

**VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING
COLLEGE SCHEME OF INSTRUCTION FOR FOUR YEAR UG
PROGRAMME [VR20] GROUP A (CSE, ECE, EIE, IT)**

SEMESTER I

CONTACT HOURS:26

S. No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	20BS1101	Basic Science	Matrices and Differential Calculus	3	0	0	3
2.	20BS1102A 20BS1102B	Basic Science	Engineering Physics (ECE/EIE) Applied Physics (CSE/IT)	3	0	0	3
3.	20ES1103	Engineering Science	Programming for Problem Solving	3	0	0	3
4.	20ES1104	Engineering Science	Basics of Electrical Engineering	3	0	0	3
5.	20HS1105	Humanities and Social Science	Technical English and Communication Skills	2	0	0	2
6.	20BS1151A	Basic Science	Engineering Physics Laboratory	0	0	3	1.5
7.	20ES1152	Engineering Science	Programming for Problem Solving Laboratory	0	0	3	1.5
8.	20HS1153	Humanities and Social Science	Technical English and Communication Skills Laboratory	0	0	3	1.5
9.	20ES1154	Engineering Science	Computing and Peripherals Laboratory	0	0	2	1
10.	20MC1106	Mandatory Course	Technology and Society	1	0	0	-
Total				15	0	11	19.5
11.	20MC1107	Mandatory Course	Induction Program				-

Category	Credits
Basic Science Courses	3 +3 +1.5 =7.5
Engineering Science Courses	3 +3 +1.5 +1 =8.5
Humanities and Social Science Courses	2 +1.5 =3.5
Mandatory Courses	0
TOTAL CREDITS	19.5

SEMESTER II

CONTACT HOURS: 27

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	20BS2101	Basic Science	Laplace Transforms and Integral Calculus	3	0	0	3
2.	20BS2102	Basic Science	Engineering Chemistry	3	0	0	3
3.	20ES2103A 20ES2103B	Engineering Science	Object Oriented Programming using Python (CSE/ECE/IT) Python Programming (EIE)	3	0	0	3
4.	20ES2104A 20ES2104B 20ES2104C	Engineering Science	Basic Electronics Engineering (CSE/IT) Circuit Analysis(ECE) Network Theory(EIE)	3	0	0	3
5.	20ES2105	Engineering Science	Engineering Graphics	1	0	4	3
6.	20BS2151B	Basic Science	Engineering Chemistry Laboratory	0	0	3	1.5
7.	20ES2152A 20ES2152B	Engineering Science	Object Oriented Programming using Python Lab (CSE/ECE/IT) Python Programming lab(EIE)	0	0	3	1.5
8.	20ES2153	Engineering Science	Engineering Workshop	0	0	3	1.5
9.	20MC2106	Mandatory Course	Professional Ethics and Practice	1	0	0	-
Total				14	0	13	19.5

Category	Credits
Basic Science Courses	3+3+1.5=7.5
Engineering Science Courses	3+3+3+1.5+1.5=12
Humanities and Social Science Courses	0
Mandatory Courses	0
TOTAL CREDITS	19.5

**VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING
COLLEGE SCHEME OF INSTRUCTION FOR FOUR YEAR UG
PROGRAMME [VR20] GROUP B (CE, EEE, ME)**

SEMESTER I

CONTACT HOURS:27

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	20BS1101	Basic Science	Matrices and Differential Calculus	3	0	0	3
2.	20BS1102	Basic Science	Engineering Chemistry	3	0	0	3
3.	20ES1103	Engineering Science	Programming for Problem Solving	3	0	0	3
4.	20ES1104A 20ES1104B 20ES1104C	Engineering Science	Introduction to Civil Engineering (CE) Mechanics for Engineers (EEE) Engineering Mechanics– I(ME)	3	0	0	3
5.	20ES1105	Engineering Science	Engineering Graphics	1	0	4	3
6.	20BS1151B	Basic Science	Engineering Chemistry Laboratory	0	0	3	1.5
7.	20ES1152	Engineering Science	Programming for Problem Solving Laboratory	0	0	3	1.5
8.	20ES1153	Engineering Science	Engineering Workshop	0	0	3	1.5
9.	20MC1106	Mandatory Course	Technology and Society	1	0	0	-
Total				14	0	13	19.5
10.	20MC1107	Mandatory Course	Induction Program				-

Category	Credits
Basic Science Courses	3 +3 +1.5 =7.5
Engineering Science Courses	3 +3 +3 +1.5 +1.5=12
Humanities and Social Science Courses	0
Mandatory Courses	0
TOTAL CREDITS	19.5

SEMESTER II

CONTACT HOURS: 26

S. No	Course Code	CourseCategory	Course Name	L	T	P	Credits
1.	20BS2101	Basic Science	Laplace Transforms and Integral Calculus	3	0	0	3
2.	20BS2102A 20BS2102B	Basic Science	Engineering Physics (EEE) Physics for Engineers (CE/ME)	3	0	0	3
3.	20ES2103B	Engineering Science	Python Programming	3	0	0	3
4.	20ES2104D 20ES2104E 20ES2104F	Engineering Science	Engineering Mechanics (CE) Network Analysis (EEE) Engineering Mechanics –II(ME)	3	0	0	3
5.	20HS2105	Humanities and Social Science	Technical English and Communication Skills	2	0	0	2
6.	20BS2151A	Basic Science Course	Engineering Physics Laboratory	0	0	3	1.5
7.	20ES2152B	Engineering Science	Python Programming Laboratory	0	0	3	1.5
8.	20HS2153	Humanities and Social Science	Technical English and Communication Skills Laboratory	0	0	3	1.5
9	20ES2154	Engineering Science	Computing and Peripherals Laboratory	0	0	2	1
10.	20MC2106	Mandatory Course	Professional Ethics and Practice	1	0	0	-
Total				15	0	11	19.5

Category	Credits
Basic Science Courses	3 +3 +1.5 =7.5
Engineering Science Courses	3 +3 +1.5 +1 =8.5
Humanities and Social Sciences	2 +1.5 =3.5
Mandatory Courses	0
TOTAL CREDITS	19.5

SEMESTER III
CONTACT HOURS:30

S.No	Course Code	CourseCategory	Course Name	L	T	P	Credits
1.	20BS3101A	Basic Science	Mechanics of Solids	3	0	0	3
2.	20ES3102A	Engineering Science	Engineering Geology	2	0	2	3
3.	20CE3303	Program Core	Surveying and Geomatics	3	0	0	3
4.	20CE3304	Program Core	Fluid Mechanics	3	0	0	3
5.	20CE3305	Program Core	Concrete Technology	2	0	2	3
6.	20ES3151A	Engineering Science Lab	Design Thinking and Civil Engineering Workshop	0	0	3	1.5
7.	20CE3352	Program CoreLab1	SurveyingLab-1	0	0	3	1.5
8.	20CE3353	Program CoreLab2	Computer Aided Civil Engineering Drawing	0	0	3	1.5
9.	20TP3106	SoftSkills-1	Logic and Reasoning	0	0	2	1
10.	20MC3107B	Mandatory Course(AICTE suggested)	Indian Constitution(CE)	2	0	0	-
Total				15	0	15	20.5

Category	Credits
Basic Science Courses	3
Engineering Science Courses	4.5
Program Core Courses	12
Skill oriented courses	1
Mandatory Courses	0
TOTAL CREDITS	20.5

SEMESTER IV
CONTACT HOURS:31

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	20BS4101	Basic Science	Probability and Statistics for Engineers	3	0	0	3
2.	20CE4302	Program Core	Structural Analysis	3	0	0	3
3.	20CE4303	Program Core	Geotechnical Engineering	3	0	0	3
4.	20CE4304	Program Core	Hydraulics and Hydraulic Machines	3	0	0	3
5.	20HS4105	Humanities and Social Sciences	Universal Human Values	3	0	0	3
6.	20CE4351	ProgramCoreLab1	Strength of Materials Lab	0	0	3	1.5
7.	20CE4352	ProgramCoreLab2	Fluid Mechanics and Hydraulic Machinery Lab	0	0	3	1.5
8.	20CE4353	ProgramCoreLab3	Geotechnical Engineering Laboratory	0	0	3	1.5
9.	20TP4106	SoftSkills-2	English for Professionals	0	0	2	1
10	20CE4607	Skill Oriented Course - 1	Autodesk Revit and Excel for Engineers	1	0	2	2
11	20MC4108A	Mandatory Course(AICTE suggested)	Environmental Studies(CE)	2	0	0	-
Total				18	0	13	22.5
Summer Internship 6 weeks (Mandatory) during summer vacation (EPICS)							
Honors / Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)				4	0	0	4

Category	Credits
Basic Science Courses	3
Program Core Courses	13.5
Engineering Science Courses	0
Skill Oriented courses	3
Humanities and Social Science courses	3
Mandatory Courses	0
TOTAL CREDITS	22.5

SEMESTER V**CONTACT HOURS:34**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	20CE5301	Program Core	Water Resources Engineering	3	0	0	3
2	20CE5302	Program Core	Environmental Engineering	3	0	0	3
3	20CE5303	Program Core (Group B)	Design of Concrete Structures	2	0	0	2
4	20CE5404	Program Elective 1		3	0	0	3
5	20CE5205	Open Elective/Job oriented elective-1	A) Geospatial Technologies B) Building Services Engineering	2	0	2	3
6	20CE5351	Program Core Lab 1	Computer Applications in Civil Engineering Lab 1	0	0	3	1.5
7	20CE5352	Program Core Lab 2	Environmental Engineering Lab	0	0	3	1.5
8	20CE5353	Program Core (Group B)	Advanced Surveying Lab	0	0	3	1.5
9	20TP5106	Soft Skills -3	Personality Development	0	0	2	1
10	20CE5354	Internship/Project(6weeks)	EPICS/Internship	0	0	3	1.5
11	20CE5607	Skill Oriented course -2	Building Information Modeling (BIM)	1	0	2	2
12	20MC5108 B	Mandatory Course (AICTE suggested)	Innovation, IPR & Entrepreneurship (Group B)	2	0	0	-
Total				16	0	18	23
Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)				4	0	0	4
Category			Credits				
Program Core Courses (Group B)			12.5				
Humanities and Social Sciences (Group B)			0				
Program Elective Courses			3				
Open Elective Courses			3				
Skill Oriented courses			3				
Internship/Project			1.5				
Mandatory Course			0				
TOTAL CREDITS			23				

SEMESTER VI**CONTACT HOURS:28**

S. No	Course Code	Course Category	Course Name	L	T	P	Credits
1	20CE6301	Program Core	Design of Steel Structures	3	0	0	3
2	20CE6302	Program Core	Transportation Engineering	3	0	0	3
3	20HS6103	Humanities and Social Sciences	Engineering Economics and Management	2	0	0	2
4	20CE6404	Program Elective 2		3	0	0	3
5	20CE6205	Open Elective /Job oriented elective-2	A) Green Buildings and Sustainability B) Advanced Construction Materials C) Quality Control and Quality Assurance	3	0	0	3
6	20CE6351	Program Core Lab 1	Transportation Engineering Lab	0	0	3	1.5
7	20CE6352	Program Core Lab 2	Computer Applications in Civil Engineering Lab-2	0	0	3	1.5
8	20HS6153	Humanities & Social Science	English and Communication Skills Lab	0	0	2	1
9	20TP6106	Soft Skills-4	Quantitative Aptitude	0	0	2	1
10	20CE6554	Internship/ Project	Mini Project-I	0	0	2	1
11	20MC6107 B	Mandatory Course (AICTE suggested)	Biology for Engineers / Foreign Languages (German/French)/ Law for Engineers/Sanskrit Bhasa/ Yoga & Meditation/ Psychology	2	0	0	0
Total				16	0	12	20

Industrial/Research Internships six weeks (Mandatory) during summer vacation				
Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)	4	0	0	4

Category	Credits
Program Core Courses (Group B)	9
Humanities and Social Sciences (Group B)	3
Program Elective Courses	3
Open Elective Courses	3
Skill Oriented courses	1
Mandatory Course	0
Internship/Project	1
TOTAL CREDITS	20

SEMESTER VII

CONTACT HOURS: 29

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	20CE7301	Program Core	Estimation and Costing	3	0	0	3
2.	20CE7402	Program Elective 3		3	0	0	3
3.	20CE7403	Program Elective 4		3	0	0	3
4.	20CE7404	Program Elective 5		3	0	0	3
5.	20CE7205	Open Elective / Job Oriented Elective - 3		2	0	2	3
6.	20CE7206	Open Elective / Job Oriented Elective - 4		2	0	2	3
7.	20CE7607	Advanced Skill Course	Computer Aided Construction Management	1	0	2	2
8.	20CE7551	Internship / Project	Mini Project - II	0	0	3	1.5
9.	20CE7552	Internship / Project	Industrial / Research Internship	0	0	3	1.5
Total				17	0	12	23

Note: Open Elective Courses 3 and 4 are self – learning. Students may opt from any MOOCS platform. They have to submit the certificate before the last instruction day of VII Semester.

Category	Credits
Program Core	3
Program Electives	9
Open Electives	6
Skill Oriented Courses	2
Internship / Project	3
TOTAL CREDITS	23

SEMESTER VIII**CONTACT HOURS:24**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	20CE8551	Internship / Project	Major Project and Internships (6 Months)	0	0	24	12
Total				0	0	24	12

****** The student should undergo internship and simultaneously he/she should work on a project with well-defined objectives. At the end of the semester the student should submit an internship completion certificate and a project report.

CREDIT DISTRIBUTION-Year Wise**GroupA(CSE,ECE,EIE,IT)**

Year	Semester I	Semester II	Total Credits
I	19.5	19.5	39
II	20.5	22.5 [82]	43
III	20.5	22.5[125]	43
IV	23	12	35
Total			160

GroupB(CE,EEE,ME)

Year	Semester I	Semester II	Total Credits
I	19.5	19.5	39
II	20.5	22.5[82]	43
III	23	20[125]	43
IV	23	12	35
Total			160

Non-Credit Courses	
Mandatory Courses(7)	(1) Induction Program (2) Technology and Society (3) Professional Ethics and practice (4) Environmental Studies (5) Indian Constitution (6) Biology for Engineers (7) Innovation, IPR and Entrepreneurship
Mandatory Student Practice Courses (2)	(1) Co-curricular participation (2) NCC/NSS/Games and Sports/Art and Cultural / Professional Society activities /Industry training certificate.

Contact Hours:

	GROUPA		GROUPB	
	ODD Semester	EVEN Semester	ODD Semester	EVEN Semester
1stYear	26	27	27	26
2ndYear	28	31	30	31
3rdYear	33	30	34	28
4 th year	29	24	29	24

CREDITDISTRIBUTION-Category Wise

Category	Suggested AICTE	Suggested APSCHE	VR17	VR 20
Humanities and Social Sciences (HSMC),including Management	12	10.5	12	9.5
Basic Sciences (BSC) including Mathematics, Physics, Chemistry,	25	21	24	21
Engineering Sciences (ESC), including Materials, Workshop, Drawing, Basics of Electrical/ Electronics /Mechanical/Computer Engineering, Instrumentation	24	24	20	25
Professional Subjects-Core (PCC), relevant to the chosen specialization / branch	48	51	58	50
Professional Subjects–Electives (PEC), relevant to the chosen specialization / branch	18	15	17	15
Open Electives (OEC), from other technical and / or emerging subject areas	18	12	14	12
Project Work, Seminar, Internship in Industry or elsewhere (PROJ)	15	16.5	16	17.5
<u>Mandatory Courses (MC)</u>				
Induction Program, Technology and Society, Professional Ethics, Environmental Studies, Indian Constitution, Biology for Engineers, Innovation, IPR & Entrepreneurship	Non-Credit	Non-Credit	Non-Credit	Non-Credit
<u>Student Practice Courses</u>				
Skill Oriented /Soft Skill Courses(SC)	--	10	04	10
Total Credits	160	160	165	160

CREDITDISTRIBUTION-Category wise and Semester wise

	BS	ES	HS	PC	PE	OE	SC/SO	PROJ	Total
Sem-1	7.5	8.5/12	3.5/0	0	0	0	0	0	19.5
Sem-2	7.5	12/8.5	0/3.5	0	0	0	0	0	19.5
Sem-3	3	4.5	0	12	0	0	1	0	20.5
Sem-4	3	0	3	13.5	0	0	3	0	22.5
Sem-5	0	0	3/0	9/12.5	3	3	3	1.5	22.5/23
Sem-6	0	0	0/3	12.5/9	3	3	1	1	20.5/20
Sem-7	0	0	0	3	9	6	2	3	23
Sem-8	0	0	0	0	0	0	0	12	12
Total	21	25	9.5	50	15	12	10	17.5	160

LIST OF OPEN ELECTIVES:**SEMESTER– V**

20CE5205:Open Elective/Joborientedelective-1

- A) Geospatial Technologies
- B) Building Services Engineering

SEMESTER–VI

20CE6205:Open Elective/Job oriented elective-2

- A) Green Buildings and Sustainability
- B) Advanced Construction Materials
- C) Quality Control and Quality Assurance

SEMESTER–VII

20CE7205: Open Elective /Job oriented elective

– 3 20CE7206:Open

Elective/Joborientedelective–4

Note: Open Elective Courses 3 and 4 are self-learning. Students may opt from any MOOCs platform. They have to submit the certificate before the last instruction day of VII semester.

PROGRAM ELECTIVES:**SEMESTER V (P.E-I)**

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20CE5404/A	ProgramElective-1	Advanced structural analysis	3	0	0	3
2	20CE5404/B	ProgramElective-1	Town planning & Architecture	3	0	0	3
3	20CE5404/C	ProgramElective-1	Air pollution and Control	3	0	0	3
4	20CE5404/D	ProgramElective-1	Environmental Geotechnology	3	0	0	3
5	20CE5404/E	ProgramElective-1	Forensics in Civil Engineering	3	0	0	3

SEMESTERVI(P.E-II)

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20CE6404/A	ProgramElective-2	Advanced Design of concrete structures	3	0	0	3
2	20CE6404/B	ProgramElective-2	Foundation Engineering	3	0	0	3
3	20CE6404/C	ProgramElective-2	Advanced Environmental Engineering	3	0	0	3
4	20CE6404/D	ProgramElective-2	Railway and Tunnel Engineering	3	0	0	3
5	20CE6404/E	ProgramElective-2	Irrigation Structures	3	0	0	3

SEMESTER VII(P.E-III)

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20CE7402/A	Program Elective-3	Earthquake Resistant Design	3	0	0	3
2	20CE7402/B	Program Elective-3	Solid Waste Management	3	0	0	3
3	20CE7402/C	Program Elective-3	Ground Improvement Techniques	3	0	0	3
4	20CE7402/D	Program Elective-3	Pavement design and Construction	3	0	0	3
5	20CE7402/E	Program Elective-3	Open channel flow & River Engineering	3	0	0	3
6	20CE7402/F	Program Elective-3	Analysis and Design of High Rise Building	3	0	0	3

SEMESTER VII (P.E-IV)

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20CE7403/A	Program Elective-4	Prefab Structures	3	0	0	3
2	20CE7403/B	Program Elective-4	Construction Equipment and Automation	3	0	0	3
3	20CE7403/C	Program Elective-4	Groundwater Hydrology	3	0	0	3
4	20CE7403/D	Program Elective-4	Instrumentation and Sensor Technology in Civil Engineering	3	0	0	3
5	20CE7403/E	Program Elective-4	Airport and Harbour Planning	3	0	0	3
6	20CE7403/F	Program Elective-4	Design and Drafting using REVIT	3	0	0	3

SEMESTER VII– (PE-V)

S.No	Course Code	Course	Subject	L	T	P	Credits
1	20CE7404/A	Program Elective-5	Design of Prestressed Concrete	3	0	0	3
2	20CE7404/B	Program Elective-5	Repair and Rehabilitation of Structures	3	0	0	3
3	20CE7404/C	Program Elective-5	Disaster Preparedness & Planning Management	3	0	0	3
4	20CE7404/D	Program Elective-5	Urban Transport Planning	3	0	0	3
5	20CE7404/E	Program Elective-5	Rural Water Supply and Sanitation	3	0	0	3
6	20CE7404/F	Program Elective-5	Analysis and Design of Industrial Structures	3	0	0	3

S.No	Specialization	Program Electives				
		Elective1	Elective2	Elective3	Elective4	Elective5
1	Structural Engineering	Advanced Structural Analysis	Advanced Design of Concrete Structures	Earthquake Resistant Design	Prefab Structures	Design of Prestressed Concrete
2	Geotechnical Engineering	Environmental Geotechnology	Foundation Engineering	Ground Improvement Techniques		
3	Environmental Engineering	Air pollution and Control	Advanced Environmental Engineering	Solid Waste Management		Rural Water Supply and Sanitation
4	Transportation Engineering		Railway and Tunnel Engineering	Pavement Design and Construction	Airport and Harbour Planning	Urban Transport Planning
5	Hydrology & Water Resources Engineering		Irrigation Structures	Open channel flow & River Engineering	Ground water Hydrology	
6	Industry Oriented Courses			Analysis and Design of High Rise Buildings using ETABS and Foundation design using SAFE for Seismic Loads	Design and Drafting using REVIT	Analysis and Design of Industrial Structures using STAAD Pro
7	Miscellaneous	Town planning & Architecture			Construction Equipment and Automation	Repair and Rehabilitation of Structures
8		Forensics in Civil Engineering			Instrumentation and Sensor Technology in Civil Engineering	Disaster Preparedness & Planning Management

LIST OF COURSES OFFERED UNDER MINORS

Note:

1. Student can opt any 4 subjects from the list given below.
2. Compulsory MOOC/NPTEL Courses for 04 credits (02 courses@ 2 credits each OR a specialization with total 16weeks duration) in addition to the list given below.

S.No	Course Code	COURSE NAME	L	T	P	Credits
FOURTH SEMESTER						
1	20CEM4701	Introduction to Civil Engineering – Concepts and Materials	3	1	0	4
FIFTH SEMESTER						
2	20CEM5702	Methodology for Civil Engineering Construction	3	1	0	4
	20CEM5711	SELF LEARNING				2
SIXTH SEMESTER						
3	20CEM6703A	System Design for Sustainability	3	1	0	4
4	20CEM6703B	Ecology & Environment	3	1	0	4
SEVENTH SEMESTER						
5	20CEM7704A	Infrastructure and Transportation System Planning	3	1	0	4
6	20CEM7704B	Construction Planning and Execution	3	1	0	4

LIST OF COURSES OFFERED UNDER HONORS

1. Student can opt any 2 subjects from each of the POOLs given below (i.e, total of 4 subjects).
2. Compulsory MOOC/NPTEL Courses for 04 credits (02 courses@ 2 credits each OR a specialization with total 16weeks duration) in addition to the list given below.

S.No	Course Code	COURSE NAME	L	T	P	Credits
FOURTH SEMESTER						
1	20CEH4801A	Stability of Structures	3	1	0	4
2	20CEH4804B	Sustainable Construction Methods	3	1	0	4
3	20CEH4801C	Design of Formwork	3	1	0	4
FIFTH SEMESTER						
4	20CEH5802A	Engineering Rock Mechanics	3	1	0	4
5	20CEH5801B	Advanced Steel Design	3	1	0	4
6	20CEH5804C	Geospatial Data Processing	3	1	0	4
SIXTH SEMESTER						
7	20CEH6803A	Traffic Analysis and Design	3	1	0	4
8	20CEH6803B	Transportation Economics	3	1	0	4
9	20CEH6802C	Advanced Foundation Engineering	3	1	0	4
SEVENTH SEMESTER						
10	20CEH7802A	Geo Synthetics and Reinforced Soil Structures	3	1	0	4
11	20CEH7803B	Intelligent Transportation Systems	3	1	0	4
12	20CEH7804C	Environmental Impact Assessment	3	1	0	4

20BS3101A	MECHANICS OF SOLIDS
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Course Category:	Basic Science	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	Engineering Mechanics 20ES2104D	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to :													
CO1		understand the concepts of stresses, strains and principles stresses and strains.													
CO2		determine the shear forces and bending moments													
CO3		determine the bending stresses and deflection at any point subjected to loads.													
CO4		determine the shear stress in beams, torsion in shafts, strain energy.													
CO5		determine the compound stresses and behavior of columns.													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3– High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO2
	CO1	3	2	2		3						2		1	3
	CO2	3	2	2		3						1		1	3
	CO3	3	2	2		3						1		1	3
	CO4	3	2	2		3						1		1	3
	CO5	3	2	2		3						1		1	3
Course Content		UNIT – I STRESSES AND STRAINS Stress and strain - Hooke's law -tension -compression and shear-Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses- Simple problems. Concept of Principal Stresses and Strains. SHEAR FORCE AND BENDING MOMENT Shear Force and Bending Moment diagrams of statically determinate beams.													

	<p>UNIT – II FLEXURAL STRESSES Theory of simple bending – Assumptions – Derivation of bending equation - Neutral axis – Determination of bending stresses – Section modulus of across various beam sections.</p> <p>SLOPE AND DEFLECTION Relationship between moment; slope and deflection; Macaulay’s method; Moment area method; Use of these methods to calculate slope and deflection for determinant beams–Simple problems; Castigliano’s theorem.</p>
	<p>UNIT – III SHEAR STRESSES AND TORSION Derivation of formula of shear stress– Shear stress distribution across various beam sections - Derivation of torsion equation and its assumptions; Applications of the equation of the hollow and solid circular shafts; Torsional rigidity; Simple problems.</p> <p>STRAIN ENERGY Introduction; Derivation of expressions for elastic strain energy in uni -axial stress; elastic strain energy in pure bending; elastic strain energy for shearing stresses; elastic strain energy of a bar in pure torsion.</p>
	<p>UNIT – IV COMPOUND STRESSES Introduction; Principle of superposition and its limitation; Stress distribution on various cross sections of members due to eccentric loads; Middle third rule; Core or Kernel of a section.</p> <p>COLUMNS Introduction, Stability of equilibrium; The Euler’s formula for columns with different end restraints; Limitations of the Euler’s formulas; Generalized Euler buckling – load formulas;</p>
Text books	<p>[T1] Er.R.K.Rajput, “Strength of Materials(Mechanics of solids)”, S.Chand& Company Ltd, New Delhi.</p> <p>[T2] S.Ramamrutham& R Narayan, “Strength of Materials”, DhanpatRai Publishing Co.(P) Ltd, New Delhi.</p>
Reference books	<p>[R1] S SBhavikatti, “Structural Analysis”, V K Publishers.</p> <p>[R2] S P Timoshenki& D H Young, “Theory of structures”.</p> <p>[R3] E P Popov, “Mechanics of materials”, Prentice-hall of India Pvt. Ltd., New Delhi.</p>
E-resources and other digital material	<p>http://nptel.ac.in/courses/105105108/</p>

20ES3102A	ENGINEERING GEOLOGY
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Course Category:	Engineering Science	Credits:	3
Course Type:	Theory & Practical	Lecture - Tutorial - Practice:	2-0-2
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	analyze and classify various minerals and rocks on the basis of their engineering properties..												
		CO2	apply quantitative skills and frame work for solving basic engineering geology problems related to geological features and geological hazards												
		CO3	understand the importance of geo physical methods making engineering decisions specially site selection of engineering projects.												
		CO4	evaluate geological problems for a meaningful solution in the context of major civil engineering projects and their environmental impact.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3– High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO 1	PSO 2
	CO1	3													3
	CO2	3													3
	CO3	3	3		3										3
	CO4	3	3		3										3
Course Content		UNIT-I GEOLOGICAL MATERIALS 1. Introduction to Engineering geology -Definition, Branches of Geology useful to Civil Engineering: Scope of geological studies in various Civil engineering projects Mineralogy - Introduction to mineralogy Mineral Identification by Physical properties . Physical properties of rock forming minerals LAB EXCERCISE-I. Identification of Common Rock forming group of Minerals a. Quartz Group b. Feldspar group c. Mica Group d. Carbonate Group 2. Petrology -Rock cycle Igneous rocks – Formation –Classification and Textures													

	<p>Sedimentary rocks – Formation –Classification and Textures, Metamorphic rocks and metamorphism – Formation –Classification and Texture, Engineering concerns of rocks</p> <p>LAB EXCERSISE- II Identification of common rocks a) Granite b) Basalt c) Diorite d) Sandston e Shale f) Limestone g) Gneiss h) Schist i) Marble</p>
	<p>UNIT-II</p> <p>EARTH PROCESS</p> <p>1. Introduction: Weathering, Engineering classification of weathered rocks : Importance of weathering in Civil Engineering. Earth quakes - Causes and effects of earthquakes Earthquake Magnitude and intensity scales. seismic zones of India: Landslides - Classification -Preventive measures</p> <p>2. Structural geology – Stress –strain behavior of rock, Concept of rock deformation Rock outcrops- Types- strike and Dip Folds- Types-Effects on construction Faults-Types- Effects on construction joints-Types- Effects on construction</p> <p>LAB EXCERSISE-III- Identification of structural features on Models.</p>
	<p>UNIT-III</p> <p>GEOLOGICAL AND GEOPHYSICAL INVESTIGATION METHODS investigation Methods</p> <p>1. Maps and their interpretation- Topographic Map and Geological Map</p> <p>LAB EXCERSISE-IV- Practicing topographic map cross section, Practicing geological maps and cross section</p> <p>2. Geophysical Methods- Principles of exploration geophysical Methods Electrical Resistivity method- Interpretation, Seismic refraction method- Interpretation</p> <p>LAB EXCERSISE-V-Electrical Resistivity survey for civil engineering application</p>
	<p>UNIT-IV</p> <p>GEOLOGICAL INVESTIGATIONS FOR MAJOR PROJECTS</p> <p>1. Dams - Site selection for dams , Geological investigation methods for dams: Reservoirs- Failure of reservoirs , Reservoir suitable rocks, Reservoir induced seismicity Tunnels- Site selection for tunnels , Geological investigation methods for Tunnels.</p> <p>2. Environmental geology—Fundamental concept of environmental geology-Environmental impact on mining construction materials- aggregate waste disposal- sand mining--Impact of environment on the construction of dams, reservoirs, Groundwater contamination-Fluoride problem- Nuclear waste disposal-Health hazards</p>

Text books	<p>[T1] F.G. Bell, Fundamental of Engineering Geology , BS Publications PVT Ltd, Hyderabad.</p> <p>[T2] Parbin Singh, " Engineering and General Geology ", Katson Publication House, 1987.</p> <p>[T3] Principals of Engineering Geology by K.V.G.K. Gokhale – B.S publications</p> <p>[T4] Engineering Geology by N.Chennkesavulu, Mc-Millan, India Ltd. 2005.</p> <p>[T5] Environmental Geology by K.S Valdia, TaTaMcGraHill, NewDelhi</p>
Reference books	<p>[R1] Krynine and Judd, " Engineering Geology and Geo techniques " McGraw Hill Book Company, 1990.</p> <p>[R2] Legeet, " Geology and Engineering ", McGraw Hill Book Company, 1998.</p> <p>[R3] Blyth, " Geology for Engineers ", ELBS, 1995.</p> <p>[R4] GoodmanR.F-Introduction to rockmechanics, JohnWiley, Chichester</p> <p>[R5] S.K Duggal et.al Engineering Geology –McGraw Hill Education</p> <p>[R6] E.A Keller-Environmental Geology- Prientice Hall .N.Jercy</p>
E-resources and other digital material	NPTEL Courses

20CE3303	SURVEYING & GEOMETRICS
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Course Category:	Programme Core	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3 – 0 – 0
Prerequisites:	Mathematics, Science	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
CO1		understand the basic principles of surveying and linear measurements													
CO2		evaluate the reduced levels and plot contours													
CO3		understand angular measurements and setting out simple curves													
CO4		evaluate areas and volumes of various sections													
CO5		understand various modern field equipments													
Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2– Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1	3	2			3				1					
	CO2	3	3	2		3				2	1			2	
	CO3	3	2	2		3				2	1				
	CO4	3	3	2						1	1			2	
	CO5	3	1			3				1					

Course Content	UNIT – I BASICS OF SURVEYING Surveying: Definition; Primary divisions; Classification; Principles; Plan and map; Scales used for maps and plans; Accuracy; Precision; Sources of errors; Types of errors. CHAIN SURVEYING Principles of chain surveying; Basic definitions; Different methods; Instruments for Chaining and taping; ranging out; Chaining a line on a flat ground; Chaining on an
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	uneven or a sloping ground; Chain & Tape corrections.
	<p>UNIT – II LEVELLING Basic definitions; Bench marks; Different methods of leveling; Classification of direct leveling methods; Auto level; Leveling staff; Terms used in levelling; Theory of differential Levelling; Levelling field book; Missing entities; Height of Instrument and rise and fall method; Profile leveling; Cross sectioning; Sources of errors in leveling.</p> <p>CONTOURING Contouring; contour interval; Characteristics of contours; Methods of locating contours; Interpolation and Sketching of contours; Uses of contour maps.</p>
	<p>UNIT – III THEODOLITE SURVEYING Main parts of a vernier theodolite; Basic definitions; Fundamental lines; Temporary adjustments; Measurement of a horizontal angle by repetition and reiteration. Measurement of vertical angle; Errors in theodolite surveying.</p> <p>CIRCULAR CURVES Basic definitions; Designation of a curve; Relationship between radius and degree of curve; Elements of a simple curves; setting out of simple curve.</p>
	<p>UNIT – IV AREAS & VOLUMES Introduction; Area of a tract with straight irregular boundaries; Boundaries with offsets at irregular intervals; Coordinates method; Planimeter: working; Area of cross sections- two level sections only; Volume of a prismoid: Trapezoidal rule; Prismoidal formula; Capacity of a reservoir.</p> <p>MODERN FIELD SURVEY SYSTEMS EDM: Principle, Types of EDM instruments; Total Station: Fundamental parameters, Field equipment, Setup, Advantages, Uses; GPS: Functioning, Applications in Civil Engineering.</p>
Text books	[T1] Surveying, Volume-1 by K. R. Arora; Standard Book House. [T2] Advanced Surveying by SatheeshGopi, R. Sathikumar, N. Madhu; Pearson Education
Reference books	[R1] Surveying, Volume-1 by B.C.Punmia; McGraw Hill Education (India) Private Limited
E-resources and other digital material	https://nptel.ac.in/courses/105/107/105107122/

20CE3304	FLUID MECHANICS
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Course Category:	Programme Core	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3 - 0- 0
Prerequisites:	20BS1101&20BS2101- Maths 20BS2102A - Engineering Physics 20ES2104A – Engineering Mechanics	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course Outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	evaluate the pressure of the flowing fluid.													
	CO2	understand the kinematic and dynamic behavior of flow.													
	CO3	apply the principles to measure the flow of fluid through pipes and Orifices/ Mouthpieces.													
	CO4	analyze the flow through pipes.													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	3	2	3											3
	CO2	3	2	3											3
	CO3	3	2	3										2	3
	CO4	3	2	3										2	3
Course Content	UNIT I: PROPERTIES OF FLUID: Introduction; Properties of Fluid; Units of measurement; Fluid Continuum; Newtonian and Non - Newtonian fluids; Vapour pressure. FLUID STATICS: Variation of static pressure; Pressure the same in all directions – Pascal’s Law; Atmospheric, Absolute and gauge pressure; Hydrostatic pressure on horizontal, vertical														

	<p>and inclined plane surfaces.</p> <p>UNIT II:</p> <p>KINEMATICS OF FLUID FLOW: Methods of describing fluid motion; Classification of flow; Steady, unsteady, uniform and non-uniform flows; Laminar and turbulent flows; Three, two and one dimensional flows; Irrotational and rotational flows; Stream line; Path line; Streak line; Continuity equation; Velocity potential and stream function.</p> <p>DYNAMICS OF FLUID FLOW: Euler's equation of motion; Bernoulli's equation; Momentum principle; Application of Momentum equation; Force exerted on a pipe bend.</p> <p>UNIT III:</p> <p>MEASUREMENT OF FLOW THROUGH PIPES: Measurement of flow through Pipes – methods and various devices; Discharge through Venturi meter; Discharge through orifice meter; Measurement of velocity by Pitot tube.</p> <p>MEASUREMENT OF FLOW THROUGH ORIFICES: Flow through orifices; Determination of coefficients for an orifice; Flow through small orifice and large rectangular orifice.</p> <p>UNIT – IV</p> <p>ANALYSIS OF FLOW THROUGH PIPES: Energy losses in pipelines; Darcy – Weishbach equation; Minor losses in pipelines; Pipes in series and parallel.</p> <p>LAMINAR FLOW: Relation between shear and Pressure Gradients in Laminar Flow; Reynold's experiment; Critical velocity; Steady laminar flow through a circular pipe – Hagen Poiseuille's Law; Laminar Flow between Parallel Plates – Both plates at rest.</p>
Text books	<p>[T1] P.N. Modi & S.N. Seth, "Hydraulics & Fluid Mechanics", 18th ed., Standard Book House, New Delhi, 2015.</p> <p>[T2] A.K. Jain, "Fluid Mechanics", 11th ed., Khanna Publishers, New Delhi, 2014.</p>
Reference books	<p>[R1] R. K. Bansal, "Fluid Mechanics and Hydraulic Machines", 9th ed., Laxmi Publications; New Delhi, 2015.</p> <p>[R2] Rajput R.K., "Fluid Mechanics and Hydraulic Machines", 3rd ed., S.Chand and Company Ltd., New Delhi, 2014.</p> <p>[R3] K. Subramanya, "Theory and Applications of Fluid Mechanics", 3rd ed., Tata McGraw Hill Publishing Company, New Delhi, 2013.</p>
E-resources and other digital material	<p>www.nptel.ac.in / courses/ 105101082/</p> <p>www.nptel.ac.in/courses/105103095/</p>

20CE3305	CONCRETE TECHNOLOGY
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Course Category:	Programme Core	Credits:	3
Course Type:	Theory cum Practice	Lecture - Tutorial - Practice:	2-0-2
Prerequisites:	-----	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
CO1		understand the manufacturing process of cement, types of cements and chemical composition of cement.													
CO2		apply properties of the constituent materials in concrete													
CO3		analyze and Compare the Properties of fresh and hardened concrete.													
CO4		understand effects of various chemical actions on concrete.													
CO5		evaluate various special concretes and concreting methods based on the scenario.													
CO6		evaluate an appropriate concrete mixdesign using Indian Standard.													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1							2						1	3
	CO2	1					1	2						1	3
	CO3			2										1	3
	CO4				2		1	2						2	2
	CO5						2	2						2	2
	CO6	1	3	3	2		3	3	2		1		1	2	2

Course Content	<p>UNIT – I</p> <p>CEMENT: Introduction to concrete as a structural material, Uses of cement, Chemical Composition of Ordinary Portland Cement, Functions of cement ingredients; Manufacturing process of cement (wet and Dry Processes), Hydration of Cement, Heat of Hydration, Water requirements for hydration, Types of cements -- Ordinary, Rapid hardening, low-heat, sulphate resisting, Portland slag, Portland pozzolana, High alumina cement, white cement and colored cement properties and their applications; Storage of cement; Field tests for cement.</p> <p>LABORATORY TESTS (As per IS Specifications): Fineness of cement, consistency, initial and final setting time, Specific gravity and compressive strength of cement.</p> <p>AGGREGATES: Classification of Aggregates; Properties of aggregates Grading of Aggregates; IS: 383 requirements for aggregates; Alkali – Aggregate reaction.</p> <p>LABORATORY TESTS (As per IS Specifications): Sieve analysis, specific gravity, bulk density of both fine and coarse aggregate, bulking of sand.</p> <hr/> <p>UNIT – II</p> <p>WATER: General; Quality of water; Use of sea water; IS: 456 requirements.</p> <p>MORTAR: Functions of sand in mortar; Classification of mortars; Uses of mortar; Properties of good mortar mix and mortar; Selection of mortar.</p> <p>ADMIXTURES IN CONCRETE: General; Air-entraining agents; Plasticizers; Accelerators; Retarders; Miscellaneous admixtures for damp proofing and Surface hardening; Introduction to mineral admixtures.</p> <p>CONCRETE: Definition; Future demand of concrete - advantages of concrete structures ; Proportioning of concrete; Water – cement ratio; Properties of Fresh Concrete – Workability, Factors Affecting Workability, Segregation; Bleeding; Yield of Concrete.</p> <p>LABORATORY TESTS (As per IS Specifications): workability tests on fresh concrete: slump cone, compaction factor.</p> <hr/> <p>UNIT – III</p> <p>MANUFACTURE OF CONCRETE: Batching of concrete; Mixing; Transporting Concrete; Placing concrete; Compaction of concrete; Curing of concrete; Finishing.</p> <p>HARDENED CONCRETE: General; Gel / space ratio; Gain of strength with age; Maturity concept of concrete; Elastic properties of concrete; Relation between modulus of Elasticity and strength; Factors affecting modulus of elasticity; Creep; Factors affecting creep; Shrinkage; Plastic shrinkage; Mechanism of shrinkage; Factors affecting shrinkage.</p> <p>LABORATORY TESTS (As per IS Specifications): Compressive strength, Effect of height / diameter ratio on strength and failure patterns, flexural strength, split tensile test, Relation between Compressive and Tensile Strength; Introduction to Non-Destructive Tests (Demo on Rebound Hammer Test, Ultrasonic Pulse Velocity Test).</p> <hr/> <p>UNIT – IV</p> <p>DURABILITY OF CONCRETE: Permeability of concrete; Sulphate attack; Methods of controlling sulphate attack; Durability of concrete in sea water; Corrosion mechanism of reinforcement in concrete, Environmental considerations, concrete durability and sustainability,</p>
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	<p>technology for sustainable development.</p> <p>SPECIAL CONCRETES & CONCRETING METHODS: Light weight concrete and No fines concrete; High strength and high performance of concrete; Polymer concrete and Fiber reinforced concrete; Guniting or shotcrete; Ferro cement; Vacuum concrete, Vacuum Dewatered Concrete, Self compacting concrete, Self healing Concrete.</p> <p>CONCRETE MIX DESIGN: Concept of mix design; List of Mix design methods; Indian standard method of mix design (IS10262-2019).</p>
Text books	<p>[T1] Concrete Technology by M. S. Shetty; S. Chand & Company (Pvt.) Ltd., New Delhi.</p> <p>[T2] Properties of Concrete by A. M. Neville; Published by Dorling Kindersley (India) Pvt. Ltd. Licensees of Pearson Education in south Asia, New Delhi.</p>
Reference books	<p>[R1] Concrete Technology by A.R.Santhakumar; Oxford University press, New Delhi..</p> <p>[R2] Concrete Technology by M. L. Gambhir; Tata McGraw – Hill Publishing Company Ltd., New Delhi.</p>
E-resources and other digital material	<p>http://nptel.ac.in/courses/105102012</p>

20ES3151A	DESIGN THINKING AND CIVIL ENGINEERING WORKSHOP
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Course Category:	Engineering Science lab	Credits:	1.5
Course Type:	Practical	Lecture - Tutorial - Practice:	0-0-3
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to :														
	CO1	analyze complex civil engineering problems innovatively with the use of different construction materials and structural elements.													
	CO2	apply various power tools for construction													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	2	2	2	2	2				2		2	2		2
	CO2	3	2	3	3	1				2		2	2		2
Course Content	1 DESIGN THINKING a. Introduction to Design Thinking An insight into Design, origin of Design thinking, Design thinking and its process models, application of Design thinking. b. Empathize In Design Thinking Role of Empathy in design thinking, methods and tools of empathy, understanding empathy tools. Explore define phase state users' needs and problems using empathy method. *Carry out the detailed questionnaire to arrive at the problem of the selected theme. The empathy report shall be prepared based on the response of the stake holders. c. Prototyping and Testing: Methods and tools of ideations, prototyping and methods of prototyping, user testing methods, Advantages and disadvantages of user Testing/ Validation. * For the problem identified, the team needs to give solution through thinking out of the box innovatively to complete the ideation stage of DTL. *Once the idea of the solution is ready, detailed design has to be formulated in the Design stage considering the practical feasibility. *If the Design of the problem is approved, the team should implement the design and come out with prototype of the system. *Conduct thorough testing of all the modules in the prototype developed and carry out integrated testing.														

