VII	PE	3	0	0	3

Preamble	This course imparts knowledge on traffic engineering, safety and management concepts on rural and urban highways.	
Unit - I	**Fundamentals of Traffic Engineering:**	**9**
Scope – Elements – Road Characteristics – Road user characteristics – PIEV theory – Vehicle characteristics - IRC standards - Design speed, volume – Performance characteristics – Fundamentals of traffic Flow – Urban traffic problems in India		
Unit - II	**Traffic surveys and level of service:**	**9**
Speed, journey time and delay surveys – Vehicle volume survey including non-motorized transports – Origin destination survey– Parking survey – Accident analyses – Statistical applications and traffic forecasting – Level of service – Highway capacity – Capacity of urban and rural roads - PCU concept – Traffic flow theory		
Unit - III	**Traffic design and visual aids:**	**9**
Design of at-grade intersections – Principles of design – Channelization - Design of rotaries – Traffic signals – Design of signal setting – Signal co-ordination – Roundabouts - Grade separated intersections – Geometric elements for divided and access controlled highways and expressways		
Unit - IV	**Traffic safety and environment:**	**9**
Road furniture - Street lighting -Traffic signs & markings – Networking pedestrian facilities & cycle tracks – Traffic regulation and control – Traffic Safety – Principles and Practices – Road Safety Audit – Traffic and environment hazards – Air and Noise Pollution, causes, abatement measures		
Unit - V	**Traffic management:**	**9**
Traffic system management (TSM) with IRC standards – Traffic regulatory measures-Travel demand management (TDM) – Direct and indirect methods – Congestion and parking pricing – All segregation methods- Coordination among different agencies – Intelligent transport System for traffic management, enforcement and education – Car pooling		

Lecture:45, Total:45

TEXT BOOK:

1. Kadiyali.L.R. “Traffic Engineering and Transport Planning”, Khanna Publishers, Delhi, 9th Edition,2016

REFERENCES:

1. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, “Principles of Highway Engineering and Traffic Analysis”, Wiley India Pvt. Ltd., New Delhi,2 nd Edition, 2011
2. Garber and Hoel, “Principles of Traffic and Highway Engineering”, CENGAGE Learning, New Delhi, 3 rd Edition,2010

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	infer the fundamental concepts of road user characteristics	Understanding (K2)
CO2	select a suitable survey for traffic parameters and highway capacity	Applying (K3)
CO3	develop channels, intersections, signals, roundabouts and parking arrangements	Applying (K3)
CO4	explain traffic signs, markings for road safety and environmental impacts.	Understanding (K2)
CO5	Implement the traffic planning and management systems	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	3	2	1			3						1	3	3
CO3	3	2	1			3						1	3	3
CO4	2	1				2							3	2
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	60	20				100
CAT2	20	50	30				100
CAT3	20	60	20				100
ESE	10	60	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE23 SITE EXPLORATION AND SOIL INVESTIGATION

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Soil Mechanics and Foundation Engineering	VII	PE	3	0	0	3

Preamble	This course enhances the knowledge on the preparation of soil exploration report based on laboratory, field exploration and testing techniques.	
Unit - I	**Scope and Objectives of Site Investigation and Subsurface Exploration:**	**9**
Site investigation –Scope and objectives – activities involved in site investigation – Preliminary desk studies- Subsurface exploration –General considerations – Objectives – Planning an exploration programme – Location – Spacing and depth of borings –Soil Profile – Bore logs – Data Presentation – Soil investigation and exploration reports. Geophysical Investigation – Multichannel analysis of surface waves (MASW)		
Unit - II	**Exploration Techniques:**	**9**
Open pits and trenches - Different methods of boring and drilling – Stabilization of bore holes – Cleaning of bore hole – Geophysical exploration and interpretation – non-displacement and displacement methods – Drilling in difficult subsoil conditions.		
Unit - III	**Soil Sampling Techniques:**	**9**
Different type of samples – sample disturbance – measurement of sample disturbance – Area and recovery ratio – RQD – Types of samplers – Undisturbed sampling technique – Drive sampling – Design criteria for drive samplers – Methods for preventing loss of samples – Surface and control sampling in site testing – Advanced sampling techniques – Offshore sampling – Preservation and handling of samples.		
Unit - IV	**Field Testing in Soil Exploration:**	**9**
Field tests – Importance of field tests in soil exploration – Penetration testing – Standard Penetration Test – Static Cone Penetration Test – Dynamic cone penetration test – Plate load test – Field Vane shear test – Pressure meter testing – Data interpretation – Cyclic plate load test – Block vibration test – Field Permeability test.		
Unit - V	**Instrumentation:**	**9**
Instrumentation in soil engineering, strain gauges, resistance and inductance type, load cells, earth pressure cells, settlement and heave gauges, pore pressure measurements -slope indicators, sensing units, case studies		

Lecture:45, Total:45

TEXT BOOK:

1. Clayton C.R, Matthews M.C, Simons N.E, “Site Investigation”, 2nd edition, Trans Tech Publications Ltd, 1995.

REFERENCES:

1. Hanna T.H, “Field Instrumentation in Geotechnical Engineering”, 2nd Edition, Trans Tech Publications Ltd, 1985.
2. Brahma S.P, " Foundation Engineering", 5th Edition., Tata McGraw-Hill Publishing Company, New Delhi, 1993.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the importance, features and stages of geotechnical investigation	Understanding (K2)
CO2	select suitable exploration technique based on type of subsoil	Applying (K3)
CO3	choose appropriate soil and rock samplers for testing	Applying (K3)
CO4	outline in-situ testing of soil and rock	Understanding (K2)
CO5	explain the geotechnical instrumentation	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	3	2	1			3						1	3	3
CO3	3	2	1			3						1	3	3
CO4	2	1				2							3	2
CO5	2	1				2							3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	40	50				100
CAT2	10	40	50				100
CAT3	30	70					100
ESE	10	50	40				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE24 - GREEN BUILDING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	VII	PE	3	0	0	3

Preamble	This course signifies eco-friendly building concepts and building certification systems as per Indian and International Standards	
Unit - I	**Introduction to Green Building Concept and Rating System**	**9**
Green Building Concept- Introduction to IGBC - Green Building Rating Tools - Green Project Management, Certification and Documentation. History of green Rating systems - Need and use of green rating systems - Structure of the rating systems - Selection of the appropriate rating system, ZEB- ZEB-ZCB ratings		
Unit - II	**Green Building Planning and Design**	**9**
Construction Operation – Maintenance – Renovation – Demolition –Global Energy Release – Harmful Impact om Nature – Fresh Water Depletion – Ozone Depletion – Sick Building Syndrome – Solid Waste Disposal – HVAC system – Alternative Building Materials		
Unit - III	**Green Building Materials & Methods:**	**9**
Building and Material Reuse - Salvaged Materials - Material Content - Manufactured Materials - Recycled Content – Eco Block - Volatile Organic Compounds (VOC's) Natural Non-Petroleum Based Materials - Alternative Construction Methods - Waste Management and Recycling - Design for Deconstruction.		
Unit - IV	**Performance Analysis & Testing:**	**9**
Cost and Performance Comparisons and Benchmarking - Building Modelling & Energy Analysis - Cost Benefit Analysis - Energy, Shell and Systems Installation Testing - Blower Door - Duct Tightness - Thermal Imagery - Moisture Testing - Commissioning, Metering, Monitoring - Weatherization - Air Sealing - Moisture Control - Energy Retrofits and Green Remodels.		
Unit - V	**Evaluation of Green Building and Certification**	**9**
Role of Green building consultant – GEM, LEED, GRIHA, BREEAM, IGBC - Determination of green points - Green Accreditation examinations - Energy modelling and energy auditing in green building ratings - Consultancy scope and services for green rating systems - Codes and Certification Programs - Green Rating Registration - Green Remodel Ratings - International Green Construction Codes and ratings – Service life span.		

Lecture:45, Total:45

TEXT BOOK:

1.	Linda Reeder, "Guide to green building rating systems ", John Wiley & Sons,3rd Edition 2010.

REFERENCES:

1.	Dru Meadows," Preparing a Building Service Life Plan for Green Buildings", McGraw-Hill Publications,1st Edition,2014.
2.	Abe Kruger, "Green Building: Principles and Practices in Residential Construction", Cengage learning India Pvt Ltd, 1st Edition, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	summarize the concepts of green building and rating system	Understanding (K2)
CO2	make use of efficient resources for the planning of green buildings	Applying (K3)
CO3	compare alternate construction materials and methods	Understanding (K2)
CO4	choose appropriate performance testing technique	Applying (K3)
CO5	apply various codes for certification of green construction.	Applying (K3)

Mapping of COs with POs and PSOs

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	3	2	1			3						1	3	3
CO3	2	1				2							3	2
CO4	3	2	1			3						1	3	3
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	33	67	-	-	-	-	100
CAT3	17	50	33	-	-	-	100
ESE	11	50	39	-	-	-	100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE25 DESIGN OF PREFABRICATED STRUCTURES

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Design of RC Elements	VII	PE	3	0	0	3

Preamble	This course enhances the knowledge among the students to understand the principles, components and design of various prefabricated structural elements.	
Unit - I	**Design Principles:**	**9**
General principles of fabrication – need for prefabrication – general principles of prefabrication – comparison with monolithic construction, types of prefabrication, site and plant prefabrication, economy of prefabrication, modular coordination, standardization – materials – modular coordination – systems – production – transportation – erection.		
Unit - II	**Prefabricated Components and Joints:**	**9**
Planning for components of prefabricated structures, Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls, disuniting of structures. Joints – joints for different structural connections, effective sealing of joints for water proofing, provisions for non-structural fastenings, expansion joints in precast construction.		
Unit - III	**Production and Fabrication:**	**9**
Production technology – Choice of production setup, manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements, dimensional tolerances, acceleration of concrete hardening. Hoisting Technology – equipment for hoisting and erection, techniques for erection of different types of members like beams, slabs, wall panels and columns, vacuum lifting pads.		
Unit - IV	**Design of Prefabricated Beams:**	**9**
Prefabricated load carrying members – Types of beams – design of simple rectangular beams and I-beams, handling and erection stresses, elimination of erection stresses – beams, columns, symmetric frames.		
Unit - V	**Design of Prefabricated Elements:**	**9**
Types of Slabs - construction of roof and floor slabs - Design of hollow core slab. Columns – construction and design principles of column.		