	<p>*Demonstrate the functioning of the prototype along with presentations of the same.</p> <p>d. Product Innovation:</p> <p>Innovation towards product design Case studies.</p> <p>* Prepare a Digital poster indicating all the stages of DTL separately. A Detailed project report also should be submitted covering the difficulties and challenges faced in each stage of DTL. Methods of testing and validation should be clearly defined both in the Digital poster as well as the report.</p> <p>e. Ideation, Prototyping And Testing of an Innovative Model Based on the Topics Learnt – (Class may be divided in to groups. some marks may be allotted for the submission of innovation. Better innovations may lead to exhibition in NITs, IITs / patents / may be useful to Atal innovation ranking).</p> <p>2. Calculate the length, area, volume, area of a built-up space and a small parcel of land - use digital distance measuring devices and To set horizontal, vertical and angle lines using different types of laser instruments.</p> <p>3. (a) To find out the different materials present in the wall using wall scanner. (b) To view the objects using an inspection camera which are not accessible & visible. (c) To set different angles to a ramp or staircase using Inclinator.</p> <p>4. (a) To cut shapes and curves in wood with its narrow blade using Jigsaw. (b) To cut through wood and other soft materials using Saber saw. (c) Polish the concrete using concrete grinder.</p> <p>5. Painting – Paint a given surface in this order - putty, primer and painting.</p> <p>6. Flooring – Suggest a suitable flooring and install in the given space.</p> <p>7. Plumbing – Design pipeline layout for the given plan and utilize proper fittings.</p> <p>8. Formwork – Suggest proper formwork for footings, stair case,</p> <p>9. Apply basic techniques for masonry and concreting works – different types of brick bonds, plumb, alignment, brick quantity estimation, estimation of material contents for cement mortar and plastering.</p>
Text books	<p>[T1] Building construction by B. C. Punmia -Laxmi Publications, New Delhi</p> <p>[T2] Design thinking for strategic Innovation, IdrisMootee, 2013, John Wiley & Sons</p> <p>[T3] Design thinking – The guidebook – Facilitated by the Royal Civil Service Commission, Bhutan</p>
Reference books	<p>[R1] Design Methods: A Structured Approach for Driving Innovation in Your Organization, Vijay Kumar, First Edition, 2012, Wiley</p> <p>[R2] Human-Centered Design Toolkit: An Open-Source Toolkit to Inspire New Solutions in the Developing World, IDEO, Second Edition, 2011, IDEO.</p>
E-resources and other digital material	--

20CE3352	SURVEYING LAB - 1
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Course Category:	Programme Core Lab - 1	Credits:	1.5
Course Type:	Lab	Lecture - Tutorial - Practice:	0 – 0 – 3
Prerequisites:	Mathematics, Science	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	evaluate distances, areas by using chain survey.												
		CO2	apply principles of compass survey to plot a traverse and determine the bearings.												
		CO3	evaluate the horizontal and vertical angles using the odolite survey.												
		CO4	apply leveling methods to determine the elevations and plot contours.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
	CO1	3	2			3				2	1	1			2
	CO2	3	2			3				2	1	1			2
	CO3	3	2			3				2	1	1			2
	CO4	3	2			3				2	1	1			2

Course Content	<ol style="list-style-type: none"> 1. Determine the area of a given parcel of land by using cross staff and chain survey. 2. Determine the distance between two points with obstacles in between. 3. Measurement of bearings of an open traverse with prismatic compass and computation of correct included angles. 4. Measurement of bearings of a closed traverse with prismatic compass and computation of area. 5. Measurement of horizontal angle by using Repetition method. 6. Measurement of horizontal angles by using Reiteration method. 7. Measurement of vertical angles using a Vernier theodolite. 8. Determination of elevations of various points remote from each other (differential leveling). 9. Survey and plot the longitudinal and cross sections of a given embankment. 10. Prepare a contour map of existing ground using an auto level.
Text books	<p>[T1] Surveying, Volume-1 by K. R. Arora; Standard Book House.</p> <p>[T2] Surveying, Volume-1 by B.C.Punmia; McGraw Hill Education (India) Private Limited</p>
Reference books	[R1] Advanced Surveying by SatheeshGopi, R. Sathikumar, N. Madhu; Pearson Education
E-resources and other digital material	---

20CE3353	COMPUTER AIDED CIVIL ENGINEERING DRAWING
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Course Category:	Programme Core Lab-2	Credits:	1.5
Course Type:	Lab	Lecture - Tutorial - Practice:	0-0-3
Prerequisites:	Engineeringgraphics20ES1105	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to :														
	CO1	apply the knowledge of Various measurements and dimensions of a building components													
	CO2	understand principles of planning, principles of architecture and building Bye-laws.													
	CO3	apply the principles of planning to secure building plans as per Building bye-laws													
	CO4	analyze the requirements of user to draw the plan, elevation, sectional view of the building as per principles of planning and NBC													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3– High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	1		2											
	CO2	1		2											
	CO3	1		2										2	2
	CO4	1		2										2	
Course Content	<p style="text-align: center;">PART A</p> <p>Introduction and Theory concepts Explanation For the Following:</p> <p>Principles of planning & architecture</p> <p>Building bye-laws & National Building Code</p> <p>Conventional signs and Symbols & Line diagrams</p> <p>Plan, Elevation, Section of a Building and site plan</p> <p>Standard dimensions of Doors, windows and measurements of different rooms</p>														

	<p>and various structural components</p> <p>(MANUALDRAWING)</p> <ol style="list-style-type: none"> 1. .Drawing practice of coventional signs and symbols 2. Drawing practice of Door, window and ventilator (Elevations only with standard measurements 3. Drawing practice of section of a wall including foundation with specifications <p>DESIGN LINE DIAGRAMS AND DRAW PLAN, ELEVATION & SECTION OF THE FOLLOWING:</p> <ol style="list-style-type: none"> 4.Residentialbuilding Drawing- Single bedroom, Living room, Kitchen(Load bearing wall structure) 5. Elevations of various types of Buildings in explanation <p>PART-B</p> <p>AUTOCAD DRAWING</p> <ol style="list-style-type: none"> 1. AutoCAD Commands introduction and practice <p>DESIGN LINE DIAGRAMS AND PREPARE THE APPROVAL DRAWINGS FOR LOCAL AUTHORITY WITH SET BACKS BY DRAWING PLAN, ELEVATIONSECTIONOFTHEFOLLOWING</p> <ol style="list-style-type: none"> 2. Single storied Residential Double bedroom building (Load bearing stucture) 3. Dog legged Stair case 4. RCC Two storied framed structure building with staircase 5. Single storied Rural hospital building/school building Plan
Text books	<p>[T1] Building planning, designing and scheduling by Gurucharan Singh and Jagdish Singh. –Standard Publishers-Delhi.</p> <p>[T2] Building Drawing by M.G. Shah, C.M. Kale and S.Y.Patki; Tata McGraw Hill Publishing Co.Ltd., New Delhi.</p>
Reference books	<p>[R1] National Building Code, Bureau of Indian Standards, New Delhi, 2005.</p> <p>[R2] Planning & Designing Buildings by Yashwant S. Sane; Allies Book Stall, Pune</p> <p>[R3] Residential Interior Design: A Guide To Planning Spaces 3rd Edition by Maureen Mitton (Author), Courtney Nystuen (Author)</p>
E-resources and other digital material	<p>www.floorplanner.com</p>

20TP3106	LOGIC & REASONING
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Course Category:	Institutional Core	Credits:	1
Course Type:	Learning by Doing	Lecture - Tutorial - Practice:	1 - 0-1
Prerequisites:		Continuous Evaluation:	100
		Semester end Evaluation:	0
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
CO1		think reason logically in any critical situation													
CO2		analyze given information to find correct solution													
CO3		to reduce the mistakes in day to day activities in practical life													
CO4		develop time management skills by approaching different shortcut methods													
CO5		use mathematical based reasoning to make decisions													
CO6		apply logical thinking to solve problems and puzzles in qualifying exams for companies and in other competitive exams													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3– High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1						2								
	CO2		2												
	CO3								2						
	CO4									2					
	CO5	2													
	CO6	1													
Course Content		UNIT-I 1. Series Completion, 2. Coding-Decoding,													

	3. Blood Relation Blood, 4. Puzzles test
	UNIT-II 1. Direction sense test, 2. Logical Venn diagrams, 3. Number test, ranking test, 4. Mathematical operations
	UNIT-III 1. Arithmetical Reasoning, 2. Inserting missing character, 3. Syllogism.
	UNIT-IV 1. Water images, 2. Mirror images, 3. Paper folding, 4. Paper cutting, 5. Embedded Figures, 6. Dot situation, 7. Cubes & Dice
Text books	[T1] R. S. Aggarwal, “ Verbal and non-verbal reasoning”, Revised Edition, S Chand publication, 2017 ISBN:81-219-0551-6
Reference books	----
E-resources and other digital material	----

20MC3107B	INDIAN CONSTITUTION
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Course Category:	Mandatory Course	Credits:	---
Course Type:	Theory	Lecture - Tutorial - Practice:	2-0-0
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to :													
CO1		understand the spirit and origin of the fundamental law of the land													
CO2		understand how fundamental rights can be protected													
CO3		understand the structure and formation of the Indian Government at center as well as state													
CO4		understand when and how an emergency can be imposed and its consequences													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3– High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO2
	CO1						2								
	CO2						2								
	CO3						2								
	CO4						2								
Course Content		UNIT – I [Text Book – 2] INTRODUCTION TO CONSTITUTION OF INDIA: Meaning of the constitution law and constitutionalism, historical perspective of the constitution of India, salient features and characteristics of the constitution of India.													
		UNIT – II [Text Book – 1 & 2] FUNDAMENTAL RIGHTS: Scheme of the fundamental rights, scheme of the fundamental right to equality, scheme of the fundamental right to certain freedoms under article 19, scope of the right to life and personal liberty under article 21.													
		UNIT – III [Text Book – 1] NATURE OF THE INDIAN CONSTITUTION: Federal structure and distribution of legislative and financial powers between the union and													

	<p>the states.</p> <p>PARLIAMENTARY FORM OF GOVERNMENT IN INDIA:</p> <p>The constitution powers and status of the President of India, amendment of the constitutional powers and procedure, the historical perspectives of the constitutional amendments in India.</p> <p>LOCAL SELF-GOVERNMENT:</p> <p>Constitutional scheme in India.</p>
	<p>UNIT – IV [Text Book – 1 & 2]</p> <p>EMERGENCY PROVISIONS:</p> <p>National emergency, president rule, financial emergency</p>
Text books	<p>[T1] Dr.J.C.Johari, “India Government and Politics”, Vishal Publications, New Delhi, 2009</p> <p>[T2] M.V.Pylee, “Introduction to constitution of India”, Vishal Publications, New Delhi, 5th edition, 2009.</p>
Reference books	<p>[R1] D.D.Basu, “Introduction to the Constitution of India”, Lexis Nexis, 2015.</p> <p>[R2] Subhas C. Kashyap, “Our Constitution”, National Book Trust India, 2nd Edition, New Delhi, 2013.</p>
E-resources and other digital material	----

20BS4101	PROBABILITY AND STATISTICS FOR ENGINEERS
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Course Category:	Basic Science										Credits:			3	
Course Type:	Theory										Lecture-Tutorial-Practice:			3-0-0	
Prerequisites:	----										Continuous Evaluation:			30	
											Semester end Evaluation:			70	
											Total Marks:			100	
Course Outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	find probabilities using axioms and understand random variables.													
	CO2	estimate Probability density functions.													
	CO3	apply random phenomena of sample to estimate errors													
	CO4	analyze correlation, regression and quality improvement , control charts.													
Contribution of Course Outcomes towards achievement of Program Outcomes (3-HIGH, 2-MEDIUM, 1-LOW)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2
	CO1	3	2			1								1	
	CO2	3	2			1								1	
	CO3	3	2			1								1	
	CO4	3	2			1								1	
Course Content	UNIT I:														
	PROBABILITY: Sample Space and events, Probability, The Axioms of probability, Addition rule of probability, Conditional probability, Multiplication rule of probability, Bayes’ theorem.														
	PROBABILITY DISTRIBUTIONS: Discrete Random Variable , Expectation, Variance and Standard deviation of discrete random variable, Binomial distribution, Poisson distribution.														
	UNIT II:														
	PROBABILITY DENSITIES: Continuous Random Variable , Expectation, Variance and Standard deviation of continuous random variable, Normal distribution, Normal approximation to the Binomial distribution.														
	OTHER PROBABILITY DENSITIES - Uniform distribution, Log normal distribution, Gamma distribution, Beta distribution, Weibull distribution.														
UNIT III:															
SAMPLING DISTRIBUTIONS: Introduction, Populations and Samples, Sampling distribution of the mean (SD known and SD unknown) – Sampling distribution of the variance.															
ESTIMATION OF MEAN: Point Estimation, Maximum error of estimate, Interval Estimation.															
UNIT IV:															
REGRESSION AND CORRELATION: Types of Correlation, Scatter diagram, Karl Pearson’s coefficient of correlation, Rank Correlation, Regression analysis.															

	THE STATISTICAL CONTENT OF QUALITY IMPROVEMENT PROGRAMS: Quality Control- Control Charts for Measurements - Control Charts for Attributes.
Text books	[T1] Probability and Statistics for Engineers ,Eighth edition by Richard A. Johnson Prentice Hall of India. [T2] Probability and statistics by K.Murugesan, P.Guruswamy, AnuRadha Publications.
Reference books	[R1] Probability & Statistics for Engineers & Scientist by R.E. Walpole, R.H.Myers&S.L.Myers, Sixth Edition, Prentice Hall of India / Pearson Education. [R2] Probability and Statistics, Purna Chandra Biswal, Pearson Education Prentice Hall of India 2007. [R3] Probability and Statistics by T.K.V.Iyengar, B.Krishna Gandhi, S.Ranganatham, M.V.S.S.N.PrasadS.Chand.
E-resources and other digital material	https://onlinecourses.nptel.ac.in/noc22 mg31/preview https://nptel. ac.in/courses/111105041

Course Category:	Program Core	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	Mechanics of Solids 20BS3101A	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	understand, draw and interpret influence line diagrams.												
		CO2	apply energy methods for analysis of indeterminate beams and frames.												
		CO3	analyze statically indeterminate structures using force and displacement methods.												
		CO4	evaluate multistory frames for vertical and horizontal loads by approximate methods.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	3				2							2	2	
	CO2	3	1			2							2	2	
	CO3	3	1			2							2	2	
	CO4	3	1			2							2	2	
Course Content		UNIT – I INFLUENCE LINES FOR STATICALLY DETERMINATE STRUCTURES : EQUILIBRIUM PRINCIPLES AND ITS APPLICATION Influence line for beam reaction; Shearing forces; Bending moment; Calculation of maximum and absolute maximum bending moment for rolling loads. INFLUENCE LINES FOR STATICALLY DETERMINATE STRUCTURES : MULLER BRESLAU PRINCIPLES AND ITS APPLICATION Muller Breslau Principle; Concept and Its Application.													

	<p>UNIT – II</p> <p>ANALYSIS OF INDETERMINATE STRUCTURES USING ENERGY METHODS : BEAMS Strain Energy Method for analysis of continuous beams up to two spans.</p> <p>ANALYSIS OF INDETERMINATE STRUCTURES USING ENERGY METHODS :FRAMES Analysis of rigid frames up to first degree of redundancy.</p>
	<p>UNIT – III</p> <p>ANALYSIS OF INDETERMINATE STRUCTURES: FORCE METHOD Propped cantilever by consistent deformation method; Fixed beams for different loadings.</p> <p>ANALYSIS OF INDETERMINATE STRUCTURES:DISPLACEMENT METHODS Slope deflection method for continuous beam (two span) and portal frames without side sway. Moment distribution method for continuous (two span) and portal frames without side sway.</p>
	<p>UNIT – IV</p> <p>APPROXIMATE METHODS OF ANALYSIS FOR MULTI STORY FRAMES: KANI’S METHOD Introduction and principles of the kani’s method; Application of the method to continuous beams; Application of method to the analysis of portal frames without side sway.</p> <p>APPROXIMATE METHODS OF ANALYSIS FOR MULTI STORY FRAMES: : ANALYSIS OF LATERAL LOADS Portal method and cantilever method.</p>
Text books	<p>[T1] Analysis of structures by Volume I –17th Edition by Vazirani&Ratwani; & Volume –II 16th Edition by Vazirani&Ratwani, Khanna Publications; Delhi,2015.</p> <p>[T2] Structural Analysis by S.S. Bhavikatti, Volume-I and II, 4th Edition, Vikas Publishing house PVT Ltd,2014.</p>
Reference books	<p>[R1] Structural analysis by Hibbeler, 6th Edition, Pearson India Education Services PvtLtd.2015</p> <p>[R2] Structural Analysis by R.Vaidyanathan Volume-I and II, 3rd Edition, Laxmi Publications (P) Ltd,2012.</p> <p>[R3] Theory of structures by S. Ramamrutham, 9th Edition, DhanapatRai Publications,2014.</p> <p>[R4] Basic Structural Engineering by C.S Reddy, Tata McGraw Hill, ThirdEdition.</p> <p>[R5] Theory of structuresVol–IbyG.S. Panditand S.P. Gupta and R.Gupta by Tata McGraw Hill Ltd., New Delhi.</p>
E-resources and other digital material	<p>Structural Analysis–I - http:// nptel.ac.in/courses/105101085</p> <p>Structural Analysis - I - http://nptel.ac.in/courses/105105166</p> <p>Structural Analysis - II - http://nptel.ac.in/courses/105101086</p>

20CE4303	GEOTECHNICAL ENGINEERING
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Course Category:	Program Core	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	understand the origin of soil and basic inter-relationships of soil components.												
		CO2	apply the index properties of soil to classify the soil.												
		CO3	analyze the Soil-Water Interaction.												
		CO4	evaluate compressibility and shear characteristics of soil.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1	3	2												3
	CO2	3	2		2										3
	CO3	3	2		2										3
	CO4	3	2		2										3
Course Content		UNIT – I INTRODUCTION, BASIC DEFINITIONS AND RELATIONS Scope of Geotechnical Engineering; Origin of Soils; Formation of soils; Types of soils; Transportation of soils; Major soil deposits of India. Phase diagrams; Volumetric relationships; Weight relationship; Volume-weight relationships; Specific gravity of soils; Three phase diagram in terms of void ratio; Inter-relationships; INDEX PROPERTIES AND SOIL CLASSIFICATION Introduction; Determination of Water content, Determination of Specific gravity; Mechanical sieve analysis; Sedimentation analysis- Stokes law*; Hydrometer analysis; Limitation of sedimentation analysis; Combined sieve and sedimentation analysis; Particle													

	<p>size distribution curve and its uses; Determination of field density (core cutter and sand replacement method), Relative density.</p> <p>Plasticity of soils; Consistency limits; Determination of liquid limit by Casagrande method*, Plastic limit* and shrinkage limit*; Uses of consistency limits, Discussion on all Consistency Indices ;Indian Standard Soil Classification System.</p>
	<p>UNIT – II SOIL MOISTURE AND PERMEABILITY Flow of water in soils; Darcy's law; Validity of Darcy's law by Reynolds number*; Determination of coefficient of permeability* by constant head and variable head methods & Indirect methods; Seepage velocity; General expression for laminar flow*; Laminar flow through porous media; Factors affecting permeability; Permeability of stratified soil deposits.</p> <p>EFFECTIVE STRESS Effective stress principle; Effective stress in a soil mass under different loading conditions – effect of depth of Water table, Surcharge loading, Capillary water, Artesian Pressures</p>
	<p>UNIT – III SEEPAGE THROUGH SOILS Seepage pressure; Quick sand conditions; Laplace equations*; Stream and potential functions*; Characteristics of flow net; Uses of flow nets; Seepage through earth dams with horizontal filter*; Uplift pressure; Flow net for anisotropic soils.</p> <p>COMPACTION OF SOILS Introduction; Standard proctor test and modified proctor test; Compaction of clayey soil and sand; Factors affecting compaction; Effect of compaction on properties of soils; Field compaction of soils and field compaction control.</p>
	<p>UNIT – IV CONSOLIDATION OF SOILS Introduction; Initial, Primary and secondary consolidation; Spring analogy for primary consolidation; Terzaghi's theory of consolidation; Solution of basic differential equation*; Consolidation test; Determination of void ratio at various load increments-height of solids and change in void ratio methods; Consolidation test results; Determination of coefficient of consolidation-square root of time and logarithmic time fitting methods; Casagrande's method for determination of pre-consolidation pressure.</p> <p>SHEAR STRENGTH OF SOILS Introduction; Mohr – coulomb theory; Different types laboratory of shear strength tests*(Triaxial test Direct shear test; Unconfined compressive strength test; Vane shear test*); Different drainage conditions and their field applicability; Mohr - coulomb failure criterion; Shear characteristic of cohesive and cohesion less soils;</p>
Text books	<p>[T1] Soil Mechanics and Foundation Engineering by K.R. Arora; Standard Publishers & Distributors, NaiSarak, New Delhi.</p> <p>[T2] Basic and Applied Soil Mechanics by GopalRanjan and A.S.R. Rao; New Age International Ltd., New Delhi.</p>

Reference books	[R1] Soil Mechanics and Foundation Engineering by Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain; Laxmi Publications (P) Ltd., New Delhi. [R2] Relevant Indian Standard Code Books.
E-resources and other digital material	Introduction to Soil Mechanics - http://nptel.ac.in/courses/105103097/ Soil Mechanics - http://nptel.ac.in/courses/105101084/

Note:

1. In Laboratory tests, only test procedures according to relevant IS codes need to be studied - no need of derivations of the formulae used in the tests
- 2.* indicates only methods and / or formulae - no derivation of formulae needed.

20CE 4304	HYDRAULICS & HYDRAULIC MACHINES
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Course Category:	Programme Core	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3 - 0 - 0
Prerequisites:	20CE 3304 – Fluid Mechanics	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	evaluate the most economical dimensions of different channel sections.													
	CO2	analyze the flow through an open channel.													
	CO3	evaluate an equation for a phenomenon using dimensional analysis.													
	CO4	analyze and select suitable type of turbine / Pump.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	3	2	3										3	
	CO2	3	2	3											3
	CO3	3	2	3											3
(1– Low, 2 – Medium, 3 – High)	CO4	3	2	3										2	3
Course Content	UNIT I: OPEN CHANNEL FLOW: UNIFORM FLOW: Introduction, Classification of flows and channels; Chezy's, Manning's, Bazin's, Kutter's Equations; Hydraulically efficient channel sections - Rectangular, Trapezoidal and Circular channels. NON-UNIFORM FLOW: Concept of specific energy; Specific energy curves; Critical flow; Critical flow in a rectangular channel; Critical slope; Different slope conditions; Channel transitions.														

	<p>UNIT II:</p> <p>GRADUALLY VARIED FLOW: Dynamic equation; Types of Surface Profiles; Computation of surface profiles by single step method; Back water Curves and Draw down curves.</p> <p>RAPIDLY VARIED FLOW: Hydraulic jump; Elements and characteristics of hydraulic jump; Types of hydraulic jumps; Applications of hydraulic jump; Energy loss in a hydraulic jump.</p> <hr/> <p>UNIT III:</p> <p>DIMENSIONAL ANALYSIS AND SIMILITUDE: Dimensional homogeneity; Rayleigh's method; Buckingham – Pi theorem; Geometric, Kinematic and dynamic similarities; Scale effect.</p> <p>IMPACT OF JETS: Force exerted by fluid jet on stationary and moving flat plates and curved plates; Force exerted by fluid jet on series of flat vanes; Angular momentum principle; Torque exerted on a wheel with radial curved vanes.</p> <hr/> <p>UNIT – IV</p> <p>HYDRAULIC TURBINES: Classification; Impulse; Reaction; Radial, Axial, mixed and tangential flow turbines; Pelton, Francis and Kaplan turbines; Velocity triangles; Head and efficiency; Draft tube theory; Concept of specific speed; Cavitation.</p> <p>CENTRIFUGAL PUMPS: Types of pumps, Manometric head; Losses and efficiencies; Working Principle and Work done; Priming; Velocity triangles; Multistage pumps; Specific speed; Cavitation.</p>
Text books	<p>[T1] P.N. Modi& S.N. Seth, “Hydraulics & Fluid Mechanics”, 18th ed., Standard Book House, New Delhi, 2015.</p> <p>[T2] A.K. Jain, “Fluid Mechanics”, 11th ed., Khanna Publishers, New Delhi, 2014.</p>
Reference books	<p>[R1] Jagadhishlal, “Hydraulic Machines”, 9th ed., Metropolis Company, New Delhi, 2012.</p> <p>[R2] R. K. Bansal, “Fluid Mechanics and Hydraulic Machines”, 9th ed., Laxmi Publications; New Delhi, 2015.</p> <p>[R3] Rajput R.K., “Fluid Mechanics and Hydraulic Machines”, 3rd ed., S.Chand and Company Ltd., New Delhi, 2014.</p> <p>[R4] K. Subramanya, “Flow in Open Channels” – 3rd ed., Tata McGraw Hill Publishing Company, New Delhi, 2013.</p>
E-resources and other digital material	<p>www.nptel.ac.in / courses/ 105103096/</p> <p>www.nptel.ac.in / courses/ 105106114/</p>

20HS4105	UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY
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Course Category:	Humanities and Social Sciences	Credits:	3
Course Type:	Mandatory course (suggested by AICTE)	Lecture - Tutorial - Practice:	2-1-0
Prerequisites:	None. Universal Human Values 1 desirable.	Continuous Evaluation:	50
		Semester end Evaluation:	50
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the students will be able to:													
	CO1	understand and aware of themselves and their surroundings(family, society and nature).													
	CO2	handle problems with sustainable solutions, while keeping human relationships and human nature in mind.													
	CO3	exhibit critical ability and become sensitive to their commitment towards their understanding of human values, human relationship and human society.													
	CO4	apply what they have learnt to their own self in different day-to-day settings in real life.													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1						1			2					
	CO2			3											
	CO3						2								
	CO4								3				2		
Course Content		UNIT – I: COURSE INTRODUCTION, NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION: PART-1: Purpose and motivation for the course, recapitulation from UHV-I, Self-exploration: what is it?, its content and process, ‘Natural acceptance’ and experiential validation- as the process for self-exploration. Continuous Happiness and Prosperity – A look at basic Human Aspirations. PART-2: Right understanding, Relationship and Physical Facility – the basic requirements for													

	<p>fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly – A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.</p> <p>(Practice sessions are to be included to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking).</p>
	<p>UNIT – II:</p> <p>UNDERSTANDING HARMONY IN THE HUMAN BEING – HARMONY IN MYSELF:</p> <p>PART-1: Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’. Understanding the needs of Self (‘I’) and ‘Body’ – happiness and physical facility, Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer).</p> <p>PART-2: Understanding the characteristics and activities of ‘I’ and harmony in ‘I’. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.</p> <p>(Practice sessions are to be included to discuss the role others have played in making material goods available to me. Identifying from one’s own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease).</p>
	<p>UNIT – III:</p> <p>UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY – HARMONY IN HUMAN-HUMAN RELATIONSHIP:</p> <p>PART-1: Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.</p> <p>PART-2: Understanding the harmony in the society (society being an extension of family); Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society–Undivided Society, Universal Order–from family to world family.</p> <p>(Practice sessions are to be included to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education, etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students’ lives).</p>
	<p>UNIT – IV:</p> <p>PART-1: UNDERSTANDING HARMONY IN NATURE & EXISTENCE – WHOLE EXISTENCE AS COEXISTENCE: Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of Nature – recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.</p> <p>PART-2: IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS: Natural acceptance of human values, Definitiveness of ethical human conduct, Basis for humanistic education, humanistic constitution and humanistic universal order, Competence in professional ethics: a) ability to utilize the professional competence for augmenting universal human order, b) ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c) ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) at the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) at the level of society: as mutually enriching institutions and organizations.</p> <p>(Part-1: Practice sessions are to be included to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology, etc. Part-2: Practice exercises and case studies are to be taken up in practice (tutorial) sessions eg. to discuss the conduct as an</p>

	engineer or scientist, etc.)
Text books	[T1] Human values and professional ethics, R. R. Gaur, R. Sangal and G. P. Bagaria, Excel Books Private Limited, New Delhi (2010).
Reference books	<p>[R1] JeevanVidya: EkParichaya, A. Nagaraj, JeevanVidyaPrakashan, Amarkantak (1999).</p> <p>[R2] Human Values, A. N. Tripathi, New Age International Publishers, New Delhi (2004).</p> <p>[R3] The Story of Stuff: The impact of overconsumption on the planet, our communities, and our health and how we can make it better, Annie Leonard, Free Press, New York (2010).</p> <p>[R4] The story of my experiments with truth: Mahatma Gandhi Autobiography, Mohandas Karamchand Gandhi, B. N. Publishing (2008).</p> <p>[R5] Small is beautiful: A study of economics as if people mattered, E. F. Schumacher, Vintage Books, London (1993).</p> <p>[R6] Slow is beautiful: New Visions of Community, Cecile Andrews, New Society Publishers, Canada (2006).</p> <p>[R7] Economy of Permanence, J. C. Kumarappa, Sarva-Seva-SanghPrakashan, Varanasi (2017).</p> <p>[R8] Bharat Mein Angreji Raj, PanditSunderlal, PrabhathPrakashan, Delhi (2018).</p> <p>[R9] Rediscovering India, Dharampal, Society for Integrated Development of Himilayas (2003).</p> <p>[R10] Hind Swaraj or Indian Home Rule, M. K. Gandhi, Navajivan Publishing House, Ahmedabad (1909).</p> <p>[R11] India Wins Freedom: The Complete Version, MaulanaAbulKalam Azad, Orient Blackswan(1988).</p> <p>[R12] The Life of Vivekananda and the Universal gospel, Romain Rolland, AdvaitaAshrama, India (2010).</p> <p>[R13] Mahatma Gandhi: The Man who become one with the Universal Being, Romain Rolland, Srishti Publishers & Distributors, New Delhi (2002).</p>
E-resources and other digital material	https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLAx6AhQ https://fdp-si.aicte-india.org/download.php#1

Course Category:	Programme core lab1	Credits:	1.5
Course Type:	Practical	Lecture - Tutorial - Practice:	0-0-3
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	understand the properties of wood, steel and other building materials as per IS code provisions.												
		CO2	analyse the behaviour in stress-strain, deflection, flexure/bending and torsion, of building components												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	3	3		3	1				2	2		1		2
	CO2	3	3		3	1				2	2		1		2
Course Content			<ol style="list-style-type: none"> Study the stress-strain characteristics of mild steel/tor steel by Universal testing machine. Determine the ultimate shear strength of mild steel rod in single and double shear. Find the Brinnel's hardness number and Rockwell's hardness number of the given material. Find the Young's modulus of the given material (Wood/Steel/Aluminum) by conducting bending test on simply supported beam. Find the Young's modulus of the given material by conducting bending test on cantilever beam and propped cantilever. Find the impact resistance of the given material by conducting Charpy test and IZOD test on Impact testing machine. Find the modulus of rigidity by conducting torsion test on solid circular shaft. Determine the modulus of rigidity of the material of the spring. Determine the ductility of steel wire. Tests on timber. 												

	11. Strain gauge application and evaluation of stress. 12. Continuous beam – deflection test 13. Torsion Test on Beams: Torque and angle of twist characteristics, shear stress, modulus of rigidity, energy 14. Deflection Test on Beams: Load deformation characteristics, Young's Modulus, Maxwell's Reciprocal law verification.
Text books	[T1] Strength of Materials by S Ramamrutham& R Narayan; Dhanpat Rai Publishing Co.(P) Ltd, New Delhi.
Reference books	[R1] Material science and metallurgy for engineers by V D Kodgire and S V Kodgire, Everest publishing house, Pune.
E-resources and other digital material	https://home.iitm.ac.in/kramesh/Strength%20of%20Materials%20Laboratory%20Manual.pdf

20CE4352	FLUID MECHANICS AND HYDRAULIC MACHINES LAB
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Course Category:	Programme Core Lab 2	Credits:	1.5
Course Type:	Practical	Lecture - Tutorial - Practice:	0-0-3
Prerequisites:	Fluid Mechanics 20CE3304	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to :														
	CO1	evaluate the flow through pipes and open channels													
	CO2	analyze the performance of various Hydraulic machines													
Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2– Medium, 3– High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	3	3	3	3					2	3		1		3
	CO2	3	3	3	3					2	3		1		3
Course Content	1. Bernoulli's Experiment a) Validate Bernoulli's energy principle experimentally along a conduit. b) Signify the variation of the pressure and velocity along a converging-diverging pipe section. 2. Venturimeter & Orificemeter a) Determine the coefficient of discharge for a Venturimeter b) Determine the coefficient of contraction and coefficient of velocity for an Orificemeter c) Determine the flow-rate of a fluid along a pipe using Venturimeter / Orificemeter. 3. Orifices & Mouthpieces a) Workout the flow rate of a liquid using orifice for steady flow in water tanks . b) Workout the flow rate of a liquid using mouthpiece for steady flow / unsteady flow. 4. Reynold's experiment a) Characterise the state of fluid flow by Reynolds's Number b) Analyse the variation of discharge coefficients for various flow measuring devices with Reynolds number 5. Notches : Determination of flow-rate in an open channel using rectangular notch /V Notch / Trapezoidal Notch 6. Estimation of friction factor and major head loss for a given pipe system. 7. Determination of minor loss of head in pipes a) Due to bends														

	<p>b) Sudden contractions c) Sudden expansion.</p> <p>8. Determine Chezy's and Manning's coefficient for free surface flow in a rough/smooth surfaced rectangular channel.</p> <p>9. Measurement of force due to impact of jet on Flat/Curved vanes used in Hydropower projects</p> <p>10. a) Find the overall efficiency of single stage centrifugal pump. b) Study the Performance characteristics of Multistage centrifugal pump i) When pump is in series ii) When pump is in parallel.</p> <p>11. Study the Performance characteristics for Multistage Submersible pump.</p> <p>12. Determine the hydraulic efficiency for Impulse turbine (Pelton).</p> <p>13. Conduct Performance test for Reaction turbine (Kaplan / Francis) at constant head and determine efficiency.</p> <p>Demonstration Experiments:</p> <ol style="list-style-type: none"> 1. Performance studies on Reciprocating pump 2. Performance studies on Gear pump
Text books	<p>[T1] Fluid Mechanics and Hydraulic machinery laboratory manual by Dr. N.Kumara Swamy, Charrotar Publishing House Pvt. Ltd.</p> <p>[T2] Experiments in fluid mechanics by Dr. Baljeet Kapoor, Khanna Publications.</p> <p>[T3] Hydraulics and fluid mechanics including hydraulic machines by Dr. P.N.Modi and Dr. SM Seth, Standard book house, New Delhi</p>
Reference books	----
E-resources and other digital material	<p>www.nptel.ac.in/courses/105103096/</p> <p>www.nptel.ac.in/courses/105106114/</p>

Course Category:	Program Core Lab 3	Credits:	1.5
Course Type:	Practical	Lecture - Tutorial - Practice:	0-0-3
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	evaluate Index properties of soils												
		CO2	evaluate Engineering properties of soils												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	3			3					3	3				3
	CO2	3			3					3	3				3
Course Content		<p>The laboratory course in Geotechnical Engineering covers all the tests on soil required for classification of soil and also to determine the behaviour of soil. The list of experiments is divided into two cycles: The focus of Cycle I is the determination of <u>Index properties of soil</u>, which are used to classify the soil into various groups. The classification of soil into groups will give us an approximate idea on the behaviour of soil. The focus of Cycle II is the determination of <u>Engineering Properties of Soil</u>, which give the exact behaviour of the soils when subjected to loads. The following is the list of experiments included in the course curriculum:</p> <p><u>Cycle I: Classification of Soils based on Index Properties</u></p> <ul style="list-style-type: none"> • Moisture Content • Specific Gravity • Field Density to find the natural density of soil at a given place • Gradation to find particle size distribution • Hydrometer Analysis to find percentage of clay 													

	<ul style="list-style-type: none"> • Consistency Limits to find Liquid and Plastic limits • Free Swell Index to find swelling of soil <p><u>Cycle II: Engineering Properties to determine Soil behaviour</u></p> <ul style="list-style-type: none"> • Permeability test to estimate seepage discharge through earth dams/compacted soil in embankments etc. • Compaction Test to determine compaction characteristics of soil used to ascertain the suitability of soil for road construction/improving the properties of soil in a given plot etc. • Shear Tests on Soil including Direct Shear Test, Unconfined Compression Test and Unconsolidated Undrained Triaxial Shear Test to determine the shear characteristics of soil which are used in determination of Safe bearing capacity, Stability of soil slopes, Earth retaining walls etc. • Consolidation Test to determine rate and magnitude of soil settlement under loads [Demonstration]
Text books	[T1] Soil Mechanics and Foundation Engineering by K.R. Arora; Standard Publishers & Distributors, NaiSarak, New Delhi.
Reference books	[R1] Relevant Indian Standard Code Books
E-resources and other digital material	----

20TP4106	ENGLISH FOR PROFESSIONALS
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Course Category:	Programme Core	Credits:	1
Course Type:	PRACTICE	Lecture - Tutorial - Practice:	0-0-2
Prerequisites:	20TP1406 English For Professionals	Continuous Evaluation:	100
		Semester end Evaluation:	0
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to :													
		CO1	how conversations are made												
		CO2	usage of grammar												
		CO3	etiquettes and manners												
		CO4	speaking Skills												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3– High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO2
	CO1									3	3				
	CO2										3				
	CO3										3				
	CO4									3	3				
Course Content		UNIT – I 1. Beginners, Functional, Situational Conversations Introduction -Importance of spoken English in the placements and Group Discussion Beginners Conversation -Self Introduction-Introducing Self -Introducing each other in a team (Pair Activity) Functional Conversation -Seeking Permission from Seniors Teachers and other superiors (Team Activity) -Asking Direction-Direction from stranger or from Helpline -Making Requests-Requests for borrowing books, applications, or any other help from office staff in college or outside. 2. Just a minute: -Give a topic and ask the student to talk impromptu.													

	<p>-To present the topic in a structured manner.</p>
	<p>UNIT – II</p> <p>3. Structuring and forming sentences</p> <ul style="list-style-type: none"> -Structure of mother tongue and pit falls in translation to English. -Formation of sentences in English <p>4. Errors in Usage</p> <ul style="list-style-type: none"> -Difficulty in right usage of words. -Difficulty in Pronunciation-Phonetic differences in mother tongue and English –areas to improve. -Idioms and Phrase –Frequently used Idiom and Phrases which help to enhance the quality of presentation and make the presentation meaningful. -Meaning of frequently used Idioms and Phrases.
	<p>UNIT – III</p> <p>4. Introduction to different ways of speaking.</p> <ul style="list-style-type: none"> -Elocution, Debate and Extempore -Principles of Elocution and its challenges practice in session. -Principles of Debates and its challenges –practice session. -Principles of Extempore - its pitfalls- practice sessions.
	<p>UNIT – IV</p> <p>5. Etiquette</p> <ul style="list-style-type: none"> -Need of Etiquette in Social arena -Dining Etiquette -Social Etiquette in conversation -formal and informal gathering. -Book a table etc. <p>6. Versant Test</p> <ul style="list-style-type: none"> -Mode of versant Test, -Aim of the test and various methods it follows -Practice session.
Text books	----
Reference books	<p>[R1] KamaleshSadanand, “A Spoken English”, VOL 1&2; Orient BlackSwan, Second Edition,2014.</p> <p>[R2] “Communicative English”; Pearson; 2010</p>
E-resources and other digital material	----

20CE4607	AUTODESK REVIT AND EXCEL FOR ENGINEERS
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Course Category:	Skill Oriented Course-1	Credits:	2
Course Type:	Practical	Lecture - Tutorial - Practice:	0-0-3
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	analyze 3D Structural elements using Autodesk Revit and develop drawings with the necessary details for construction												
		CO2	apply spreadsheet techniques to solve different engineering problems.												
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	2	1			2						3		2	1
	CO2	2	2			2						3		2	1
Course Content		PART-A: AUTODESK RIVET STRUCTURES Design and Drawing the details of the following 3D Structural elements . 1. Create additional grids and levels, family content 2. Working with Structural Columns, Beams, walls, floors, foundations 3. Creating and managing Call out views,duplicatingviews, Annotations 4. Demonstrate the Skills and knowledge required to convert Autocadd 2D drawing to 3D model using Autodesk Rivet Structures 5. Modelling Steel truss frame and design connections 6. Demonstration on sheets Creation and managing materials, Cost analysis of whole structure, walkway through and sun path analysis													

	<p>B: Excel for Engineers</p> <ol style="list-style-type: none"> 1. Using excel as a engineering tool that helps solve real world problems related to civil engineering. 2. Gain knowledge in excel and visual basics for applications. 3. Create spreadsheets to solve different structural design problems. 4. Utilize excel engineering for optimization and uncertainty analysis. 5. Introduce user forms and user controls for overall project control
Text books	<p>[T1] Auto desk Rivet structures manual.</p> <p>[T2] Exploring Autodesk Revit 2020 for structures, 10th edition, by Prof. Sham Tickoo, Purdue University Northwest, USA</p> <p>[T3] MS Excel user manual.</p>
Reference books	<p>[R1] Autodesk Revit 2021 Structure Fundamentals by By ASCENT publications</p> <p>Published August 10, 2020, ISBN: 978-1-63057-358-4 ISBN 10: 1630573582</p>
E-resources and other digital material	<p>https://www.coursera.org/learn/autodesk-revit-for-structural-design-exam-prep</p>

20MC4108A	ENVIRONMENTAL STUDIES
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Course Category:	Mandatory Course	Credits:	---
Course Type:	Theory	Lecture-Tutorial-Practice:	2-0-0
Prerequisites:	Consciousness of Environment to make it a better place to live.	Continuous Evaluation:	40+40+3+17
		Semester end Evaluation:	
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
CO1	identify various factors causing degradation of natural resource, (remember, understand, apply)	
CO2	identify various ecosystem and need for biodiversity(apply)	
CO3	realize and explore the problems related to environmental pollution and its management(analyze, evaluate)	
CO4	apply the information and technology to analyze social issues, use acts associated with environment (create)	

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, Medium-2, 3- High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO1	1							1					1	
	CO2		1	1							1			1	
	CO3				1	1							1	1	
	CO4						1	1	1					1	

Course Content	UNIT I The Multidisciplinary Nature of Environmental Studies Definition, scope and importance Need for public awareness. NATURAL RESOURCES : RENEWABLE AND NON-RENEWABLE RESOURCES: Natural resources and associated problems. (a)FOREST RESOURCES: Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forests and tribal people. (b)WATER RESOURCES: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. (c)MINERAL RESOURCES: Use and exploitation, environmental effects of extracting and using mineral resources. (d)FOOD RESOURCES: World food problems, changes caused by agriculture
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	<p>and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.</p> <p>(e)ENERGY RESOURCES: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.</p> <p>(f)LAND RESOURCES: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.</p>
	<p>UNIT II</p> <p>ECOSYSTEMS</p> <p>Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)</p> <p>BIODIVERSITY AND ITS CONSERVATION</p> <p>Introduction, definition: genetic, species and ecosystem diversity. Biogeographically classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.</p>
	<p>UNIT III</p> <p>ENVIRONMENTAL POLLUTION</p> <p>Definition, Causes, effects and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards</p> <p>SOLID WASTE MANAGEMENT: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.</p> <p>DISASTER MANAGEMENT: Floods, earthquake, cyclone and landslides.</p>
	<p>UNIT IV</p> <p>SOCIAL ISSUES AND THE ENVIRONMENT:</p> <p>From unsustainable to sustainable development. Urban problems related to energy.</p> <p>Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns.</p> <p>ENVIRONMENTAL ETHICS Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products.</p> <p>ENVIRONMENT PROTECTION ACT</p> <p>Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues</p>

	<p>involved in enforcement of environmental legislation.</p> <p>PUBLIC AWARENESS</p> <p>Human Population and the Environment, Population growth, variation among nations, Population explosion—Family Welfare Programme.</p> <p>ENVIRONMENT AND HUMAN HEALTH</p> <p>Human rights, Value education, HIV/AIDS, Women and Child Welfare.</p> <p>Role of Information Technology in environment and human health.</p> <p>FIELD WORK/ CASE STUDIES</p> <p>Visit to a local area to document environmental assets—river/forest/grassland/hill/ mountain. Visit to a local polluted site—Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.</p>
Self-Study	Water resources, soil resources, mineral resource: radioactive elements, Threats to biodiversity, Solid waste management, Role of Information Technology in environment and human health.
Text books	[T1] Erach Bharucha. 2004, Environmental Studies for undergraduate courses, University Grants Commission, New Delhi, Bharati Vidyapeeth Institute of Environment Education and Research.
Reference books	<p>[R1] AnjaneyuluY. Introduction to Environmental sciences, B S Publications PVT Ltd, Hyderabad</p> <p>[R2] Anjireddy.M Environmental science & Technology, BS Publications PVT Ltd, Hyderabad.</p> <p>[R3] Benny Joseph, 2005, Environmental Studies, The Tata McGraw- Hill publishing company limited, New Delhi.</p> <p>[R4] Principles of Environmental Science. &Engg. P.Venu Gopala Rao, 2006, Prentice-Hall of India Pvt. Ltd., New Delhi.</p> <p>[R5] Ecological and Environmental Studies – Santosh Kumar Garg, Rajeswari Garg (or) Rajani Garg, 2006, Khanna Publishers, New Delhi.</p> <p>[R6] Essentials of Environmental Studies, Kurian Joseph & R Nagendran, Pearson Education publishers, 2005.</p> <p>[R7] A.K Dee – Environmental Chemistry, New Age India Publications.</p> <p>[R8] BharuchaErach- Biodiversity of India, Mapin Publishing Pvt.Ltd..</p>
E-resources and other digital material	https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

20CEM 4701	INTRODUCTION TO CIVIL ENGINEERING- CONCEPTS AND MATERIALS.
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Course Category:	Minor	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3 - 1- 0
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	understand evaluation of civil engineering materials and use of stone as a primary component.													
	CO2	evaluate the quality of bricks and timber.													
	CO3	apply test on cement and understand varieties of concrete.													
	CO4	analyze the quality of steel and paints.													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	3						2							3
	CO2	3						2							3
	CO3	3						2							3
	CO4	3						2							3
Course Content	UNIT – I INTRODUCTION General Introduction to Civil Engineering; History of Civil Engineering; Relevance of Civil Engineering in the overall infrastructural development of the country. STONES: Classification of rocks; Qualities of a good building stone; Uses of Stones; Stone quarrying;														

	Tools for blasting; Common building stones of India.
	UNIT – II BRICKS: Composition of good brick earth; Qualities of good bricks; Tests for bricks; Classification of bricks; Size and weight of bricks. TIMBER: Definition; Structure of a tree; Qualities of good timber; Preservation of timber; Seasoning of timber; Advantages of timber construction; Use of timber.
	UNIT – III CEMENT Basic Ingredients; Grades of cement; Properties of cement; Field tests on cement. CONCRETE Definition; properties; Special Concretes-Light weight concrete, High density concrete, Fibre reinforced concrete, Polymer concrete.
	UNIT – IV STEEL General; Manufacture of steel; Uses of steel; Market forms of steel; Properties of mild steel; Properties of hard steel; PAINTS, VARNISHES AND DISTEMPERS General; Painting; Varnishing; Distempering; Wall paper; White washing; Colour washing.
Text books	[T1] Engineering Materials by S. C. Rangwala; Charotar Publishing House. [T2] Building construction by B. C. Punmia -Laxmi Publications, New Delhi.
Reference books	[R1] Building construction and construction materials by G.S.Birdie and T.D.Ahuja, Dhanpathrai publishing company, New Delhi.
E-resource and other digital material	http://nptel.ac.in/courses/105102088/

20CEM5702	METHODOLOGY FOR CIVIL ENGINEERING CONSTRUCTION
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Course Category:	Minor	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	evaluate the feasibility of the construction project												
		CO2	apply planning and construction contracts												
		CO3	analyse construction finance and organization structure												
		CO4	evaluate the materials and adopt the quality control procedures												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	1	1	1							1	2			1
	CO2	1	1	1							1	2			1
	CO3	1	1	1						1	1	2			1
	CO4	1		1							1	2			1
Course Content		UNIT – I INTRODUCTION Role of government and construction agencies, classification of construction works, various stages in construction of a project, the construction team. PROJECT FEASIBILITY REPORTS Introduction, technical analysis, financial analysis, economic analysis, ecological analysis, schematic diagram for feasibility study.													

	<p>UNIT – II PLANNING FOR CONSTRUCTION PROJECTS General, steps involved in planning, objectives, principles, advantages of planning, limitations, stages and types of planning, stages of planning by different agencies.</p> <p>CONSTRUCTION CONTRACTS & TENDERS General, contract documents, types of contract, tender notice, types of tenders, tender documents, Earnest money deposit and security deposit.</p>
	<p>UNIT – III CONSTRUCTION FINANCING AND CONTROL Introduction, costs associated with constructed facilities, estimates, effect of scale on construction cost, means of financing, application of financial assistance, cost control.</p> <p>ORGANISING FOR CONSTRUCTION Importance, general principles, types of organization structures, forms of business organizations.</p>
	<p>UNIT – IV MATERIALS MANAGEMENT Importance, Objectives, Costs, functions of material management, uses, stores management, material procurement, maintaining stocks, material handling.</p> <p>QUALITY CONTROL IN CONSTRUCTION Elements of quality, Organisation for quality control, Quality assurance techniques, Documentation, Quality control circles, variation.</p>
Text books	[T1] Dr.S.Seetharaman, "Construction Engineering and Management", 5 th Edition, Umesh Publications, New Delhi,
Reference books	[R1] Kumar Neeraj Jha, "Construction Project Management", 2nd Edition, Pearson Education India, New Delhi, 2015
E-resources and other digital material	---

Course Category:	Minor	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

		Upon successful completion of the course, the student will be able to:													
		CO1	understand selection of resources with low environmental impact;												
		CO2	apply design of products with low environmental impact;												
		CO3	analyse product-Service System Design for eco-efficiency;												
		CO4	evaluate design for social equity and cohesion.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	1		1			2	3					1		2
	CO2	1		1			2	3					1		2
	CO3	1		1			2	3					1		2
	CO4	1		1			2	3					1		2
Course Content		UNIT – I INTRODUCTION Addressing Sustainability by design; An Introduction to Sustainable Product-Service Systems Applied to Distributed Renewable Energy; United Nations Sustainability Energy for All (SE4A) Agenda. DISTRIBUTED ENERGY SYSTEMS Distributed Renewable Energy Systems and Integrating S.PSS with DE													

	<p>UNIT – II SUSTAINABLE PRODUCT-SERVICE SYSTEM (S.PSS) Introduction to S.PSS; Types; Sustainability Benefits; Barriers and Limits</p> <p>SUSTAINABLE PRODUCT-SERVICE SYSTEM APPLIED TO DISTRIBUTED RENEWABLE ENERGIES</p> <p>A Win-Win Opportunity; Scenario for S.PSS applied to Distributed Renewable Energy(DRE); S.PSS Applied to DRE: Sustainability Potential Benefits; S.PSS Applied to DRE: Sustainability Potential Benefits</p>
	<p>UNIT – III DESIGN FOR SUSTAINABILITY: AN INTRODUCTION Evolution of Design for Sustainability ; Product Life Cycle Design or Eco-Design ;Design for Eco-Efficient Product-Service Systems ;Design for Social Equity and Cohesion ;Design for Socio-Technical Transitions ;State of the Art of Design for Sustainability Human-Centred and Universal Design</p> <p>SYSTEM DESIGN FOR SUSTAINABLE ENERGY FOR ALL: A NEW ROLE FOR DESIGNERS System Design for Sustainable Energy for All (SD4SEA); SDSEA Design Criteria, Guidelines and Examples</p>
	<p>UNIT – IV METHOD AND TOOLS FOR SYSTEM DESIGN FOR SUSTAINABLE ENERGY FOR ALL(SD4SEA)</p> <p>Method for System Design for Sustainable Energy; for All; Sustainability Design Orienting Scenario; (SDOS) on S.PSS&DRE; Sustainable Energy for All Idea Tables and Cards; E.DRE—Estimator for Distributed Renewable Energy; PSS + DRE Innovation Map S.PSS + DRE Design Framework & Cards ; The Energy System Map Innovation Diagram for S.PSS&DRE; Concept Description Form for S.PSS and DRE Stakeholder Motivation and Sustainability Table</p> <p>PRACTICAL EXAMPLES OF APPLICATION OF SDSEA APPROACH/TOOLS AND OTHER METHODS TO ACHIEVE SUSTAINABILITY</p> <p>Solar Energy Company, Botswana; SMEs for Energy, Uganda ; Summary and Considerations; green design; emotionally durable design; cradle to cradle design, biomimicry design; design for base of a pyramid design; design for social innovation</p>
<p>Text books</p>	<p>[T1] FabrizioCeschin , İdilGaziulusoy, Design for Sustainability A Multi- level Framework from Products to Socio- technical Systems , Taylor and Francis, 2020.</p> <p>[T2] Carlo Vezzoli; FabrizioCeschin; Lilac Osanjo; Mugendi K. M’Rithaa; Richie Moalosi; VennyNakazibwe; Jan Carel Diehl, Designing Sustainable Energy for All Sustainable Product-Service System Design Applied to Distributed Renewable Energy; Green Energy and Technology, Springer, 2018.</p>

Reference books	<p>[R1] Ceschin, F., and Gaziulusoy, I. (2016) Design for Sustainability: An Evolutionary Review, in Lloyd, P. and Bohemia, E. (eds.), Future Focused Thinking - DRS International Conference 2016, 27 - 30 June, Brighton, United Kingdom.</p> <p>[R2] Elisa Bacchetti, Towards sustainable energy for All Designing Sustainable Product-Service System applied to Distributed Renewable Energy, Politecnico di Milano, Milano, Italy 2017</p>
E-resources and other digital material	<p>Quality as Driver for Sustainable Construction—Holistic Quality Model and Assessment.pdf</p>

20CEM6703B	ECOLOGY AND ENVIRONMENT
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Course Category:	Minor	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	20CH1102 - Engineering chemistry 20MC4108B -Environmental studies	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	analyze the issues concerned with ecology, environment and sustainability.												
		CO2	evaluate the quantity and quality of water based on the available natural sources.												
		CO3	evaluate the water purification units and components of the distribution systems.												
		CO4	analyse the effect of various attributes of environmental pollution												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High))		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO 1	PSO2
	CO1	1						2					2		
	CO2	2	3		3		1						1		2
	CO3	2	1	3			1								3
	CO4	1	1	2	1										2
Course Content		UNIT – I INTRODUCTION TO ECOLOGY AND ENVIRONMENT Definition, scope & importance, need for public awareness- environment - definition, ecology, eco system - balanced ecosystem, human activities - food, shelter, economic and social security. SUSTAINABILITY Sustainability – definition, significance, sustainability goals, impacts of climate change, Case Studies.													

	<p>UNIT – II WATER SUPPLY - QUANTITY OF WATER Sources of water, objectives of water supply systems, Per capita consumption; Types of demands; Fluctuations in demand.</p> <p>QUALITY OF WATER Impurities in water; routine water analysis - physical, chemical and bacteriological tests; Standards for drinking water; Water borne diseases.</p>
	<p>UNIT – III WATER TREATMENT Fundamentals of purification of water; plain sedimentation; coagulation and types of coagulants; sedimentation and coagulation tanks; theory of filtration; slow sand and rapid sand filters; operation; disinfection.</p> <p>DISTRIBUTION SYSTEMS Methods of supply; Layouts, Plumbing-pipes and fittings; Traps; One pipe and Two pipe systems.</p>
	<p>UNIT – IV ENVIRONMENTAL POLLUTION Environmental Pollution and their effects. Water pollution, Land pollution, Air pollution, Public Health aspects.</p> <p>SOLID WASTE MANAGEMENT Solid waste characteristics–basics of on-site handling and collection–separation and processing – Incineration- Composting-Solid waste disposal methods – fundamentals of land filling.</p>
Text books	<p>[T1] Benny Joseph, “Environmental Studies”, Tata Mc Graw Hill, 2005 [T2] Ignaci Muthu S, “Ecology and Environment”, Eastern Book Corporation, 2007 [T3] Birdie G.S. and Birdie J. S., “Water Supply and Sanitary Engineering”, 9th ed., Dhanpat Rai Publishing Company, New Delhi, 2015.</p>
Reference books	<p>[R1] Garg S. K., “Environmental Engineering Vol. I& II- Water supply engineering”, Khanna Publishers, New Delhi, 2017. [R2] Gurucharan Singh, “Water Supply and Sanitary Engineering”, Standard Publishers Distributors, Delhi, 2009. [R3] Anjaneyulu Y. “Introduction to Environmental sciences”, B S Publications PVT Ltd, Hyderabad 2004.</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/127106004 (Ecology and environment by Dr. Abhijit P. Deshpande, IIT Madras).</p>

Course Category:	Minor	Credits:	4
Course Type:	Theory	Lecture - Tutorial -Practice:	3 - 1 - 0
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	understand different pavement structures													
	CO2	understand materials and methods used for construction													
	CO3	understand the components of the Railway Track.													
	CO4	analyse geometric features of railway track													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	3						1						3	
	CO2	3						1					1	3	
	CO3	3												3	
	CO4	3												3	
Course Content	UNIT-I INTRODUCTION TO ROADWAYS Different Modes of Transportation, Road development in India during twentieth century, Classification of different types of roads, Highway cross section elements,														
	PAVEMENTS Different types of pavements – Cross section, functions of pavement layers, Need for design, importance of drainage														
	UNIT-II MATERIALS FOR PAVEMENTS Materials used in highway construction- soil, fine and coarse aggregate, bituminous binders, cement, water.														
	CONSTRUCTION OF PAVEMENTS Construction of flexible pavement, Construction of rigid pavement, Equipment for excavation, equipment for compaction.														

	<p>UNIT-III INTRODUCTION TO RAILWAYS Historic development of railways in India, Classification of Indian Railways, Different gauges in Indian Railways</p> <p>COMPONENTS OF RAILWAY TRACK Permanent way cross section and functions, Types of rails, Types of Sleepers, Types of ballast, cross section of ballast, coning of wheels, sleeper density, length of rails.</p>
	<p>UNIT-IV</p> <p>GEOMETRIC FEATURES AND OPERATION Super elevation or cant, cant deficiency, cant excess, negative super elevation concept, types of transition curves, gradient types.</p> <p>POINTS AND CROSSINGS Switches, crossings, working principle of turnout, classification of signals, interlocking.</p>
Text books	<p>[T1] Sk Khanna, CEG Justo, A Veeraragavan, Highway Engineering, Nem Chand & Bros, 10th Edition, 2018</p> <p>[T2] Satish Chandra, MM Agarwal, Railway Engineering, Oxford University Press, 2nd Edition 2013</p>
Reference Book	<p>[R1] Saxena, S.C. and Arora. S, Railway Engineering, Dhanpat Rai, NDLS, 2009</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/105/105/105105107/ https://nptel.ac.in/courses/105/101/105101087/ https://archive.nptel.ac.in/courses/105/107/105107123/</p>

Course Category:	Minor	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	-	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	evaluate planning process of various construction projects and apply various software in various construction process												
		CO2	apply scheduling of various construction projects and apply PERT and CPM networking methods.												
		CO3	apply the various types of construction contracts and understand the elements of quality planning and the implication												
		CO4	analyse the various legal requirements and understand the various safety concepts and requirements applied to construction projects.												
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
	CO1	2	2	2	2	2				2	2	3	2		2
	CO2	2	2	2		2				2	3	3	2		2
	CO3	2	2					2	2	2	2	3			2
	CO4	2	2					2	2	2	2	3			2
(1 – Low, 2 - Medium, 3 – High)															
Course Content		UNIT – I PLANNING Steps involved in Planning; Objectives; Principles; Advantages; Limitations; Stages of planning; IT APPLICATIONS IN CONSTRUCTION Construction process – Computerization in Construction – Computer aided Cost Estimation – Developing application with database software.													

	<p>UNIT – II SCHEDULING Preparation of construction schedules; Methods of scheduling; Bar charts; Mile stone charts; Controlling; Job layout; Factors affecting job layout; Project work break down. PERT AND CPM Advanced planning and scheduling concepts – Computer applications – Case study.</p>
	<p>UNIT –III CONSTRUCTION CONTRACTS Indian Contracts Act – Elements of Contracts – Types of Contracts – Features – Suitability – Design of Contract Documents – International Contract Document – Standard Contract Document – Law of Torts QUALITY MANAGEMENT Introduction – Definitions and objectives – Factor influencing construction quality - Responsibilities and authority</p>
	<p>UNIT – IV LEGAL REQUIREMENTS Insurance and Bonding – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning, Local Government Laws for Approval. SAFETY MANAGEMENT Accidents and their Causes – Human Factors in Construction Safety - Costs of Construction Injuries – Occupational and Safety Hazard Assessment – Legal Implications, Owners responsibility and safety – owners responsibility clause.</p>
<p>Text books</p>	<p>[T1].Ming Sun and Rob Howard, “Understanding I.T. in Construction, Spon Press, Taylor and Francis Group, 2004. [T2].Feigenbaum,L., “Construction Scheduling with Primavera Project Planner: Prentice Hall Inc., 2002. [T3].George J.Ritz , “Total Construction Project Management”, McGraw-Hill Inc,1994.</p>
<p>Reference books</p>	<p>[R1] Gajaria G.T., “Laws Relating to Building and Engineering Contracts in India”, 4 th Edition, M.M.Tripathi Private Ltd., Bombay, 2000. [R2] Jimmie Hinze, “Construction Contracts”, 3 rd Edition, McGraw Hill, 2010. [R3] Joseph T. Bockrath, “Contracts and the Legal Environment for Engineers and Architects”, 7 th Edition McGraw Hill, 2010. [R4] Paulson, B.R., “Computer Applications in Construction”, Mc Graw Hill, 1995.</p>
<p>E-resources and other digital material</p>	<p>https://nptel.ac.in/courses/105103093 https://nptel.ac.in/courses/105104161</p>

20CEH4801A	STABILITY OF STRUCTURES
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Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	20CE5404/A – Advanced Structural Analysis.	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	analyze the buckling of columns, beam-columns and find critical loads using energy and non-energy methods												
		CO2	analyze the lateral buckling of beams by energy and non-energy methods												
		CO3	analyze the buckling of rectangular plates and find critical compressive loads for various boundary conditions												
		CO4	analyze the buckling of axially loaded cylindrical shells												
Contribution of Course Outcomes towards achievement of Program Outcomes (L – 1, M - 2, H – 3)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
	CO1	3	2		1	1								3	
	CO2	3	2		1	1								3	
	CO3	3	2		1	1								3	
	CO4	3	2		1	1								3	
Course Content		UNIT – I BUCKLING OF COLUMNS Introduction; Methods of finding critical loads; Critical loads for straight columns with different end conditions and loading; Inelastic buckling of axially loaded columns; Energy methods; Prismatic and non-prismatic columns under discrete and distributed loading. BEAM COLUMNS Theory of Beam column – Stability analysis of beam column with different types of loads.													
		UNIT – II BEAMS UNDER PURE BENDING Cantilever and simply supported beams of rectangular and I sections.													

	<p>BEAMS UNDER TRANSVERSE LOADING Energy methods; Solution of simple problems.</p>
	<p>UNIT – III</p> <p>PLATES SIMPLY SUPPORTED ON ALL EDGES Plates simply supported on all edges and subjected to constant compression in one or two directions.</p> <p>PLATES SIMPLY SUPPORTED ALONG TWO OPPOSITE SIDES Plates simply supported along two opposite sides perpendicular to the direction of compression and having various edge conditions along the other two sides.</p>
	<p>UNIT – IV</p> <p>BUCKLING OF AXIALLY COMPRESSED CYLINDRICAL SHELLS Introduction to buckling of axially compressed cylindrical shells, failure of axially compressed cylindrical shells.</p> <p>CRITICAL LOAD OF AN AXIALLY LOADED CYLINDER Linear theory of cylindrical shells-donnell equations, critical load of an axially loaded cylinder.</p>
Text books	<p>[T1] Theory of elastic stability by Timoshenko & Gere, McGraw Hill, 1961. [T2] Background to buckling by Allen and Bulson, McGrawHill, 1980.</p>
Reference books	<p>[R1] Elastic stability of structural elements by N.G.R.Iyengar, Macmillan India Ltd., 2007. [R2] Principles of Structural stability theory by AlexandarChajes, 1974.</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/105105166 https://youtu.be/ZSQ_5lRj5gI https://nptel.ac.in/courses/105108141</p>

20CEH4804B	SUSTAINABLE CONSTRUCTION METHODS
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Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	apply the green buildings and sustainable design aspects												
		CO2	analyze the water conservation and energy efficiency												
		CO3	evaluate the sustainable materials and wellbeing of residents												
		CO4	apply principles of green rating systems in construction												
Contribution of Course Outcomes towards achievement of Program Outcomes (Low – 1, Medium - 2, High – 3)		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	1		1				2	1						1
	CO2	1		1				2	1						1
	CO3	1		1			2	2	1						2
	CO4	1		1				2	1						2
Course Content		UNIT – I INTRODUCTION Green building, Global warming, requirement of Green Building, Benefits of green buildings SUSTAINABLE DESIGN Local building requirements, soil erosion control, natural topography, vegetation, heat island effect, roof & non-roof, passive architecture, basic house hold amenities, green education & awareness													

	<p>UNIT – II</p> <p>WATER CONSERVATION Water efficient plumbing fixtures, rain water harvesting, landscape design, management of irrigation system, recycle and reuse of waste water, water quality</p> <p>ENERGY EFFICIENCY HCFC free equipment, minimum energy performance, enhance energy performance, alternate water heating systems, on-site renewable energy – common lighting, energy efficiency in common area equipment, integrated energy monitoring system</p>
	<p>UNIT – III</p> <p>MATERIALS & RESOURCES Separation of house-hold waste, green procurement policy, local materials, eco friendly wood based materials, alternate construction material, handling of construction & demolition material.</p> <p>RESIDENT HEALTH & WELLBEING Minimum day lighting, Ventilation design, no smoking policy, enhanced day lighting, enhanced ventilation design, cross ventilation</p>
	<p>UNIT-IV</p> <p>CONSTRUCTION AND OPERATIONS Construction, Occupancy & Operations</p> <p>GREEN RATING SYSTEMS IGBC, LEED, GRIHA, BEE, benefits of rating systems, procedure to get IGBC certification</p>
<p>Text books</p>	<p>[T1] IGBC Green homes rating system Version 3.0 – A bridged reference guide, September 2019 [T2] Jerry Yudelson, “Green building through Integrated design”, Mc Graw Hill, 2009 [T3]Gautham R K, “Green Homes”, BSP Books Private Limited, New Delhi, 2009.</p>
<p>Reference books</p>	<p>[R1] “Sustainable building technical manual- Green building design, constructions and operation”, Produced by Public Technology Inc., US Green Building Council</p>
<p>E-resources and other digital material</p>	<p>---</p>

20CEH4801C	DESIGN OF FORMWORK
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Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:		Continuous Evaluation:	
		Semester end Evaluation:	
		Total Marks:	

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	apply a right material for manufacturing false work and form work suiting specific													
	CO2	analyze the pressure of concrete on form work													
	CO3	evaluate the adequacy of decking, form work and false work.													
	CO4	evaluate the sequence of construction of civil engineering structures and safety steps involved in the design of form work and false work.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
	CO1		1			2	1	1		1	1				2
	CO2	2	2	1		2								2	
	CO3	3	3	3			1			1				3	1
(Low – 1, Medium - 2, High – 3)	CO4	1	2			1	2	1		1	1			2	
Course Content	UNIT – I INTRODUCTION Formwork and false work, Temporary work systems, Construction planning and site constraints. MATERIALS OF FORMWORK Materials and construction of the common formwork and false work systems, Special and proprietary forms.														
	UNIT – II FORM WORK Formwork – Design: Concrete pressure on forms, Design of timber and steel forms														

	<p>ANALYSIS OF FORMWORK Loading and moment of formwork.</p> <p>UNIT – III DESIGN OF DECKS Types of beam, decking and column formwork, Design of decking</p> <p>FALSE WORKS False work design, Effects of wind load, Foundation and soil on false work design.</p> <p>UNIT – IV SPECIAL FORMS The use and applications of special forms.</p> <p>CONSTRUCTION SEQUENCE AND SAFETY IN USE OF FORMWORK Sequence of construction, Safety use of formwork and false work.</p>
Text books	<p>[T1] Robert L. Peurifoy and Garold D. Oberiender, “Formwork for Concrete Structures”, McGraw-Hill, 1996 .</p> <p>[T2] Tudor Dinescu and Constantin Radulescu, “Slip Form Techniques”, Abacus Press, Turn Bridge Wells, Kent, 2004.</p>
Reference books	<p>[R1] Austin, C.K., “Formwork for concrete”, Cleaver - Hume Press Ltd., London, 1996</p> <p>[R2] Michael P. Hurst, “Construction Press”, London and New York., 2003</p>
E-resources and other digital material	Open web

20CEH5802A	ENGINEERING ROCK MECHANICS
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Course Category:	Honors	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	20ES3102A - Engineering Geology	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	evaluate rock masses based on classification systems												
		CO2	apply the field and laboratory testing on rocks to assess engineering properties												
		CO3	analyze rocks based on the failure criteria under various stress fields												
		CO4	evaluate the bearing capacity of foundation on rocks and understand various slope stability methods												
Contribution of Course Outcomes towards achievement of Program Outcomes (Low – 1, Medium - 2, High – 3)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	3	2	2			3								1
	CO2	3	2	2			3								1
	CO3	3	2	2			3								1
	CO4	3	2	2			3								1
Course Content		UNIT – I INTRODUCTION TO ROCK MECHANICS AND CLASSIFICATION OF ROCKS Objectives of rock mechanics, Fields of application of rock mechanics. Geological Classification of igneous, sedimentary and metamorphic rocks based on texture and stratification ROCK MASS CLASSIFICATIONS Rock Quality Designation (RQD), Rock Structure Rating (RSR), Rock Mass Rating (RMR).													

	<p>UNIT - II LABORATORY TESTS - PHYSICO —MECHANICAL PROPERTIES OF ROCKS Compressive strength, Tensile strength, Direct shear test, Triaxial shear test, Slake durability test, Schmidt rebound hardness test</p> <p>FIELD TESTS - PHYSICO —MECHANICAL PROPERTIES OF ROCKS Uniaxial jacking test- Pressure meter tests Hydraulic fracturing- Flat jack test Stress. Electric resistivity method- Seismic refraction method</p>
	<p>UNIT – III FAILURE CRITERIA FOR ROCK AND ROCK MASSES Mohr-Coulomb Yield Criterion, Hoek-Brown Criterion,</p> <p>STRENGTH AND DEFORMABILITY OF JOINTED ROCK MASS Shear strength of Rock joints, Deformability of Rock joints, Concept of joint compliance</p>
	<p>UNIT - IV FOUNDATION ON ROCKS Estimation of bearing capacity, Settlement in rocks, Pile foundation in rocks. STABILITY OF ROCK SLOPES AND METHODS TO IMPROVE ROCK MASS RESPONSES Modes of failure. Grouting in Rocks, Rock bolting, Rock Anchors.</p>
Text books	<p>[T1] Goodman-Introduction to Rock mechanics,Wiley International(1980). [T2] Ramamurthy, T. - Engineering in Rocks for slopes, foundations and tunnels, Prentice Hall of India.(2007) [T3] Rock mechanics in engineering practice: Stagg and Zienkiewicz, John Wiley & sons</p>
Reference books	<p>[R1] Jaeger, J. C. and Cook, N. G. W. — Fundamentals of Rock Mechanics, Chapman and Hall, London.(1979). [R2] Hoek, E. and Brown, E. T. Underground Excavation in Rock, Institution of Mining and Metallurgy, 1982. [R3] Brady, B. H. G. and Brown, E. T. - Rock Mechanics for Underground Mining, Chapman & Hall, 1993. [R4] Rock mechanics for engineers: Varma, B.P,Khanna Publishers</p>
E-resources and other digital material	---

20CEH5801B	ADVANCED STEEL DESIGN
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Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	Design of Steel Structures	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
CO1		analyse safe section for Tension members with lug angle and Built up Compression Members													
CO2		analyse safe section for Plate girders													
CO3		analyse for safe section for gantry girders													
CO4		analyse safe section for eccentric connections													
Contribution of Course Outcomes towards achievement of Program Outcomes (Low – 1, Medium - 2, High – 3)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	2		2		3	1						1	3	
	CO2	2		2		3	1						1	3	
	CO3	2		2		3	1						1	3	
	CO4	2		2		3	1						1	3	
Course Content		UNIT - I TENSION MEMBERS (IS800-2007) Design of tension members with Lug angles with bolted and welded connections. COMPRESSION MEMBERS (IS800-2007) Design of axially loaded built up compression members with Laced and Battened columns with bolted and welded connections.													