Lecture:45, Total:45

TEXT BOOK:

1. Ramachandra Murthy D.S., “Design and Construction of Precast Concrete Structures”, 1st Edition, Dipti Press OPC Private Limited, Chennai; 2017.

REFERENCES:

1. Kim S. Elliott, "Precast Concrete Structures", 2nd Edition, CRC Press, United States, 2016.
2. "PCI Design Hand Book", 6th Edition, Precast / Prestressed Concrete Institute, ACI, Chicago, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the principles, manufacture and erection of prefabricated components	Understanding (K2)
CO2	illustrate the production, erection and loading process	Understanding (K2)
CO3	summarize the behaviour of the components of prefabricated structures and different joints	Understanding (K2)
CO4	apply the design procedure to prefabricated beams	Applying (K3)
CO5	apply the design procedure to the prefabricated slab and column	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	2	1				2							3	2
CO3	2	1				2							3	2
CO4	3	2	1			3						1	3	3
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50					100
CAT2	30	70					100
CAT3	30	30	40				100
ESE	25	40	35				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE26 CONSTRUCTION EQUIPMENT AND MANAGEMENT

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Construction Engineering and Management	VII	PE	3	0	0	3

Preamble	This course imparts knowledge in selection strategies of various equipment based on the requirement of the project at optimum cost and time.	
Unit - I	**Earthwork Equipment:**	**9**
Tractors - Motor Graders - Scrapers - Front end Loaders - Earth Movers -Equipment for Dredging and Trenching- Tunnelling methods and equipment's- Compaction Equipment - Diaphragm wall equipment- Pile Driving Equipment - Drilling and Blasting- Safety measures		
Unit - II	**Equipment's for Screening and Transporting:**	**9**
Forklifts and related equipment - Portable Material Bins - Tower crane - Conveyors - Aggregate Crushers - Feeders - Screening Equipment - General Crane - Gantry girder.		
Unit - III	**Concreting Equipment:**	**9**
Batching and Mixing Equipment - Hauling equipment - RMC- Modern Formwork Techniques- MIVAN Construction - Shuttering - Types of pumps used for Construction - Boom placer- Equipment for Grouting and Dewatering - 3D Concrete Printing.		
Unit - IV	**Equipment Management:**	**9**
Role of heavy construction equipment – Factors in Selection of Equipment – Cost of Owning – Cost of Operating – Equipment Life Cycle – Replacement of Equipment.		
Unit - V	**Equipment Maintenance:**	**9**
Rent and Lease Considerations – Construction Equipment Maintenance – Construction Equipment Site Safety – Construction Equipment Security – insurance – Inventory procedures and practices.		

Lecture: 45

TEXT BOOK:

1.	Sharma.S. C., "Construction Equipment and its Management", 1st Edition, Khanna Publishers, India, 2016.

REFERENCES:

1.	Douglas D. Gransberg, "Construction Equipment Management for Engineers, Estimators, and Owners", 22nd Edition, CRC Press, 2020.
2.	Peurifoy R.L., "Construction Planning, Equipment and Methods", 7th Edition, McGraw Hill, Singapore, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify the best earthwork equipment for different earth conditions	Understanding(K2)
CO2	infer equipment required for screening and transporting	Understanding(K2)
CO3	choose the best and effective equipment needed for concreting and its method	Understanding(K2)
CO4	select suitable equipment needed for building construction	Applying (K3)
CO5	adopt various maintenance techniques for equipment	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1			3	2							3	2
CO2	2	1			3	2							3	3
CO3	2	1			3	2							3	3
CO4	3	2	1		3	2							3	3
CO5	3	2	1		3	2							3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50					100
CAT2	40	60					100
CAT3	25	50	25				100
ESE	25	50	25				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE27 SURFACE HYDROLOGY

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Water Resources & Irrigation Engineering	VII	PE	3	0	0	3

Preamble	This course imparts knowledge about various hydrological components and well hydraulics.	
Unit - I	**Hydrometeorology:**	**9**
Concept of hydrology-Hydrologic cycle- Components of hydrologic cycle - Annual water resources balance of India - Triple cell air circulation – Recording and non-recording rain gauges – Density and Adequacy of rain gauges – Optimum number of rain gauges.		
Unit - II	**Precipitation:**	**9**
Forms and types of Precipitation - Measurement of precipitation - Mean aerial depth of Precipitation - Competition of missing data, double mass analysis, computation of rainfall data network density, DAD curves.		
Unit - III	**Abstractions from Precipitation:**	**9**
Evaporation process - Evaporimeters – Empirical evaporation equations – Blaney Criddle equation – Modified Penman equation – Reservoir evaporation and reduction methods – Transpiration – Evapotranspiration – Measurements of evapotranspiration – equations – Potential evapotranspiration – Actual evapotranspiration – Interception – Depression storage – Infiltration – Infiltrometer - Infiltration indices - Horton's curve.		
Unit - IV	**Runoff and Hydrograph Analysis:**	**9**
Runoff volume - Flow duration curve - Flow mass curve – Droughts - Surface water resources in India – Hydrograph – Factors affecting flood hydrograph – components - Base flow separation – Effective rainfall – Unit hydrograph – Derivation, Uses, limitations, duration – Synthetic unit hydrograph.		
Unit - V	**Floods:**	**9**
Flood routing: Muskingum method of channel Routing – Reservoir routing – modified pulse method. Flood estimation and flood frequency: Rational method – Empirical formulae – Unit hydrograph method – Flood frequency studies – Gumbel's method – Log-Pearson type III distribution – Partial duration series – Regional flood frequency analysis – Design flood – storm – Risk reliability and safety factor.		

Lecture: 45Total: 45

TEXT BOOK:

1. Subramanya K., "Engineering Hydrology", 4th Edition, McGraw Hill Publishing Company, New Delhi, 2013.

REFERENCES:

1. Jaya Rami Reddy, P. "A text book of Hydrology", Laxmi publications,2009
2. VenTe Chow, David R. Maidment, Larry W.Mays., "Applied Hydrology", Revised Edition, Tata McGraw-HillPublishing Company, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	illustrate with the concept of hydrological cycle and types of rain gauges	Understanding (K2)
CO2	calculate the amount of precipitation and infiltration	Applying (K3)
CO3	calculate the evaporation losses	Applying (K3)
CO4	calculate the flood runoff and draw the hydrograph	Analyzing (K4)
CO5	determine the flood discharge using Gumbel's and Log Pearson method	Applying (K3)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30	-			100
CAT2	20	40	25	15			100
CAT3	15	30	40	15			100
ESE	25	30	30	15			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE28 INTELLIGENT TRANSPORTATION SYSTEM

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Transportation Engineering	VII	PE	3	0	0	3

Preamble	This course imparts knowledge about the importance of Intelligent Transportation System in transportation engineering.	
Unit - I	**Introduction**	**9**
Definition of ITS and Identification of ITS objectives – ITS user services - Historical background – Benefits of ITS - ITS data collection techniques – Detectors – Automatic vehicle location (AVL) – Automatic vehicle identification (AVI) – Geographic Information Systems (GIS)		
Unit - II	**Telecommunications in ITS**	**9**
Importance of telecommunications in the ITS system, Information management, Traffic management centers (TMC). Vehicle – Road side communication – Vehicle positioning System		
Unit - III	**ITS functional areas**	**9**
Advanced Traffic Management Systems (ATMS) – Advanced traveler information systems (ATIS) – Commercial vehicle operations (CVO) – Advanced vehicle control systems (AVCS) – Advanced public transportation systems (APTS) – Advanced rural transportation systems (ARTS)		
Unit - IV	**ITS user needs and services**	**9**
Travel and traffic management – Public transportation management – Electronic Payment – Commercial vehicle operations – Emergency management – Advanced vehicle safety systems – Information Management.		
Unit - V	**Automated Highway Systems**	**9**
Critical ITS Issues - Vehicles in Platoons – Integration of automated highway systems – ITS Programs – Overview of ITS implementations in developed countries – ITS in developing countries – Smart car – Smart road		

Lecture:45, Total:45

TEXT BOOK:

1. Pradip Kumar, Amit Kumar Jain, “Intelligent Transport Systems”, 1st Edition ,PHI Learning Pvt Ltd, New Delhi,2017.

REFERENCES:

1. Ignacio Julio, Enrique Onieva , “Intelligent Transport Systems”, 1st Edition, Wiley India PvtLtd,Noida, 2015.
2. Mashrur A. Chowdhury, and Adel Sadek, “Fundamentals of Intelligent Transportation Systems Planning”, 1st Edition, Artech House, Inc., 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the common techniques and benefits of ITS,AVL and GIS	Understanding (K2)
CO2	interpret the concepts of telecommunication in ITS	Applying (K3)
CO3	implement the various advanced ITS methodologies in transportation system	Applying (K3)
CO4	infer various public services and their usage	Understanding (K2)
CO5	make use of automated highway system	Applying (K3)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	**20**	**60**	20				**100**
CAT2	**20**	**50**	30				**100**
CAT3	**20**	**50**	30				**100**
ESE	**20**	**50**	30				**100**

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE29 REINFORCED SOIL STRUCTURES

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Soil Mechanics and Foundation Engineering	VII	PE	3	0	0	3

Preamble	This course imparts knowledge on geosynthetics, design principles and mechanism of reinforced soil, soil nailing and its applications in dams, embankments, pavements and foundation structures.	
Unit - I	**Principles and Mechanisms:**	**9**
Historical background – Initial and recent developments – Principles – Concepts and mechanisms of reinforced soil – Factors affecting behaviour and performance of soil – Reinforcement interactions.		
Unit - II	**Materials and Material Properties:**	**9**
Materials used in reinforced soil structures – Fill materials, reinforcing materials, metal strips, Geotextile, Geogrids, Geomembranes, Geo-composites, Geo-jutes, Geofoam, natural fibres, coir Geotextiles – Bamboo – Timber – Facing elements – Properties – Methods of testing – Advantages and disadvantages – Preservation methods.		
Unit - III	**Design Principles and Applications:**	**9**
Design aspects of reinforced soil – Soil reinforcement function – Separator, Filtration, Drainage, Barrier function – Design and applications of reinforced soil of various structures – Retaining walls – Mechanically stabilized earth walls –stability of internal and external walls - Foundations – Embankments and slopes –Seismic aspects.		
Unit - IV	**Geosynthetics and Applications:**	**9**
Introduction – Historical background – Applications – Design criteria – Geosynthetics in roads – Design – Giroud and Noiray approach – Geosynthetics in landfills – Geosynthetic clay liner – Design of landfills – Barrier walls.		
Unit - V	**Geosynthetics in environmental geotechnics:**	**9**
Application of geo synthetics in solid waste management, rigid or flexible liners, bearing capacity of compacted fills, foundation for waste fill ground		

Lecture:45, Total:45

TEXT BOOK:

1.	Sivakumar Babu G.L., Introduction to Soil Reinforcement and Geosynthetics,2nd edition, University Press,2013.

REFERENCES:

1.	Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Earthworks, London, 1982.
2.	Koerner, R.M., Designing with Geosynthetics, (Third Edition), Prentice Hall, 1997.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the soil reinforcement interaction mechanism.	Understanding (K2)
CO2	summarize properties, testing methods of geosynthetics in earth reinforcement.	Understanding (K2)
CO3	select suitable reinforcing material to suit the functional requirement	Applying (K3)
CO4	select suitable design criteria for use of geosynthetics in landfills, pavement, liners	Applying (K3)
CO5	apply geosynthetics in environmental geotechnic.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	2	1				2							3	2
CO3	3	2	1			3						1	3	3
CO4	3	2	1			3						1	3	3
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	80					100
CAT2	15	40	45				100
CAT3	10	40	50				100
ESE	10	40	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE30 SAFETY IN CONSTRUCTION PRACTICES

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	VII	PE	3	0	0	3

Preamble	This course makes the students well-versed with the latest safety and health regulations and the Indian Standards applicable to the construction industry.	
Unit - I	**Introduction to construction safety:**	**9**
History of safety in construction – Safety thinking and Practices – Terminologies used in safety-types of injuries-safety pyramid-Accident patterns-theories of accidents -Role of top management and workers in construction safety.		
Unit - II	**Planning for safety:**	**9**
Introduction to OSHA regulations – causes and effects of accidents at site - Safety personnel -safety budget - safety culture –planning for PPE - Role of stakeholders in safety- Workers' compensation Act.		
Unit - III	**Site safety programs:**	**9**
SOP (Safe Operating Procedures) – Construction equipment- materials handling-disposal - hand tools- Safety during construction -alteration - demolition works		
Unit - IV	**Hazards in construction projects:**	**9**
Job Safety Analysis (JSA)- Job hazard analysis (JHA) -– Health hazards – Fatalities and Injuries- Hazard and Prevention Act – Precautionary Measures -Hazard Management -Accident investigation- Accident indices – Violation – Penalty		
Unit - V	**Construction safety management:**	**9**
Introduction- Safety in construction operations -Project coordination and safety procedures Ergonomics – MSD (Musculoskeletal Disorders) – Causes and Remedies – preventive methods – Role of BIM in safety		

Total:45

TEXT BOOK:

1.	S.K.Bhatta charjee, "Safety Management in Construction",1st Edition, Khanna Publishers, New Delhi,2011

REFERENCES:

1.	Stefan Mordue &Roland Finch, "BIM for Construction Health and Safety" 1st Edition, NBS Publications, Philippines,2014
2	Rita Yi Man Li& Sun Wah Poon, "Construction Safety" ,1st Edition, Springer, New York,2013

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the role of safety in construction site	Understanding (K2)
CO2	Illustrate the causes and effects of construction accidents	Understanding (K2)
CO3	make use of site safety programs at construction site	Applying (K3)
CO4	identify the hazards in construction projects	Applying (K3)
CO5	apply construction safety management at site	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	2	1				2							3	2
CO3	3	2	1			3						1	3	3
CO4	3	2	1			3						1	3	3
CO5	3	2	1			3						1	3	3

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	7	60	33				100
CAT2	7	20	73				100
CAT3	10	33	57				100
ESE	7	40	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE31 DESIGN OF BRIDGES

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Structural Analysis & Design of RC elements	VIII	PE	3	0	0	3

Preamble	The course deals with the analysis and design of long and short span bridges. It also deals with the bearings and balanced cantilever bridges	
Unit - I	**Introduction:**	**9**
Introduction to bridges – Classification – Computation of discharge – Linear waterway – economic span – Afflux, scour depth – Design loads for bridges – Introduction to I.R.C. loading standards – Load Distribution Theory – Bridge slabs – Effective width – Introduction to methods as per I.R.C.		
Unit - II	**Short span bridges and culvert:**	**9**
Load distribution theory – General design principles for bridge deck – Slab culverts – T-beam and slab bridges		
Unit - III	**Long span bridges:**	**9**
General design principles for deck slab – Girder, wing wall, return wall –Detailing of slab and girder bridges - Detailing of skew slab and curved bridge		
Unit - IV	**Piers and bearings:**	**9**
Introduction to Bridge bearings - Types of bearings – Piers – Bed block – Materials for piers and abutments – Types of piers – Forces acting on piers and design of pier. Abutments –Forces acting on abutments – design of abutment – Types of wing walls and approaches.		
Unit - V	**Balanced cantilever bridges:**	**9**
General features – arrangement of supports – Design features – Shear variation – Articulation – Design procedure of double cantilever bridge.		

Lecture:45, Total:45

TEXT BOOK:

1.	Krishna Raju N., "Design of Bridges", 5thEdition, Oxford and IBH Publishing Company, New Delhi, 2019

REFERENCES:

1.	Jagadeesh T.R., “Design of Bridge Structures”, 2ndEdition, Prentice Hall of India Pvt. Ltd, New Delhi, 2010.
2.	Haifan X., “Conceptual Design of Bridges”, 1stEdition, S.K. Kataria& Sons, New Delhi, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	classify the forces acting on bridges as per IRC loading standards	Understanding (K2)
CO2	explain the design principles of short span bridges	Understanding (K2)
CO3	Explain the design principles of long span bridges	Understanding (K2)
CO4	determine the stability of the piers and abutments	Applying (K3)
CO5	explain the design principles of balanced cantilever and rigid frame bridges	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	2	1				2							3	2
CO3	2	1				2							3	2
CO4	3	2	1			3						1	3	3
CO5	2	1				2							3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50					100
CAT2	25	50	25				100
CAT3	20	50	30				100
ESE	35	40	25				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE32 DISTRESS MONITORING AND REHABILITATION OF STRUCTURES

(IS 801,807,811,875, 1024,3370,6533 (part 2) codes are permitted)

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Pre requisite	Concrete Technology	VIII	PE	3	0	0	3