	<p>UNIT - II</p> <p>INTRODUCTION TO GANTRY GIRDER Introduction, Various loads, Load effects, explanation of how to calculate loads, Calculation of Maximum SF and Maximum BM using influence lines, Deflections</p> <p>DESIGN OF GANTRY GIRDER Design of Gantry Girder, Problems on design of gantry girder.</p>
	<p>UNIT - III</p> <p>INTRODUCTION TO PLATE GIRDERS Introduction to plate girder, Elements eccentric depth, Design of web and flanges, Design of plate girders without stiffeners, Problems</p> <p>DESIGN OF PLATE GIRDERS Design of plate girders with stiffeners, Design of plate girders with intermediate stiffeners, Problems on plate girders with intermediate stiffeners</p>
	<p>UNIT – IV</p> <p>SEATED CONNECTIONS Introduction to Connections, Unstiffened seated connections-bolted and welded, Stiffened seated connection-bolted and welded</p> <p>BRACKET CONNECTIONS Bracket Connections, type1-bolted and welded, Bracket connection type2-bolted and welded</p>
Text books	<p>[T1] Duggal, S.K., Limit State Design of Steel Structures, McGraw-Hill, NDLS, 2019. [T2] Bhavikatti, S.S., Design of Steel Structures-By Limit State Method as per IS:800-2007, I. K. IBH Pvt. Ltd., NDLS, 2019.</p>
Reference books	<p>[R1] Subramanian, N., Design of Steel Structures-Limit State Method Oxford University press, HYB, 2018. [R2] Ram, K.S.S., Design of Steel Structures, Pearson Education India, NDLS, 2015. [R3] Chandra, R. and Gehlot, V., Limit State Design of Steel Structures, Scientific Publishers, NDLS, 2010.</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/105105162 https://nptel.ac.in/courses/105106113</p>

20CEH5804C	GEOSPATIAL DATA PROCESSING
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Course Category:	Honors	Credits:	4
Course Type:	Theory and practical	Lecture - Tutorial - Practice:	3 - 0- 2
Prerequisites:	NIL	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	understand the concepts of Geographical information systems and apply them in various engineering applications.													
	CO2	evaluate appropriate remote sensing data products for mapping, monitoring and management applications.													
	CO3	apply various image processing techniques and their applications.													
	CO4	apply RS and GIS techniques for solving Engineering applications.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	3	2	3		3									3
	CO2	3	2	3		3									3
	CO3	3	2	3		3								2	
	CO4	3	2	3		3								2	
(Low – 1, Medium - 2, High – 3)															
Course Content	UNIT-I GEOGRAPHICAL INFORMATION SYSTEM Components of GIS, Types of Data, coordinate systems, Geographic coordinate system, Projected coordinate system, Maps and scales, Types of Maps and scales, Projections, Types of Projections, Geo referencing, Data structures, GIS analysis functions. DATA EDITING AND STORAGE Raster and vector data models, Digitization, Data editing, Errors and corrections, data presentation and generation of thematic maps, spatial database management systems, Data														

representation, Data storage, Entity relationship models.

Practise

1. Introduction to Arc GIS and Georeferencing, projections and re-projections
2. Creating a shape file, clip and attribute data manipulation.

UNIT-II

INTRODUCTION TO REMOTE SENSING

Introduction, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, and vegetation), Resolution, image registration and elements of visual interpretation techniques.

DATA ACQUISITION AND PLATFORMS

Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms-IRS, Landsat, Sentinel, SPOT, CARTOSAT, etc. sensors, sensor resolutions (spatial, spectral, radiometric and temporal), Optical, Thermal and Microwave, signal to noise ratio, LiDAR data acquisition and processing.

Practise

3. Data Digitization (Draw, edit, delete and update)

UNIT-III

IMAGE CLASSIFICATION TECHNIQUES

Supervised Classification, Unsupervised classification, ANN and SVM classification techniques

SPECTRAL INDICES

Vegetation indices, water related indices, Digital elevation model, Digital terrain model, Triangulated irregular networks.

Practise

4. Data Analysis – Overlay, Buffer
5. Generation of DEM and DTM using raster data.

UNIT-IV

APPLICATIONS IN SCIENCE DOMAIN

Applications of Remote sensing in various Engineering and Science domains such as Agriculture, Forest, Soil, Geology

APPLICATIONS IN ENGINEERING DOMAIN

LU/LC, Water Resources, Urban, Disaster Management, etc.

	Practise 6.Assignment on Application of Geospatial techniques in Civil Engineering.
Text books	[T1] Photogrammetry, GIS & Remote Sensing, <u>SSManugula</u> , VeerannaBommakanti,, Educreation Publishing, 2018 [T2] Text Book of Remote Sensing and Geographical Information Systems, M. Anji Reddy, BS Publications/BSP Books, 4 th edition, 2012
Reference books	[R1] Remote Sensing and Image Interpretation, Lillesand, T.M, R.W. Kiefer andJ.W. Chipman, Wiley India Pvt. Ltd., New Delhi,7th Edition 2015 [R2] Remote Sensing and GIS, BasudeBhatta, Oxford UniversityPress,2nd Edition, 2011
E-resources and other digital material	https://nptel.ac.in/courses/105/103/105103193/ https://nptel.ac.in/courses/105/101/105101206/ https://nptel.ac.in/courses/105/107/105107206/

Course Category:	Honors	Credits:	4
Course Type:	Program Elective	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	20CE6302	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO 1	understand traffic engineering studies, analyse the data and present the results.													
	CO 2	evaluate traffic and road facilities, and intersection control measures for smooth traffic movement.													
	CO 3	analyse appropriate traffic control and management measures.													
	CO 4	apply the principles of queuing theory to analyse delay at signalized and unsignalized intersections.													
Contribution of Course Outcomes towards achievement of Program Outcomes (Low – 1, Medium - 2, High – 3)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO 1	3	2	1	3	1	1			1					
	CO 2	3	3							1				3	
	CO 3	3			2	2	3			1					3
	CO 4	3	3							1					3
Course Content	UNIT – I TRAFFIC ENGINEERING STUDIES AND ANALYSIS Sampling in Traffic Studies, Adequacy of Sample Size; Objectives, Methods of Study, Equipment.														

	<p>Data Collection, Analysis and Interpretation Case Studies of (a) Speed (b) Speed and Delay (c) Volume (d) Origin and Destination (e) Parking (f) Accident & other Studies</p>
	<p>UNIT – II DESIGN OF TRAFFIC ENGINEERING FACILITIES Control of Traffic Movements through Time Sharing and Space Sharing Concepts.</p> <p>Design of Islands Design of Channelising Islands, T, Y, Skewed, Staggered, Roundabout, Mini-roundabout and other forms of AT-Grade Crossings including provision for safe crossing of Pedestrians and Cyclists; Grade Separated Intersections, their Warrants and Design Features; Bus Stop Location and Bus Bay Design</p>
	<p>UNIT – III TRAFFIC REGULATION AND MANAGEMENT Traffic Signs, Markings and Signals; Principles of Signal Design, Webster's method of Signal Design, Redesign of Existing Signals including Case Studies; Signal System and Coordination.</p> <p>TRAFFIC MANAGEMENT MEASURES Speed, vehicle, parking, enforcement regulations, mixed traffic regulation, various management techniques .</p>
	<p>UNIT – IV TRAFFIC STREAM MODELS Fundamental Equation of Traffic Flow, Speed-Flow-Concentration Relationships, Normalised Relationship, Fluid Flow Analogy Approach, Shock Wave Theory, Platoon Diffusion and Boltzman Like Behaviour of Traffic Flow, Car-Following Theory, Linear and Non-Linear Car-Following Models, Acceleration Noise.</p> <p>QUEUING ANALYSIS Fundamentals of Queuing Theory, Demand Service Characteristics, Deterministic Queuing Models, Stochastic Queuing Models, Multiple Service Channels, Models of Delay at Intersections and Pedestrian Crossings.</p>
Text books	<p>[T1] Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna publishers, 2011. [T2] The Institute of Transportation Engineers, Traffic Engineering Handbook, 7th edn, 2016.</p>
Reference books	<p>[R1] IRC-SP41: Guidelines for the Design of At-Grade Intersections in Rural & Urban Areas [R2] Pignataro, L., Traffic Engineering – Theory & Practice, John Wiley, 1973. [R3] Salter, R J., Highway Traffic Analysis and Design, ELBS, 1996</p>
E-Reference	<p>Nil</p>

Course Category:	Honors	Credits:	4
Course Type:	Program Elective	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	20CE6302	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	apply the economic principles and estimating the various cost components in transportation												
		CO2	apply the possible project alternatives for the economic analysis and applying the appropriate economic analysis method												
		CO3	analyze Demand and Supply modelling												
		CO4	understand Knowledge on Regulation and Policy making of Economic Evaluation												
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2
	CO1	3	3	1		1				1		1		3	3
	CO2	3	3	1	1	3				1		1			
	CO3	3	1	1	3										
	CO4	3							3	1		1			3
Course Content		UNIT – I TRANSPORT COSTS AND BENEFITS Principles of economic analysis, Fixed and variable cost, cost of improvement, maintenance cost, cost estimating methods, accounting for inflation, external costs. CONSEQUENCES OF TRANSPORT PROJECTS, ROAD USER CONSEQUENCES Reduced vehicle operation costs, value of travel time savings, value of increased comfort and convenience, cost of accident reduction, reduction in maintenance cost, non-user consequences – travel time.													

	<p>UNIT – II</p> <p>ECONOMIC ANALYSIS METHODS</p> <p>Generation and screening of project Alternatives</p> <p>DIFFERENT METHODS OF ECONOMIC ANALYSIS</p> <p>annual cost and benefit ratio methods, discounted cash flow methods, shadow pricing techniques, determination of IRR and NPV, examples of economic analysis, application economic theory in traffic assignment problem.</p> <p>UNIT – III</p> <p>TRANSPORT DEMAND</p> <p>The Basic Framework- measuring the demand in a spatial and temporal setting. Traditional Four-Stage Demand Model; modern approaches to modelling demand and practical issues in demand estimation.</p> <p>TRANSPORT SUPPLY</p> <p>The nature of output in transport, output and costs, economies of size, density and scope, empirical estimation of transport cost functions- the approaches and illustrations.</p> <p>UNIT – IV</p> <p>REGULATION AND POLICY</p> <p>Theory of Regulation, Deregulation and Privatisation in Transport. Approaches to privatisation of transport infrastructure and services and a competition policy for transport. Evolution of transport policy in India with focus on case studies regarding different modes.</p> <p>EVOLUTION OF POLICY</p> <p>Evolution of transport policy in India with focus on case studies regarding different modes.</p>
Text books	<p>[T1] McCarthy, P. S., Transportation Economics, Massachusetts: Blackwell Publishers. 2001</p> <p>[T2] Winfrey R, Highway Economic Analysis, International Textbook Company, 1969.</p>
Reference books	<p>[R1] Kenneth J. Button, Transport Economics, Elgar, 2010</p> <p>[R2] David A. Hensher, Ann M. Brewer, Transport: An Economics and Management Perspective, Oxford University Press, 2001.</p> <p>[R3] Emile Quinet, Roger Vickerman, Principles of Transport Economics, Edward Elgar Pub, 2005</p> <p>[R4] Road User Cost Study, Central Road Research Institute</p> <p>[R5] Dickey J.W, Project Appraisal for Developing Countries, John Wiley, 1984</p>
E-resources and other digital material	<p>https://www.civil.iitb.ac.in/~dhingra</p>

Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	20CE6404/B Foundation Engineering	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	apply various bearing capacity determination techniques and												
		CO2	analysis for determination of bearing capacity and settlement of shallow foundation												
		CO3	evaluate safe capacity of pile foundation for all types of loads												
		CO4	analyze section for stability of well foundation / caisson.												
Contribution of Course Outcomes towards achievement of Program Outcomes (Low – 1, Medium - 2, High – 3)		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2
	CO1	3	1	1									2		2
	CO2	3	1	1									2		2
	CO3	3	1	1									2		2
	CO4	3	1	1									2		2
Course Content		UNIT – I BEARING CAPACITY OF SHALLOW FOUNDATIONS Vesic method, IS Code method; Effect of Water Table; Footings with Eccentric or Inclined Loads, Footings on Layered Soils. ESTIMATION OF BEARING CAPACITY BASED ON FIELD TESTS Bearing Pressure using SPT& CPT,													
		UNIT – II CONCEPT OF SETTLEMENT CLASSIC THEORIES Immediate Settlement, Consolidation Settlement; Secondary Compression Settlement. SETTLEMENT ESTIMATION - EMPIRICAL METHODS Settlement of foundations on Sands-Schmertmann													

	<p>UNIT – III PILES IN COMPRESSION Static capacity of piles, Point Bearing Resistance with SPT and CPT ;Ultimate Capacity of Pile Groups in Compression, Settlement; Pile Load Test; Negative Skin Friction.</p> <p>SPECIAL PILES AND SETTLEMENTS OF PILE Laterally Loaded Piles -Ultimate Lateral Resistance; Batter Piles; Under Reamed Piles; Mini and Micro Piles, Pullout & Lateral Load; Efficiency; Settlements of Pile Groups;</p> <p>UNIT – IV WELL FOUNDATIONS Open wells; Design of pier foundations and well foundations; Lateral stability of well foundations; R.C.C. designs of wells</p> <p>PNEUMATIC CAISSONS Introduction to Pneumatic Caissons, construction of piers;</p>
Text books	<p>[T1] Das, B. M. Principles of Foundation Engineering 5th Edition Nelson Engineering, 2004. [T2] Coduto, D.P. Foundation Design Principles and Practices, 2nd edition, Pearson, Indian edition, 2012. Phi Learning, 2008. [T3] Bowles, J. E. Foundation Analysis & Design 5th Edition McGraw-Hill Companies, Inc., 1996. [T4] Poulos, H. G. & Davis, E. H. Pile Foundation Analysis and Design, John Wiley & Sons Inc, 2008.</p>
Reference books	<p>[R1] Reese, L. C. & Van Impe, W. F. Single Piles and Pile Groups under Lateral Loading -Taylor & Francis Group (Jan 2000) [R2] Rowe, R. K. Geotechnical & Geo-environmental Engineering Hand Book -Springer ,2001. [R3] Tomlinson, M. J. Foundation Design and Construction, PHI , 2003.</p>
E-resources and other digital material	<p>nptel.ac.in/courses/105107120 nptel.ac.in/courses/105101083</p>

20CEH7802A	GEOSYNTHETICS AND REINFORCED SOIL STRUCTURES
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Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	Geotechnical Engineering	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	analyze the properties of geo synthetics													
	CO2	understand functions and applications of geo synthetics													
	CO3	evaluate a typical section for the construction of reinforced earth walls													
	CO4	evaluate reinforced earth slopes and foundations													
Contribution of Course Outcomes towards achievement of Program Outcomes (Low– 1, Medium - 2, High – 3)															
	CO1	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO2	3	3	3		3								3	3
	CO3	3	3	3		3								3	3
	CO4	3	3	3		3								3	3
Course Content	UNIT – I GEOSYNTHETICS Introduction to Geosynthetics-Types of geosynthetics- Functions of Geosynthetics- Applications of Geosynthetics- Strength of reinforced soils MANUFACTURING OF GEOSYNTHETICS Manufacture of geotextiles- Manufacture of geogrids- Manufacture of geonets- Manufacture of geomembranes- Manufacture of geocomposites														
	UNIT – II PROPERTIES OF GEOSYNTHETICS Physical properties-Mechanical Properties-Hydraulic Properties-Endurance Properties-Degradation properties														

	<p>TESTING OF GEOSYNTHETICS Need for testing of Geosynthetics-Testing of geogrids-Testing of geonets-Testing of geomembranes-Testing of GCLs</p> <p>UNIT – III EXTERNAL STABILITY ANALYSIS OF REINFORCED SOIL WALLS Different Types of Soil Retaining Structures-Construction Aspects of Geosynthetic Reinforced Soil Retaining Walls-External Stability Analysis of Reinforced Soil Retaining Walls</p> <p>INTERNAL STABILITY ANALYSIS OF REINFORCED SOIL WALLS Internal Stability Analysis of Reinforced Soil Walls- Testing requirements for Reinforced Soil Retaining Walls- Design of Gabions.</p> <p>UNIT – IV STABILITY ANALYSIS OF REINFORCED SOIL EMBANKMENTS Stability analysis of reinforced soil Embankments resting on soft foundation soils-Stability analysis of reinforced soil slopes- Reinforced soil for supporting shallow foundations-Natural geosynthetics and their applications.</p> <p>GEOSYNTHETICS FOR LANDFILLS Geosynthetics for construction of municipal waste landfills-Geosynthetics for construction of hazardous waste landfills</p>
Text books	<p>[T1] Koerner, R.M. “Designing with Geosynthetics”, Prentice Hall, Eaglewood cliffs, NJ, 2005. [T2] Sanjay Kumar Shukla, Jian-Hua Yin, Taylor, “Fundamentals of Geosynthetics Engineering” & Francis, Milton Park, Abingdon, UK, 2010. [T3] Saran, S. “Reinforced Soil and Its Engineering Applications”, I.K. International Pvt Ltd, New Delhi, 2005.</p>
Reference books	<p>[R1] Venkatappa Rao, G. and Suryanarayana Raju, GVS. “Engineering with Geosynthetics”, Tata McGraw Hill Publishing Company Limited – New Delhi, 2008. [R2] Koerner, R.M. and Welsh, J. P. “Construction and Geotechnical Engineering using Synthetic Fabrics” by. John Willey and Sons, New York, 1993.</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/105/101/105101143/[J. N. Mandal, Geosynthetics Engineering]</p>

20CEH7803B	INTELLIGENT TRANSPORTATION SYSTEMS
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Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial -Practice:	3 - 1 – 0
Prerequisites:	Transportation Engineering	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	evaluate the need and basics of ITS and data collection techniques													
	CO2	apply ITS for different functional areas													
	CO3	apply ITS for different user needs and services													
	CO4	understand the significance of ITS in developed and developing countries													
Contribution of Course Outcomes towards achievement of Program Outcomes (Low – 1, Medium - 2, High – 3)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	2		2		2									2
	CO2	2				2									2
	CO3	2	2			2									2
	CO4	2	2			2							2		2
Course Content	UNIT-I														
	INTRODUCTION TO ITS Definition of ITS, ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.														
	TELECOMMUNICATIONS IN ITS Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System														
	UNIT-II														
	ITS FUNCTIONAL AREAS Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO),														
	ITS FUNCTIONAL AREAS IN TRANSPORTATION SYSTEM Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).														

	UNIT-III ITS USER NEEDS Travel and Traffic management, Public Transportation Management, Electronic Payment, ITS User Services Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.
	UNIT-IV AUTOMATED HIGHWAY SYSTEMS Automated highway system - Vehicles in Platoons – Integration of Automated Highway Systems. ITS PROGRAMS IN THE WORLD Overview of ITS implementations in developed countries, ITS in developing countries.
Text books	[T1] Ghosh. S, T. Lee, T.S Lee. “Intelligent Transportation Systems: New Principles and Architectures”, 1 st ed, CRC Press, Boca Raton, 2000. [T2] Sussman. J, “Perspective on Intelligent Transport System ITS”, 1 st ed, Artech House Publishers, Boston 2005.
Reference Book	[R1] M.A. Chowdhury, & A. Sadek, “Fundamentals of Intelligent Transportation Systems Planning”, 1st ed, Artech House Publishers, Boston, 2003. [R2] J. Miles, K. Chen, C.J.C Miles, “ITS Hand Book 2000: Recommendations for World Road Association (PIARC)” 1 st ed, Artech House Publishers, Boston, 1999
E-resources and other digital material	https://www.civil.iitb.ac.in/~vmtom/nptel/591_ITS_1/web/web.html https://coeut.iitm.ac.in/ITS_synthesis.pdf [https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-212j-an-introduction-to-intelligent-transportation-systems-spring-2005/lecture-notes/

20CEH7804C	ENVIRONMENTAL IMPACT ASSESSMENT
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Course Category:	Honours	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3 - 1- 0
Prerequisites:	17MC4108B – Environmental studies	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	understand the Concept of EIA, EIA methodologies.													
	CO2	analyze the effect on different sources on developmental activities.													
	CO3	analyze the effect of development on flora and fauna.													
	CO4	understand the different acts and case studies.													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	3					2						1		2
	CO2	3	2							3					2
	CO3	3	2										1		2
	CO4						2								2
(Low – 1, Medium - 2, High – 3)															
Course Content	UNIT I INTRODUCTION TO ENVIRONMENTAL IMPACT ASSESSMENT Basic concept-Salient Features of EIA, EIA Procedure – Analytical functions of EIA – classification and prediction of impacts -Elements of EIA - Factors affecting EIA – Impact evaluation and analysis - Preparation of environmental base map - Classification of environmental parameters. EIA METHODOLOGIES Criteria for the selection of EIA Methodology – EIA methods - Adhoc methods, matrix methods, network method - Environmental medium quality index method, overlay methods and cost/benefit analysis.														

	<p>UNIT II ENVIRONMENTAL IMPACT ASSESSMENT ON SOIL AND GROUND WATER Introduction, Prediction and assessment - Soil quality -Methodology for the assessment of soil and groundwater - Delineation of study area - Identification of activities.</p> <p>ENVIRONMENTAL IMPACT ASSESSMENT OF SURFACE WATER AND AIR Impact prediction - Assessment of impact significance - Identification and incorporation of mitigation measures - EIA in surface water, air and biological environment: Methodology for the assessment of impacts on surface water environment. Air pollution sources, Air pollution effect - Generalized approach for assessment of air pollution Impact.</p>
	<p>UNIT III ASSESSMENT OF IMPACT ON VEGETATION AND WILDLIFE</p> <p>Assessment of impact of developmental activities on vegetation and wildlife - Environmental impact of deforestation – Causes and effects of deforestation.</p> <p>ENVIRONMENTAL AUDIT Environmental audit and environmental legislation - Objectives of environmental audit - Types of environmental audit - Audit protocol - Stages of environmental audit - Onsite activities - Evaluation of audit data and preparation of audit report.</p>
	<p>UNIT – IV ENVIRONMENTAL ACTS Post audit activities - The Environmental protection act - The water act - The air act - Wild life act.</p> <p>CASE STUDIES Case studies and preparation of environmental impact assessment statement for various industries.</p>
Text books	<p>[T1] Anjaneyulu, VallManickam, “Environmental Impact Assessment Methodologies”, 2nd Edition ,B.S. Publications, 2007.</p> <p>[T2] Glynn. J, and Gary W. Heinke, “Environmental Science and Engineering”, PHI, NDLS, 1996.</p>
Reference books	<p>[R1] Barthwal, R. R., “Environmental Impact Assessment”, New Age International Publications</p> <p>[R2] Dhameja,S.K., Environmental Engineering and Management, Kataria, NDLS, 2010.</p> <p>[R3] Bhatia,H.S., A Text Book of Environmental Pollution and Control, Galgotia NDLS, 2003.</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/120/108/120108004/</p>

20CE5301	WATER RESOURCES ENGINEERING
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Lecture :Tutorial: Category:	Program Core	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3 - 0 - 0
Prerequisites:	--	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	evaluate various irrigation methods and Irrigation management practices in the field.													
	CO2	analyze the Run-off and estimate the ground water yield.													
	CO3	apply the design principles of various Channel sections.													
	CO4	evaluate reservoir capacity and summarize various types of hydraulic structures													
Contribution of Course Outcomes towards achievement of Program Outcomes		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
	CO1	3													
	CO2	3		2	2									2	
	CO3	3		2	2									3	
(1 – Low, 2 – Medium, 3 – High)	CO4	3		3		2								3	
Course Content	UNIT – I IRRIGATION:WATER APPLICATION METHODS Definition; Necessity; Benefits of irrigation; Ill-effects of irrigation; Types of irrigation and methods of applying water to crops; Uncontrolled or wild flooding; Free flooding; Contour laterals; Border strip method; Check flooding; Basin flooding; Zig zag method; Furrow														

	<p>method; Contour Farming; Sub-surface irrigation; Sprinkler Irrigation; Drip irrigation</p> <p>.WATER REQUIREMENT OF CROPS:</p> <p>Saturation capacity; Field capacity; Wilting point; Available moisture and readily available moisture; Duty and Delta; Base period; Relation between Duty and Delta; Factors affecting duty; Methods of improving duty; Gross command area; Culturable command area; Culturable cultivated and uncultivated area; Kor depth and Kor period; Standards of irrigation water; Assessment of irrigation water.</p>
	<p>UNIT – II</p> <p>HYDROLOGY:</p> <p>Introduction to Engineering Hydrology and its applications; Hydrologic cycle; Precipitation types; Rain gauges; Computation of average rain fall over a basin; Run off; Factors affecting run off; Computation of run-off. Hydrograph; definition of Unit hydrograph; Limitations and applications of unit hydrograph, construction of a flood hydrograph resulting from rainfall of unit duration; Application of unit hydrograph to construction of a flood hydrograph resulting from two or more periods of rainfall; Construction of unit hydrograph of different unit duration from a unit hydrograph of some given unit duration. S-hydrograph</p> <p>WELL IRRIGATION:</p> <p>Introduction; Aquifer; Aquicludes; Aquifuge; Specific yield; Specific retention; Water table; types of aquifers; Dupit's theory for confined and unconfined aquifers; Constant level pumping test, Recuperation test.</p>
	<p>UNIT-III</p> <p>IRRIGATION CHANNELS – SILT THEORIES & DESIGN PROCEDURE:</p> <p>Classification; Canal alignment; Silt theories–Kennedy's theory, Lacey's regime theory; Kennedy's method of channel design; Silt supporting capacity according to Kennedy's theory; Use of Garret's diagram in channel design; Lacey's theory applied to channel design; Use of Lacey's regime diagrams; Drawbacks in Kennedy's theory; Defects in Lacey's theory; Comparison of Kennedy's theory and Lacey's theory</p> <p>WATERLOGGING, CANAL LINING</p> <p>Water logging,causes,effects and remedial measures.Lining of Irrigation canals, Types of lining; Design of lined canal</p>
	<p>UNIT-IV</p> <p>DAMS IN GENERAL:</p> <p>Classification; Gravity dams, Arch dams, Buttress dams, Steel dams, Timber dams, Earth dams and rock fill dams; factors governing selection of site for a dam.</p> <p>RESERVOIR PLANNING:</p> <p>Selection of site for a reservoir; Zones of storage in a reservoir; Storage capacity and yield; Mass inflow curve and demand curve; Calculation of reservoir capacity for a specified yield</p>

	from the mass inflow curve; Determination of safe yield from a reservoir of a given capacity; Life of reservoir;
Text books	<p>[T1] Irrigation and water power Engineering by Dr. B.C. Punmia & Dr. Pande B.B. Lal; Laxmi Publications Pvt. Ltd., New Delhi., 2006.</p> <p>[T2] Irrigation Engineering and Hydraulic structures by S. K. Garg; Khanna publishers New Delhi, 2006.</p> <p>[T3] Irrigation Engineering and Hydraulic structures by SR Sahasrabudhe, Katson Publishing house. 2005</p>
Reference books	<p>[R1] Irrigation, Water Resources & Water Power Engineering by Dr. P.N. Modi; standard Book House, New Delhi., 2006</p> <p>[R2] Irrigation water power and water resources engineering by K R ARORA, Standard published distributors, New Delhi., 2006.</p> <p>[R3] A text book of hydrology by Dr. P. Jayarami Reddy, published by Laxmi Publications.</p> <p>[R4] Journals in Water resources</p>
E-resources and other digital material	www.nptel.ac.in/courses/105104103

Course Category:	Programme core	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CH1102 - Engineering chemistry 20MC4108B -Environmental studies	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	evaluate the source of water for water supply scheme with reference to quantity and quality of water.												
		CO2	apply and design the treatment units for purification of water and to understand the components of distribution systems and its analysis.												
		CO3	understand the methods of collection, conveyance, quality and estimate the quantity of sewage.												
		CO4	apply appropriate treatment and disposal methods of sewage.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	1											1		1
	CO2	3		2	3										1
	CO3	2	2										1		
	CO4	3	2	3	3										3
Course Content		UNIT – I INTRODUCTION AND QUANTITY OF WATER Objectives of water supply systems, Per capita consumption; Design period; Types of demands; Fluctuations in demand; Prediction of population. QUALITY OF WATER Impurities in water; Routine water analysis - physical, chemical and bacteriological tests; Standards for drinking water; Water borne diseases.													

	<p>UNIT – II</p> <p>PURIFICATION OF WATER Purification of water; Plain sedimentation; coagulation and types of Coagulants; Sedimentation and coagulation tanks; Design aspects; Theory of filtration; Slow sand and rapid sand filters; Construction and Operation; Disinfection methods-chlorination; Miscellaneous treatments-Removal of hardness, De-fluoridation.</p> <p>DISTRIBUTION SYSTEMS Methods of supply; Layouts; Distribution reservoirs; Capacity of balancing tank; Methods of analysis of distribution systems; valves. Plumbing-pipes and fittings; Traps; One pipe and Two pipe systems.</p>
	<p>UNIT – III</p> <p>INTRODUCTION TO SANITARY ENGINEERING, QUANTITIES, SEWERS AND SEWER APPURTENANCES Sanitation; Conservancy and water carriage system; Sewerage systems; Relative merits, Sanitary and storm water sewage; Estimation of their quantities. Sewers-types, design, construction and maintenance; sewer appurtenances-types.</p> <p>QUALITY OF SEWAGE AND PRIMARY TREATMENT OF SEWAGE Characteristics of sewage-physical, chemical and biological; decomposition cycles; BOD and COD. Primary treatment- theoretical concepts of Screens, Grit chamber; Skimming tanks; design aspects of Sedimentation tanks. Septic tank-Design and effluent disposal.</p>
	<p>UNIT – IV</p> <p>SECONDARY TREATMENT OF SEWAGE Trickling filters and high rate trickling filters at primary level, Principles of action; Recirculation; Operational problems and remedies; Activated sludge process; Principles of action; Methods of aeration; Sludge bulking; Sludge volume index.</p> <p>SEWAGE DISPOSAL Methods; Disposal by dilution; Self-purification process; Oxygen sag; Zones of pollution of river; Disposal by irrigation.</p>
Text books	<p>[T1] Duggal K.N., “Elements of public health engineering”, S. Chand & Company Ltd., New Delhi, 2014.</p> <p>[T2] Birdie G.S. and Birdie J. S., “Water Supply and Sanitary Engineering”, 9th ed., Dhanpat Rai Publishing Company, New Delhi, 2015.</p>
Reference books	<p>[R1] Garg S. K., “Environmental Engineering Vol. I& II- Water supply engineering”, Khanna Publishers, New Delhi, 2017.</p> <p>[R2] Gurucharan Singh, “Water Supply and Sanitary Engineering”, Standard Publishers Distributors, Delhi, 2009.</p> <p>[R3] CPHEEO and Ministry of Urban Development, “Manual on Water Supply & Treatment”, Govt.</p>

	of India, New Delhi,2005.
E-resources and other digital material	www.https://nptel.ac.in/courses/103107084 wwwnptel.ac.in/courses/105105048

20CE5303	DESIGN OF CONCRETE STRUCTURES
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Course Category:	Programme Core	Credits:	2
Course Type:	Theory	Lecture - Tutorial - Practice:	2-0-0
Prerequisites:	20CE3305 Concrete Technology	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the students will be able to:													
CO1		analyze for a section for R.C. beams													
CO2		evaluate a section for R.C. flanged beam & R.C slabs													
CO3		analyze for a safe section for R.C columns													
CO4		evaluate a section for Footings													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	2		3		3								3	
	CO2	2		3		3								3	
	CO3	2		3		3								3	
	CO4	2		3		3								3	
Course Content		UNIT – I GENERAL Loading standards as per IS 875, Grades of steel and cement, Stress- Strain characteristics of concrete and steel, Introduction to working stress method and Limit State Method (L.S.D.) of design. Characteristic load and strengths, Design values, Partial safety factors, Factored loads.													

	<p>ALL DESIGNS IN LIMIT STATE METHOD: DESIGN OF BEAMS (IS456-2000). Flexural and Shear in R. C. beams; Check for development length. Deflection and cracking. Design of singly reinforced rectangular section, Doubly reinforced rectangular section.</p> <p>UNIT – II DESIGN OF FLANGED BEAM (IS456-2000) T-Beams introduction, Analysis and Design of singly reinforced flanged sections.</p> <p>DESIGN OF SLABS (IS456-2000). One way and Two-way action of slabs, Choosing slab thickness. Design of one way slab. (only simply supported one way slab) Design of restrained and unrestrained Two way slabs as per I.S. code provision (IS456-2000).</p> <p>UNIT – III DESIGN OF COLUMNS FOR AXIAL COMPRESSION (IS456-2000). Define short and long columns, estimation of effective length of a column. Code requirements on slenderness limits, minimum eccentricity and reinforcement. Design of short column under axial compression with lateral ties only.</p> <p>DESIGN OF COLUMNS FOR COMBINED ACTION (IS456-2000) Design of short columns subjected to combined axial load and uniaxial moment</p> <p>UNIT – IV CLASSIFICATION OF FOUNDATIONS Different types of shallow foundations and deep foundations. General aspects of footings.</p> <p>DESIGN OF ISOLATED FOOTING (IS456-2000) Design and detailing of Isolated Column footings.</p>
Text books	<p>[T1] Shah H.J., “ Reinforced Concrete Vol-1”, 11th ed., Charotar Publication House , Gujarat , 2016.</p> <p>[T2] Jain A.K, “ Reinforced Concrete (Limit State Design)”, 7th ed Nem Chand & Bros., Roorkee Uttarakhand , 2012.</p>
Reference books	<p>[R1] Varghese P.C , “ Limit state designed of reinforced concrete ”, 2nd et., , Printice Hall of India ; New Delhi, 2004.</p> <p>[R2] Arther H.Nilson , “ Design of concrete structures ”, 1st ed., Tata McGraw-Hill Publishing Co. Ltd , New Delhi, 2017.</p>
E-resources and other digital material	<p>www.nptel.ac.in/courses/105105105</p> <p>www.nptel.ac.in/courses/105105104</p>

20CE5404/A	ADVANCED STRUCTURAL ANALYSIS
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Course Category:	Programme Elective-1	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE4302 – Structural Analysis	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to :													
CO1		analyze arches and cables													
CO2		evaluate statically indeterminate beams using flexibility matrix method													
CO3		evaluate statically indeterminate beams and frames by stiffness matrix method													
CO4		apply the basic concepts of plastic analysis and finite element method													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
	CO1	3	3	1										3	
	CO2	3	3	1										3	
	CO3	3	3	1										3	
	CO4	2	2	1										3	
Course Content		UNIT – I ARCHES Eddy's Theorem; Analysis of three hinged and two hinged Parabolic and Circular arches for Static loads. CABLES Analysis of cables under uniformly distributed and concentrated loads; Shape of the cable under self - weight; Effect of temperature changes in suspension cables.													

	<p>UNIT – II MATRIX METHODS OF ANALYSIS</p> <p>Static Indeterminacy; Matrix Methods; Flexibility and Stiffness; Flexibility Matrix; Stiffness Matrix; Relationship between Flexibility and Stiffness Matrix.</p> <p>FLEXIBILITY METHOD (FORCE METHOD)</p> <p>Analysis of continuous beams and rigid jointed plane frames (Single bay, single storey with vertical legs only) by flexibility method.</p>
	<p>UNIT – III STIFFNESS METHOD (DISPLACEMENT METHOD)</p> <p>Notations, Kinematic Indeterminacy, Generating Stiffness Matrices and analysis of continuous beams by Stiffness method.</p> <p>STIFFNESS METHOD FOR PORTAL FRAMES</p> <p>Analysis of rigid Jointed frames by stiffness method with matrix approach.</p>
	<p>UNIT – IV PLASTIC ANALYSIS OF STRUCTURES</p> <p>Idealized stress - strain curve for mild steel; Ultimate load carrying capacity of members carrying axial forces; Moment - Curvature relationship for flexural members; Evaluation of fully plastic moment; Shape factor; Collapse load factor; Upper and lower bound theorems.</p> <p>FINITE ELEMENT ANALYSIS</p> <p>Equilibrium Conditions; Strain-displacement relations; Linear Constitutive relations; Principle of Virtual work, Energy Principles; Application to finite element method. Element Strains and Stresses; Element Stiffness matrix. Stiffness matrix formulation for bar element, beam element.</p>
Text books	<p>[T1] Structural Analysis–A matrix approach by Pandit. G.S.&Gupta. S.P, Tata Mc.Graw–Hill Publishing Co.Ltd., New Delhi, 2008.</p> <p>[T2] Basic Structural Analysis by Reddy. C. S, Mc Graw Hill Education, 3rd Edition, 2010.</p> <p>[T3] Finite Element Analysis–Theory and Programming by Krishna Murthy. C.S, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2013.</p>
Reference books	<p>[R1] Analysis of structures Vol.2 by Prof Vazirani. V. N, Ratwani. M. M, Duggal. Sk, 16th Edition, Khanna Publishers, New Delhi, 2016.</p> <p>[R2] Indeterminate Structural Analysis by Wang. C. K, 5th Edn Mc Graw Hill Education, New Delhi, 2014.</p>
E-resources and other digital material	<p>http://onlinecourses.nptel.ac.in/courses/105106050</p>

Course Category:	Program elective-1	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE3353 Programme core Lab-2 Computer aided civil engineering Drawing	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to :													
		CO1	apply the principles of urban design												
		CO2	apply the techniques used in Planning of urban infrastructure systems.												
		CO3	analyze the principles of architecture by understanding history												
		CO4	evaluate the concept of sustainable development												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	1				1	1								
	CO2	1				1	1							1	
	CO3	1				1	1								
	CO4	1				1	1							1	
Course Content		UNIT – I URBAN DESIGN Concepts and theories of urban design; Urban design interventions for sustainable development and transportation; Historical and modern examples of urban design; Public spaces, spatial qualities and Sense of Place; Elements of urban built environment – urban form, spaces, structure, pattern, etc; Urban renewal and conservation; Site planning; Landscape design													

	<p>CITY PLANNING</p> <p>Evolution of cities; principles of city planning; planning regulations, Development controls – FAR, densities and building byelaws; sustainable development</p>
	<p>UNIT – II TECHNIQUES OF PLANNING</p> <p>Planning survey techniques; preparation of development plans; site planning principles and design; application of G.I.S and remote sensing techniques in urban and regional planning</p> <p>CONCEPTS OF CITY MASTER PLANNING AND SATELLITE TOWNS</p> <p>Definition importance, features, various phases in the preparation of a Master plan and Satellite towns, advantages, Examples -Hyderabad master plan and Noida satellite town</p>
	<p>UNIT – III HISTORY OF ARCHITECTURE</p> <p>Indian – Indus valley, Vedic, Buddhist, Indo-Aryan, Dravidian and</p> <p>Mughal periods: European – Egyptian, Greek, Roman, medieval and renaissance periods construction and Architectural styles; vernacular and traditional architecture. Principles of Architecture</p> <p>ENVIRONMENTAL STUDIES IN BUILDING SCIENCE</p> <p>Components of Ecosystem; ecological principles concerning environment; energy efficient building design; thermal comfort; solar architecture; principles of lighting and styles for illumination; basic principles of architectural acoustics</p>
	<p>UNIT – IV LANDSCAPE DESIGN:</p> <p>Principles of landscape design and site planning; history of landscape styles; landscape elements and materials</p> <p>URBAN INFRASTRUCTURE, SERVICES AND AMENITIES</p> <p>Green building rating system-GRIHA and LEED Basic understanding of sustainable Development, green infrastructure; urban rainwater harvesting; power supply and communication systems – guidelines</p>
<p>Text books</p>	<p>[T1] Brown, P. “ Indian Architecture (Buddhist and Hindu period)”, Taraporevala , CSTM, 2015.</p> <p>[T2] Bandopadhyay, A.” Text book of Town Planning”, Books and Allied, HRH, 2000</p>

Reference books	[R1] Evans.M, “Housing, Climate & Comfort, Architectural” , LN, UK, 1980. [R2] Grover,S. “The Architecture of India (Buddhist and Hindu period)”, Vikas, NDLS, 2017. [R3] Gurucharan Singh and Jagadish Singh,” Building planning designing and scheduling” Standard publishers distributors, Delhi 2011
E-resources and other digital material	https://nptel.ac.in/courses/124/105/124105001/ https://nptel.ac.in/courses/124/105/124105004/ www.european-science.com

Course Category:	Programme Elective-1	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	NIL	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to :														
	CO1	evaluate various types of air pollution and their effects													
	CO2	apply the dispersion phenomenon of air pollutants with regard to meteorological parameters													
	CO3	analyze the samples, pollutants from chimney stacks and ambient atmosphere													
	CO4	apply as necessary, various types of equipment to control air pollution													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	3													3
	CO2	3													3
	CO3	3	3		1						1				3
	CO4	3		3	1										
Course Content	UNIT – I INTRODUCTION TO AIR POLLUTION AND EFFECTS OF AIR POLLUTION Composition of air, Air pollution-definition, Prominent air pollution disasters episodes, Sources of air pollution-Stationary and mobile sources and Effects of air pollutants on human health; Effects on plants and economic effects. CLASSIFICATION OF AIR POLLUTANTS Classification-Natural Contaminants; Particulate Matter Aerosols and Gaseous pollutants; Primary and secondary pollutants.														

	<p>UNIT – II</p> <p>METEOROLOGY AND AIR POLLUTION</p> <p>Meteorological factors influencing dispersion of air pollutants-Wind direction and wind speed, Atmospheric stability, temperature inversions, Mixing height, precipitation and humidity.</p> <p>MEASUREMENT OF METEOROLOGICAL PARAMETERS</p> <p>Wind direction recorder, Wind speed recorder, Humidity Measurement, Temperature measurement; Wind Rose; Plume behavior.</p>
	<p>UNIT – III</p> <p>STACK SAMPLING:</p> <p>Stack sampler; Sampling Procedure-Sampling point – size - Isokinetic Conditions-sampling of Particulate matter and Gases.</p> <p>AMBIENT AIR SAMPLING:</p> <p>Sampling methods- Sedimentation, filtration, impingement methods, electrostatic precipitation and thermal precipitation. Sampling suspended particulates by high volume sampler. Sampling SO₂ and NO_x and Carbon Monoxide gases. –Indian standard methods of analysis of SO₂ and NO_x gases Air Quality and Emission standards.</p>
	<p>UNIT – IV</p> <p>METHODS OF CONTROLLING AIR POLLUTION:</p> <p>Different means of control of effluent discharges into the atmosphere. Control of Particulate matter by equipment - Settling chamber, inertial separators- fabric filters-wet scrubbers- Electrostatic Precipitators.</p> <p>CONTROL OF GASEOUS POLLUTANTS:</p> <p>Controlling methods of Gaseous Emissions- combustion, adsorption, absorption, closed collections and recovery systems – Control of SO₂ and NO_x gases</p>
Text books	<p>[T1] Air Pollution and Control by Rao, M.N and Rao, H.N. Tata McGraw Hill, New Delhi, 2007</p> <p>[T2] Environmental Engineering and Management, (2nd Edition) by Suresh, I., Kartarai S.K. & Sons, 2005.</p>
Reference books	<p>[R1] An Introduction to Air pollution by Trivedi, R.K., B.S. Publications, 2005.</p> <p>[R2] Air pollution by Wark and Warner, Addison-Wesley Publications, 1998.</p>
E-resources and other digital material	<p>http://nptel.ac.in/courses/webcourse-contents/IIT-delhi/Environmental%20Air%20Pollution/</p>

20CE5404/D	ENVIRONMENTAL GEOTECHNOLOGY
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Course Category:	Programme Elective-1	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practice:	3-0-0
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	apply the principles of environmental geotechnology												
		CO2	apply the concepts in evolving various components of waste containment facility												
		CO3	evaluate containment areas and remediate them.												
		CO4	analyze geotechnical re-use of waste												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1	3						3							3
	CO2	3		3			3								3
	CO3	3			3	1									
	CO4	3				1		1							3
Course Content		UNIT-I FUNDAMENTALS OF ENVIRONMENTAL GEOTECHNOLOGY Introduction; Scope of Environmental Geotechnology; Sources of contamination; Types of contaminants; Impact of subsurface contamination SOURCES AND CHARACTERISTICS OF WASTES Waste characterization; Environmental concerns with wastes; Waste management strategies; engineered waste disposal facilities													

	<p>UNIT-II</p> <p>SOIL-WATER INTERACTION</p> <p>Soil mineralogy characterization and its significance in determining soil behavior; Soil-water interaction and concepts of double layer; Forces of interaction between soil particles.</p> <p>CONTAMINANT TRANSPORT</p> <p>Soil-water-contaminant interactions and its implications; Factors effecting retention and transport of contaminants</p>
	<p>UNIT-III</p> <p>CONTAMINATED SITE ASSESSMENT</p> <p>Need for contaminated its characterization, Characterization methods– Electromagnetic resistivity; Ground penetrating radar; Electro chemical and electro-optical sensing methods</p> <p>CONTAINMENT FACILITY</p> <p>Concept and principles of waste containment; Site selection criteria for containment facility; Different components of waste containment system; Design of waste containment facilities</p>
	<p>UNIT-IV</p> <p>CONTAMINATED SITE REMEDIATION</p> <p>Remediation methods for subsurface contamination; Selection and planning of remediation methods, bio–remediation, incineration, soil washing, electro-kinetics, soil heating.</p> <p>RECYCLING AND REUSE</p> <p>Geotechnical reuse of waste materials; Waste characteristics for soil replacement; Waste materials suitable for geotechnical construction</p>
Text books	<p>[T1] Sharma, H.D. and Reddy, K.R., Geoenvironmental Engineering, John Wiley, NY, USA, 2004.</p> <p>[T2] Gulhati, S.K. and Datta M., Geotechnical Engineering, Mc Graw Hill India, New Delhi ,2005.</p>
Reference books	<p>[R1] Rowe, R.K.-Geotechnical and Geo environmental Engineering Handbook, Kluwer Academic, AM, Netherland, 2001.</p> <p>[R2] Reddy, L.N. and Inyang, H.I.- Geoenvironmental Engineering: Principles and Applications, CRC Press, FL, USA 2000.</p> <p>[R3] Mohamed, A.M.O. and Antia, H.E., Geoenvironmental Engineering, Elsevier, AM, Netherlands, 1998.</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/105102160/</p> <p>https://nptel.ac.in/courses/105103025/</p>

20CE5404/E	FORENSICS IN CIVIL ENGINEERING
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Course Category:	Programme Elective	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE4303- Geotechnical engineering 20CE4304- Hydraulics and Hydraulic Machines	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	apply forensic engineering to demonstrate structural and geotechnical failures												
		CO2	understand reinforced concrete Structures and steel structure failures through case studies												
		CO3	evaluate different geotechnical failures through case studies												
		CO4	analyze reasons for geo-environmental and fluid and hydraulic failures												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1	2	1	2			1								2
	CO2	2	1	2			1								2
	CO3	2	1	2			1								2
	CO4	2	1	2			1								2
Course Content		UNIT – I INTRODUCTION Definition of a Forensic Engineer, Typical Clients, Types of Damage, Civil litigation, Important legal terms, Causes of failure, Preliminary information about failure, Data collection, Hierarchy of forensic investigation. FORENSIC STRUCTURAL INVESTIGATION Load tests, Instrumentation, Dimensional measurements, concrete and													

	<p>masonry tests, Metal tests, Wood tests, Weld tests, water and air penetration tests, Heat loss tests.</p>
	<p>UNIT – II</p> <p>REINFORCED CONCRETE STRUCTURES CASE STUDIES The Pentagon Attack, Skyline Plaza in Bailey's Crossroads.</p> <p>STEEL STRUCTURES CASE STUDIES Pittsburgh Convention Center Expansion Joint Failure, Minneapolis I - 35W Bridge Collapse.</p>
	<p>UNIT – III</p> <p>FORENSIC GEOTECHNICAL INVESTIGATION Test Pits, Bore hole logs, In-place strength tests, Instrumentation, Dimensional Measurements, Seismic tests.</p> <p>CASE STUDIES Vaiont Dam Reservoir Slope Stability Failure, Leaning tower of Pisa.</p>
	<p>UNIT – IV</p> <p>GEO-ENVIRONMENTAL CASE STUDIES Love Canal, Valley of the Drums, Saskatchewan Water Treatment Failure</p> <p>FLUID MECHANICS AND HYDRAULICS CASE STUDIES Johnstown Flood, Malpasset Dam, New Orleans Hurricane Katrina Levee Failures.</p>
Text books	<p>[T1] Robert, W. D., Forensic Geotechnical and Foundation Engineering, Second Edition, McGraw-Hill, NY, US, 2011.</p> <p>[T2] Delatte, N. J., Beyond Failure –Forensic case studies for Civil Engineers, ASCE, US, 2009.</p>
Reference books	<p>[R1] Kenneth, L. C., Forensic Engineering, CRC Press, 2nd Edition, NY, US, 2000</p> <p>[R2] Rao, V. V. S. and Babu, G. L. S., Forensic Geotechnical Engineering, Developments in Geotechnical Engineering series, Springer, SG, 2016.</p> <p>[R3] Paul, A. B., Pamalee, A. B., Norbert, J. D. and Kevin, M. P., Failure case studies in civil Engineering-Structures, Foundations and Geoenvironment, 2nd Edition, ASCE, Virginia, US, 2013</p>
E-resources and other digital material	NIL

20CE5205/A	GEOSPATIAL TECHNOLOGIES
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Course Category:	Open Elective	Credits:	3
Course Type:	Theory cum Practical	Lecture - Tutorial - Practice:	2 - 0 - 2
Prerequisites:	Nil	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to													
CO1		apply the recent advances GIS technology in various fields of Engineering.													
CO2		evaluate the opportunities and available methods for integrating GIS in various engineering applications.													
CO3		apply cartography technique using GIS.													
CO4		analysis of vector maps by digitization.													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1		1		3	3							1	3	
	CO2		1		3	3							1	3	
	CO3		1		3	3							1	3	
	CO4		3				3								3

Course Content	<p>UNIT I</p> <p>INTRODUCTION TO GIS Introduction to GIS, History of GIS, Early developments in GIS, Applications of GIS</p> <p>MAP AND MAP SCALES Introduction to Maps, History of Maps, Map Scales, Types of Maps, Map and Globe</p> <p>Practices: 1.Introduction to GIS-Getting familiar with ARCGIS/QGIS interface-Concept of plugin in ARCGIS/QGIS 2.Geo-referencing in ARCGIS/QGIS - Concept of Geographic and Projection coordinate system.</p> <hr/> <p>UNIT II</p> <p>GEOREFERENCING AND PROJECTION Understanding Earth ,Coordinate System, Map Projection, Transformation, Geo referencing</p> <p>SPATIAL DATABASE MANAGEMENT SYSTEMS Introduction, Data Storage, Database Structure Models, Database Management system, Entity Relationship.</p> <p>Practices: 3.Point, Line Features Extraction in ARCGIS/QGIS -Vectorisation- Shape file Creation for simple Vector data 4.Manipulation of attribute data-Polygonize- Topology checker, Labelling data and Preparation of Map, Layout</p> <hr/> <p>UNIT III</p> <p>DATA MODELS AND DATA STRUCTURES Introduction, GIS Data Model, Vector Data Structure, Raster Data structure ,Geo database and metadata.</p> <p>SPATIAL DATA INPUT AND EDITING Primary Data, Secondary Data, Data Editing, Data types – Spatial and Non Spatial(attribute) data.</p> <p>Practices: 5.Application of Processing Tools-Vector Analysis-Interpolation 6.Application of Processing Tools-Network Analysis 7.Demonstration on Data management Tools, Geometry Tools and Analysis Tools.</p>
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	<p>UNIT IV</p> <p>MODELLING IN GIS:</p> <p>Introduction to Web GIS, Digital Terrain Modelling, Digital Elevation Modelling, Triangular Irregular Network.</p> <p>APPLICATIONS OF GIS:</p> <p>Multidisciplinary applications of GIS.</p> <p>Practices:</p> <p>8.Introduction to Google Earth Interface-Extracting coordinates of an area 9.Digitisation of Transportation Network and Water bodies in QGIS 10.Extraction of contour lines and DEM from Google Earth</p>
Text books	<p>[T1] Anji Reddy M.,Remote Sensing & Geographical Information Systems by, BPS Publications-Hyderabad,4thedition 2011.</p> <p>[T2] BasudebBhatta., Remote Sensing & GIS, Oxford University Press, New Delhi,2011</p>
Reference books	<p>[R1] Lillyand TM ., Kiefer R W., Remote sensing and Image interpretation ; John Willeyand sons.7th edition, 2015</p> <p>[R2] ChandraAM ., Ghosh S K Remote sensing and Geographical information System ; Narosa Publishing House, Second Edition New Delhi,2015</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/105/102/105102015</p>

Course Category:	Open Elective-IV	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	2-0-2
Prerequisites:	--	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	evaluate the types, basic planning and specifications of buildings.												
		CO2	apply ventilation and thermal insulation in structures												
		CO3	apply the plumbing and electrical fixtures in structures												
		CO4	analyze the considerations for fire prevention and fighting and termite prevention in buildings.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1	3						2							2
	CO2	1						2							2
	CO3	1				1	1	2							2
	CO4	1				1	1	2		2	2				2
Course Content		UNIT-I BASICS OF BUILDINGS: Types of structures: Load bearing walled structures & Framed structures, Different types of buildings: Residential, Public, Assembly, Hospitals, Institutional etc; Building height regulations; Calculation of plinth, floor and carpet area; Floor space index.													

	<p>BASIC BUILDING PLANNING AND ELEMENTS: Factors effecting the Selection of Site for residential building; Space requirement– Establishing areas for different units - Grouping, Circulation, Orientation, Aspect and prospect, Privacy, Elegance and economy; Basic building elements: Stair cases, doors and windows -Guidelinesforstaircaseplanning;Guidelinesforselectingdoorsandwindows.</p>
	<p>UNIT–II</p> <p>VENTILATION AND AIR CONDITIONING: Ventilation: Necessity of Ventilation, Functional Requirements ; Types of ventilation: Natural Ventilation, Artificial Ventilation; Air Conditioning– Systems of Air Conditioning, Essentials of Air Conditioning systems, Protection against fire to becaused by Air Conditioning systems.</p> <p>THERMAL INSULATION: Heat transfer: Thermal Insulating Materials; Thermal Insulation Methods; Insulation of Walls, Roofs, Doors & Windows.</p>
	<p>UNIT–III</p> <p>PLUMBING SERVICES: Types of plumbing; Plumbing fittings and accessories; Water Meters; Drainage – Sanitary Fittings: Bath tubs, wash basins, sinks, flushing cisterns, water closets; Principles governing design of building drainage; Guidelines for laying of Gas supply systems.</p> <p>ELECTRICAL INSTALLATION IN BUILDINGS: Electrical Considerations for Office Buildings, School Buildings & Residential Buildings; Lighting, Fannage, Electrical Installation for Air Conditioning/ Heating, Reception and distribution of main supply; Method of internal wiring; Earthing; Lightening arrestors.</p>
	<p>UNIT–IV</p> <p>FIRE SAFETY: Causes of fire in buildings; Planning considerations for fire resistance : Non-combustible materials in construction, fire escapes, Special features required for physically handicapped and elderly people ; Heat and smoke detectors, Fire alarm system, snorkel ladder, Fire fighting pump; Dry risers and wet risers, Automatic sprinklers.</p> <p>ANTI-TERMITE TREATMENT: Pre construction treatment, Post construction treatment; Construction of anti termite groove in buildings for termite prevention.</p>
Text books	<p>[T1] Building ConstructionbyB.C.Punmia;AshokKumarJain;ArunKumarJain,2005;LaxmiPublications,New Delhi</p> <p>[T2] Building Construction by Janardhan Jha; S.K. Sinha; 2007; Jain Book Agency, New Delhi.</p>

Reference books	[R1] National Building Code, 2015 [R2] Building Construction by P.C. Varghese, 2005, PHI Publications, New Delhi [R3] Building Services Engineering by David V. Chatterton, Sixth Edition, 2013, Routledge Publications.
E-resources and other digital material	https://nptel.ac.in/courses/105102176/

Course Category:	Programme Core – Lab -1	Credits:	1.5
Course Type:	Practical	Lecture - Tutorial - Practice:	0-0-3
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the students will be able to:														
		CO1	evaluate cross sectional/ reinforcement required and prepare structural drawings for various structural elements by using AUTOCAD													
		CO2	apply Microsoft Excel/Mat Lab to execute design problems													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	
	CO1	2	1			2						3		2	1	
	CO2	2	2			2						3		2	1	
Course Content		PART-A: AUTOCAD Design and Drawing the reinforcement details of the following RCC Structural elements / steel structural elements. 1. Detailed study of architectural plan elevation and section 2. Detailed study of structural drawings of RCC Building 3. Roof/Floor System (Continuous) with flanged beams 4. Doglegged staircase 5. Two way slabs (Simply supported slabs corners held down) 6. Two way slabs (Simply supported slabs corners not held down)														

	<p>7. 5.R.C.C Beam - Column joint</p> <p>8. Isolated and Combined footing</p> <p>PART - B:PROGRAMMING</p> <p>Students are required to write & execute the programs using Microsoft Excel language</p> <p>1. Design of singly reinforced beam for flexure by LSM.</p> <p>2. Design of doubly reinforced beam for flexure by LSM.</p> <p>3. Design of R.C.C column of rectangular section for axial load by LSM.</p>
Text books	<p>[T1] Venu gopal. K, “ Engineering Drawing and Graphics and AUTOCAD”,1sted., New Age International Publishers, 2001.</p> <p>[T2] Anand R.K.“Computer Application in Civil Engineering”, 1st ed., Vayu education of india, New Delhi, 2013.</p> <p>[T3]Dr. Ritu Agarwal &Khushbu Naruka Dr. Hari Singh Parihar, “ Computer Application in Civil Engineering ”, 1st ed., Neelkanth Publishers, 2012.</p>
Reference books	<p>[R1] Jeya poovan. T, “Engineering Graphics using AUTOCAD”,1st ed., Vikas Publishing House Pvt. Ltd., 2000.</p>
E-resources and other digital material	NIL

20CE5352	ENVIRONMENTAL ENGINEERING LAB
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Course Category:	Programme core – Lab2	Credits:	1.5
Course Type:	Lab	Lecture - Tutorial - Practice:	0-0-3
Prerequisites:	20BS1151B Engineering chemistry lab	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	analyze the various parameters and understand their significance and application.												
		CO2	evaluate the suitability of water for various applications by knowing water quality standards.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2
	CO1	1			3		1			1			1		2
	CO2	1			3		1						1		2
Course Content		1. Determination of pH value of water sample. 2. Determination of total suspended and dissolved solids in water sample. 3. Determination of alkalinity of water sample. 4. Determination of acidity of water sample. 5. Determination of sulphate content in a given water sample. 6. Determination of turbidity of water sample. 7. Determination of temporary and permanent hardness of water sample.													

	<p>8. Determination of chloride concentration of water sample.</p> <p>9. Determination of optimum dose of coagulant.</p> <p>10. Determination of dissolved oxygen of water sample.</p> <p>11. Determination of biochemical oxygen demand (BOD) of waste water.</p> <p>12. Determination of chemical oxygen demand (COD) of waste water.</p> <p>13. Determination of chlorine demand and residual chlorine.</p>
Text books	[T1] Garg S. K., “Environmental Engineering Vol. I- water supply engineering”, 18th ed., Khanna Publishers, New Delhi, 2004.
Reference books	<p>[R1] CPHEEO and Ministry of Urban Development, “Manual on Water Supply & Treatment”, Govt. of India, New Delhi, 2005.</p> <p>[R2] APHA, AWWA, and WEF, “Standard Methods for the Examination of Water and Wastewater. Standard Methods”, Washington DC, 2012.</p>
E-resources and other digital material	https://nptel.ac.in/courses/105104102

20CE5353	ADVANCED SURVEYING LAB
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Course Category:	Programme Core	Credits:	1.5
Course Type:	Lab	Lecture - Tutorial - Practice:	0-0-3
Prerequisites:	20CE3303 Surveying & Geomatics, 20CE3352 Surveying Lab	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	apply the surveying principles for setting boundaries, computing area and elevation using a total station												
		CO2	apply setting out for buildings and curves using various instruments												
		CO3	evaluate the contours for any given area												
		CO4	apply advanced instruments for surveying												
Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2 - Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
	CO1	2				3					1			1	2
	CO2	2				3									2
	CO3	2		2		3					1			1	2
	CO4	2				3					1				2
Course Content		<ol style="list-style-type: none"> 1. Measure the boundaries of a given tract of land and determine the area using Total Station. 2. Set out a building using chain and tape. 3. Set out a building using total station. 4. Set out a simple circular curve using chain and tape. 													

	<ol style="list-style-type: none"> 5. Set out a simple circular curve using chain, tape and theodolite. 6. Set out a simple circular curve using a total station. 7. Determine the elevation of a remote object. 8. Plot the contour map for a given area using total station. 9. Determine the area of a given tract of land using DGPS. 10. Set out a building using DGPS. 11. Demonstration of Unmanned Aerial Vehicle (UAV).
Text books	<p>[T1] Duggal S K, “Surveying Volume-1”, 2nd ed., Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2004.</p> <p>[T2] Dr. Arora K R, “ Surveying Volume-2”, 15th ed., Standard Book House, New Delhi, 2018</p>
Reference books	<p>[R1] Satheesh Gopi, Sathi Kumar R, Madhu N, “Advanced Surveying”, 2nd ed., Pearson, 2017</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/105107158</p>

20TP5106	PERSONALITY DEVELOPMENT
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Course Category:	Institutional Core	Credits:	1
Course Type:	PRACTICE	Lecture - Tutorial - Practice:	0-0-2
Prerequisites:		Continuous Evaluation:	100
		Semester end Evaluation:	0
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	analyze the corporate etiquette.												
		CO2	apply presentation techniques effectively with appropriate body language												
		CO3	apply positive attitude												
		CO4	apply the core competencies to succeed in professional and personal life												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
	CO1								2		3				1
	CO2									2	3				1
	CO3										3				1
	CO4									2	3				1
Course Content		UNIT I ANALYTICAL THINKING Self-Introduction, Shaping Young Minds - A Talk by Azim Premji (Listening Activity), Self – Analysis, Developing Positive Attitude, Perception.													

	<p>COMMUNICATION SKILLS</p> <p>Verbal Communication, Non Verbal Communication (Body Language)</p>
	<p>UNIT II</p> <p>SELF-MANAGEMENT SKILLS</p> <p>Anger Management, Stress Management, Time Management, Six Thinking Hats, Team Building, Leadership Qualities</p> <p>ETIQUETTE</p> <p>Social Etiquette, Business Etiquette, Telephone Etiquette, Dining Etiquette</p>
	<p>UNIT III</p> <p>STANDARD OPERATION METHODS</p> <p>Note Making, Note Taking, Minutes Preparation, Email& Letter Writing</p> <p>VERBAL ABILITY</p> <p>Synonyms, Antonyms, One Word Substitutes-Correction of Sentences-Analogies, Spotting Errors, Sentence Completion, Course of Action-Sentences Assumptions, Sentence Arguments, Reading Comprehension, Practice work</p>
	<p>UNIT – IV</p> <p>CAREER-ORIENTED SKILLS</p> <p>Group Discussion, Mock Group Discussions</p> <p>INTERVIEW SKILLS</p> <p>Resume Preparation, Interview Skills, Mock Interviews</p>
Text books	<p>[T1] Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.</p> <p>[T2] Dhanavel, S.P. English and Soft Skills, Orient Blackswan, 2010.</p>
Reference books	<p>[R1] R.S.Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S.Chand& Company Ltd., 2018.</p> <p>[R2] Raman, Meenakshi& Sharma, Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2011.</p>
E-resources and other digital material	<p>www.indiabix.com</p> <p>www.freshersworld.com</p>

20CE5354	ENGINEERING PROJECT IN COMMUNITY SERVICES (EPICS)
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Course Category:	Project work/ Internship	Credits:	1.5
Course Type:	Practical	Lecture - Tutorial - Practice:	0 - 0 - 3
Prerequisites:		Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	evaluate the societal problem from the villages or towns or local communities with well defined objectives.													
	CO2	analyze and solve the problems by applying modern tools and materials for appropriate solution.													
	CO3	apply team work, communication and presentation skills													
	CO4	evaluate the context of the problem and prepare a technical report as per the specified guidelines													
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low(1), M – Medium(2), H – High(3))		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1	2			2	2	3	3	2	3	3				1
	CO2	2			2	2	3	3	2	3	3				1
	CO3	2			2	2	3	3	2	3	3				1
	CO4	2			2	2	3	3	2	3	3				1

Course Content	Engineering Project In Community Services (EPICS): <ul style="list-style-type: none"> ➤ Students will go to the society (villages/ towns/ local communities/ hospitals/schools/recreation clubs etc,) to identify the problem and study the relevant articles or journal papers to come up with viable alternative solutions. ➤ The work will be carried out during summer vacation after IV semester and submitted the work at the end of the V semester. ➤ The student is encouraged to work on real world problems that will lead to the creation of innovative model building.
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20CE5607	BUILDING INFORMATION MODELING (BIM)
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Course Category:	Skill Oriented Course -2	Credits:	2
Course Type:	Lab	Lecture - Tutorial - Practice:	1-0-2
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the students will be able to:													
		CO1	apply their knowledge to model the structure with Architectural, Structural and MEP components.												
		CO2	apply the software commands to create industry standard architectural drawings.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
	CO1			2		3				3	3	3		2	
	CO2			2		3				3	3	3		2	

Course Content	<ol style="list-style-type: none"> 1. Modelling of Architectural Components for a structure using Revit Architecture. 2. Modelling of Structural Components for a structure using Revit Structures. 3. Modelling of MEP systems using Revit MEP. 4. Generating the walkthrough for the structure. 5. Detailing and creation of Drawings for a structure as per IS Code. 6. Extraction of Bill of Materials from a Model. 7. Extraction of Bill of Quantities from a Model. 8. Preparing a schedule for construction of the structure with model. 9. Architectural Rendering, interference checking, and modeling of energy consumption.
Text books	<p>[T1] Auto desk Rivet structures manual.</p> <p>[T2] Exploring Autodesk Revit 2020 for structures, 10th edition, by Prof. Sham Tickoo, Purdue University Northwest, USA.</p> <p>[T3] Commercial Design using Autodesk Revit Architecture 2015, Daniel John Stine, SDC Publications ISBN #: 978-1-58503-512-0</p>
Reference books	<p>[R1] Autodesk Revit 2021 Structure Fundamentals by By ASCENT publications Published August 10, 2020, ISBN: 978-1-63057-358-4 ISBN 10: 1630573582</p>
E-resources and other digital material	<p>https://www.coursera.org/learn/autodesk-revit-for-structural-design-exam-prep</p>

20MC5108B	INNOVATION, IPR AND ENTREPRENEURSHIP
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Course Category:	Mandatory Course	Credits:	0
Course Type:	Theory	Lecture - Tutorial - Practice:	2-0-0
Prerequisites:	--	Continuous Evaluation:	100
		Total Marks:	100

		Upon successful completion of the course, the student will be able to													
		CO1	understanding the concept of innovation and its importance in organizations.												
		CO2	apply innovation management strategy in new product development.												
		CO3	understanding the Intellectual Property Rights and the key legal aspects												
		CO4	analyze the concept of entrepreneurship and skills												
Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3-High)		PO 1	PO2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	P O 11	P O1 2	PS O1	PS O2
	CO1		1						2	2		2			
	CO2		2						1	2		2			
	CO3		2						2	3		3			
	CO4		1						3	2		2			
Course Content		UNIT – I INNOVATION MANAGEMENT Definition of Innovation - Need for Innovation - Types of Innovation (Product, Process and Organization) - Sources of Innovation - Technology Adoption - Barriers to Innovation													
		UNIT – II INNOVATION: NEW PRODUCT DEVELOPMENT Meaning and Classification of New Product - Role of Innovation in New Product Development - Key Factors in New Product Development Strategy - Organizational Growth through New Product Development – Managing Innovations													

	UNIT – III INTELLECTUAL PROPERTY RIGHTS (IPRs) Definition of IPRs - Need for IPRs - Kinds of Intellectual Property Rights: Patents, Copy rights, Trade Marks, Trade Secret, Design, Geographical Indications - Legal Aspects of IPRs - IPRs in India
	UNIT – IV ENTREPRENEURSHIP Concept and Nature of Entrepreneurship - Need for Entrepreneurship – Types of Entrepreneurship - Entrepreneurial Skills - Emerging Trends in Entrepreneurship - Environment for Entrepreneurship
Text Books	[T1] Paul Trott, Innovation Management and New Product Development, Pearson Education Limited, UK, 2017. [T2] Nithyananda, K V., Intellectual Property Rights: Protection and Management, Cengage Learning India Private Limited, 2019. [T3] Dr.S S Khanka, Entrepreneurial Development, S Chand, New Delhi, 2020.
Reference Books	[R1] Managing innovation: Integrating Technological, Market and Organizational Change, Joe Tidd, John Besant, 2018. [R2] Neeraj, P., &Khusdeep, D, Intellectual Property Rights. PHI learning Private Limited, India, 2019. [R3] Vasant Desai, The Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, India, 2022.
E-resources and other digital material	https://edisciplinas.usp.br/pluginfile.php/5553082/mod_folder/content/0/Trott%20-%202017%20-%20%20roz%20Innovation-Management-and-New-Product-Development.pdf?forcedownload=1

Course Category:	Programme Core	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	analyze the adequacy of bolted& welded connections												
		CO2	analyze the adequacy of bolted & welded connections in tension and compression members.												
		CO3	evaluate the adequacy of laterally supported and unsupported steel beams												
		CO4	evaluate the adequacy of steel column bases												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	2		3		3	1							3	
	CO2	2		3		3	1							3	
	CO3	2		3		3	1							3	
	CO4	2		3		3	1							3	
Course Content		UNIT – I GENERAL Fundamental Concepts of limit state design of structures, Different types of rolled steel sections available to be used in steel structures. Stress – Strain relationship for mild steel. SIMPLE CONNECTIONS (IS800-2007) Bolted connections: Types of joints, Behaviour of bolted joints, Design strength of ordinary black bolts, Simple connections. Design of bolted joints subjected to axial load. Welded Connections: Advantages of welding, Types and properties of welds, Types of joints, weld specifications, Design of welded joints subjected to axial load.													
		UNIT – II TENSION MEMBERS (IS800-2007) Types of tension members, slenderness ratio, displacement of tension members, behaviour of tension members, modes of failure, factors affecting strength of tension members, design of tension members with bolted and welded connections.													

	<p>COMPRESSION MEMBERS (IS800-2007) Possible failure modes, behaviour of compression members, Effective length, radius of gyration and slenderness of compression members, Allowable stresses in compression, Design of axially loaded compression Members with bolted and welded connections.</p> <p>UNIT – III BEAMS- LATERALLY SUPPORTED (IS800-2007) Introduction; classification of sections; Lateral stability of beams; web buckling; Web crippling. Design of laterally supported beams. BEAMS- LATERALLY UNSUPPORTED (IS800-2007) Design of laterally unsupported beams.</p> <p>UNIT – IV COLUMN BASE (IS800-2007) Introduction to column bases and types of column bases. Allowable stress in Bearing. SLAB BASE Design of slab base with bolted and welded connections.</p>
Text books	<p>[T1] Subramanian, N. Design of steel structures - Oxford university press, NDLS., 2018. [T2] Duggal S K, Limit state design of steel structures –McGraw Hill (I) Pvt Ltd., 2017. [T3] Ramchandra and Gehlot V, Limit State Design of steel structures – Scientific Publishers (I).,2012.</p>
Reference books	<p>[R1] Sai Ram K. S, Design of steel structures - Pearson Education India., 2020. [R2] Bhavikatti S.S, Design of steel structures by Limit State Method as per IS: 800-2007 –IK IPHPvt. Ltd., NDLS-2019.</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/105105162. https://nptel.ac.in/courses/105106112.</p>

Course Category:	Programme Core	Credits:	3
Course Type:	Theory and Practice	Lecture - Tutorial - Practice:	3 - 0 - 0
Prerequisites:	NIL	Internal Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to													
		CO1	analyze the best alternative route for highways												
		CO2	apply the studies to regulate traffic control and management												
		CO3	evaluate geometrics and pavement crust												
		CO4	analyze the Construction and Maintenance of Highways												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	3		3											
	CO2				3		1								3
	CO3	3		3										3	
	CO4			3		3		1							
Course Content	UNIT I HIGHWAY NETWORK PLANNING AND ALIGNMENT Different Modes of Transportation, Road Classification, Road Patterns, 20 Year Road Development plans. Highway Alignment: Requirements, factors controlling, Engineering Surveys. HIGHWAY GEOMETRIC DESIGN Geometric Design: Highway Cross Section Elements Sight Distance Stopping Sight Distance, Overtaking Sight Distance, Intermediate Sight Distance, Design of Horizontal Alignment- Super elevation, transition curves, extra widening, Design of Vertical Alignment-Grades and Grade Compensation.														
	UNIT II TRAFFIC STUDIES Introduction, Road User Characteristics, Vehicle Characteristics, Traffic Volume Studies														

	<p>objectives, methods, presentation of data(no numerical), Speed Studies, Methods and presentation of data, various methods of speed and delay studies, Traffic Flow Characteristics, Traffic Capacity and concept of Level of Service.</p> <p>DESIGN OF TRAFFIC CONTROL DEVICES</p> <p>Traffic Operations-Traffic Regulation, Traffic Control Devices- types of Signs, types of traffic signals, types of traffic signal system, design of traffic signal by Webster's method.</p>
	<p>UNIT III</p> <p>DESIGN OF FLEXIBLE PAVEMENTS</p> <p>Types of Pavement Structures, Design Factors, Design of Flexible Pavements- IRC Method</p> <p>DESIGN OF RIGID PAVEMENT</p> <p>Design of Rigid Pavement- Wheel Load stresses, Temperature Stresses, Frictional Stresses.</p>
	<p>UNITIV</p> <p>HIGHWAY CONSTRUCTION</p> <p>Construction Steps of Embankment, earth roads, Granular Sub Base (GSB), Wet Mix Macadam (WMM), Dense Bituminous Macadam (DBM), Bituminous Concrete (BC) as per MORTH.</p> <p>HIGHWAY MAINTENANCE</p> <p>Pavement failures, causes, failures in flexible pavement, failures in rigid pavements, maintenance of Bituminous pavements and concrete pavements.</p>
Text books	<p>[T1] Khanna, S. K., Justo, C. E. G.,Veeraragavan,A." Highway Engineering Revised 10th Edition Nem Chand Bros .Roorkee 2017.</p> <p>[T2] Kadyali,L R “Principles and Practices of Highway Engineering”, Khanna Publishers, New Delhi, 2004.</p>
Reference books	<p>[R1]Principles of Transportation Engineering by ParthaChakraborty&Animesh Das; PHI Learning Pvt. Ltd.; New Delhi, Second edition 2017</p> <p>[R2] Ministry of Road Transport and Highways- Specifications for Roads and Bridge Works, Fifth Revision, IRC, New Delhi, India-2013</p> <p>[R3] IRC 37:2012- Guidelines for the design of flexible pavements (Third Revision)</p> <p>[R4] IRC58-2015 Guidelines for the Design of Plain Jointed Rigid Pavements for Highway</p>
E-resources and other digital material	<p>https://nptel.ac.in/downloads/105101087/</p> <p>https://nptel.ac.in/courses/105105107/</p>

20HS6103	ENGINEERING ECONOMICS AND MANAGEMENT
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Course Category:	Humanities and Social Sciences	Credits:	2
Course Type:	Theory	Lecture - Tutorial - Practice:	2 – 0 – 0
Prerequisites:	NIL	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:														
	CO1	understand the principles of economics, income and goods and service tax.													
	CO2	apply the concepts of management and demand forecasting.													
	CO3	evaluate time value of money and various forms of decision making.													
	CO4	apply the concept of financial importance in projects and budgeting process.													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO 11	PO1 2	PSO 1	PSO 2
	CO1	2					1		2						2
	CO2	3	1	2		2				1					2
	CO3	2	2			2	2		2				2		2
	CO4	3	2	2		2				1	1	2	2		2
Course Content	UNIT – I ECONOMICS Introduction to Engineering Economics, Theory of Demand, Elasticity of Demand, Supply and Law of Supply, Indifference Curves, Budget Line. MANAGERIAL ECONOMICS, MONEY, NATIONAL INCOME, GOODS AND SERVICE TAX Introduction to Managerial Economics, Scope of Managerial Economics, Techniques of Managerial Economics, Applications of Managerial Economics, Money, National Income, Goods and Services Tax.														
	UNIT – II CONCEPTS IN MANAGEMENT & HUMAN RESOURCE MANAGEMENT Characteristics of Management, Scope of Management, Functions of Management, Levels of Management, Skills of Management, Managerial Roles, Administration and Management, Human Resource Management, Human Resource Planning, Recruitment and Selection. DEMAND FORECASTING Introduction to Demand forecasting, Forecasting Horizons, Steps to Forecasting, Forecasting Methods, Seasonal Adjustments, Forecasting Performance Measures, Break-Even Analysis.														

	<p>UNIT – III TIME VALUE OF MONEY Introduction to time value of money, Simple Interest, Compound Interest, Present Worth Analysis, Future Worth Analysis, Annual Cash Flow Analysis, Rate of Return Analysis, Normal and Effective Interest Rate, Perpetual Payment. DECISION MAKING Types of Decision-Making Environments, Decision Tree Analysis, Multiple Criteria Decision Making.</p>
	<p>UNIT – IV FINANCIAL STATEMENT & FINANCIAL RATIOS Financial Analysis, Financial Statement, Trading Account, Profit and Loss Account, Balance Sheet Requirements, Distinction between Profit and Loss Account and Balance Sheet. CAPITAL BUDGETING Capital Financing and Allocation Functions, Sources of Capital Funds, Capital Asset Pricing Model, Weighted Average Cost of Capital, Leasing Decisions, Capital Allocation.</p>
Text books	<p>[T1] Pravin Kumar, “Engineering Economy and Management”, 1st ed., Willey India, New Delhi, 2012. [T2] R. Pannerselvam, “Engineering Economics”, 13th ed., PHI Learning Pvt. Ltd., New Delhi, 2012. [T3] M. Mahajan, “Industrial Engineering and Production Management” 2nd ed., Dhanpat Rai Publications.</p>
Reference books	<p>[R1] Philip Kotler & Gary Armstrong “Principles of Marketing”, Pearson Prentice Hall, New Delhi, 2012 Edition. [R2] IM Pandey, “Financial Management” 11th ed., Vikas Publications. [R3] B.B Mahapatro, “Human Resource Management”, New Age International publishers, 2011.</p>
E-resources and other digital material	<p>https://www.toppr.com/guides/fundamentals-of-economics-andmanagement/supply/supply-function/ https://keydifferences.com/difference-between-personnel-management-and-humanresource-management.html http://productlifecyclestages.com/ https://speechfoodie.com/cash-flow-diagrams/</p>

Course Category:	Programme Elective -II	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE5303 Design of Concrete Structures	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the students will be able to:													
		CO1	evaluate sectional details for staircase and flat slab.												
		CO2	analyse foundations and retaining walls for safety.												
		CO3	evaluate safe section for water tanks												
		CO4	analyze for safe composite structures.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	3		2		1								3	
	CO2	3		2		1								3	
	CO3	3		2		1								3	
	CO4	3		2		1								3	
Course Content		UNIT – I DESIGN OF STAIRCASE Types; Design and detailing of reinforced concrete doglegged staircase. DESIGN OF FLAT SLABS Design of Flat Slab: Direct design method – Distribution of moments in column strips and middle strip-moment and shear transfer from slabs to columns – Shear in Flat slabs-Check for one way and two-way shears, Limitations of Direct design method, Introduction to Equivalent frame method.													
		UNIT – II DESIGN OF FOUNDATIONS Structural Design of Pile Foundations: Types of piles, Load carrying capacity of piles, Structural design of RC piles, Design of pile cap for 2, Reinforcement detailing. DESIGN OF RETAINING WALLS Introduction – Types of retaining walls –Active and passive earth pressure- Design principles of cantilever retaining walls with horizontal back fill –With sloping back fill. Reinforcement detailing.													