Preamble	This course aims to impart knowledge in maintenance and rehabilitation of concrete structures by the application of various repair materials and suitable strengthening techniques.	
Unit - I	**Introduction**	**9**
Maintenance, rehabilitation, repair, retrofit and strengthening - need for rehabilitation of structures - Cracks in R.C. buildings - causes and effects - importance of maintenance, routine and preventive maintenance.		
Unit - II	**Repair Materials**	**9**
Criteria for material selection -Special mortars and concrete - Polymer Concrete and Mortar - Quick setting compounds - Grouting materials - Gas forming grouts - Bonding agents -Latex emulsions - Epoxy bonding agents - Protective coatings - FRP sheets.		
Unit - III	**Damage Diagnosis and Assessment**	**9**
Visual inspection – Non-Destructive Testing - Rebound hammer, Ultra sonic pulse velocity - Semi destructive testing - Probe test - Pull out test - Chloride penetration test – Carbonation - Corrosion activity measurements		
Unit - IV	**Crack Repair Techniques**	**9**
Methods of crack repair –Grouting – Routing – sealing – Stitching - Dry packing - Repair of active cracks - dormant cracks - Corrosion of embedded steel in concrete – Mechanism - Stages of corrosion - Repair techniques of corroded structural elements.		
Unit - V	**Retrofitting of Structures**	**9**
Jacketing - Column jacketing - Beam jacketing - Beam Column joint -Reinforced concrete jacketing - Steel jacketing - FRP jacketing – Strengthening - shear strengthening - Flexural strengthening		

Lecture:45; Total 45

TEXT BOOK:

1.	Concrete Structures: Protection, Repair and Rehabilitation by R. Dodge Woodson, Delhi: Elsevier India Pvt Limited, 2012

REFERENCES:

1.	Handbook on repair and rehabilitation of RCC buildings, CPWD, Government of India.
2.	Handbook on seismic retrofit of buildings, A. Chakrabartiet.al.,Narosa Publishing House, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	summarize the causes and effects of distress in concrete structures	Understanding (K2)
CO2	summarize the importance of maintenance of structures, types and properties of repair materials.	Understanding (K2)
CO3	identify the damage of corroded structures	Applying (K3)
CO4	apply various repair techniques for cracked and corroded elements	Applying (K3)
CO5	apply various methods of strengthening the structural components	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	2	1				2							3	2
CO3	3	2	1			3						1	3	3
CO4	3	2	1			3						1	3	3
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50					100
CAT2	25	25	50				100
CAT3	25	25	50				100
ESE	25	25	50				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE33 WATER POWER ENGINEERING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Environmental Engineering, Fluid Mechanics and Hydraulics.	VIII	PE	3	0	0	3

Preamble	This course helps to understand the importance and function of Hydro power plants and the components, layouts needed to generate power in a power house.	
Unit - I	**Water Power:**	**9**
Introduction - Sources of energy– Water Power - development and use - Statistics of power - estimation of hydro power potential - mini and pumped storage plant - cost and value of water power - Relation of water power and hydrology- Collection and analysis of stream flow data, mass curve and flow duration curves.		
Unit - II	**Hydro Power Plants and Machines:**	**9**
Classification of hydro power plants - General arrangements - Valley dam plants - Diversion canal plants - High head diversion plants - Storage and poundage - Unit arrangements-Impact of Jets- Turbines-Basic Principles – Classifications- Efficiency Problems - Pumps- Classifications –Centrifugal and Reciprocating pumps- Efficiency Problems.		
Unit - III	**Water Conveyance:**	**9**
Penstock - Types - Design criteria - Anchor Blocks - Valves, Bends and Manifolds- Intakes -Types - Losses - Aeration - Fore bays - Canals – Tunnels - Water Hammer - Surge tanks.		
Unit - IV	**Tidal Power:**	**9**
Tidal Phenomenon - Tidal power - Basic principle - Location - Difficulties - Components -Modes of generation - Constructional aspects - Estimate of energy and power - Regulation of power output - - Economic feasibility - Promising sites.		
Unit - V	**Power House and Equipment:**	**9**
Surface power stations - Power House structure - Dimensions - Lighting and ventilations -Design variations. Underground power stations - Location - Types - Advantages -Components - Layout types - Limitations. Environmental impact of Hydroelectric power projects -Introduction to economic analysis of Hydro power projects.		

Lecture: 45, Total: 45

TEXT BOOK:

1. Dandekar M.M. and Sharma K.N., - "Water Power Engineering", 2nd Edition,Vikas Publishing House Pvt. Ltd., New Delhi, 2009.

REFERENCES:

1. Sharma R.K. and Sharma T.K., - "A Text Book of Water Power Engineering", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2012.
2. Duggal K.N. and Soni J.P., -"Elements of Water Resources Engineering", 1st Edition, New Age International Publishers, Chennai, 2001.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the source of energy and the stream flow data	Understanding (K2)
CO2	solve the problems in the operation of pumps and turbines	Applying (K3)
CO3	calculate the losses in water conveyance in a hydro power plant	Applying (K3)
CO4	identify the economic feasibility of tidal power generation	Applying (K3)
CO5	explain the various components of hydroelectric power stations	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	3	2	1			3						1	3	3
CO3	3	2	1			3						1	3	3
CO4	3	2	1			3						1	3	3
CO5	2	1				2							3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	40	30				100
CAT2	20	40	40				100
CAT3	15	40	45				100
ESE	25	45	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE34 TRANSPORTATION ECONOMICS

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Transportation Engineering	VIII	PE	3	0	0	3

Preamble	This course helps the students to understand the concept and evaluation of economics in various transportation projects	
Unit - I	**ECONOMIC EVALUATION**	**9**
Need for economic evaluation of urban transport projects – Principles of economic analysis – Methods of economic evaluation – Comparison of various methods – Application of simulation modeling in evolving suitable evaluation techniques – Sensitivity analysis.		
Unit - II	**MODELING OF ROAD USER COSTS**	**9**
Components of vehicle operating cost – Factors affecting vehicle operating cost – Value of travel time saving – Accident cost – Concept of route switching mechanism – Ripple effects in developing new infrastructure – Simulation modeling exercise.		
Unit - III	**TRANSPORT DEMAND SUPPLY CONCEPT**	**9**
Transport demand and supply concepts - Status of transport demand supply in metropolitan cities – Demand and Supply equilibrium – Subsidy in Transport demand – Supply augmentation and saturation consideration – simulation modelling of transport demand and supply for sustainability		
Unit - IV	**TRANSPORT PRICING**	**9**
Transport costs – Elasticity of demand – Average cost and marginal cost pricing – Market pricing and market segmentation – Second best pricing – Pricing policy – Congestion pricing – Public and private transport pricing – Price Co-ordination		
Unit - V	**FINANCING TRANSPORT SYSTEM**	**9**
Characteristics of transportation infrastructure – Trends in transportation infrastructure – Investment needs, options and budgetary support in transport sector – Existing financing practices – Principles of build, operate and transfer (BOT) – BOT variants and its applicability– Special purpose vehicles – Alternative financial resources.		

Lecture:45,Total:45

TEXT BOOK:

1. Khanna, S.K., Justo C.E.G. and Veeraragavan, A. “Highway Engineering”, New Chand and Brothers, Roorkee, 10th edition, 2013

REFERENCES:

1. Kadiyali, L.R. and Lai, N.B. “Highway Engineering (Including Expressways and Airport Engineering)”, Khanna Publishers, New Delhi, 5th edition, 2013.
2. Kadiyali.L.R. “Traffic Engineering and Transport Planning”, Khanna Publishers, Delhi, 10 th Edition,2016

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify the concepts of economic evaluation of urban transport projects	Applying (K3)
CO2	make use of vehicle operating cost for modelling	Applying (K3)
CO3	develop demand supply concept in metropolitan cities	Applying (K3)
CO4	explain the concepts of road pricing in public and private transportation	Understanding (K2)
CO5	illustrate various budgetary support in transportation projects	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1			3						1	3	3
CO2	3	2	1			3						1	3	3
CO3	3	2	1			3						1	3	3
CO4	2	1				2							3	2
CO5	2	1				2							3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	20	80					100
ESE	20	50	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE35 GEOTECHNICAL EARTHQUAKE ENGINEERING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	Soil Mechanics and Foundation Engineering	VIII	PE	3	0	0	3

Preamble	This course imparts knowledge on earthquake mechanism, earthquake Hazards and mitigation, ground motion, liquefaction and earthquake resistant design in the field of geotechnical engineering.	
Unit - I	**Seismology and Earthquakes:**	**9**
Seismic waves and their properties- interior of earth- Theory of plate tectonics - Plate boundaries - Faults and their properties -Elastic Rebound Theory- Determination of epicentre - Intensity and Magnitude		
Unit - II	**Earthquake Hazards and Evaluation:**	**9**
Strong ground motion parameters – Amplitude - Frequency content - duration, Estimation of ground motion parameters - Deterministic Seismic Hazard Analysis - Probabilistic Seismic Hazard Analysis		
Unit - III	**Ground Response Analysis - Local site effects and Design ground motion:**	**9**
Kinematics of earthquake wave propagation from source to site - characteristics of ground motion – Factors influencing ground motion – Evaluation of shear wave velocity – Lab tests – Site effects - Design ground Motion - Developing design ground motion -Need for ground response analysis – Methods of ground response analysis.		
Unit - IV	**Liquefaction:**	**9**
Concepts of liquefaction - Factors affecting liquefaction potential - Cyclic shear stress - laboratory determination of liquefaction potential - cyclic resistance ratio and its determination using field and laboratory experiments - Factor of safety against liquefaction - Simplified procedure for evaluation of liquefied potential as per IS 1893 - (part 1): 2016 (SEED Method)		
Unit - V	**Seismic Analysis and Design of Various Geotechnical Structures:**	**9**
Pseudo-static method - Pseudo dynamic method - other dynamic methods - Seismic analysis of retaining wall - Seismic slope stability analysis - Behaviour of reinforced soil under seismic - conditions -Seismic design of retaining structures - seismic design of shallow foundations, seismic design of pile foundations - Codal provisions/guidelines for seismic design of geotechnical structures.		