	<p>UNIT – III DESIGN OF RECTANGULAR WATER TANKS Rectangular Water Tanks: Introduction – General design requirements according to Indian standard code of practice – Design of on ground water tanks Design of overhead water tanks- Reinforcement detailing. DESIGN OF CIRCULAR WATER TANKS Introduction – General design requirements according to Indian standard code of practice – Joints in water tanks – Circular tank with flexible joint between floor and wall – Circular tank with rigid joint between floor and wall.</p> <p>UNIT – IV DESIGN OF COMPOSITE STRUCTURES Introduction – Design principles – Composite action of components- Equivalent section – prefabricated steel and in-situ concrete – composite members DESIGN OF SHEAR CONNECTORS Shear connectors – channel connectors - Spiral connectors - Composite beams and bridge deck</p>
Text books	<p>[T1] Ramamrutham. S and Narayanan. P, “Design of Reinforced concrete structures”, Dhanapat Rai Publishing Co. (P) Ltd., NDLS, 2010 [T2] Punmia, B.C, “Limit state design of Reinforced concrete”, Laxmi Publications, NDLS, 2007. [T3] Punmia, B.C, “Reinforced concrete structure design”, Laxmi Publications, NDLS, 2010 [T4] Sinha SN, “Reinforced Concrete Design”McGraw Hill, Third edition, 2017</p>
Reference books	<p>[R1] Shah, V.L. and Karve, S.R., Limit State theory & Design of reinforced concrete Structures, Pune, 2003 [R2] Elliot. K, Precast Concrete Structures, Elsevier, CH, 2002. [R3] Multi-Storey Precast Concrete Framed Structures, Kim S. Elliott, Colin Jolly, Wiley-Blackwell publications, second edition-2013, Wiley-Blackwell . [R4] IS 456:2000- Code of Practice for Plain and Reinforced Concrete [R5] SP16 – Design aids of IS 456:2000 [R6] IS 13920 (1993) Ductile Designing of Reinforced Concrete Structures subjected to Seismic Forces.</p>
E-resources and other digital material	<p>www.nptel.ac.in/courses/105105105 www.nptel.ac.in/courses/105105104</p>

20CE6404/B	FOUNDATION ENGINEERING
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Course Category:	Program Elective -II	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE4303 - Geotechnical Engineering	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to													
		CO1	evaluate sub soil properties through geotechnical investigations; understand distribution of stresses below footing level due to geostatic loads.												
		CO2	analyse the earth pressures behind retaining walls and analyse soil slopes												
		CO3	evaluate the capacity of shallow foundations and estimate settlements												
		CO4	analyze the capacity of various types of deep foundations.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	3	3	2	3								2	2	
	CO2	3	3	2	3								2	2	
	CO3	2	2	2	2								2		1
	CO4	3	3	2	3								2		1
Course Content		UNIT – I SUB-SOIL INVESTIGATIONS AND SAMPLING Planning of sub-surface exploration program; Methods of exploration; Soil sampling and samplers; Bore hole logging; In-situ tests – Standard penetration test, Static cone penetration test, Dynamic cone penetration test and Vane shear tests. STRESSES DUE TO APPLIED LOADS Vertical and horizontal stresses due to concentrated loads; Boussinesq and Westergaard solutions; Isobars; Influence diagram; Newmark's influence charts; Contact pressure distribution.													
		UNIT – II LATERAL EARTH PRESSURE & RETAINING WALLS Different types of lateral earth pressure; Rankine's and Coulomb's earth pressure theories; Graphical methods; Types of retaining walls; Proportioning of retaining walls.													

	<p>STABILITY OF SLOPES Soil slopes, Types of slope failures; Various factors affecting the stability of slopes; Method of slices; Friction Circle method and Taylor's stability charts; Methods of improving stability of slopes.</p> <hr/> <p>UNIT – III BEARING CAPACITY OF SHALLOW FOUNDATION Terzaghi's bearing capacity theory; nature of shear failures; effect of water table on bearing capacity; eccentric load and Bearing capacity from in-situ tests viz., Plate load test. SETTLEMENT ANALYSIS Settlement of foundations; Immediate and consolidation settlements; Allowable settlement.</p> <hr/> <p>UNIT – IV PILE FOUNDATIONS Necessity of pile foundation; Classification of piles; Load carrying capacity of single pile from static, Pile capacity from in-situ tests viz., Pile load test; Pile group and its efficiency; Settlement of pile foundation; Negative skin friction. WELL FOUNDATION Different shapes of wells; Individual components of well; Forces acting on well foundation, Terzaghi's Concept of design of well foundation; Measures for rectification of tilts and shifts.</p>
Text Books	<p>[T1] Basic and Applied Soil Mechanics, Gopal Ranjan and Rao A.S.R, 8th Edition, 2018, New Age International (P) Limited Publishers, New Delhi [T2] Soil Mechanics and Foundation Engineering, Arora K.R, 2011, Standard Publishers and Distributors, New Delhi.</p>
Reference Books	<p>[R1] Advanced Foundation Engineering, Murthy V.N.S. , 2018, CBS Publishers and Distributors, New Delhi. [R2] Foundation Analysis and Design, Bowles J. E., 4th Edition, 1996, McGraw-Hill International Editions, [R3] Relevant Indian Standard Code Books.</p>
E-resources and other digital material	<p>nptel.ac.in/courses/105107120 nptel.ac.in/courses/105101083</p>

Course Category:	Program Elective-II	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE5302 - Environmental Engineering	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO1	evaluate the protection of water bodies against contamination on disposal of waste water.												
		CO2	apply new concepts of waste water treatment and choose a selection of low cost treatment units.												
		CO3	evaluate suitable treatment process for selected industrial effluents.												
		CO4	analyze the effects of air pollutants and acquaint devices to Control particulate matter, Levels of and effects of Noise Pollution.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	3		1									1		
	CO2	3		3											2
	CO3	3		2											3
	CO4	1											1		
Course Content		UNIT – I STREAM SANITATION Introduction; Characteristics of the treatment plant effluents; Pattern of pollution and self purification in a stream; Dissolved oxygen balance in streams; Oxygen Sag Curve Impact of pollutants on stream waters and usage of stream waters with reference to flora and fauna. DESIGN OF LOW COST WASTE WATER TREATMENT SYSTEMS Introduction, Biological kinetics of waste water, Stabilization ponds, Aerated lagoons, Oxidation ditch, Extended aeration process.													
		UNIT – II INDUSTRIAL WASTE WATER TREATMENT: SUGAR PLANT and DAIRY INDUSTRY Introduction, Characteristics and treatment of industrial effluents, Difference between Industrial & Domestic wastewater. Quantity of liquid waste; Characteristics of liquid waste, Processing and Manufacturing Units, Methods of its treatment and disposal.													

	<p>PULP AND PAPER INDUSTRY Quantity of liquid waste, Characteristics of liquid waste, Manufacturing Units, Methods of its treatment and disposal.</p>
	<p>UNIT – III NEW CONCEPTS IN BIOLOGICAL WASTE TREATMENT: Introduction; Nitrogen removal by biological nitrification and de-nitrification; Phosphate removal from the activated sludge process; Rotating disc biological contactor ; An-aerobic filters; U-tube aeration systems. AIR POLLUTION and EFFECTS OF AIR POLLUTION: Definition, Stationary and mobile sources, Primary and secondary pollutants, Natural contaminants, Particulate matter, Aerosols, Gases. Effects of air pollutants on human health, Effects on plants and economic effects.</p>
	<p>UNIT – IV METEOROLOGY AND CONTROL OF AIR POLLUTION BY EQUIPMENT: Atmospheric stability and temperature inversions; Mixing height; Wind direction and speed; Wind direction recorder; Wind speed recorder; Humidity measurement; Temperature measurement; Plume behavior. Objectives; Types of collection equipment; Settling chambers; Inertial separators; Cyclones; Filters; Electrostatic precipitators; Scrubbers. NOISE POLLUTION: Introduction; Levels of noise; Noise rating systems; Measures of noise; Sources of noise and their noise levels; Acceptance of noise levels; Effects of noise; Control of noise.</p>
Text books	<p>[T1] Air Pollution and Control by Rao, M. Nand Rao, H. N., Tata McGraw Hill, New Delhi, 2007 [T2] Environmental Engineering and Management, (2nd Edition) by Suresh, I. Kartarai S. K. & Sons, 2005.</p>
Reference books	<p>[R1] An Introduction to Air pollution by Trivedi, R. K., B. S. Publications, 2005. [R2] Air pollution by Wark and Warner, Addison-Wesley Publications, 1998.</p>
E-resources and other digital material	<p>http://nptel.ac.in/courses/webcourse-contents/IIT-delhi/Environmental%20Air%20Pollution/</p>

20CE6404/D	RAILWAY AND TUNNEL ENGINEERING
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Course Category:	Program Elective -II	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	Nil	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
CO1		evaluate the components of the railway track													
CO2		analyze the geometric section of railway track and control movement of locomotive													
CO3		analyze the stages in tunnel construction													
CO4		understand tunnelling methods													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1	3				2									3
	CO2	3	3	3		3								3	
	CO3	3				3									2
	CO4	3		2		2									3
Course Content		UNIT – I INTRODUCTION TO RAILWAYS Introduction to Railways, Comparison of railway and highways transportation; Classification of Indian Railways, Gauges in Railway Track, Permanent way- Cross section and functions COMPONENTS OF RAILWAY TRACK Rails – Types, Coning of Wheels, Rail failures, Creep of Rails, Rail Joints-Types, Sleepers -Types, Types of Ballast materials, Specifications of Indian Railways, Ballast Profile, Formation; Specifications of Formation UNIT – II GEOMETRIC DESIGN OF RAILWAY TRACK Geometric Design Necessity; Gradients – types, Gradient Compensation; Super elevation- definition, expression for super elevation; Cant deficiency and cant excess; Negative Super elevation concept, Numerical on Negative super elevation													

	<p>POINTS AND CROSSINGS & SIGNALLING Types of crossing, Turnouts components and its working principle, Classification of signals, Classification of stations and yards</p>
	<p>UNIT – III GENERAL ASPECTS OF TUNNELLING Definition of Tunnel and Open cut, Comparison of by passing alternatives, advantages and disadvantages of tunnel, classification of tunnels, shapes of tunnel, problems in tunneling STAGES IN TUNNEL CONSTRUCTION Investigations at tunnel site, setting out of tunnel, excavation, safety precautions in tunneling</p>
	<p>UNIT – IV TUNNELLING METHODS Methods of tunneling – for soft soil and rock TUNNEL LINING Objectives, materials for lining, sequence of lining</p>
Text books	<p>[T1] Saxena, S.C. and Arora. S, “Railway Engineering”, Dhanpat Rai Publications, NDLS, 2009. [T2] Srinivasan, R “Harbour Dock and Tunnel Engineering”, 29th ed., Charotar Publishing House Pvt Ltd, Anand, 2018.</p>
Reference books	<p>[R1] Agarwal.MM, Satish Chandra, “Railway Engineering”, 2nd ed., Oxford University Press; New Delhi, 2013.</p>
E-resources and other digital material	<p>https://archive.nptel.ac.in/courses/105/107/105107123/</p>

Course Category:	Programme Elective-II	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3 - 0 - 0
Prerequisites:	Water Resources Engineering	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes	Upon successful completion of the course, the student will be able to:															
	CO1	analyze the basics of diversion head works and canal regulation														
	CO2	apply the design principles of various cross drainage works														
	CO3	evaluate various types of dams and principles of Aarthur cotton technology														
	CO4	evaluate various types of spill ways.														
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	
	CO1									3				2		
	CO2	3	3	3		2								2		
	CO3	3	3	3		2								3	3	
	CO4														2	
Course Content	UNIT – I DIVERSION HEAD WORKS: Component parts of a Diversion Head works. Types of weirs, causes of failures of weirs and their remedies. – Bligh’s Creep Theory, & Khosla’s Theory. Canal falls; Necessity location and classification of falls. Silt control at head works. CANAL REGULATION WORK Canal regulators; Off-take alignment; Head regulators and cross-Regulators; Canal escape.															
	UNIT – II CROSS DRAINAGE WORKS: Introduction; Types of cross - drainage works; Selection of suitable type of cross - drainage work; Classification of Aqueducts and Syphon Aqueducts; Selection of a suitable type. COTTONS TECHNOLOGIES Introduction to Aarthur cotton technologies for present day needs, modern substitutes for Aarthur cottons materials, introduction to design of Krishna anicut, introduction to design of Godavari anicut															

	<p>UNIT – III STABILITY ANALYSIS OF GRAVITY DAMS: Introduction; Forces acting on a gravity dam; modes of failure and stability analysis of gravity dams.</p> <p>DESIGN OF GRAVITY DAMS Elementary profile of a gravity dam; Practical profile of a gravity dam; Limiting height of a gravity dam; High and low gravity dams; Galleries; Joints; Keys and water seals.</p>
	<p>UNIT – IV EARTH DAMS: Introduction; Types of earth dams; Causes of failure of earth dams; Criteria for safe design of earth dams; Section of an earth dam; Seepage control measures.</p> <p>SPILLWAYS: Introduction; Types of spillways; Profile of ogee spillway; Energy dissipation below spillways for relative positions of jump height curve and tail water curve; Stilling basins; Types and description only.</p>
Text books	<p>[T1] Irrigation and Water Power Engineering by Punmia B.C &Pande B.B. Lal; Laxmi Publications pvt. Ltd., New Delhi. 2006.</p> <p>[T2] Water Power Engineering by Dandekar M.M and Sharma K.K ; Vikas Publishing House Pvt. Ltd., New Delhi.,2006.</p> <p>[T3] Irrigation Engineering and Hydraulic Structures by SahasraBudhe S.R.,Katson Publishing House, Ludhiana. 2000.</p> <p>[T4] Sir Arthur Cottons Technologies for todaysanicut, dams, aqueducts, bridges, barrages, kissing reservoirs., by Lakshmana Rao G, Prasad KSR</p>
Reference Books:	<p>[R1] Irrigation Engineering and Hydraulic Structure by Garg SK ; Khanna Publishers, Delhi.,2006</p> <p>[R2] Irrigation, Water Resources and Waterpower Engineering by Modi PN ; Standard Book House, New Delhi. 2006.</p> <p>[R3] Journals in Water Resources Methods of Numerical Analysis, Sastry SS , PHI , 2005.</p>
E-resources and other digital material	<p>www.nptel.ac.in/courses/105105110</p>

20CE6205/A	GREEN BUILDINGS AND SUSTAINABILITY
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Course Category:	Open Elective / Job Oriented Elective-II	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	Science, Environmental Science	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

		Upon successful completion of the course, the student will be able to:													
		CO1	understand Green building & sustainable design concepts												
		CO2	evaluate sustainable materials and factors influencing the design of green buildings												
		CO3	analyze construction process and maintenance of green buildings												
		CO4	apply the requirements of IGBC certification.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
	CO1	1		1			1	3	2					1	
	CO2	1		1			1	3	2						2
	CO3	1		1			1	3	2						2
	CO4	1		1			1	3	2						2
Course Content	UNIT – I INTRODUCTION Green Buildings, Global warming, requirement of Green Building, Benefits of Green Buildings, Requisites for Constructing a Green Building, sustainable construction focus point: site, water, energy, material, indoor air quality, construction procedures. ECONOMICS OF GREEN HOMES Economics of green buildings, Selecting environmentally and economically balanced building materials, Project cost, Income and expenses.														

	<p>UNIT – II</p> <p>SITE & WATER ISSUES site analysis and design, site development and layout, watershed protection, drainage of concentrated Runoff, water efficiency and conservation, rain water harvesting, water reclamation</p> <p>SUSTAINABLE MATERIALS Reduce / Reuse / Recycle, Natural Sources, concrete, masonry, metals, wood and plastic, finishes</p>
	<p>UNIT – III</p> <p>PASSIVE SOLAR DESIGN Passive solar design, Day lighting, Building envelope, Renewable energy</p> <p>INDOOR ENVIRONMENTAL QUALITY Significance, design principle, ventilation control, occupant activity control, significance of acoustics.</p>
	<p>UNIT – IV</p> <p>CONSTRUCTION PROCESS AND MAINTENANCE OF GREEN BUILDING Environmental construction guidelines, building operations and maintenance</p> <p>INDIAN GREEN BUILDING COUNCIL Introduction to IGBC green homes, Benefits of IGBC, IGBC green home rating system, introduction to USGBC, LEED rating system, procedure to get IGBC certification</p>
Text books	<p>[T1] “Sustainable building technical manual- Green building design, constructions and operation”, Produced by Public Technology Inc., US Green Building Council.</p> <p>[T2] Gautham R K, “Green Homes”, BSP Books Private Limited, New Delhi, 2009.</p> <p>[T3] IGBC Green homes rating system Version 3.0 – A bridged reference guide, September 2019</p>
Reference books	<p>[R1] “Green Building A Basic Guide to Building and Remodeling Sustainably”, Tree Hugger Consulting</p> <p>[R2] “Green Building Guide – Design Techniques, Construction Practices & Materials for Affordable housing”, Published by Rural Community Assistance Corporation (RCAC)</p>
E-resources and other digital material	<p>https://onlinecourses.nptel.ac.in/noc19_ce40/</p>

Course Category:	Open Elective-II	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	--	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will have an ability to:													
		CO1	evaluate different types of modern materials, Paints, Enamels and Varnishes that are used in construction.												
		CO2	analyze the importance of special concretes and glass materials used in Building Construction.												
		CO3	understand the classification and usage of materials like plastics, bitumen and sound absorbent materials												
		CO4	evaluate building material like gypsum and various adhesives.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1	1	1				2								2
	CO2	1	1				2								2
	CO3	1	1				2								2
	CO4	1	1				2								2
Course Content		UNIT-I MODERN MATERIALS: Ceramics, Sealants for joints, fibreglass reinforced plastic, refractories-composite materials, Geosynthetics. PAINTS, ENAMELS AND VARNISHES: Introduction, rubber paints, plastic emulsion paints, plastic paints, enamel paints, texture paints, varnish, wax polish.													

	<p>UNIT-II</p> <p>SPECIAL CONCRETES: Light Weight concrete, High density concrete, Fiber reinforced concrete, polymer concrete.</p> <p>GLASS: Composition, classification, properties and types of glass.</p>
	<p>UNIT-III</p> <p>PLASTICS, BITUMEN: Composition, polymerization, Classification of plastics, biodegradable plastic, Grades of Bitumen.</p> <p>SOUND ABSORBENT MATERIALS: Porous materials, porous-cum-elastic materials, perforated materials, Baffle materials.</p>
	<p>UNIT-IV</p> <p>GYPSUM: Introduction, plaster of Paris, gypsum wall plasters, gypsum plaster boards, Non-load bearing Gypsum partition blocks.</p> <p>MISCELLANEOUS MATERIALS: Adhesives-advantages and disadvantages, properties, types of Adhesives; Different types of Building faced cladding materials; heat insulating materials; water proofing materials.</p>
<p>Text books</p>	<p>[T1] Engineering Materials by Rangwala S.C; Charotar Publishing House, 33rd Edn 2017. [T2] Building materials by Duggal SK ;New Age Internationalpublishers,3rdEdn,2009.</p>
<p>Reference books</p>	<p>[R1] BuildingmaterialsbyP.CVarghese;PHILearning,2ndEdn2005.</p>
<p>E-resources and other digital material</p>	<p>www:http://nptel.ac.in/courses/105102088/</p>

20CE6205/C	QUALITY CONTROL AND QUALITY ASSURANCE
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Course Category:	Open Elective-II	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	-----	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
CO1		understand meaning of quality, TQM and Quality Circles													
CO2		apply quality monitoring procedures													
CO3		apply statistical QC techniques and quality assurance techniques													
CO4		analyze bad quality of work and contents of quality manual													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3– High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1	3													3
	CO2														3
	CO3	3	3			3							3		3
	CO4	3	3												3
Course Content		<p>UNIT – I QUALITY MANAGEMENT Introduction – Definitions and objectives – Factors influencing construction quality – Responsibilities and authority – Quality Management , TQM Concept</p> <p>QUALITY SYSTEMS Introduction - Quality system – ISO 9000 family of standards — Quality related training – Implementing a Quality system – case study of Third party Certification. Quality circles.</p> <p>UNIT – II QUALITY PLANNING Quality Policy, Consumers feedback & satisfaction , Ergonomics, Discussion on IS code on sampling, sampling plans, acceptance criteria, quality inspection.</p> <p>QUALITY PROCEDURES Develop, schedule and implement procedures. The Three-Phase Control</p>													

	<p>System: Preparatory Phase, Initial Phase and Follow-up Phase. Notify appropriate personnel of time, date and agenda.</p> <p>UNIT – III QUALITY CONTROL Definition, Objectives, Regulatory agencies, statically tolerances, Taguchi concept, Statistical methods: Mean, variance, standard deviation, coefficient correlation, coefficient regression, control charts, Numerical on the above concepts, Contractor Quality Control, Quality Control Personnel, Safety considerations and Activity Hazard Analyses (AHAs).</p> <p>QUALITY ASSURANCE Quality Characteristics of QA process. Methods used in QA, Non functional testing, Factors influencing construction quality , Quality Assurance Personnel and their role, Quality Management Record Keeping, The Contractor Quality Control Report,</p> <p>UNIT – IV QUALITY IMPROVEMENT TECHNIQUES Definition, objectives, quality appraisal, techniques of quality assurance, Quality manual, specification for few construction items/ construction techniques.</p> <p>FORENSIC ANALYSIS FOR BAD QUALITY Pareto analysis, cause effect diagram and its application in construction industry and day to day life.</p>
Text Books	<p>[T1] Juran Frank, J.M. and Gryna, F.M. "Quality Planning and Analysis", McGraw Hill, 2001</p> <p>[T2] ThomsPyzdec; Rozeer W. Berger, "Quality Engineering Hand Book", TATA MC GRAW- HILL, New Delhi, 1995.</p> <p>[T3] Statistical Quality Control 7th Edition , Eugene L Grant, McGraw-Hill Series, 1980.</p>
Reference Books	<p>[R1] Dale Besterfield, Carl Besterfield-Michner, Glan Besterfield, MaryBesterfield-Sacre, 2nd edition, Total Quality Management, Printice Hall, 1999.</p> <p>[R2] ShridharaBhat, "Total Quality Management- Cases", Himalaya Publihing House, Mumbai, 2009.</p>
E-resources and other digital material	<p>http://nptel.ac.in/courses/</p>

Course Category:	Program Core Laboratory	Credits:	1.5
Course Type:	Laboratory	Lecture - Tutorial - Practice:	0-0-3
Prerequisites:	Nil	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
		CO 1	analyze the suitability of aggregates and bitumen in pavement construction.												
		CO 2	understand the importance of traffic studies at mid block section												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO 1	2		3	3			2		3	3				3
	CO 2	2		3	3			2		3	3				3
Course Content		<p>A. TESTS ON AGGREGATES:</p> <ol style="list-style-type: none"> 1. Determine the strength of aggregate and discuss the suitability in pavement construction. 2. Determine the toughness of aggregate and discuss the suitability in pavement construction. 3. Determine the hardness of aggregate and discuss the suitability in pavement construction. 4. Determine the flakiness and elongation index of aggregate and discuss the suitability in pavement construction. 5. Perform gradation of aggregate, analyze and discuss its importance in pavement layers 6. Determine the Specific gravity Test of aggregate and discuss its application in pavement layers <p>B. TESTS ON BITUMINOUS MATERIALS:</p> <ol style="list-style-type: none"> 1. Determine the grade of bitumen using different methods (penetration test and viscosity test) 2. Perform different tests on bitumen and discuss the suitability of bitumen in flexible pavement construction. <p>C. TESTS ON SOIL</p> <ol style="list-style-type: none"> 1. Determine the CBR of soil. 													

	<p>2. Plate bearing test – (demo)</p> <p>D. TEST ON BITUMINOUS MIXES</p> <p>1. Analyze and determine the optimum Binder content for construction of flexible pavement construction – (demo)</p> <p>E. TRAFFIC VOLUME STUDIES</p> <p>1. Traffic volume study at mid block section</p> <p>2. Traffic volume study at intersection</p> <p>3. Speed study</p>
Text books	[T1] Khanna, S. K., C. E. G. Justo, A.Veeraragavan" Highway Engineering Revised 10th Edition Nem Chand Bros .Roorkee 2017.
Reference books	[R1] Ministry of Road Transport and Highways- Specifications for Roads and Bridge Works, Fifth Revision, IRC, New Delhi, India-2013
E-resources and other digital material	https://www.iitk.ac.in/ce/test/IS-codes/is.2386.4.1963.pdf https://www.iitk.ac.in/ce/test/IS-codes/is.2386.1.1963.pdf https://www.iitk.ac.in/ce/test/IS-codes/is.2386.3.1963.pdf https://www.iitk.ac.in/ce/test/IS-codes/is.1201-1220.1978.pdf https://ia803004.us.archive.org/5/items/gov.in.is.2720.16.1987/is.2720.16.1987.pdf

20CE6352	COMPUTER APPLICATIONS IN CIVIL ENGINEERING LAB-2
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Course Category:	Programme Core -Lab-2	Credits:	1.5
Course Type:	Practical	Lecture - Tutorial - Practice:	0-0-3
Prerequisites:	20CE3503 Design of Concrete Structures	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the students will be able to:														
		CO1	analysis for cross section and requirement of reinforcements of various structural elements by using STAAD.Pro/ ETABS.													
		CO2	analyse for rates and quantities and prepare rate analysis for various works in construction of a building using Spread Sheets													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	
	CO1	2		2	1	3		2		2	1			3	1	
	CO2	3		1	2	1		2		1	2			1	3	
Course Content		PART-A Analysis of the following concrete & steel structural elements using STAAD. Pro / ETABS Software. 1. Design of continuous beam; 2. Design of plane frame 3. Design of space frame. 4. Design of G+4 Residential building: Creating model from the given drawing, Assigning Loads and Load Combinations 5. Design of G+4 Residential building: Preparation of detail drawing 6. Design of G+4 Residential building: Preparation of Design Documents 7. Design of Roof Truss PART – B 1. Estimate & Working out rates using spread sheets for the different items in a single story building. 2. Demonstration of software’s ETABS, CYPE														
Text books		[T1] Sarma T.S, “Staad Pro V8i for Beginners 1st Edition”, 1 st ed., Notion Press, New Delhi, 2014. [T2] Sarma. T.S., “ Design of R C C Buildings using Staad Pro V8i with Indian Examples ”, 1 st ed., Educreation Publishing , New Delhi, 2017.														
References		----														
e-Resources		----														

20HS6153		ENGLISH AND COMMUNICATION SKILLS LAB			
Course Category:	HS			Credits:	1
Course Type:	Lab			Lecture - Tutorial - Practice:	0-0-2
Prerequisites:				Continuous Evaluation:	30
				Semester end Evaluation:	70
				Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to :													
		CO1	evaluate elements of listening and spoken skills complemented by the abilities of argumentation and skills of public speaking												
		CO2	apply the nuances of requisite Advanced Reading Skills and higher order written communication required for administrative and corporate compilations												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
	CO1						1		1	2	3	2	2		
	CO2				1		1			2	3	2	1		
Course Content		<p>TED TALKS (Advanced Listening Skills) Listening involving 5R Method ELEVATOR PITCH (Advanced Listening Skills): Pitches for technical audience and administrators- exposure through soft components and illustrations</p> <p>INTERPERSONAL COMMUNICATION (Advanced Spoken Communication Skills) Individual and Group - Pyramid discussion- Conceptual framework and practice</p> <p>DYNAMICS OF TECHNICAL AND PROFESSIONAL PRESENTATIONS(Advanced Spoken Communication Skills) Illustrations and Practice including paralinguistic elements</p> <p>EFFECTIVE READING(Advanced Reading and interpretation skills) SQ3R Method, ERRQ Method and SPE Method with textual practice LOGICAL READING(Advanced Reading and interpretation skills) Syllogisms -illustrations and practice</p> <p>ADVANCED COMPILATION AND DRAFTING SKILLS(Advanced Writing and other professional communication skills) Minuets, <u>Résumé& Video profile, Review and case writing</u></p>													

	LIFE SKILLS FOR WORK PLACE COMMUNICATION(Advanced Writing and other professional communication skills) Sensitivity towards gender and diversity in communication- Multi-genre Activity
Text books	[T1] Lokesh Mehra, Sanjiva Dubey, S. P. Singh (Ed.) “Corporate Employability skills” , 1 st edition, CEGR, New Delhi, 2016 [T2] Brent C. Oberg.C. , Interpersonal Communication , 1 st Impression , Jaico Publishing, Mumbai, 2005 [T3] Eclectic materials offered by the Department of English
Reference books	[R1] Chauhan, Gajendra Singh, Smitha Kashiramka, “Technical Communication”, Cengage , Delhi, 1 st Impression ,2018 [R2] Quintanilla Kelly M , Shan T Wahl, “ Business and Professional Communication: Keys for Workplace Excellence”, SAGE , New Delhi, 2 nd Impression 2012 [R3] Selinkar, Larry et al, English for Academic and Technical Purposes, I edition, Newbury House Publishers, 1981. [R4] John Langan, College Writing Skills, McGraw Hill, IX Edition, 2014 [R5] Martin Cutts, Oxford Guide to Plain English, 7 th Impression, OUP, 2011
E-resources and other digital material	www.britishcouncil.org/learning-english-gateway .

20TP1606	QUANTITATIVE APTITUDE
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Course Category:	Soft Skill Core	Credits:	1
Course Type:	Learning by Doing	Lecture - Tutorial - Practice:	0 - 0 - 2
Prerequisites:		Continuous Evaluation: Semester end Evaluation: Total Marks:	100 0 100

Course outcomes		Upon successful completion of the course, the student will be able to													
	CO1	apply various Basic Mathematics problems by following different methods													
	CO2	apply shortcut methods to solve problems and follow strategies in minimizing time consumption in problem solving													
	CO3	analyze any mathematical problems and utilize these mathematical skills both in their professional as well as personal life.													
	CO4	evaluation information in quantitative forms including table, graphs and formulas													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1	2							3	3	3				
	CO2		2						3	3	3				
	CO3	2							3	3	3				
	CO4				2				3	3	3				

Course Content	UNIT I NUMERICAL ABILITY I Number system, HCF & LCM, Average, Simplification, Problems on numbers NUMERICAL ABILITY II Ratio & Proportion, Partnership, Percentages, Profit & Loss
	UNIT II ARITHMETICAL ABILITY I Problems on ages, Time & Work, Pipes & Cistern, Chain Rule. ARITHMETICAL ABILITY II Time & Distance, Problems on boats & Steams, Problems on Trains

	UNIT III ARITHMETICAL ABILITY III Allegation, Simple interest and compound interest, Races & Games of skills, Calendar and Clock, LOGICAL ABILITY Permutations and Combination, and Probability.
	UNIT IV MENSURATION Geometry, Areas, Volumes, DATA INTERPRETATION Tabulation, Bar graphs, Pie charts, line graphs
Text books	[T1] R. S. Aggarwal “Quantitative Aptitude”, Revised., S Chand publication, New Delhi, 2017, ISBN:8121924987
Reference books	---
E-resources and other digital material	---

20MC6107B	BIOLOGY FOR ENGINEERS
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Course Category:	Mandatory Core	Credits:	---
Course Type:	Theory	Lecture - Tutorial - Practice:	2-0-0
Prerequisites:		Continuous Evaluation: Semester end Evaluation: Total Marks:	100 0 100

Course outcomes		upon successful completion of the course, the student will be able to:													
		CO1	evaluate the fundamental principles and methods of engineering												
		CO2	analyse the functions of different types in bio-molecules												
		CO3	apply mechanisms underlying the working of molecular biological process including enzyme catalysis, metabolic pathways, gene expression												
		CO4	analyze biological processes using Excel, MATLAB and other computational tools												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1	2	3				3	3		3	3				
	CO2		3				3	3		3	3				
	CO3		2		3		3	3		3	3				
	CO4		1		2	3	3	3		3	3				

Course Content	<p>UNIT – I INTRODUCTION AND CLASSIFICATION OF LIVING ORGANISMS Fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Biology as an independent scientific discipline. Discuss how biological observations of 18th century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor.</p> <p>CLASSIFICATION Classification of living organisms based on (a) Cellularity- Unicellular or multicellular (b) Ultrastructure- prokaryotes or eukaryotes. (c) Energy and Carbon utilization –Autotrophs, heterotrophs, lithotrophs (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitat-aquatic, terrestrial (e) Molecular taxonomy- three major kingdoms of life.</p>
	<p>UNIT – II BIOMOLECULES Biomolecules: Structures of sugars (Glucose and Fructose), starch and cellulose. Nucleotides and DNA/RNA. Amino acids and lipids. Proteins- structure and functions- as enzymes, transporters, receptors and structural elements.</p> <p>ENZYMES Enzyme classification. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters</p>
	<p>UNIT – III GENETICS “Genetics is to biology what Newton’s laws are to Physical Sciences” Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Concepts of recessiveness and dominance. Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring.</p> <p>INFORMATION TRANSFER DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.</p>
	<p>UNIT – IV METABOLISM Exothermic and endothermic versus endergonic and exergonic reactions. Concept of K_{eq} and its relation to standard free energy. ATP as an energy currency. Breakdown of glucose to $CO_2 + H_2O$ (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (photosynthesis). Energy yielding and energy consuming reactions.</p> <p>MICROBIOLOGY Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Growth kinetics. Ecological aspects of single celled organisms. Microscopy.</p>

Text books	<p>[T1] Biology: A global approach: Campbell, N.A.; Reece, J.B.; Urry, Lisa; Cain, M.L.; Wasserman, S.A.; Minorsky, P.V.; Jackson, R.B. Pearson Education Ltd</p> <p>[T2] Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons</p>
Reference books	<p>[R1] Principles of Biochemistry (V Edition), By Nelson, D.L.; and Cox, M.M.W.H. Freeman and Company</p> <p>[R2] Molecular Genetics (Second Edition), Stent, G.S.; and Calender, R.W.H. Freeman and Company, Distributed by Satish Kumar Jain for CBS publisher Microbiology.</p> <p>[R3] Prescott, L.M J.P. Harley and C.A.Klein 1995. 2nd edition Wm, C.Brown publishers</p>
E-resources and other digital material	International Standard Book Number-13: 978-1-4398-9402-6 (eBook - PDF)

20CE7301	ESTIMATION AND COSTING		
Course Category:	Programme Core	Credits:	3
Course Type:	Theory	Lecture - Tutorial -Practice:	3 - 0 - 0
Prerequisites:	20CE3353- Computer Aided Civil Engineering Drawing, 20CE5303 – Design of Concrete structures	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course Outcomes		Upon successful completion of the course, the student will be able to:													
		CO 1	understand various Estimating methods and prepare Building Estimates.												
		CO 2	apply suitable procedures to estimate Roads, Canal works, Steel sanchion and RCC Bridges.												
		CO 3	apply specifications for determining rate analysis for civil engineering works												
		CO 4	evaluate Building Valuation based on rental method and understand PWD procedures												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	1		3		1	1					2		2	
	CO 2	1		3		1	1					2		2	
	CO 3	1		3		1	1					2		2	
	CO 4	1		3		1	1					2		2	
Course Content		UNIT - I METHODS AND PROCEDURE OF BUILDING ESTIMATE Introduction, Units of measurement, Main items of work, Deduction for openings, Comparison of Individual wall method and Centre line method for a single room building. RCC BUILDINGESTIMATE Estimate of Single storey RCC framed residential building with Trapezoidal footings, Estimate of RCC Beam: Standard hooks, Lateral ties and Cranks													
		UNIT - II ESTIMATE OF ROAD AND CANAL WORKS Estimate of earthwork of road from longitudinal section and cross section with reduced levels of ground and formation levels of road data													

	<p>Types of Canal Cross Sections, Estimate of earthwork in irrigation channel both in banking and cutting with longitudinal and cross sections data.</p> <p>ESTIMATE OF STEEL SANCHION AND RCC BRIDGE COMPONENTS Detailed estimate of Steel sanchion with base plate gusset plate and connections, Detailed estimate of RCC T-Beam Decking: T-Beams, Fillets, Deck Slab, Railing posts and Kerbs.</p> <p>UNIT - III DETAILED SPECIFICATIONS Purpose and method of writing Detailed specifications, Procedure of Detailed Specifications for the following: Brick work and R.C.C slab work.</p> <p>ANALYSIS OF RATES Introduction, Task or outturn work, Labor and materials required for different works, Rates of various materials and different types of Labor, Preparing analysis of rates for the following items of work: RCC slab Works, Plastering for super structure walls, Hands on exercise using EZ construction estimator.</p> <p>UNIT – IV PWD ACCOUNTS AND PROCEDURE OF WORKS Organization of Engineering department, Contract and various types, condition of contract, contract Document, Tender notice, Tender procedure- Earnest money, Security money, Measurement book, Revised Estimate, Supplementary estimate, Penalty.</p> <p>VALUATION OF BUILDINGS Introduction, Methods of valuation, Valuation of building based on rental method problem - Out goings, Depreciation, Gross income, Net income, Scrap value, Salvage value, Obsolescence, sinking fund, Capitalized value, Years purchase.</p>
Text Books	<p>[T1]Estimating & Costing in Civil Engineering by B N Dutta, UBS Publishers Pvt Ltd. New Delhi, 2018.</p> <p>[T2]Estimating, Costing & Valuation by Rangwala, Universal Publications, New Delhi, 2017.</p>
Reference Books	<p>[R1]Estimating and Costing by D. D. Kohli and R. C. Kohli., S. Chand Publications-New Delhi-2013</p> <p>[R2]M. Estimating & costing by Chakraborty, Variuos, New Delhi,2012.</p>
E-resources and other digital material	<p>http://nptel.ac.in/courses/105103093/15</p>

20CE7402A	EARTHQUAKE RESISTANT DESIGN
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Course Category:	Program Elective 3	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20BS3101A - Mechanics of Solids, 20CE4302 - Structural Analysis, 20CE5303 - Design of Concrete Structures	Continuous Evaluation: 30 Semester end Evaluation: 70 Total Marks: 100	

Course Outcomes		Upon successful completion of the course, the student will be able to:													
		CO 1	understand the basics of Engineering Seismology and understand the elements of Earthquake Engineering												
		CO 2	Apply the single and multi-degree of freedom systems subjected to vibration including earthquake and understand the concepts of seismic-resistant building architecture.												
		CO 3	analyze the earthquake design forces using appropriate methods as per IS 1893-2002(Part-I) and apply the concept of ductile detailing in earthquake resistant design												
		CO 4	analyze and design a single storey and single bay RCC plane framed building subjected to an Earthquake												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	3													3
	CO 2	3	3	2	2	1								3	
	CO 3	2	3	3										3	
	CO 4	2	3	3										3	
Course Content		UNIT – I ENGINEERING SEISMOLOGY: Introduction, Internal Structure of Earth, Continental Drift Theory, Plate Tectonics, Faults, Causes of Earthquakes. ELEMENTS OF EARTHQUAKE ENGINEERING Earthquake magnitude and intensity, Focus and Epicenter, Seismic waves, Earthquake Measuring Instruments, Causes and Effects of Earthquakes, Characteristics of Earthquake, Seismic zone mapping.													