Lecture:45, Total:45

TEXT BOOK:

1. Kramer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International series Pearson Education (Singapore) Pvt. Ltd.,1st edition, 2004.

REFERENCES:

1. Bharat Bhushan Prasad, Fundamentals of Soil Dynamics and Earthquake Engineering,1st edition, PHI Learning Pvt.Ltd.,New Delhi, 2009.
2. Bharat Bhushan Prasad, Advanced Soil Dynamics and Earthquake Engineering, 1st edition, PHI Learning Pvt.Ltd.,New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	infer the intensity of earthquake and strong ground motion parameters from a recorded seismogram	Understanding (K2)
CO2	identify seismic hazard considering the different soil properties and site conditions	Applying (K3)
CO3	utilize the principles of wave propagation through soil media to derive ground response analysis	Applying (K3)
CO4	determine factor of safety against liquefaction.	Applying (K3)
CO5	plan earthquake resistant geotechnical structures	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	3	2	1			3						1	3	3
CO3	3	2	1			3						1	3	3
CO4	3	2	1			3						1	3	3
CO5	3	2	1			3						1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	20	40	30			100
CAT2	10	20	30	40			100
CAT3	10	20	30	40			100
ESE	10	10	40	40			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEE36 DISASTER PREPAREDNESS AND PLANNING

Programme & Branch	B.E. & CIVIL ENGINEERING	Sem.	Category	L	T	P	Credit
Prerequisite	NIL	VIII	PE	3	0	0	3

Preamble	This course imparts knowledge about various natural hazards like Earthquakes, slope stability, floods, droughts and Tsunami and the mitigation measures	
Unit - I	**Introduction to Disasters:**	**9**
Definition - Disaster, Hazard, Vulnerability, Resilience, Risks - Disasters: Types of disasters - Earthquake, Landslide, Flood, Drought, Fire, Forest Fire, Industrial and Technological Disasters, Climate Change- Classification, Causes, Impacts - Do's and Don'ts during disaster - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change		
Unit - II	**Earthquakes and Tsunami:**	**9**
Earthquakes - causes of earthquakes – effects - plate tectonics - seismic waves - measures of size of earthquakes - earthquake resistant design concepts. Tsunami – causes – effects – undersea earthquakes – landslides – volcanic eruptions – impact of sea meteorite – remedial measures – precautions – case studies.		
Unit - III	**Floods and Droughts**:	**9**
Climatic Hazards – Floods - causes of flooding - regional flood frequency analysis – flood control measures - flood routing - flood forecasting - warning systems. Droughts – causes - types of droughts - effects of drought – mitigation - case studies.		
Unit - IV	**Landslides and Slope stability: Management**	**9**
Landslides - Causes - principles of stability analysis – remedial and corrective measures for slope stabilization – mitigation – cause studies.		
Unit - V	**Disaster Preparedness and Management:**	**9**
Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness. NDLA, National Disaster Management.		

Lecture: 45, Total: 45

TEXT BOOK:

1.	R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies, 1st Edition,New Royal book Company**,**2007.

REFERENCES:

1.	Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi.
2.	J Michael Duncan and Stephan G Wright, Soil Strength and Slope Stability,2nd edition, John Wiley & Sons, Inc, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain different forms of disaster and their causes	Understanding (K2)
CO2	identify the causes, effects and precautionary measures of earthquakes and tsunami	Applying (K3)
CO3	identify the causes and control measures of flood and droughts	Applying (K3)
CO4	choose suitable remedial measures for slope stabilization	Applying (K3)
CO5	develop a disaster management cycle with disaster risk reduction measures	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				2							3	2
CO2	3	2	1			3	1					1	3	3
CO3	3	2	1			3	1					1	3	3
CO4	3	2	1			3	1					1	3	3
CO5	3	2	1			3	1					1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	50	40				100
CAT2	10	40	50				100
CAT3	10	30	30	30			100
ESE	10	20	40	30			100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

OPEN ELECTIVES

20CEO01 - REMOTE SENSING AND ITS APPLICATIONS

Programme & Branch	CIVIL	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	V	OE	3	0	2	4

Preamble	This course gives the knowledge on the remote sensing and its working principles. It also describes the Image processing techniques using GIS for real time applications which motivates towards innovations in the relevant fields.	
Unit - I	**Principles of Remote Sensing:**	**9**
Definition - Components of Remote sensing - EMR Spectrum - EMR interactions with atmosphere - EMR interactions with Earth - Spectral signature curves of Earth surface features – Concept of Photogrammetry- IFOV – Stereoscope and Its applications.		
Unit - II	**Orbits and Platforms:**	**9**
Motions of planets and satellites – Newton's law of gravitation - Gravitational field and potential - Escape velocity - Kepler's law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites .		
Unit - III	**Sensing Techniques:**	**9**
Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV –Orbital and sensor characteristics of live Indian earth observation satellites.		
Unit - IV	**Data products and interpretation:**	**9**
Photographic and digital products – Types, levels and open source satellite data products –- selection and procurement of data– Visual interpretation: basic elements and interpretation keys – Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification.		
Unit - V	**Remote Sensing for Urban Planning:**	**9**
Urban Area Definition and Characterization–Base Map Preparation – Urban Land use Classification –Visual and Digital Techniques for Land use Mapping - Urban Structure and Patterns– Urban Land Cover Classification – Feature Extraction techniques –Change Detection – Sprawl Detection and Characterization - Mapping of Urban Morphology –Building Typology		

List of Exercises / Experiments :

1.	Study of Toposheet ,Aerial Photographs and Satellite Images.
2.	Data Input – Onscreen Digitisation – Creation of Point, Line and Polygon layers.
3.	Geo-referencing the base image.
4.	Preparation of Base Map from Survey of India Toposheets.
5.	Extracting area of Interest (AOI).
6.	Preparation of Land use map using Satellite Data.
7.	Preparation of Land cover map using Satellite Data.
8.	Testing stereovision with test card and Stereoscopic acquity.
9.	Mirror stereoscope- base lining and orientation of aerial photographs.
10.	Use of parallax bar to find the height of point.

Lecture:45, Practical:15, Total:60

TEXT BOOK:

1.	Thomas Lillesand, Ralph W. Kiefer, Jonathan ChipmanThomas Lillesand, Ralph W. Kiefer & Jonathan Chipman, "Remote Sensing and Image Interpretation", 7th Edition, Willey Publications, United States, 2015.

REFERENCES:

1.	George Joseph , Jeganathan C, "Fundamentals of Remote Sensing", 3rd Edition, Universities Press (India) Private limited, Hyderabad, 2018.

2.	Basudeb Bhatta, "Remote Sensing and GIS", 2nd Edition, Oxford University Press, Oxford, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	make use the principles of EM spectrum to categories the earth features in an image and the sensor properties for various applications of remote sensing	Understanding (K2)
CO2	acquire knowledge about satellite orbits and different types of satellites	Understanding (K2)
CO3	understand the different types of remote sensors	Understanding (K2)
CO4	gain knowledge about the concepts of interpretation of satellite imagery	Applying (K3)
CO5	apply Remote Sensing for Mapping of Urban Elements and Processes	Applying (K3)
CO6	imparts the knowledge in preparation of base map and thematic maps	Applying (K3), Precision (S3)
CO7	input the data in the computer and prepare the Map Layout Design process	Applying (K3), Precision (S3)
CO8	apply the working of Stereoscope in aerial photographs	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1											3	3
CO2	2	3	1										3	3
CO3		3	1										3	3
CO4	2	3	1										3	3
CO5	1	1	3										3	3
CO6	3	3	3	3	3								3	3
CO7	3	3	3	3	3								3	3
CO8	3	3	3	3	3								3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70					100
CAT2	30	40	30				100
CAT3	10	40	50				100
ESE	30	40	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEO02 - DISASTER MANAGEMENT

Programme & Branch	CIVIL	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	1	0	4

Preamble	To get idea about the various natural hazards like Earthquakes, slope stability, floods, droughts and Tsunami and the mitigation measures.	
Unit - I	**Introduction to Disasters:**	**9+3**
Definition - Disaster, Hazard, Vulnerability, Resilience, Risks - Disasters: Types of disasters - Earthquake, Landslide, Flood, Drought, Fire, Forest Fire, Industrial and Technological Disasters, Climate Change- Classification, Causes, Impacts – Do's and Don'ts during disaster - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change.		
Unit - II	**Pre and Post Disaster Risk Reduction Strategies:**	**9+3**
Disaster cycle - Phases of Disaster - Disaster Mapping - Predictability, forecasting and Warning - Disaster Preparedness Plan - Land- use Zoning for Disaster Management - Preparing Community through IEC - Disaster Mitigation - Disaster Relief: Search, Rescue and Evacuation - Shelter for Victims - Livestock and Relief Measures - Clearance of Debris and Disposal of the Dead - Control of Situation - Damage Assessment -Rehabilitation: Social and economic Aspects - Reconstruction and Rehabilitation as means of Development.		
Unit - III	**Inter-Relationship between Disasters and Development:**	**9+3**
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Landuse etc. - Climate Change Adaptation - IPCC Scenario and Scenarios in the context of India.		
Unit - IV	**Disaster Management in India:**	**9+3**
Disaster Management Act 2005 - Hazard and Vulnerability profile of India, Roles and responsibilities of community, Panchayat Raj Institutions/Urban Local Bodies (PRIs/ULBs), NGO's States, Centre - Disasters of India and Lesson learnt from it.		
Unit - V	**Applications of Science and Technology for Disaster Management:**	**9+3**
Geo-informatics in Disaster Management (RS, GIS & GPS)- Early Warning and Its Dissemination-Land Use Planning and Development Regulations-Disaster Safe Designs and Constructions-Structural and Non Structural Mitigation of Disasters - Institutions for Disaster Management in India.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Singhal J.P., "Disaster Management", 1st Edition, Laxmi Publications, India, 2007.