	<p>UNIT – II DYNAMICS FOR EARTHQUAKE ANALYSIS Equations of Motion for SDOF and MDOF Systems; Undamped Free Vibration of SDOF and MDOF Systems, Mode Shapes and Frequencies of MDOF System.</p> <p>SEISMIC-RESISTANT BUILDING ARCHITECTURE Introduction; Lateral load resisting systems- Moment Resisting Frame, Building with shear wall or Bearing wall system, Building with dual system; Building configuration – Problems and solutions; Building characteristics – Mode shape and fundamental period, Building frequency and ground period, Damping, Ductility, foundation soil/ liquefaction.</p> <p>UNIT – III DESIGN FORCES FOR BUILDINGS Introduction; Equivalent static method; Mode superposition technique; Dynamic inelastic time history analysis; Advantages and disadvantages of these methods; Determination of lateral forces as per IS 1893(Part 1) – Equivalent static method, Model analysis using response spectrum.</p> <p>DUCTILITY CONSIDERATIONS IN EARTHQUAKE RESISTANT DESIGN OF RCC BUILDINGS Introduction; Impact of ductility; Requirements for ductility; Assessment of ductility– Member/element ductility, Structural ductility; Factor affecting ductility; Ductility factors; Ductility considerations as per IS13920.</p> <p>UNIT – IV ANALYSIS OF SINGLE STOREY AND SINGLE BAY RCC PLANE FRAME (COLUMNS VERTICAL) (AS PER IS:1893(PART-I)-2002) Calculation of lateral force due to earthquake using Equivalent Static Method; Analysis for different load combinations; Design forces and moments in beam and columns.</p> <p>DESIGN OF SINGLE STOREY AND SINGLE BAY RCC PLANE FRAMES (COLUMNS VERTICAL) (AS PER IS:456-2000 AND IS:13920-1993) Design of column; Design of beam; Design of footing; Detailing of entire frame</p>
Text Books	<p>[T1]Pankaj Agarwal and Manish Shrikande, “Earthquake Resistant Design of Structures”, 2nd ed., Prentice Hall of India Publications, 2014.</p> <p>[T2]Anil Chopra, “Dynamics of Structures”, 3rd ed., Prentice Hall India Publications, 2015.</p> <p>[T3]S.K. Duggal, “Earthquake Resistant Design of Structures”, 2nd ed., New Delhi, Oxford University Press, 2013.</p>
Reference Books	<p>[R1]Jaikrishna, Chandarsekaran and Brijesh Chandra, “Elements of Earthquake Engineering, 1st ed., New Delhi: South Asian Publishers, 1994.</p> <p>[R2] R.W. Clough and J. Penzien, “Dynamics of Structures”, 3rd ed., McGraw Hill Civil Engineering Series, 2015.</p> <p>[R3]Relevant Latest Revisions of IS codes - IS1893, IS456, IS13920, IS13827, IS13828, IS13935</p>
E-resources and other digital material	<p>“www.nptel.ac.in / courses/ 105101004/”</p> <p>“www.nptel.ac.in / courses/ 105107105107204/”</p>

20CE7402B	SOLID WASTE MANAGEMENT
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Course Category:	Program Elective 3	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE5302-Environmental Engineering	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:														
		CO 1	understand the sources and composition of Municipal Solid Waste.													
		CO 2	analyze methods of collection, transport and disposal of Municipal Solid Waste.													
		CO 3	apply methods of separation and recycling of Municipal Solid Waste.													
		CO 4	understand handling of Bio-medical, plastic and e-waste.													
Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2-Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
	CO 1	3		1		1	2	1				1			2	
	CO 2	3		3		3	2	1				1			2	
	CO 3	3		1		1	2	1				1			2	
	CO 4	3		1		1	2	1				1			2	
Course Content		UNIT – I SOURCES, TYPES AND COMPOSITION OF MUNICIPAL SOLID WASTE Sources, Types, Composition of Solid Waste, Effects of improper disposal of solid waste, public health effects, Types of materials recovered from MSW.														
		WASTE HANDLING, SEPARATION AND STORAGE On– site handling and separation at solid waste, on - site storage of solid waste, options under Indian conditions.														

	<p>UNIT – II COLLECTION OF MUNICIPAL SOLID WASTE Methods of collection, equipment, types of vehicles, man power requirement.</p> <p>TRANSFER AND TRANSPORT OF MUNICIPAL SOLID WASTE Need for Transfer operations, Transfer Stations, Selection of Location of Transfer Stations, Transport means and methods.</p>
	<p>UNIT – III OFF-SITE PROCESSING,SEPARATION,TRANSFORMATION: Size Reduction, Separation, Density separation, Magnetic Separation, Pyrolysis, Composting, Incineration.</p> <p>DISPOSAL OF SOLID WASTE Disposal of Solid Waste – Sanitary land Fills, Site selection, Planning, Design and operation of Sanitary land fills, Leachate collection</p>
	<p>UNIT – IV BIO-MEDICAL WASTE MANAGEMENT Sources & generation of Bio-medical Waste, Biomedical Waste Management.</p> <p>PLASTIC AND E-WASTE MANAGEMENT Dangers of Plastics, Recycling of Plastic waste, Disposal of plastic waste. Health Hazards of E- waste, E- waste Management</p>
Text Books	<p>[T1] Goerge, T. Hilary,T. & Samuel, A.V. Integrated Solid waste management, McGraw Hill Indian Edition, 2014.</p> <p>[T2] Amalendu, B. Design of Land Fills and Integrated Solid waste management John Wiley & Sons 3RD Edition, 2004</p>
Reference Books	<p>[R1] CPCB Manual on solid waste Management, NDLS, 2016.</p> <p>[R2] Sasi kumar, K. Sanoop, G. Solid waste management, PHI, NDLS, 2009</p> <p>[R3] Urvashi, D. Solid waste management in India, NDLS, 2014</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/105103205“ https://www.coursera.org/learn/solid-waste-management#instructors”</p>

20CE7402C	GROUND IMPROVEMENT TECHNIQUES		
Course Category:	Program Elective 3	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE4303 - Geotechnical Engineering	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:														
		CO 1	understand need and methods of ground improvement techniques													
		CO 2	apply suitable ground improvement technique for a given site													
		CO 3	apply different grouting techniques, geotextiles and their functions													
		CO 4	evaluate the expansivity of soils and types of foundations for expansive soils and suggest soil stabilization techniques based on field conditions													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)			P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	1	2	2		2	1					1				2
	CO 2	1		2		2	1					1				2
	CO 3	1	2	2			1					1				2
	CO 4	1	2	2	2	2	1									2
Course Content		UNIT - I: INTRODUCTION: Need of Ground Improvement: Different methods of Ground improvement, Mechanical, Hydraulic, Physico-chemical, Electrical, Thermal methods. GROUND IMPROVEMENT METHODS IN GRANULAR SOILS In place densification by Dynamic Compaction, Vibroflotation, Compaction pile, Vibro-Compaction Piles and Blasting.														

	<p>UNIT – II DENSIFICATION METHOD IN COHESIVE SOILS Introduction, Preloading, Vacuum dewatering, Sand Drains, Stone columns, Prefabricated vertical drains.</p> <p>GROUTING TECHNIQUES Grouting in soil, Desirable characteristics, Grouting pressure, Grouting methods.</p>
	<p>UNIT – III GEOSYNTHETICS Introduction – Type of geosynthetics: Functions and their applications, geogrid – functions.</p> <p>REINFORCED EARTH Principles – Components of reinforced earth – factors – governing design of reinforced earth walls – design principles of reinforced earth walls.</p>
	<p>UNIT – IV EXPANSIVE SOILS Problems of expansive soils, Identification tests for expansive soils, I.S. test methods for swelling – pressure of a soil, Improvement methods for expansive soils.</p> <p>SOIL STABILIZATION Types of soil stabilization, Lime stabilization - Base exchange mechanism, Pozzolanic reaction, lime-soil interaction. Lime stabilization mix design, Cement stabilization: Mechanism, amount, age and curing.</p>
Text Books	<p>[T1] Hausmann, M.R., Engineering Principles of Ground Modification, McGraw-Hill International Editions, NY, US, 1990.</p> <p>[T2] Purushothama, R. P., Ground Improvement Techniques, Tata McGrawHill, NDLS, 1995.</p>
Reference Books	<p>[R1] Chattopadhyay, B. C. and Maity, J., Ground Control and Improvement Techniques, PEEDOT, HWH, 2011.</p> <p>[R2] Korner, R. M., Design with Geosynthetics, Prentice Hall, NJ, US, 2002</p> <p>[R3] Han, J., Principles and Practice of Ground Improvement, John Wiley, NJ, US 2015.</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/105108075/</p>

20CE7402D		PAVEMENT DESIGN AND CONSTRUCTION														
Course Category:		Program Elective 3							Credits:				3			
Course Type:		Theory							Lecture - Tutorial - Practice:				3 - 0 – 0			
Prerequisites:		20CE6302- Transportation Engineering							Continuous Evaluation:				30			
									Semester end Evaluation:				70			
									Total Marks:				100			
Course Outcomes		Upon successful completion of the course, the student will be able to:														
		CO 1	understand the factors affecting pavement design and analyze layer system													
		CO 2	evaluate the thickness of flexible and rigid pavements													
		CO 3	understand different materials and methods used in construction of pavements													
		CO 4	analyze and design pavement overlays													
Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2 –Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
	CO 1		2	2											2	
	CO 2		2	3										3		
	CO 3					3									2	
	CO 4		2	3										3		
Course Content		UNIT – I FLEXIBLE PAVEMENT - INTRODUCTION Requirements of highway pavement, Types of pavement structures, Flexible pavement components and functions, factors affecting design and performance of flexible pavements, stresses in flexible pavement- single layer system, two layer system. DESIGN OF FLEXIBLE PAVEMENT CBR method, Flexible pavements design as per IRC guidelines IRC 37:2012, AASHTO Method- basis for AASHTO method, performance criteria, traffic and material inputs, pavement design as per AASTHO criteria.														

	<p>UNIT – II RIGID PAVEMENT - INTRODUCTION Rigid pavement components and functions, Types of joints, factors affecting design and performance of CC pavement, stresses in rigid pavement (numerical).</p> <p>DESIGN OF RIGID PAVEMENTS Design of rigid pavement as per IRC guidelines, design of joints, design of dowel bars, design of tie bars</p> <hr/> <p>UNIT – III CONSTRUCTION OF FLEXIBLE PAVEMENTS Construction of highway embankment – material, construction steps, QC checks, Construction of subgrade - material, construction steps, QC checks, Construction of GSB – material, construction, QC checks, Construction of Base course- WMM material, construction steps, QC checks, Preparations before constructing bituminous layer over GSB, Preparations before laying bituminous pavement layer over existing bituminous layer, Prime coat, tack coat, Construction of bituminous macadam – materials, construction steps, QC checks, Dense graded bituminous mixes – materials, construction steps, QC checks.</p> <p>CONSTRUCTION OF RIGID PAVEMENTS Construction of CC pavement- construction of supporting layers, construction of cc pavement slab, construction of joints, QC checks, Interlocking concrete block pavements.</p> <hr/> <p>UNIT – IV PAVEMENT EVALUATION Pavement deterioration, objectives of maintenance, classification of maintenance, structural evaluation of flexible pavement- principle of FWD method, Evaluation by Benkelman beam method (no numerical).</p> <p>PAVEMENT OVERLAYS Design of flexible pavement overlay using BBD data, strengthening of existing flexible pavement by overlays, strengthening of cc pavements by overlays.</p>
Text Books	<p>[T1] SK Khanna, CEG Justo & A Veeraragavan, “Highway Engineering”, 10th ed., Nem Chand & Bros, Roorkee, 2017.</p> <p>[T2] AASHTO Guide for Design of Pavement Structures, American Association of State Highway and Transportation Officials (AASHTO), 1993</p>
Reference Books	<p>[R1] H HYang, “Pavement Analysis and Design”, 2nd ed., Pearson, NJ, 2003.</p> <p>[R2] E J Yoder & M W Witczak, “Principles of Pavement Design”, 2nd ed., Wiley India Pvt Ltd, New Delhi, 2012</p> <p>[R3] R L Brocken brough & K J Boedecker, “Highway Engineering Handbook”, 2nded.,, McGraw hill, New Delhi, 2003</p> <p>[R4]Guidelines for the design of flexible pavements, IRC: 37, Indian Roads Congress, 2012</p> <p>[R5]Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, IRC 58, Indian Roads Congress, 2015</p> <p>[R6]Guidelines for Strengthening of flexible road pavements using Benkelman Beam Deflection Technique, IRC 81, Indian Roads Congress, 1997.</p>

	[R7]Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique, IRC 115, Indian Roads Congress, 2014
E-resources and other digital material	“https://nptel.ac.in/courses/105/105/105105107/” “https://nptel.ac.in/courses/105/101/105101087/”

20CE7402E	OPEN CHANNEL FLOW AND RIVER ENGINEERING
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Course Category:	Program Elective 3	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3- 0- 0
Prerequisites:	20CE4304 – Hydraulics &Hydraulic Machines 20CE5301- Water resources Engineering	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course Outcomes		Upon successful completion of the course, the student will be able to:													
		CO 1	apply energy principles for Uniform flow.												
		CO 2	evaluate various surface profiles in an open channel flow.												
		CO 3	understand the behavior of flow through non-prismatic channels.												
		CO 4	analyze river flow hydraulics.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2 –Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1		3	2										3	
	CO 2		3	2										3	
	CO 3		3	2											2
	CO 4		3	2											2
Course Content		UNIT I: OPEN CHANNEL FLOW: Basic concepts of free surface flow; Velocity and Pressure distribution; Differential form of continuity and momentum equations; Energy principles and applications; Energy equation; energy and momentum correction coefficients. STEADY UNIFORMFLOW: Shear stress on the boundary; chezy's equation and Manning's formula; Resistance formulae for practical use; Equivalent roughness; Uniform flow computations; Computation of Normal depth; Compound Sections													

	<p>UNIT II: GRADUALLY VARIED FLOW: Gradually varied flow; Governing equations; Classification of surface profiles; Computation of gradually varied flow in Prismatic and Non-Prismatic channels – Graphical and Direct integration methods.</p> <p>RAPIDLY VARIED FLOW: Application of Momentum equation; Hydraulic Jump in horizontal and sloping rectangular channels, Basic characteristics of the Jump; location and length of jump; Jump as energy dissipater; Control of Jump by Sills.</p> <hr/> <p>UNIT – III FLOW THROUGH NON-PRISMATIC CHANNELS: Sudden Transitions; Subcritical flow through sudden Transitions; Contractions and Expansions in Supercritical flow; constrictions; Subcritical flow through Constrictions; Backwater effect due to Constriction.</p> <p>RAPIDLY VARIED UNSTEADY FLOW: Waves and classification; Celerity of waves; Moving Hydraulic Jump; Surges; Equations of motion; Method of Characteristics.</p> <hr/> <p>UNIT IV: FLUVIAL HYDRAULICS: Basic characteristics of river beds and sediments, Initiation of motion; regimes of flow; Resistance to flow in alluvial streams; Theories of Bed Load, Suspended Load and Total Load.</p> <p>RIVER ENGINEERING: Classification of Rivers; Meandering - Causes; Features of Meandering – Factors controlling process of Meandering; Cutoffs; Guide Banks; Groynes; River training and its objectives; Classification of river training works; Methods river training works.</p>
Text Books	<p>[T1]K. Subramanya, “Flow in Open Channels”, 5th edition, Tata McGraw Hill Education Private Limited, New Delhi, 2019.</p> <p>[T2]Dr. B.C. Punmia and Dr. Pande B.B. Lal, “Irrigation and Water Power Engineering”, Laxmi Publications, New Delhi, 2005.</p>
Reference Books	<p>[R1] V.T. Chow, “Open Channel Hydraulics”, Mc Graw Hill Book Company, Inc. London, Reprint, Blackburn Press, 2009.</p> <p>[R2] Garde and Ranga Raju, K.G., “Mechanics of Sediment Transportation and Alluvial Stream Problems”, 3rd edition, New Age Publishers, New Delhi, 2000.</p>
E-resources and other digital material	<p>www.nptel.ac.in/courses/105105110/ www.nptel.ac.in/courses/105107059/</p>

20CE7402F	ANALYSIS AND DESIGN OF HIGH RISE BUILDINGS
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Course Category:	Program Elective 3	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE4302-Structural Analysis; 20CE3601- Design of Reinforced Concrete Structures	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course Outcomes		Upon successful completion of the course, the student will be able to :													
		CO 1	understand structural systems of High Rise buildings.												
		CO 2	apply the latest construction practices and processes for various structural systems.												
		CO 3	evaluate the wind & seismic effects on behavior of high rise buildings												
		CO 4	analyze and design of high rise buildings												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1		3	2										3	
	CO 2	2	3	3										3	
	CO 3	2	3	2										2	
	CO 4	2	3	3										3	
Course Content		UNIT – I INTRODUCTION TO HIGH RISE BUILDINGS: Evolution of tall buildings – Introduction - Classification of Buildings- lateral loads like Wind loads, Earthquake loads & Blast loads- Design criteria for structural design of Tall building - Concept of premium for height - Development of high rise architecture. CONSTRUCTION OF HIGH RISE BUILDINGS: Assembly of Building and site investigation, Building performance –cost, quality and time													

	<p>UNIT – II ENVIRONMENTAL REQUIREMENTS: Industrialization & Robotics in Construction - Introduction to safety and Health Management System - Stages of site Investigation - Site Reconnaissance & Ground investigation-Field tests & Laboratory tests.</p> <p>FOUNDATION SYSTEMS: Material handling and Mechanization - Material handling considerations - Earthmoving equipment's - Horizontal and vertical movements - Selection & Utility of Cranes (Tower Cranes & Climbing Cranes).</p> <p>UNIT – III WIND & SEISMIC EFFECTS ON BEHAVIOR OF TALL STRUCTURES: Outlook of Design considerations and Characteristics of wind - Codal wind loads and cladding pressures on behavior of tall buildings - Introduction to Tall building behavior during earthquakes and seismic design philosophy.</p> <p>STRUCTURAL FORMS & FLOORING SYSTEMS: Introduction of Various structural forms and their importance to high rise architecture - Introduction to various Flooring Systems in concrete & steel.</p> <p>UNIT – IV METHODS OF ANALYSIS: Structural behavior of Rigid frames – Simplified methods of analysis – Substitute frame method & Portal method.</p> <p>MODELING FOR ANALYSIS : Approaches for analysis - Assumptions involved in modeling - Reduction techniques - Application using Structural engineering Software.</p>
Text Books	<p>[T1]Taranath B, Steel, “Concrete and Composite Design of Tall Buildings”, 2nd Edition, McGraw Hill, 2016.</p> <p>[T2]White and Salmon, “Building Structural Design Handbook”, John Wiley & Sons, 1987.</p> <p>[T3]Wolfgang Schueller, “The Design of Building Structures”, Prentice Hall , 1996.</p>
Reference Books	<p>[R1]Kazimi, S. M. A. "The analysis of shear-wall buildings." Building Science 1, no. 4 (2015): 271-276.</p> <p>[R2]Gere, James M., and William Weaver. Analysis of framed structures. Van Nostrand, 2009.</p> <p>[R3]Mohraz, Bijan. "Review of The Design of Building Structures by Wolfgang Schueller." Journal of Architectural Engineering 2.2 (1996): 82-83.</p>
E-resources and other digital material	<p>“www.nptel.ac.in / courses/ 105101082/”.</p>

20CE7403A	PREFAB STRUCTURES
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Course Category:	Program Elective 4	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE5303 - Design of concrete structures 20CE6301 - Design of steel structures	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course Outcomes		Upon successful completion of the course, the student will be able to:														
		CO 1	understand the plant prefabricated and production													
		CO 2	analyse the prefabricated load carrying members													
		CO 3	analyze the production technology of prefabrication													
		CO 4	evaluate and detailing of precast UNIT for factories with single storey simple frames													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
	CO 1	2	1	2	3	2	1							2	2	
	CO 2	2	1	1	3	2	1							2	2	
	CO 3	2	1	2	3	2	1							2	2	
	CO 4	2	1	1	3	3	1							2	2	
Course Content		UNIT – I														
		INTRODUCTION: Need for prefabrication – General Principles of Prefabrication - Comparison with monolithic construction, types of prefabrication.														
		PLANT FABRICATION Site and Plant prefabrication, economy of prefabrication, modular coordination, standardization – Materials – Modular coordination – Systems –Production – Transportation – Erection.														
		UNIT – II PREFABRICATED COMPONENTS Prefabricated Load Carrying Members-Planning for components of prefabricated structures, disuniting of structures, design of simple rectangular beams and I-beams, handling and erection stresses, elimination of erection stresses, beams, columns, symmetric frames. BEHAVIOUR OF STRUCTURAL COMPONENTS														

	<p>Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls. Joints - Joints for different structural connections, effective sealing of joints for water proofing, provisions for non-structural fastenings, expansion joints in precast construction.</p> <p>UNIT – III PRODUCTION TECHNOLOGY Production Technology - Choice of production setup, manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements, dimension altolerances, acceleration of concrete hardening.</p> <p>HOISTING TECHNOLOGY 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.</p> <p>UNIT – IV APPLICATIONS Applications - Designing and detailing of precast UNIT for factory structures, purlins, principal rafters, roof trusses, lattice girders, gable frames, singe span single storied simple frames, single storied buildings, slabs, beams and columns.</p> <p>DESIGN FOR ABNORMAL LOADS Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.</p>
Text Books	<p>[T1]Bruggeling A.S. G and Huyghe G.F. "Prefabrication with Concrete", A.A. Balkema Publishers, USA,1991.</p> <p>[T2]Lewitt, M. " Precast Concrete- Materials, Manufacture, Properties And Usage", Applied Science Publishers , London And New Jersey, 1982.</p> <p>[T3]Bachmann, H. and Steinle, A. "Precast Concrete Structures", Ernst &Sohn, Berlin, 2011.</p> <p>[T4]Gerostiza C.Z., Hendrikson C. and Rehat D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994</p>
Reference Books	<p>[R1]Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH, 1976.</p> <p>[R2] "Handbook on Precast Concrete Buildings", Indian Concrete Institute, 2016.</p> <p>[R3] "Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009.</p> <p>[R4]CBRI, Building materials and components, India, 1990</p>
E-resources and other digital material	<p>https://archive.nptel.ac.in/courses/124/105/124105013/– “https://www.youtube.com/watch=FdbHC4sfqBo”</p>

20CE7403B	CONSTRUCTION EQUIPMENT AND AUTOMATION		
Course Category:	Program Elective 4	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:													
CO 1		analyze the feasibility of specific equipment by understanding their working principles to be used in different construction activities													
CO 2		understand the procedures of concrete production and procedure of dewatering and grouting													
CO 3		apply the concept and procedure of automation in construction sector													
CO 4		apply the latest techniques of automation in construction sector													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	2				2									1
	CO 2	2				2									2
	CO 3	3		2		2							1		2
	CO 4	3		2		2							1		2
Course Content		<p>UNIT – I INTRODUCTION: Unique features of construction equipment; Need of construction Equipment; Past history.</p> <p>CONSTRUCTION EQUIPMENT: Capacity, Feasibility, Productivity of Different Equipment: Excavators, Pavers, Plastering machines; Pre-stressing jacks and grouting equipment; Cranes and Hoists, etc.</p> <p>UNIT – II CONCRETE BATCHING PLANTS: Crushers and crushing plants; Compressors; Feeders; Screening equipment; Handling equipment; Batching and Mixing equipment; Hauling; Pouring and Pumping equipment; Transporters.</p> <p>GROUTING AND DE-WATERING EQUIPMENTS: Foundation and pile driving equipment; Grouting; Special concrete</p>													

	for repairs and pumping equipment; Types of pumps; Dewatering principle and technique;
	UNIT – III INTRODUCTION TO AUTOMATION IN CONSTRUCTION SECTOR Concept and application of Building Automation Systems (BAS); Requirements and design considerations and its effect on functional efficiency; Architecture and components of BAS. AUTOMATION IN CONSTRUCTION INDUSTRY: Need and Benefit of automation; Automation in Canal lining; Automation in Construction of Highway; Automation in concrete technology.
	UNIT – IV ROBOTICS IN CONSTRUCTION: Introduction; Benefits of robots in construction industry with respect to time, cost, quality, safety; Use of robots for construction activities like Brick laying, Demolition, Material Handling, Structural steel cutting, Rebar tying/bending. 3D PRINTING: Printer components; Types of printers – Robotic arm, Gantry Printer; layered parts and objects of homes, buildings, bridges and roads; Form work mould making.
Text Books	[T1] Construction Equipment and Management, Sharma S.C., Khanna Publishing; First edition, 2019. [T2] Automation in Construction Management, Javad Majrouhi Sardroud, Scholars' Press, 2014. [T3] Construction Planning, Methods and Equipment, R.L Peurifoy, McGraw Hill, 2011.
Reference Books	[R1] Construction Equipment and its planning and application, Varma. M., Metropolitan, NDLS, 1983. [R2] Robotics and Automation in Construction, Open access peer- reviewed edited volume.
E-resources and other digital material	http://buildingsolutions.honeywell.com/en-US/Pages/default.aspx http://www.isa.org https://www.youtube.com/watch?v=T_CMr2KFSd4

20CE4703C	GROUND WATER HYDROLOGY
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Course Category:	Program Elective 4	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE5301 - Water Resources Engineering	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:															
		CO 1	understand components, fluctuations, flow rate and measurement of velocity of ground water.														
		CO 2	evaluate the storage capacity, ground water potential and the methods for assessment of ground water.														
		CO 3	apply the design principles of wells and assessment of ground water quality.														
		CO 4	understand sea water intrusion and artificial ground water recharge.														
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2		
	CO 1	3				2									2		
	CO 2	3		2											2		
	CO 3	3	2	2											3		
	CO 4	3		3		2		3			2				3		
Course Content		UNIT – I INTRODUCTION TO GROUND WATER HYDROLOGY: General Water Balance, Regional Ground Water Balance, Distribution of subsurface water, Components of ground water studies. Ground water level fluctuations. OCCURRENCE AND MOVEMENT OF GROUND WATER: Origin & age of ground water, ground water flow rates and flow directions. Ground Water velocity measurement- Preliminary and chemical methods.															
		UNIT – II METHODS OF LOCATING GROUND WATER: General-Investigations- Geologic maps- Field Procedures, Depth Sounding Curve.															
		GROUND WATER ASSESSMENT: Discharge by wells, Safe yield & overdraft, Calculation of safe yield- Simpson’s method, calculation of Ground Water Storage capacity and ground water potential.															

	<p>UNIT – III METHODS OF WELL DESIGN General – Steps involved in the design of a tube well- Mechanical Analysis- Methodology- Effective grain size- Well Screen length-Well screen slot openings well screen diameter.</p> <p>GRAVEL PACKING AND GROUND WATER QUALITY: Head losses through the screens-gravel packing and formation, stabilization. Ground Water quality Standards for drinking, irrigation and Industrial purpose.</p>
	<p>UNIT – IV SEA WATER INTRUSION IN COSTAL AQUIFERS: Physical characteristics of water intrusion, causes of salinity, recognition of sea water in ground water, relationship between salt water and fresh water.</p> <p>ARTIFICIAL RECHARGE: Direct benefits of artificial recharge, principles adopted in recharge, factors to be considered in selection of artificial recharge sites, Artificial recharge techniques.</p>
Text Books	[T1]Ground water by S. Ramakrishna, SCITECH Publications India Pvt, Ltd, 2011.
Reference Books	[R1]Numerical Groundwater Hydrology by A.K.Rastogi, Penram International Publishing India Pvt. Ltd, 2007 [R2]Ground water by HM Raghunath, New Age International Publishers, 2011. [R3] Journals in Ground Water.
E-resources and other digital material	http://nptel.ac.in

20CE7403D		INSTRUMENTATION AND SENSOR TECHNOLOGY IN CIVIL ENGINEERING														
Course Category:		Program Elective 4								Credits:				3		
Course Type:		Theory								Lecture - Tutorial - Practice:				3-0-0		
Prerequisites:		---								Continuous Evaluation:				30		
										Semester end Evaluation:				70		
										Total Marks:				100		
Course Outcomes		Upon successful completion of the course, the student will be able to:														
		CO 1	apply various strain gauges in given conditions													
		CO 2	apply various piezoelectric sensors in given conditions													
		CO 3	evaluate the types of sensors used for temperature measurement													
		CO 4	understand various sensors used in flow, pressure, level measurement													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
	CO 1	2			1	2									2	
	CO 2	2			1	2									2	
	CO 3	2			1	2									2	
	CO 4	2			1	2									2	
Course Content		UNIT – I STRAIN GAUGES Various types of strain gauges, principles & performance- Electrical resistance strain gauges - Gauge sensitivity - gauge factor - Simple strain gauge circuits – application.														
		WHEAT STONE BRIDGE Balanced Wheatstone bridge condition derivation using Kirchhoff’s Rules – Wheatstone bridge and Meter Bridge. Application of Meter Bridge														
		UNIT – II LVDT Characteristics of structural vibrations - Linear variable differential transformer (LVDT), Digital data acquisition systems- principles and applications, vibration meter – Seismographs.														

	<p>PIEZOELECTRIC SENSORS Piezoelectric sensors and their application in maturity of concrete & corrosion aspects.</p>
	<p>UNIT – III INTERNET OF THINGS Introduction to Internet of Things (IoT), working phenomenon, various applications IoT in CE(Concrete technology and crack detection).</p> <p>TEMPERATURE MEASUREMENT Introduction, Principles of Temperature measurement, Thermoelectric effect sensors, Varying resistance devices, Radiation thermometers, thermography, Thermal expansion methods, Intelligent temperature measuring instruments, thermal imaging camera</p>
	<p>UNIT – IV PRESSURE MEASUREMENT Introduction, Diaphragms, Capacitive Pressure sensor, Fibre-Optic Pressure sensor, Bellows, Bourbon tube, Manometers, Resonant Wide devices, Dead-weight gauge, Special measurement devices for low pressures, high-pressure measurement, Intelligent pressure transducers</p> <p>FLOW MEASUREMENT & LEVEL MEASUREMENT Introduction, Mass flow rate, Volume flow rate, Intelligent flow meters, Introduction to level measurement, Dipsticks, float systems, ultrasonic level gauge, radar methods, radiation methods, intelligent level measuring systems</p>
Text Books	<p>[T1] L. S. Srinath, “Experimental Stress Analysis”, Tata McGraw Hill, 2004. [T2] Alan S Morris, “Measurement and Instrumentation Principles”, 3rd /e, Butterworth Hienemann, 2001. [T3] Wang, M.L., Lynch, J.P. and Sohn, H. eds., “Sensor technologies for civil infrastructures”, Woodhead publications, 2014. [T4] Dalley. J.W and Riley.W.F, “Experimental Stress Analysis”, Tata Mc Graw Hill company Ltd, New York, 1991.</p>
Reference Books	<p>[R1] Sirohi .R.S, Radha Krishna .H.C, "Mechanical Measurements", New Age International (P) Limited, 1997.</p>
E-resources and other digital material	<p>https://www.sensy.com/en/blog/instrumentation-for-civil-engineering-applications-b38 https://onlinecourses.nptel.ac.in/noc21_me02/preview</p>

20CE7403E	AIRPORT PLANNING AND HARBOUR PLANNING
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Course Category:	Program Elective 4	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:													
		CO 1	understand airport and aircraft characteristics.												
		CO 2	analyse various obstructions at airport.												
		CO 3	evaluate airport runway pavement.												
		CO 4	understand components of docks and harbors.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1		3												2
	CO 2	3		2											2
	CO 3	3	3	2							1		1	3	
	CO 4					3					1		1		2
Course Content		UNIT – I AIR TRANSPORT Different modes of transportation, Introduction to NAA, IAAI, AAI and ICAO. AIRPORT PLANNING AND CHARACTERISTICS Airport classification based on ICAO, airport components, Aero plane components; Air–craft characteristics; Selection of site for airport; Surveys for site selection.													
		UNIT – II AIRPORT OBSTRUCTIONS Zoning laws, Imaginary surfaces, Approach zone, turning zone. RUNWAY DESIGN Runway orientation- cross wind component, wind rose diagram, types of wind rose; Basic runway length; Corrections for elevation, Temperature and gradient; Runway geometric design. Runway configurations, geometric design standards of taxiway design.													

	<p>UNIT – III STRUCTURAL DESIGN OF AIRFIELD PAVEMENT FLEXIBLE PAVEMENT Various design factors, Design methods for flexible airfield Pavement CBR Method, Mcleod Method and Burmister's Method.</p> <p>RIGID PAVEMENT rigid pavement Design- PCA Method; LCN Method of pavement design.</p>
	<p>UNIT – IV DOCKS Dry Docks , Wet Docks and Slipways.</p> <p>HARBOR Harbor Layout: types of harbors, port terms, site selection, Break Waters, Piers and wharves.</p>
Text Books	<p>[T1] Airport Planning and Design by S. K. Khanna ,M. G. Arora & SS Jain; Nemchand & Bros, Roorkee- 2012</p> <p>[T2] Airport Engineering: Planning and Design, Subhash C Saxena, CBS Publisher, 2012</p> <p>[T3] Hasmukh P. Oza, Gautam H. Oza , Dock And Harbour Engineering, Charotar, Anand, GJ, 2016.</p>
Reference Books	<p>[R1] Airport Engineering – Rangwala, Charotar Publishing House Pvt. Ltd., 2012</p> <p>[R2] Virender Kumar and Satish Chandra, "Airport Planning and Design"- Galgotia Publication Pvt Ltd 2012</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/105107123</p>

20CE7403F	DESIGN AND DRAFTING USING REVIT
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Course Category:	Program Elective 4	Credits:	3
Course Type:	Laboratory	Lecture - Tutorial - Practice:	2-0-2
Prerequisites:	20CE4607- Autodesk Revit & Excel for Engineers 20CE5607- Building Information Modeling (BIM)	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course Outcomes		Upon successful completion of the course, the student will be able to													
		CO 1	understand the Revit Software and its user interface.												
		CO 2	apply the process of drafting, designing, and modelling the building using Revit												
		CO 3	evaluate a project using Revit Software that will cater to the industrial Requirements												
		CO 4	understand the preparation of construction drawings in detail.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1		2	3		3				1				3	
	CO 2		2	3		3				1				3	
	CO 3		2	3		3				1				3	
	CO 4		2	3		3				1				3	
Course Content		UNIT – I INTRODUCTION TO AUTODESK REVIT Autodesk Revit, Building Information Modeling (BIM), Understanding Revit Terms, Parametric, element behavior in Parametric Modeler, Element Properties, User Interface- Ribbon, quick access toolbar, Project Browser, drawing area, properties palette, view control bar, Families- system families, loadable families, in-place families. CREATING A PROJECT Creating a project using template, grids and levels, import from other formats, defining named positions, creating solar studies, rotating a view to true North, site design -topo surfaces, Cut/Fill Volumes, Building pads, parking components.													

	<p>UNIT – II ARCHITECTURAL MODELLING- WALLS, DOORS, WINDOWS, COMPONENTS & CIRCULATIONS Walls, Doors, windows, components- types, placing, modifying, type & Instance Properties. Circulations- Stairs, Ramps, railings.</p> <p>ARCHITECTURAL MODELLING- COLUMNS, FLOOR, ROOF Columns- adding, attaching, detaching, modifying, properties. Floor- adding, changing type, editing, sloped floors. Roof- Creating, modifying, adding elements, roof slope. Openings in walls, floors & roof.</p>
	<p>UNIT – III STRUCTURAL MODELLING Structural Template, Structural columns, Beams, Structural walls, Floors, Slabs, Trusses – Creating, Placing, modifying, Properties.</p> <p>FOUNDATIONS & REINFORCEMENT Wall Foundations, Isolated foundations, Foundations slabs. Rebar- cover, shapes, hooks, sets, Area & Path reinforcement.</p>
	<p>UNIT – IV DOCUMENTING THE PROJECT 2D & 3D Views, legend views, Schedules, Project Phasing, annotating, Detailing, Preparing Construction Documents, Rendering, walk through.</p> <p>ANALYZE THE DESIGN Structural Analytical Model, Analysis visualization, Analysis display styles and analysis results.</p>
Text Books	[T1] Autodesk Rivet structures 2011- Users guide
Reference Books	[R1] Eric Wing, “Autodesk Revit 2017 for Architecture- No Experience required”, Autodesk.
E-resources and other digital material	https://www.youtube.com/channel/UCxOAhtBLD4AltcVULZmHH3g/videos https://www.coursera.org/learn/autodesk-revit-architectural-design

20CE7404A	DESIGN OF PRESTRESSED CONCRETE		
Course Category:	Program Elective 5	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE5303 - Design of Concrete structures	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:														
		CO 1	understand Basic concept of prestressing and Systems of Prestressed concrete													
		CO 2	apply the various Losses in Prestressed concrete													
		CO 3	analyse the resultant stresses, moments and shear forces in members and design by using appropriate methods.													
		CO 4	analyze the Deflections for various support conditions													
		CO 5	evaluate the stresses at end zone and Design of End block as per IS method													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
	CO 1	1		1			1							1		
	CO 2	1		1	1									2		
	CO 3	1		2	2		1	1	1		1		1	3		
	CO 4	1		1					1					2		
	CO 5	1		1	2		1		1		1		1	3		
Course Content		UNIT – I														
		INTRODUCTION AND SYSTEMS														
		Basic concepts of prestresseing; Historical development; Need for High strength steel and High strength concrete; Advantages of prestressedconcrete.Tensioning devices; Hoyer's long line system of pretensioning; Post tensioning systems; Detailed study of Freyssinet system and Gifford – Udall system; Thermo – electric prestressing; Chemical prestressing, Precast Concrete – types, advantages and manufacturing.														
		LOSSES OF PRESTRESS														
		Types of losses in pre and post tensioning ;Loss due to elastic deformation of concrete, shrinkage of concrete, creep of concrete, relaxation of stress in														

	<p>steel, friction and anchorage slip; Total losses allowed for in design.</p>
	<p>UNIT – II ANALYSIS OF PRESTRESS AND BENDING STRESSES Basic assumptions; Analysis of prestress; Resultant stresses at a section; Pressure (Thrust) line and internal resisting couple; Concept of Load balancing.</p> <p>DESIGN OF FLEXURAL STRENGTH OF PRESTRESSED CONCRETE SECTIONS Basic assumptions of flexural design, Ultimate moment resistance .Check for flexural capacity based on I.S. 1343 Code.</p>
	<p>UNIT – III ELASTIC DESIGN OF PRESTRESSED CONCRETE SECTIONS FOR FLEXURE Permissible compressive stresses in concrete as per IS 1343; Elastic design of rectangular and I – sections of TYPE 1, TYPE 2 members. LINs approach.</p> <p>SHEAR RESISTANCE Shear and Principal stresses; Ultimate shear resistance of prestress concrete members; Design of shear reinforcement</p>
	<p>UNIT – IV DEFLECTIONS OF PRESTRESSED CONCRETE MEMBERS Importance of control of deflections; Factors influencing deflections; Short term deflections of un cracked members.</p> <p>TRANSFER OF PRESTRESS IN PRE-TENSIONED MEMBERS&ANCHORAGE ZONE STRESSES IN POST-TENSIONED MEMBERS Transmission length; Bond stresses; Transverse tensile stresses; End zone reinforcement; Stress distribution in end block; Design of anchorage and end block.</p>
Text Books	<p>[T1] N. Krishna Raju “Prestressed Concrete”, 5th ed., Tata McGraw- Hill Publishing Company Limited, New Delhi, 2012.</p> <p>[T2] N.Raja Gopalan, “Prestressed Concrete”, 2nd ed., Narosa Publishing House, 2002</p>
Reference Books	<p>[R1] Lin T.Y. and Ned.H.Burns, “Design of prestressed Concrete Structures”, Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.</p> <p>[R2] Dayaratnam.P., “Prestressed Concrete Structures”, Oxford and IBH, 2013.</p> <p>[R3] IS 1343:1980, Code of Practice for Prestressed Concrete, Bureau of Indian Standards, New Delhi, 2012</p>
E-resources and other digital material	<p>Dr. Amlan Kumar Sengupta, Prof. Devdas Menon IIT/Madras – Prestressed concrete structures – “www.nptel.ac.in/courses/105106117”</p>

20CE7404B	REPAIR AND REHABILITATION OF STRUCTURES		
Course Category:	Program Elective 5	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE3305 - Concrete Technology and 20CE5303 - Design of Concrete structures	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course Outcomes		Upon successful completion of the course, the student will be able to:															
		CO 1	understand the mechanisms of deterioration of structures and diagnosis of failure														
		CO 2	Understand the damages occurred in reinforced concrete building and knowing the remedies for damages.														
		CO 3	apply different types of special materials used for repair technique														
		CO 4	apply different types of strengthening techniques used for existing structures														
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2		
	CO 1	1					1								1		
	CO 2	1				1		1		1	2				2		
	CO 3	1					2		1		1		1		2		
	CO 4	1					1	1	1	1					2		
Course Content		UNIT – I INTRODUCTION Introduction: Deterioration of structures with aging; Definition of Maintenance, repair, retrofitting and rehabilitation, Need for rehabilitation, Diffentiate between repair and rehabilitation. Importance of Maintenance. Facets of Maintenance. CAUSES OF DAMAGE TO STRUCTURES Causes of Distress in structures-Extrinsic and Intrinsic Causes for damage of Structures, Types of damages; effects of damages; Assessment procedure for evaluating a damaged structure; Diagnosis of construction failures.															