REFERENCES:

1. Gupta.M.C., "Manual on natural disaster management in India", NIDM, New Delhi, 2000.
2. "National Disaster Management Policy", Government of India, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	diagnose the different forms of disaster and their causes.	Understanding (K2)
CO2	construct a disaster management cycle with disaster risk reduction measures	Applying (K3)
CO3	interpret the various effects of development projects	Applying (K3)
CO4	identify the agencies involved to manage the disaster in india	Understanding (K2)
CO5	summarize the role of technology in disaster	Understanding (K2)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1				3	1					1	3	2
CO2	3	2	1			3	1					1	3	3
CO3	2	1				3	1					1	3	2
CO4	2	1				3	1					1	3	2
CO5	3	2	1			3	1					1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	50	30				100
CAT2	10	30	60				100
CAT3	30	70					100
ESE	20	50	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEO03 - INTRODUCTION TO SMART CITIES

Programme & Branch	CIVIL	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	VII	OE	3	0	0	3

Preamble	To understand and explain national smart city mission of India, components, policies, challenges and future of smart city in India.	
Unit - I	**Introduction:**	**9**
Definitions – Evolution – Features and strategies – Challenges – India 100 smart cities policy and mission, smart city planning and development, financing smart cities development. Governance of smart cities – case studies in India.		
Unit - II	**Smart Urban Mobility and Smart Energy:**	**9**
Need for urban mobility – multiple perspectives – objectives – components – emerging concepts and strategies – ICT supported smart mobility systems – policy priorities. Introduction to smart energy – urban density and energy use – objectives – elements of smart energy management system – strategies – smart grid – challenges.		
Unit - III	**Water and Waste Management:**	**9**
Smart water management – definitions – water resource and cycle – functions and objectives – steps in implementation – benefits – policy challenges. Smart waste management – approaches and implementation – existing systems – strategies – challenges and polices.		
Unit - IV	**Smart Environment and Smart Buildings:**	**9**
Global background of environmental concerns – concept of environmental resources - basic environmental challenges – smart environment – stakeholders – ICT framework for environmental management. Intelligent buildings – objectives – components – systems of smart building – benefits, challenges.		
Unit - V	**E- Governance and ICT:**	**9**
Governance challenges in new era – history of smart governance – functions and objectives – ICT in governance – system infrastructure – benefits, challenges and future vision. Taxonomy of layers of ICT architecture – major technology areas – components – emerging technologies in ICT – challenges and concerns in ICT.		

Lecture:45; Total:45

TEXT BOOK:

1. Anilkumar P.P, "Introduction to Smart Cities", 1st Edition, Pearson India Education Service Pvt Ltd, Noida,Uttar Pradesh, India, 2019.

REFERENCES:

1. Germaine R. Halegoua, "Smart Cities", 1st Edition, The MIT Press Essential Knowledge Series, London, England, 2020.
2. Andy Pike, Andres Rodriguez-Pose & John Tomaney, "Handbook of Local and Regional Development", 3rd Edition, Taylor & Francis, United Kingdom, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	discuss the importance, features and case histories of smart cities in India	Understanding (K2)
CO2	describe mobility and energy in smart city	Understanding (K2)
CO3	explain water and waste management techniques in smart city	Understanding (K2)
CO4	model smart environment and smart buildings	Applying (K3)
CO5	plan e-governance and ICT in smart city	Applying (K3)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	70					100
CAT2	30	70					100
CAT3	10	30	60				100
ESE	20	50	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEO04 - ENVIRONMENTAL HEALTH AND SAFETY

Programme & Branch	CIVIL	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	VII	OE	3	0	0	3

Preamble	To enhance the knowledge in regulation and statutory requirements relevant to Environmental, Health and Safety.	
Unit - I	**Occupation, Safety and Management:**	**9**
Occupational Safety - Health and Environmental Safety Management - Principles & practices - Role of Management in Industrial Safety - Organization Behaviour - Human factors contributing to accident.		
Unit - II	**Monitoring for Safety, Health & Environment:**	**9**
Bureau of Indian Standards on Safety and Health: 14489 - 1998 and 15001 - 2000 - ILO and EPA Standards - Principles of Accident Prevention - Definitions - Incident - accident - injury - dangerous - occurrences - unsafe acts - unsafe conditions - hazards - error - oversight - mistakes.		
Unit - III	**Education, Training and Employee Participation in Safety:**	**9**
Element of training cycle - Techniques of training, design and development of training programs - Training methods and strategies types of training - Competence Building Techniques (CBT) - Employee Participation: Purpose - methods - Role of trade union in SHE.		
Unit - IV	**Management Information System:**	**9**
Sources of information on Safety, Health and Environment - Compilation and collation of information - Analysis & use of modern methods of programming - storing and retrieval of MIS for Safety, Health and Environment - QCC HS Computer Software Application and Limitations.		
Unit - V	**Legislation on Safety, Health & Environment:**	**9**
Overview of SHE - The factories act, 1948 (Amended) and Rules - Contract Labour Act - Social Accountability - SA 8000 - Water (Prevention & Control of Pollution) Act 1974 and Rules - Air (Prevention & Control of Pollution) Act 1981 and Rules - Environment Protection Act.		

Lecture:45; Total:45

TEXT BOOK:

1. Narayanan K.T., "Safety, Health and Environment Handbook", 1st Edition, McGraw Hill, New Delhi, 2017.

REFERENCES:

1. Nicholas P.Cheremisinoff & Madelyn L.Graffia, "Environmental and Health & Safety Management- A Guide to Compliance", 1st Edition, William Andrew Publisher, Norwich, 1995.
2. David Yates W., "Safety Professional's Reference & Study Guide", 2nd Edition, CRC Press Publishers, New Delhi, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the concept of EHS and their framework.	Applying (K3)
CO2	identify the monitoring principles in workplace systems.	Applying (K3)
CO3	choose the need of training and methods of EHS.	Applying (K3)
CO4	organize the safety auditing management systems and their prevention techniques.	Applying (K3)
CO5	identify the key steps involved in HSE legislations.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	2	3									3	2
CO2	3	2	3	2									3	3
CO3	3	2	3	2									3	3
CO4	3	2	2	3									3	3
CO5	3	2	2	3									3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	50	30				100
CAT2	15	40	45				100
CAT3	25	40	35				100
ESE	20	45	35				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEO05 - INFRASTRUCTURE PLANNING AND MANAGEMENT

Programme & Branch	CIVIL	Sem.	Category	L	T	P	Credit
Prerequisites	NA	VIII	OE	3	0	0	3

Preamble	To understand and explain the basic concepts of infrastructure and the challenges to successful infrastructure planning and implementation.	
Unit - I	**Basic Concepts Related to Infrastructure:**	**9**
Introduction to infrastructure, Governing Features, Historical overview of Infrastructure development in India, Infrastructure Organizations & Systems		
Unit - II	**Infrastructure Planning:**	**9**
Typical infrastructure planning steps, Planning and appraisal of major infrastructure projects, Screening of project ideas, Life cycle analysis, Multi-criteria analysis for comparison of infrastructure alternatives, Procurement strategies, Scheduling and management of planning activities, Infrastructure Project Budgeting and Funding, Regulatory Framework, Sources of Funding		
Unit - III	**Private Involvement in Infrastructure:**	**9**
Overview of Infrastructure Privatization - Benefits of Infrastructure Privatization - Problems and Challenges in Infrastructure Privatization		
Unit - IV	**Challenges to Successful Infrastructure Planning and Implementation:**	**9**
Mapping and Facing the Landscape of Risks in Infrastructure Projects, Economic and Demand Risks - Political Risks - Socio-Environmental Risks - Cultural Risks in International Infrastructure Projects - Legal and Contractual Issues in Infrastructure - Challenges in Construction and Maintenance of Infrastructure.		
Unit - V	**Strategies For Successful Infrastructure Project Implementation:**	**9**
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.		

Total:45

TEXT BOOK:

1. Neil S Grigg, "Infrastructure Engineering and Management", 1st Edition, John Wiley & Sons, 1988.

REFERENCES:

1. Ronald Hudson W., Ralph Haas & Waheed Uddin, "Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation", 1st Edition, McGraw-Hill, New Delhi, 1997.
2. World Development Report: Infrastructure for Development, 1994.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the basic concepts related to Infrastructure	Understanding (K2)
CO2	demonstrate the various analysis techniques in infrastructure planning	Applying (K3)
CO3	explain the role of private sector in infrastructure growth	Understanding (K2)
CO4	explain the challenges in infrastructure planning and management	Understanding (K2)
CO5	carry out strategic planning for successful Infrastructure Project implementation.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1										2	1
CO2	3	2	1										2	1
CO3	3	2	1										2	1
CO4	3	2	1										2	1
CO5	3	2	1										2	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	40	30				100
CAT2	30	40	30				100
CAT3	30	40	30				100
ESE	30	40	30				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CEO06 - ENVIRONMENTAL LAWS AND POLICY

Programme & Branch	CIVIL	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	VIII	OE	3	0	0	3

Preamble	To enhance the basic concepts of environmental regulations to ensure environmental safety along with the amendments.	
Unit - I	**Overview of Environment & Law:**	**9**
Origin of Environmental Law - Indian Constitution and Environmental Protection - Multilateral Environmental agreements and Protocols - Montreal Protocol, Kyoto agreement, Rio declaration - Environmental Protection Acts.		
Unit - II	**Environment Protection Mechanisms:**	**9**
Introduction to Public Interest Litigation - Forest Cases & Responses (Case Laws) - Right to Information Act - Introduction to Environment Tribunals -The National Green Tribunal Act, 2010.		
Unit - III	**National Environmental Laws:**	**9**
Environmental Law and the Indian Constitution - The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 and Forest Conservation Act, 1980 - Panchayats Extension to Scheduled Areas (PESA) Act 1996 - Wildlife Protection Act, 1972 - Land Acquisition Act, 1894 - Tenure & Property Rights and Community Rights.		
Unit - IV	**Environment (Protection) Act 1986:**	**9**
Provisions of Act - Delegation of powers - Role of state and central government - Siting of industries - Coastal zone regulations - Responsibilities of local bodies - Legislation's on Solid waste Management (MSW, Biomedical, Plastic, E-waste & Hazardous waste).		
Unit - V	**Role of Regulatory Boards:**	**9**
Sustainable Development - Roles and functions of Regulatory bodies and Local bodies - Significance - Organisational setup - TNPCB - CPCB -TWAD Board - CMWSSB - Case Studies.		

Total:45

TEXT BOOK:

1. Aruna Venkat, "Environmental Law and Policy", 1st Edition, PHI learning private limited, New Delhi, 2011.

REFERENCES:

1. CPCB, "Pollution Control Acts, Rules and Notifications issued there under Pollution Control Series - PCL/2/1992", 1st Edition, Central Pollution Control Board, New Delhi, 1997.
2. Shyam Divan & Armin Roseneranz, "Environmental law and policy in India", 1st Edition, Oxford University Press, New Delhi, 2001.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the origin and behaviour of environmental protection acts.	Understanding (K2)
CO2	illustrate the environmental protection mechanisms based on environmental indicators.	Understanding (K2)
CO3	describe the national environmental policies for enhanced ecology.	Understanding (K2)
CO4	classify the significance of federal and state environmental protection acts.	Understanding (K2)
CO5	recommend the code of ethics given by pollution regulatory boards to safeguard the environment.	Applying (K3)

Mapping of COs with POs and PSOs														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2										2	2
CO2	3	2	2	2									2	2
CO3	3	2	2	2									2	2
CO4	3	2	2	2									2	2
CO5	3	3	3	2									3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20				100
CAT2	40	45	15				100
CAT3	35	40	25				100
ESE	35	40	25				100

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

Annexure – III

List of One credit courses, on-line courses and syllabi, Transfer of credits from UGC and AICTE approved institutions and Credit transfer from foreign universities under R2018 & R2020 (from the year 2021-22 onwards)

The following one / two credit courses, on-line courses may be offered to the UG – Civil Engineering students

One/Two Credit Courses

S.N0	Course Name	Credits
1	Drone Surveying	01
2	Structural stability analysis of buildings	01

On-line courses

S. No.	Course Code	Course Name	credits
1.	noc21-ar12	Introduction to Urban Planning	2
2.	noc21-ar13	Urban utilities Planning: Water Supply, Sanitation and Drainage	3
3.	noc21-ar14	Urban Land use and Transportation Planning	3
4.	noc21-ar15	Principles and Applications of Building Science	1
5.	noc21-ce45	Theory of Elasticity	3
6.	noc21-ce47	Sustainable Engineering Concepts and Life Cycle Analysis	2
7.	noc21-ce48	Water Economics and Governance	3
8.	noc21-ce50	Project Planning & Control	2
9.	noc21-ce51	Glass Processing Technology	3
10.	noc21-ce52	Glass in buildings: Design and applications	3
11.	noc21-ce60	Optimization methods for Civil engineering	3
12.	noc21-ce64	Dynamics of Structures	3
13.	noc21-ce67	Photogeology in Terrain Evaluation (Part 1 and 2)	2
14.	noc21-ce70	River Engineering	2

noc21-ar12 Introduction to Urban Planning

Course layout

1.Introduction: Need and Objective of Planning; Evolution of Planning; Characteristics of settlements; Types of Plans and planning process

2. Problems and Issues of Urban areas: Land Use, Communication System, Slums, Sporadic growth and Conurbation

3. Planning Framework and process for various development plan: Planning process, components and techniques; Concept of Master Plan; its elements, preparation and implementation; Perspective Plan, Perspective plan, Zonal plan; Participatory and inclusive planning

4.Planning Legislation: legislation as tools of plan implementation and development; Review of Planning legislation in India, complaint and redress mechanism

noc21-ar13 Urban utilities Planning: Water Supply, Sanitation and Drainage

Course layout
Week 1: Urban utilities planning: Introduction
Week 2: Urban Water Supply
Week 3: Collection of water
Week 4: Pumping and storage
Week 5: Water supply Distribution system and Plans
Week 6: Water Quality, testing, treatment and cost
Week 7: Sanitation and Drainage Fundamentals
Week 8: Water carriage system
Week 9: Sewer design
Week 10: Sewer appurtenances and master plans
Week 11: Sewage treatment
Week 12: Drainage and recharge

noc21-ar14 Urban Land use and Transportation Planning

Course layout
Week 1: Introduction and Overview of Land use Transportation Planning
Week 2: Land use Transportation Models and Frameworks
Week 3: Data Collection and Survey Techniques
Week 4: Microsimulation and Population Synthesis
Week 5: Urban Growth, Land suitability, Accessibility and Land price
Week 6: Residential Location Choice
Week 7: Trip Generation and Distribution
Week 8: Mode Choice
Week 9: Trip Assignment
Week 10: Transportation Demand Modelling using software (Part 1-5)
Week 11: Urban Freight
Week 12: Other Models

noc21-ar15 Principles and Applications of Building Science

Course layout
Week 1: Solar geometry, climate responsive building design, thermal comfort
Week 2: Bio climatic design, building envelop, glazing systems, energy efficiency
Week 3: Fundamentals of building acoustics, Quality indicators, Acoustic materials, Noise control
Week 4: Visual quality in built environment, Effective day lighting design, Integrated design

noc21-ce45 Theory of Elasticity

Course layout

Week 1: Mathematical Preliminaries Introduction to Tensor
Week 2: Concept of Stresses and Strains
Week 3: Material Behaviour– 1 General anisotropic material, strain energy density, constitutive relation
Week 4: Material Behaviour– 2 Material symmetry, linear elastic material, Generalized Hook's law
Week 5: Formulation of boundary value problems in elasticity Equilibrium, compatibility, formulation in Cartesian and Polar coordinates
Week 6: Solution of boundary value problems in elasticity– 1 Plane stress and plane strain problems
Week 7: Solution of boundary value problems in elasticity– 1 Problems in flexure
Week 8: Solution of boundary value problems in elasticity– 1 Problems in Torsion
Week 9: Introduction to Thermo-elasticity
Week 10: Introduction to photo-elasticity
Week 11: Introduction Nonlinear elasticity
Week 12: Introduction to photo-elasticity

noc21-ce47Sustainable Engineering Concepts and Life Cycle Analysis

Course layout

Week 1: 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)

Week 2: Risk and Life Cycle Framework for Sustainability (Introduction, Risk, Environmental Risk Assessment, Example Chemicals and Health Effects, Character of Environmental Problems)

Week 3: 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)

Week 4: 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)

Week 5: Life Cycle Inventory and Impact Assessments (Unit Processes and System Boundary Data Quality, Procedure for Life Cycle Impact Assessment, LCIA in Practice with Examples, Interpretation of LCIA Results)

Week 6: Factors for Good LCA Study (ISO Terminologies, LCA Steps Recap, Chemical Release and Fate and Transport, and Green Sustainable Materials)

Week 7: Design for Sustainability (Environmental Design for Sustainability: Economic, Environmental Indicators, Social Performance Indicators, Sustainable Engineering Design Principles and Environmental Cost Analysis)

Week 8: Case Studies (e.g., Odour Removal for Organics Treatment Plant, Comparison of Hand Drying Methods, Biofuels for Transportation, Kerosene Lamp vs. Solar Lamp, Bioplastic etc.).

noc21-ce48 Water Economics and Governance

Course layout

Week 1: Introduction: General outline; Water availability and uses: national and international scenario; Challenges in water management.

Week 2: Water Rights: Need of water rights; Water and sanitation in international law; Right to Water; Entitlements and criteria.

Week 3: Water Sustainability: Concept of sustainable water uses; The Dublin statement; Sustainable water management with economical, engineering, ecological and social viewpoints; Stakeholders' participation.

Week 4: Valuing Water: The use and non-use values of water; Valuation methods; non-revenue waters (NRW) and unaccounted for water (UFW); Metering water uses; Water management through economic instruments.

Week 5: Water Pricing - Approach and Models: Significance of water pricing; Average and marginal cost pricing; Shortrun marginal cost pricing; Water pricing models - flat rate, uniform rate, increasing block tariff and seasonal rate models.

Week 6: Conflicts in Water Pricing: Conflicts on subsidy verses sustainability, efficiency verses fairness in supply, development decisions verses capacity restrictions; Water pricing practices in India and abroad; relevant case studies.

Week 7: Economics of Water Projects: Economics of sectoral water allocation; Capital budgeting in water projects; Costs concepts of capital budgeting; Financial evaluation of water projects.

Week 8: Economic Evaluation Methods: Methods of project evaluation; Payback Period; Discounted Payback Period; Net Present Value; Internal Rate of Return; Average Rate of Return; Benefit-Cost Ratio.

Week 9: Water Governance: Elements and dimensions of water governance; Building blocks; Effective water governance schemes; Benchmarking water governance; Indicators of good governance.

Week 10: Water Governance in India: National water policies and water acts; Water regulatory authorities; Power and roles of central and state regulatory authorities; Legal and regulatory framework for hydro projects; Institutional arrangement and administrative controls of water service; Interstate water management initiatives; Stakeholders' participation; NGOs and social movements

Week 11: Water Disputes Management: Interstate and intrastate water disputes resolutions practices; Judiciary involvements; Tribunals for water disputes resolutions; Treaties and bilateral agreements; Environmental issues and disputes related to water resources projects; relevant case studies.

Week 12: Global Water Diplomacy: International freshwater agreements; Global water treaties and transboundary water agreements between the countries on international water resources; multi-national water disputes and their resolution mechanisms; relevant case studies.

noc21-ce50 Project Planning & Control

Course layout

Week 1: Introduction, Course Context, Construction Project Management

Week 2: Time Management, Work Breakdown Structure (WBS), Gantt Charts

Week 3: Duration Estimation, Network Representation & Analysis -1

Week 4: Network Representation & Analysis -2; Two-Span Bridge: Scheduling, Network Analysis and Application

Week 5: Time-Cost Trade-off (Crashing)

Week 6: Resource Scheduling

Week 7: Precedence Diagramming Method (PDM), Project Monitoring & Control

Week 8: Project Monitoring & Control (Earned Value Concepts), Uncertainty in Project Schedules (PERT), Course Summary

noc21-ce51 Glass Processing Technology

Course layout

Glass Manufacturing Process
Float Glass Manufacturing
Coating Technology
Glass as a Building Material
Glass Selection

Applications
Glass Processing
Industrial & Glass handling safety
Warehouse Management
Production Planning & Control
Pre-Processing – Cutting/ Grinding/ Drilling/ Washing
Tempering
Insulated Glass Unit
Lamination
Heat Soak
Ceramic fritting- Roller/Screen/Digital
Processing Standards
Quality Test
Non-Conformity
Root Cause Analysis for Troubles
Testing & Certification
Post Manufacturing Expenses
5S – Housekeeping Practices
Quality Management Systems (QMS)
Cost Saving Programs
Glazing Systems, Hardware & Fabrications
Sustainability (Eco-packaging & Naked Dispatch)
People Development

noc21-ce52 Glass in buildings: Design and applications

Course layout

Modern Architectural Requirements
Requirements as per Standards – NBC – Fire & Structural
How to design a Sustainable Building
Building Physics
Green Buildings Requirements
Codal Recommendations – ECBC/IS
Segment Based Design
Manufacturing of glass
Types of Glass
Coating Technology – High Performance Glass
Innovative Applications – Electrochromic & Digital Printing
Processing
Tempering/ Double glazing/ Lamination
Printing on Glass
Glass as Building Envelope Material
Glass Parameters
Façade Fundamentals
Façade Design & Testing
How to Design Façade for Daylighting & Energy efficiency – Modeling
Design Tools & Simulation Software's used for Design
How to understand high performance glass
Glass for Acoustics, Fire & Interior applications
Glass for Safety & Security
Case Studies
On Design & Detailing
Application Impact
Building Measurements & its Impact

noc21-ce60 Optimization methods for Civil Engineering

Course layout
Week-1: Introduction to optimization
Week-2: Linear Programming Problem
Week-3: Classical Optimization methods
Week-4: Classical Optimization methods
Week-5: Classical Optimization methods
Week-6: Classical Optimization methods
Week-7: Metaheuristic optimization methods
Week-8: Metaheuristic optimization methods
Week-9: Metaheuristic optimization methods
Week-10: Engineering application using Matlab and Excel solver
Week-11: Engineering application using Matlab and Excel solver
Week-12: Civil Engineering Application

noc21-ce67 Photogeology in Terrain Evaluation (Part 1 and 2

Course layout

Week 1: Introduction to Photogeology and its Applications, Aerial Photography/ Satellite Imaging and their Applications, Aerial/ Satellite Photographs and Exercise on handling photographs, Principles of Stereoscopy and Exercise on creating 3D image using Stereoscope

Week 2: Photogrammetry, Exercise on Elements of Photo Interpretation and Line of Flight, Photogrammetry, Exercise on Photographic Measurements and Photo Scale, Role of Vertical Exaggeration in, Photogrammetry, Related Lab Exercise, Role of Relief Displacement in Photogrammetry - Related Lab Exercise, Concept of Stereoscopic Parallax - Related Lab Exercise

Week 3: Introduction to Lithology Sedimentary Rocks, Introduction to Lithology Metamorphic Rocks, Introduction to Lithology Igneous Rocks, Related Exercise, Introduction to Physical and Structural geology, Introduction to Physical and Structural geology

Week 4: Introduction to Physical and Structural geology Related Exercise on Identification of structures, Fluvial Geomorphology Exercise on Landform Mapping, Fluvial Geomorphology Exercise on Terrace Mapping, Morphometric Analysis Exercise on performing Morphometric Analysis, Generation of Anaglyph using Stereo-pair in ENVI software Lab Exercise

Week 5: Introduction to Physical and Structural, geology, Introduction to Physical and Structural geology - Related Exercise on Identification of structures, Introduction to Lithology, Sedimentary Rocks

Week 6: Introduction to Lithology, Sedimentary Rocks, Metamorphic, Rocks, Igneous Rocks

Week 7: Fluvial Geomorphology Exercise on, Landform Mapping, Coastal and Aeolian Landforms, Active Tectonics and Geomorphology

Week 8: Active Tectonics and Geomorphology, Morphometric Analysis. Exercise on performing Morphometric Analysis, Photogeology in Lithological Mapping

noc21-ce70 River Engineering

Course layout

Week 1: PHYSICAL PROPERTIES AND EQUATIONS
Dimensions and units
Properties of water and sediment
River flow kinematics
Conservation of mass
Equations of motion
Hydraulic and energy grade lines

Week 2: STEADY FLOW IN RIVERS
Steady River flow
Steady-nonuniform River flow
Sediment transport in rivers

Week 3: UNSTEADY FLOW IN RIVERS
River continuity equation
River momentum equations
River flood waves
Loop-rating curves
River flood routing
River flow and sediment-duration curves

Week 4: RIVER EQUILIBRIUM
Particle stability
Channel stability
Regime relationships
Equilibrium in river bends
Downsteam hydraulic geometry
Bars in alluvial rivers
River meandering
Lateral River migration

Week 5: RIVER DYNAMICS
River dynamics
Riverbed degradation
Riverbed aggradation
River confluences and branches
River databases

Week 6: RIVER STABILIZATION AND RIVER TRAINING WORK
Riverbank stability
Riverbank riprap revetment
Riverbank protection
River flow-control structures
River training along braided rivers.

Week 7: RIVER ENGINEERING
River flood control
River closure
Canal headworks
Bridge scour
Navigation waterways

Week 8: RIVER MODELLING
Rigid-bed model
Mobile-bed River models
Finite-difference approximations
One-dimensional River models
Multidimensional River models

Annexure – IV

Syllabi for PhD courses under R2020 from the academic year 2021-22 onwards

NIL

Annexure – V

Online examination system to be followed for the April/May 2021 End Semester Examinations as given below:

Question Paper Pattern:

- Each Question paper will contain 75 Multiple Choice Questions (MCQ) with 15 questions from each unit.
- All the questions should be answered.
- Time duration: 90minutes.
- There is no negative marking

Examination Procedure:

- Students are allowed to answer the questions, one after another in ascending order only.
- Students are not allowed to answer previous questions.
- Without answering the current question, students are not allowed to move on to the next / subsequent questions.
- Once a question is answered and submitted, then the answer cannot be altered.