	<p>UNIT – II DAMAGE ASSESSMENT AND EVALUATION METHODS Damage testing methods; Semi –destructive (CORE,LOK and CAPO test) Non-destructive testing methods(Rebound Hammer ,Ultrasonic pulse velocity and Electrical resistivity test).</p> <p>REINFORCEMENT PROTECTION Methods of corrosion prevention –Corrosion coatings, Inhibitors, Cathodic protection and Corrosion resistant steel.</p>
	<p>UNIT – III REPAIR MATERIALS Essential parameters for selection of repair materials, Polymer concrete, Fibre reinforced concrete, High strength concrete, Ferrocement concrete, Polymer mortar ,Epoxy mortar and Bonding agents.</p> <p>TECHNIQUES FOR REPAIR AND PROTECTION METHODS Crack repair techniques-crack stitching,Mortar and dry pack, Epoxy injection, routing and sealing ,overlays, Gunite and Shotcrete. Repair to dormant cracks.</p>
	<p>UNIT – IV METHODS FOR STRENGTHENING Repairs to overcome Low member strength-Jacketing (Concrete and Steel),FRP Confinement.</p> <p>CASE-STUDIES Repair of structures distressed due to corrosion, fire, leakage, Earthquake, Transportation of Structures from one place to other -Case studies.</p>
Text Books	<p>[T1]Vidivelli. B Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009.</p> <p>[T2]Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008</p>
Reference Books	<p>[R1]Shetty. M. S. Concrete Technology-Theory and Practice, S. Chand and Company, 2008.</p> <p>[R2]Varghese. P.C Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd 2014.</p> <p>[R3]Diagnosis and treatment of structures in distress by R.N.Raikar, Published by R&D Centre of Structural Designers & Consultants Pvt.Ltd., Mumbai, 19.</p>
E-resources and other digital material	<p>“www.nptel.ac.in/courses/105106202”</p>

20CE7404C	DISASTER PREPARDENESS AND PLANNING MANAGEMENT
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Course Category:	Program Elective 5	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:															
		CO 1	understand the Concept of Disaster to Management														
		CO 2	analyze the relationship between development and disasters														
		CO 3	understand Categories of Disasters														
		CO 4	apply the responsibilities to society														
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2		
	CO 1	2				1						1			1		
	CO 2	2										1			1		
	CO 3	2					2					1			1		
	CO 4	2										1			1		
Course Content		UNIT – I INTRODUCTION Concepts and definitions: disaster, hazard, vulnerability, resilience, risks severity, frequency and details, capacity, impact, prevention, mitigation.															
		DISASTERS Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.															
		UNIT – II DISASTER IMPACTS-1 Environmental, physical, social, ecological, economic, political, etc.															

	<p>DISASTER IMPACTS-2 Health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.</p>
	<p>UNIT – III DISASTER RISK REDUCTION (DRR) Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications).</p> <p>ROLES AND RESPONSIBILITIES Government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.</p>
	<p>UNIT – IV DISASTERS, ENVIRONMENT Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.) sustainable and environmental friendly recovery; reconstruction and development methods.</p> <p>DEVELOPMENT METHODS Sustainable and environmental friendly recovery; reconstruction and development methods.</p>
Text Books	<p>[T1] Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall [T2] Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication [T3] Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation</p>
Reference Books	<p>[R1] Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003 [R2] Inter-Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC</p>
E-resources and other digital material	<p>http://ndma.gov.in/ (Home page of National Disaster Management Authority) http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).</p>

20CE7404D	URBAN TRANSPORT PLANNING		
Course Category:	Program Elective 5	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:		Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:														
		CO 1	analyze various stages in transport Planning Process													
		CO 2	apply various methods for data collection													
		CO 3	apply and finalize the route choice and network design													
		CO 4	evaluate transport projects with the help of various methods													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
	CO 1			3											2	
	CO 2	3	3									3		2	2	
	CO 3	3	3	3		3								2		
	CO 4	3							3						2	
Course Content		UNIT – I TRANSPORT PLANNING PROCESS Systems Approach to Transport Planning, Stages in Transport Planning, Survey and analysis of Existing Conditions, Forecast Analysis of Future Conditions and plan synthesis, Evaluation, Program Adoption and Implementation, Continuing Study, Citizen Participation, Difficulties in the Transport Planning Process.														
		TRANSPORTATION SURVEY Study Area, Zoning, Type of Surveys, Home Interview Surveys, Commercial Vehicle Surveys, Road Side Interview Surveys, Public Transport Surveys, Inventory of Transport Facilities, Expansion of Data from Samples.														

	<p>UNIT – II TRIP GENERATION Factors governing trip generation and attraction rates - Multiple linear regression analysis, Category analysis - Critical appraisal of techniques.</p> <p>TRIP DISTRIBUTION Uniform factor method, average factor methods - Gravity model and its calibration – opportunity model.</p> <p>UNIT – III TRIP ASSIGNMENT Traffic assignment - General principles - Assignment techniques - Multiple root assignment Capacity - Restraint assignment - Diversion curves.</p> <p>MODAL SPLIT Modal split - Advantages and limitations, Earlier Modal split models, trip end type models, trip interchange models, logit model, Multinomiallogit model.</p> <p>UNIT – IV ECONOMIC EVALUATION OF TRANSPORTATION PLANS Economic evaluation techniques – Road user cost, Benefit cost ratio method.</p> <p>RETURN METHODS Net present value method, internal rate of return method, comparison of various methods.</p>
Text Books	<p>[T1] Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna, NDLS, 2006.</p> <p>[T2]Paque, J.R., Ashford, N.J. Wright, P.L.H. Transportation Engineering Planning and Design, NY, 2000</p>
Reference Books	<p>[R1] Dicky,J.W. Metropolitan Transportation Planning, Tata McGraw, NDLS, 2000</p> <p>[R2] Bruton, M.J. An Introduction to Transportation Planning, LN,UK, 2001.</p>
E-resources and other digital material	<p>[1] http://nptel.ac.in/courses/105106058/</p> <p>[2] http://nptel.ac.in/courses/105107067/</p> <p>[3]https://ocw.mit.edu/courses/urban-studies-and-planning/11-540j-urbantransportation-planning-fall-2006/</p> <p>[4] http://nptel.ac.in/courses/105104098/</p>

20CE7404E	RURAL WATER SUPPLY AND SANITATION		
Course Category:	Program Elective 5	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE5302 - Environmental Engineering, 20CE7402/B - Solid Waste Management	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course Outcomes		Upon successful completion of the course, the student will be able to:													
		CO 1	understand various rural water supply programs in India.												
		CO 2	apply various low cost sanitation methods in India.												
		CO 3	understand the methods used for wastewater treatment.												
		CO 4	apply the methods of low cost sanitation.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1		1		2										
	CO 2		1	3	2										2
	CO 3		1		2		1								
	CO 4		1	3			1								1
Course Content		UNIT – I RURAL WATER SUPPLY PROGRAMS IN INDIA Need for a protected water supply, Issues of rural water supply –Various techniques for rural water supply- merits- National rural drinking water program- rural water quality monitoring and surveillance- operation and maintenance of rural water supplies.													
		SOURCES OF WATER Investigation and Selection water sources, springs, dug wells, infiltration wells etc., Collection, Protection of well waters, Drinking water quality standards.													
		UNIT – II PROBLEMS AND WATERBORNE DISEASES Introduction – Epidemiological aspects of water quality, waterborne Diseases, Need of treatment, methods for water treatment - Specific contaminant removal systems,													

	<p>LOW COST WATER TREATMENT METHODS Specific problem in rural water supply and treatment e.g. iron, manganese, fluorides, arsenic for drinking water, surface water treatment, slow sand filtration, Disinfection in RWS etc.</p>
	<p>UNIT – III RURAL SANITATION Introduction to rural sanitation- Need, Objectives, Community and sanitary systems - Planning of wastewater collection system in rural areas, sanitation schemes in India.</p> <p>TREATMENT Wastewater - Compact and simple wastewater treatment units and systems in rural areas stabilization ponds - Effluent disposal.</p>
	<p>UNIT – IV WASTE DISPOSAL Low Cost Sanitation Methods, Centralised and Decentralised Methods of Rural Sanitation, Pit Privy, Aqua Privy, Water Seal Latrine, Bore-hole Latrine, Trench Latrine, Overhung Latrine, Compost Privy, Double Pit Latrine, Pour Flush Latrine, Improved Double Pit Pour Flush Latrine, Septic Tank, design of Septic Tank, disposal of Septic tank effluent.</p> <p>WASTE MANAGEMENT Disposal of Solid Wastes- Composting- land filling incineration- Biogas plants - Rural health - Other specific issues and problems encountered in rural sanitation.</p>
Text Books	<p>[T1]S. K. Garg, “Environmental Engineering – II”, Standard Publication 2002. [T2]S. K. Garg, “Water Supply Engineering: Environmental Engineering (Vol I)”, Khanna Publishers, New Delhi, 2012 [T3]Kapoor, B. S.,” Environmental Sanitation“, S.Chand and company, New Delhi, 2001 [T4]Manual of water supply and treatment, 3rd edition, CPHEEO, GOI, New Delhi. [T5]Murali Krishna, KVSG, “Rural, Municipal and Industrial Water Management”, Reem Publications Pvt. Ltd., 2008</p>
Reference Books	<p>[R1]Low cost on site sanitation option, Hoffman & Heijno Occasional Nov.1981 paper No. 21. [R2]Wagner, E.G. and Lanoik, J.N. Water supply for rural areas and small communities, Geneva : W.H.O., 1959. [R3]Wright, F. B. Rural water supply and sanitation, Robert E. Kriegler Publishing company, 3rd Edition, new York, 1977.</p>
E-resources and other digital material	<p>“https://nptel.ac.in/courses/105101215”</p>

20CE7404F	ANALYSIS AND DESIGN OF INDUSTRIAL STRUCTURES		
Course Category:	Program Elective 5	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	20CE5303- Design of Concrete Structures, 20CE6301- Design of Steel Structures	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course Outcomes		Upon successful completion of the course, the student will be able to:															
		CO 1	understand the functional requirements for industrial structures														
		CO 2	evaluate various elements of gantry girders and roof trusses														
		CO 3	apply the concepts in design bunkers and silos														
		CO 4	evaluate the design principles of industrial floorings														
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2		
	CO 1														2		
	CO 2		1	1										3			
	CO 3		2	2										2			
	CO 4		1	3										2			
Course Content		UNIT – I INRODUCTION – INDUSTRIAL BUILDINGS Classification of Industries and Industrial structures.															
		FUNCTIONAL REQUIREMENTS FOR FRAMED BUILDINGS Planning for Layout requirements regarding lighting, ventilation and fire safety - Protection against noise and vibration.															
		UNIT – II GANTRY GIRDERS (INDUSTRIAL STRUCTURES) Loads, fatigue effects, specifications, design procedure.															
		ROOF TRUSSES (INDUSTRIAL STRUCTURES): Selection of the type of truss, types of member sections, loads on roof truss, load combinations, analysis of roof truss, design procedure of roof truss.															

	<p>UNIT – III BUNKERS (STORAGE STRUCTURES): Design of Rectangular Bunkers, Design of Circular Bunkers.</p> <p>SILOS(STORAGE STRUCTURES): Design of Silos, Janssen’s Theory, Airy’s Theory.</p>
	<p>UNIT – IV MATERIALS AND CONSTRUCTION DETAILS(INDUSTRIAL FLOORINGS): Sub base, Slip membrane, Concrete quality and admixtures, Joints, Monolithic finishes, Weld mesh reinforcement, Fibres.</p> <p>DESIGN(INDUSTRIAL FLOORINGS): Ground conditions, Performance requirements, Loadings, Robustness, Flatness and levelness.</p> <p>The design principles : The large-pour weld mesh models, The traditional model: stress regimes and structural model The large-pour steel fibre hybrid model. The steel fibrejointless model.</p>
Text Books	<p>[T1] S.K.Duggal “ Limit State Design of Steel Structures”, 3rded., McGraw Hill Publishers, Chennai, 2019</p> <p>[T2] S.S.Bhavikatti,“Advanced RCC Design”2nd ed., New Age Publishers, New Delhi, 2012.</p> <p>[T3] Frank R. Neal, “ ICE design and practice guide Concrete industrial ground floors”, 2nded.,Thomas Telford Publishing, Thomas Telford Ltd, 1 Heron Quay, London, 2002</p>
Reference Books	<p>[R1] Subramanian, N. Design of steel structures - Oxford university press, NDLS., 2018.</p> <p>[R2] B. C. Punmia“RCC Designs”, Vol-3, Standard Publishers Distributors, Delhi</p> <p>[R3] National Building Code 2016, Bureau of Indian Standards</p> <p>[R4]Concrete Industrial Ground Floors, Report of Concrete Society, 3rd ed, The concrete Society, 2003</p>
E-resources and other digital material	<p>http://www.thomastelford.com</p>

20CE7205	LAND SURVEYING
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Course Category:	Job Oriented Elective - 3	Credits:	3
Course Type:	Theory/Practical	Lecture - Tutorial - Practice	1- 0-3
Prerequisites:	Surveying & Geomatics, Surveying Lab-I, Advanced Surveying lab	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course outcomes		Upon successful completion of the course, the student will be able to:													
	CO 1	prepare a base map of the area													
	CO 2	assess the area of the given attribute by cadastral survey													
	CO 3	analyse & design the stake out of curves in a road													
	CO 4	evaluate the earthwork quantities in a project													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	2				3	1			2	1			1	
	CO 2	2	2	1		3	1			2	1			1	
	CO 3	2				3	1			2	1			1	
	CO 4	2	2	1		3	1			2	1			1	

Course Content	UNIT – I TOPOGRAPHICAL SURVEY & DRAWING Title, Legend, Compass, Scale, Symbols, other details; GO No 119 Govt of AP: Size of Drawing Sheets, Notation for Coloring of Plans, Dimensions, Details of Plans to be submitted.
	LABORATORY TESTS <ul style="list-style-type: none"> Survey and prepare a detailed topographical map of an existing site using Total Station Draw a building plan in the base map as per byelaws and set out in the field using a Total Station
	UNIT – II CADASTRAL SURVEY Meebhoomi, Bhunaksha, Adangal, Passbook, Village Map, FMB, RS Number, Sub Divisions, Enjoyment Area, Tolerance.

	LABORATORY TESTS <ul style="list-style-type: none"> • Draw a FMB sketch using AutoCAD • Measure the existing field using Total Station and compare with the FMB dimensions • Stake out the boundaries of a field as per the FMB using Total Station
	UNIT – III HIGHWAY ALIGNMENT Geometric Design: Highway Cross Section Elements, Horizontal Alignment, Vertical Alignment, Types of Curves, Elements of curves, curves designation LABORATORY TESTS <ul style="list-style-type: none"> • Set out a curve using Total Station
	UNIT – IV EARTH WORK Profile leveling, Cross sectioning, Contouring, Cutting & filling LABORATORY TESTS <ul style="list-style-type: none"> • Estimate the cutting and filling quantities of earthwork in a site using Total Station. • Estimate the cutting and filling quantities of earthwork in a site using Drone survey.
Text books	[T1]Surveying, Volume-1 by K. R. Arora; Standard Book House. [T2]Advanced Surveying by Satheesh Gopi, R. Sathikumar, N. Madhu; Pearson Education
Reference books	[R1]Surveying, Volume-1 by B.C.Punmia; McGraw Hill Education (India) Private Limited
E-resources and other digital material	http://meebhoomi.ap.gov.in/ https://bhunaksha.ap.gov.in/bhunakshalpm/

20CE7206	CONSTRUCTION QUALITY CONTROL & MONITORING
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Course Category:	Job Oriented Elective-4	Credits:	3
Course Type:	Theory/Practical	Lecture - Tutorial - Practice:	1-0-3
Prerequisites:	Concrete Technology, Estimation and Costing,	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:													
CO 1		explain features of TQM													
CO 2		describe various aspects of QCIP of various construction activities													
CO 3		identify the payment quality.													
CO 4		design energy efficient buildings													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	2		1								1			1
	CO 2	2		1		1						1			1
	CO 3	2	2	1								1			1
	CO 4	2	1	2				3					1		1
Course Content		UNIT – I TOTAL QUALITY MANAGEMENT (TQM) IN CONSTRUCTION Concept of quality control, Quality assurance, Quality management, Aims of TQM, Development and design Concept of TQM, Accuracy in calculation, finding area, volume. LABORATORY TESTS <ul style="list-style-type: none"> Based on the site usage conditions, recommend appropriate mix design UNIT-II: CONSTRUCTION QUALITY CONTROL INSPECTION PROGRAM Duties, responsibilities, qualification of staff in organization Checklists for - Quality of Materials - Masonry - Plastering, - Concrete construction- Batching, Mixing, Transporting, Placing, Compaction, Finishing, Curing -													

	<p>Reinforcement Work - Formwork - Timber & steel construction, - Doors & windows, - Plumbing & drainage.</p> <p>LABORATORY TESTS</p> <ul style="list-style-type: none"> • By studying the unique requirements of high-rise building recommend appropriate quality control measures
	<p>UNIT – III CONSTRUCTION QUALITY CONTROL AND ROAD INSPECTION Optimum Binder Content Determination (Marshall Mix Design), Pavement Evaluation-Benklemen Beam Method, FWD Method.</p> <p>LABORATORY TESTS</p> <ul style="list-style-type: none"> • Assesses the payment quality material and recommend their suitability for flexible and rigid payment
	<p>UNIT-IV: SUSTAINABLE BUILT ENVIRONMENT GREEN BUILDING Green building, Definition – Green Building, Green Construction, Sustainable building, Goals of Green building, Advantages and disadvantages, Introduction to Life cycle assessment (LCA).</p> <p>LABORATORY TESTS</p> <ul style="list-style-type: none"> • Asses the building rating (as per IGBC) with different building materials and components.
Text Books	<p>[T1]Total Quality Management G.Kanji Springer Science & Business Media</p> <p>[T2]Fundamentals of Quality Control and Improvement Amitva Mitra Wiley India Private Limited .</p>
Reference Books	<p>[R1]Manual on Quality Control -- Gujarat Engineering Research Institute</p> <p>[R2]Ambuja Technical Literature Series -- Ambuja Cements</p>
E-resources and other digital material	<p>https://archive.nptel.ac.in/courses/110/104/110104080</p> <p>https://onlinecourses.nptel.ac.in/noc20_mg18/preview</p>

20CE7607	COMPUTER AIDED CONSTRUCTION MANAGEMENT
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Course Category:	Advanced Skill Course	Credits:	2
Course Type:	Theory cum Practice	Lecture - Tutorial - Practice:	1-0-2
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will be able to:													
	CO 1	understand the planning and scheduling, networking methods, resource optimization techniques in various construction projects													
	CO 2	apply EPS in a project and Create a Work Breakdown Structure (WBS)													
	CO 3	analyse Network Diagram with the identification of activities and their underlying relationships													
	CO 4	apply various resources like labor,non-labor,material													
	CO 5	analyse critical path, forward/backward pass, resource leveling and base lining													
	CO 6	analyse the project plan and measure variances and report performances													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	1	2	2	2	3	3		2			3	2		3
	CO 2	1	2	2	2	3	3		2			3	2		3
	CO 3	1	2	2	2	3	3		2			3	2		3
	CO 4	1	2	2	2	3	3		2			3	2		3
	CO 5	1	2	2	2	3	3		2			3	2		3
	CO 6	1	2	2	2	3	3		2			3	2		3
Course Content		UNIT – I INTRODUCTION -BASIC CONCEPTS Project ,Project Management, Five Process Groups of Project Management, Schedule and its Importance, Project Management Through Networks, Critical Path Method, PERT for Scheduling, Understanding a Gantt Chart, Project Management Fundamentals, Optimization of cost through networks, Resource Allocation Techniques.													

	<p>LABORATORY TESTS INTRODUCTION TO MS PROJECT</p> <ul style="list-style-type: none"> • Tools in MS Project • MS Project Interface and Preferences
	<p>UNIT – II LABORATORY TESTS</p> <ul style="list-style-type: none"> • Organizational Breakdown Structure. <p>ENTERPRISE ENVIRONMENT IN MS PROJECT</p> <ul style="list-style-type: none"> • Enterprise Project Structure, • Work Breakdown Structure, • Access Control in MS Project
	<p>UNIT – III LABORATORY TESTS PLANNING AND CREATING A NEW PROJECT</p> <ul style="list-style-type: none"> • Planning your Project Schedule, • Understanding a Sample Project, • Creating a New Project in MS Project, • Project Window Options, • Total Float and Project Must Finish Date <p>CALENDARS</p> <ul style="list-style-type: none"> • Role of Calendars in Scheduling, • Adding and Assigning Calendars
	<p>UNIT – IV LABORATORY TESTS WBS AND BASIC FORMATTING</p> <ul style="list-style-type: none"> • Creating WBS in MS Project • Formatting Columns and Timescale • Percentage Complete Types in MS Project <p>FORMULATING ACTIVITIES</p> <ul style="list-style-type: none"> • Activity Types in MS Project • Setting Defaults for New Activities • Adding Activities • Estimating Duration of Activities • Adding Duration of Activities • Recourses & how to create S-curve & Manpower histogram • Import, Export & Print

Text Books	<p>[T1]Feigenbaum,L., "Construction Scheduling with Primavera Project Planner" Prentice Hall Inc., 2002.</p> <p>[T2]Software Project Management, 6th Edition, Bob Hughes, Mike Cotterel, Rajib Mall, McGraw-Hill, 2018</p> <p>[T3]Seetharaman. S, Construction Engineering and Management, Umesh, NDLS, 2006</p> <p>[T4]Peurifoy R Construction Planning, Equipment & Methods; McGraw Hill, LN, UK, 2010.</p>
Reference Books	<p>[R1]Bhattacharjee, S.K. Fundamentals of PERT/CPM and Project Management, Khanna, NDLS, 1996.</p> <p>[R2] Paulson, B.R., "Computer Applications in Construction", McGraw Hill, 1995.</p>
E-resources and other digital material	<p>https://onlinecourses.nptel.ac.in/noc19_cs70/preview</p> <p>https://archive.nptel.ac.in/courses/105/102/105102199/</p>

20CE7551	MINI PROJECT II
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Lecture :	0	Internal Assessment:	30 Marks
Tutorial :	0	Semester End Examination:	70 Marks
Practical :	3 hrs/Week	Credits:	1.5

Course Outcomes		Upon successful completion of the course, the student will be able to:													
CO 1		review the research literature, identify the problem, to solve the problems using the necessary fundamentals of engineering.													
CO 2		illustrate the concepts, methods, techniques and using modern tools to address the problems of the society and suggest a feasible solution.													
CO 3		prepare a technical report ethically - as per guidelines.													
CO 4		demonstrate team work, communication and presentation skills.													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	1		2	1		2	1	1				1	2	
	CO 2	2	3	3	3	3	2	1		1			1	3	3
	CO 3	1	2			1			2		3				1
	CO 4	1				2				3	3	1		1	
Course Content		1. Formulate Analysis and design, Elaboration through Modeling and Implementation through available state of the art technology. 2. Develop appropriate model/ programs and experimentation offering reliable solutions. 3. Discuss the results and summarize the findings through oral presentations. 4. Prepare a ethical technical report following the stipulated guidelines (IEEE format)(Aim and objectives, literature study, materials and Methodology, results and discussions, conclusions and references) 5. Imbibe team spirit among students during the project work.													
		Continuous Evaluation: Day to day assessment = 10; Two reviews (10+10) = 20 Total = 30													
		Semester End Evaluation (SEE) = 70 M; Report = 40 Presentation and Viva Voce = 30													

MINORS

20CEM 4701	INTRODUCTION TO CIVIL ENGINEERING- CONCEPTS AND MATERIALS.
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Course Category:	Minors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3 - 1- 0
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:															
		CO 1	understand evaluation of civil engineering materials and use of stone as a primary component.														
		CO 2	evaluate the quality of bricks and timber.														
		CO 3	apply test on cement and understand varieties of concrete.														
		CO 4	analyse the quality of steel and paints.														
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2		
	CO 1	3						2							3		
	CO 2	3						2							3		
	CO 3	3						2							3		
	CO 4	3						2							3		
Course Content		UNIT – I INTRODUCTION: General Introduction to Civil Engineering; History of Civil Engineering; Relevance of Civil Engineering in the overall infrastructural development of the country. STONES: Classification of rocks; Qualities of a good building stone; Uses of Stones; Stone quarrying; Tools for blasting; Common building stones of India.															
		UNIT – II BRICKS: Composition of good brick earth; Qualities of good bricks; Tests for bricks; Classification of bricks; Size and weight of bricks.															

	<p>TIMBER: Definition; Structure of a tree; Qualities of good timber; Preservation of timber; Seasoning of timber; Advantages of timber construction; Use of timber.</p>
	<p>UNIT – III CEMENT: Basic Ingredients; Grades of cement; Properties of cement; Field tests on cement.</p> <p>CONCRETE: Definition; properties; Special Concretes-Light weight concrete, High density concrete, Fibre reinforced concrete, Polymer concrete.</p>
	<p>UNIT – IV STEEL: General; Manufacture of steel; Uses of steel; Market forms of steel; Properties of mild steel; Properties of hard steel.</p> <p>PAINTS, VARNISHES AND DISTEMPERS: General; Painting; Varnishing; Distempering; Wall paper; White washing; Colour washing.</p>
Text Books	<p>[T1] Engineering Materials by S. C. Rangwala; Charotar Publishing House.</p> <p>[T2] Building construction by B. C. Punmia -Laxmi Publications, New Delhi.</p>
Reference Books	<p>[R1] Building construction and construction materials by G.S.Birdie and T.D.Ahuja, Dhanpathrai publishing company, Newdelhi</p>
E-resources and other digital material	<p>http://nptel.ac.in/courses/105102088/</p>

20CEM5702	METHODOLOGY FOR CIVIL ENGINEERING CONSTRUCTION
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Course Category:	Minors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will have an ability to:													
		CO 1	evaluate the feasibility of the construction project												
		CO 2	understand planning and construction contracts												
		CO 3	understand construction finance and organization structure												
		CO 4	understand the materials and adopt the quality control procedures												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	1	1	1							1	2			1
	CO 2	1	1	1							1	2			1
	CO 3	1	1	1						1	1	2			1
	CO 4	1		1							1	2			1
Course Content		UNIT – I													
		INTRODUCTION													
		Role of government and construction agencies, classification of construction works, various stages in construction of a project, the construction team.													
		PROJECT FEASIBILITY REPORTS													
		Introduction, technical analysis, financial analysis, economic analysis, ecological analysis, schematic diagram for feasibility study.													
		UNIT – II													
		PLANNING FOR CONSTRUCTION PROJECTS													
		General, steps involved in planning, objectives, principles, advantages of planning, limitations, stages and types of planning, stages of planning by different agencies.													
		CONSTRUCTION CONTRACTS & TENDERS													
		General, contract documents, types of contract, tender notice, types of tenders, tender documents, Earnest money deposit and security deposit.													

	<p>UNIT – III CONSTRUCTION FINANCING AND CONTROL Introduction, costs associated with constructed facilities, estimates, effect of scale on construction cost, means of financing, application of financial assistance, cost control.</p> <p>ORGANISING FOR CONSTRUCTION Importance, general principles, types of organization structures, forms of business organizations.</p>
	<p>UNIT – IV MATERIALS MANAGEMENT Importance, Objectives, Costs, functions of material management, uses, stores management, material procurement, maintaining stocks, material handling.</p> <p>QUALITY CONTROL IN CONSTRUCTION Elements of quality, Organisation for quality control, Quality assurance techniques, Documentation, Quality control circles, variation.</p>
Text Books	[T1]Dr.S.Seetharaman, "Construction Engineering and Management", 5 th Edition, Umesh Publications, New Delhi
Reference Books	[R1]Kumar Neeraj Jha, "Construction Project Management", 2nd Edition, Pearson Education India, New Delhi, 2015
E-resources and other digital material	---

20CEM6703A	SYSTEM DESIGN FOR SUSTAINABILITY
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Course Category:	Minors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will have an ability to:														
		CO 1	understand selection of resources with low environmental impact;													
		CO 2	apply design of products with low environmental impact;													
		CO 3	analyse product-Service System Design for eco-efficiency;													
		CO 4	evaluate design for social equity and cohesion.													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
	CO 1	1		1			2	3	3	2	2		1		2	
	CO 2	1		1			2	3	3	2	2		1		2	
	CO 3	1		1			2	3	3	2	2		1		2	
	CO 4	1		1			2	3	3	2	2		1		2	
Course Content		UNIT – I INTRODUCTION Addressing Sustainability by design; An Introduction to Sustainable Product-Service Systems Applied to Distributed Renewable Energy; United Nations Sustainability Energy for All (SE4A) Agenda. DISTRIBUTED ENERGY SYSTEMS Distributed Renewable Energy Systems and Integrating S.PSS with DE.														
		UNIT – II SUSTAINABLE PRODUCT-SERVICE SYSTEM (SPSS) Introduction to SPSS; Types; Sustainability Benefits; Barriers and Limits.														
		SUSTAINABLE PRODUCT - SERVICE SYSTEM APPLIED TO DISTRIBUTED RENEWABLE ENERGIES A Win-Win Opportunity; Scenario for S.PSS applied to Distributed Renewable Energy(DRE); S.PSS Applied to DRE: Sustainability Potential Benefits.														

	<p>UNIT – III DESIGN FOR SUSTAINABILITY: AN INTRODUCTION Evolution of Design for Sustainability ; Product Life Cycle Design or Eco-Design ;Design for Eco-Efficient Product-Service Systems ;Design for Social Equity and Cohesion ;Design for Socio-Technical Transitions ;State of the Art of Design for Sustainability Human-Centred and Universal Design.</p> <p>SYSTEM DESIGN FOR SUSTAINABLE ENERGY FOR ALL: A NEW ROLE FOR DESIGNERS System Design for Sustainable Energy for All (SD4SEA); SDSEA Design Criteria, Guidelines and Examples.</p> <p>UNIT – IV METHOD AND TOOLS FOR SYSTEM DESIGN FOR SUSTAINABLE ENERGY FOR ALL(SD4SEA) Method for System Design for Sustainable Energy; for All; Sustainability Design Orienting Scenario; (SDOS) on S.PSS&DRE; Sustainable Energy for All Idea Tables and Cards; E.DRE—Estimator for Distributed Renewable Energy; PSS + DRE Innovation Map, SPSS + DRE Design Framework &Cards ; The Energy System Map, Innovation Diagram for S.PSS&DRE; Concept Description Form for S.PSS and DRE Stakeholder Motivation and Sustainability Table.</p> <p>PRACTICAL EXAMPLES OF APPLICATION OF SDSEA APPROACH/TOOLS AND OTHER METHODS TO ACHIEVE SUSTAINABILITY Solar Energy Company, Botswana; SMEs for Energy, Uganda ; Summary and Considerations; green design; emotionally durable design; cradle to cradle design, biomimicry design; design for base of a pyramid design; design for social innovation.</p>
Text Books	<p>[T1]Fabrizio Ceschin , İdil Gaziulusoy, Design for Sustainability A Multi- level Framework from Products to Socio- technical Systems , Taylor and Francis, 2020.</p> <p>[T2]Carlo Vezzoli; Fabrizio Ceschin; Lilac Osanjo; Mugendi K. M'Rithaa; Richie Moalosi; Venny Nakazibwe; Jan Carel Diehl, Designing Sustainable Energy for All Sustainable Product-Service System Design Applied to Distributed Renewable Energy; Green Energy and Technology, Springer, 2018.</p>
Reference Books	<p>[R1]Ceschin, F., and Gaziulusoy, I. (2016) Design for Sustainability: An Evolutionary Review, in Lloyd, P. and Bohemia, E. (eds.), Future Focused Thinking - DRS International Conference 2016, 27 - 30 June, Brighton, United Kingdom.</p> <p>[R2]Elisa Bacchetti, Towards sustainable energy for All Designing Sustainable Product-Service System applied to Distributed Renewable Energy, Politecnico di Milano, Milano, Italy 2017</p>
E-resources and other digital material	<p>Quality as Driver for Sustainable Construction—Holistic Quality Model and Assessment.pdf</p>

20CEM6703B	ECOLOGY AND ENVIRONMENT
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Course Category:	Minors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	20CH1102 - Engineering chemistry 20MC4108B - Environmental studies	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course Outcomes		Upon successful completion of the course, the student will be able to:														
		CO 1	analyze the issues concerned with ecology, environment and sustainability.													
		CO 2	evaluate the quantity and quality of water based on the available natural sources.													
		CO 3	understand the water purification units and components of the distribution systems.													
		CO 4	evaluate the effect of various attributes of environmental pollution													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
	CO 1	1					2	2		1			2			
	CO 2	2	3		2		1	2			1		1		2	
	CO 3	2	1	3			1	1					1		3	
	CO 4	1	1	2	1		2			1	1		2		2	
Course Content		UNIT – I INTRODUCTION TO ECOLOGY AND ENVIRONMENT Definition, scope & importance, need for public awareness- environment - definition, ecology, eco system - balanced ecosystem, human activities - food, shelter, economic and social security.														
		SUSTAINABILITY Sustainability – definition, significance, sustainability goals, impacts of climate change, Case Studies.														
		UNIT – II WATER SUPPLY - QUANTITYOF WATER Sources of water, objectives of water supply systems, Per capita consumption; Types of demands; Fluctuations in demand.														
		QUALITY OF WATER Impurities in water; routine water analysis - physical, chemical and bacteriological tests; Standards for drinking water; Water borne diseases.														

	<p>UNIT – III WATER TREATMENT Fundamentals of purification of water; plain sedimentation; coagulation and types of coagulants; sedimentation and coagulation tanks; theory of filtration; slow sand and rapid sand filters; operation; disinfection.</p> <p>DISTRIBUTION SYSTEMS Methods of supply; Layouts, Plumbing-pipes and fittings; Traps; One pipe and Two pipe systems.</p>
	<p>UNIT – IV ENVIRONMENTAL POLLUTION Environmental Pollution and their effects. Water pollution, Land pollution, Air pollution, Public Health aspects.</p> <p>SOLID WASTE MANAGEMENT Solid waste characteristics–basics of on-site handling and collection–separation and processing – Incineration- Composting-Solid waste disposal methods – fundamentals of land filling.</p>
Text Books	<p>[T1] Benny Joseph, “Environmental Studies”, Tata McGraw Hill, 2005</p> <p>[T2] Ignaci Muthu S, “Ecology and Environment”, Eastern Book Corporation, 2007</p> <p>[T3] Birdie G.S. and Birdie J. S., “Water Supply and Sanitary Engineering”, 9th ed., Dhanpat Rai Publishing Company, New Delhi, 2015.</p>
Reference Books	<p>[R1] Garg S. K., “Environmental Engineering Vol. I& II- Water supply engineering”, Khanna Publishers, New Delhi, 2017.</p> <p>[R2] Gurucharan Singh, “Water Supply and Sanitary Engineering”, Standard Publishers Distributors, Delhi, 2009.</p> <p>[R3] Anjaneyulu Y. “Introduction to Environmental sciences”, B S Publications PVT Ltd, Hyderabad 2004.</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/127106004 (Ecology and environment by Dr. Abhijit P. Deshpande, IIT Madras).</p>

20CEM7704A	INFRASTRUCTURE AND TRANSPORTATION SYSTEM PLANNING				
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Course Category:	Minors	Credits:	4
Course Type:	Theory	Lecture - Tutorial -Practice:	3 - 1 – 0
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will be able to:														
		CO 1	understand different pavement structures													
		CO 2	understand materials and methods used for construction													
		CO 3	understand the components of the Railway Track.													
		CO 4	analyse geometric features of railway track													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
	CO 1	3						3	3		3	3			3	
	CO 2	3						3	3		3	3			3	
	CO 3	3						3	3		3	3			3	
	CO 4	3						3	3		3	3			3	
Course Content		UNIT-I INTRODUCTION TO ROADWAYS: Different Modes of Transportation, Road development in India during twentieth century, Classification of different types of roads, Highway cross section elements. PAVEMENTS: Different types of pavements – Cross section, functions of pavement layers, Need for design, importance of drainage.														
		UNIT-II MATERIALS FOR PAVEMENTS: Materials used in highway construction- soil, fine and coarse aggregate, bituminous binders, cement, water.														

	<p>CONSTRUCTION OF PAVEMENTS: Construction of flexible pavement, Construction of rigid pavement, Equipment for excavation, equipment for compaction.</p>
	<p>UNIT-III RAILWAYS: INTRODUCTION TO RAILWAYS: Historic development of railways in India, Classification of Indian Railways, Different gauges in Indian Railways.</p> <p>COMPONENTS OF RAILWAY TRACK Permanent way cross section and functions, Types of rails, Types of Sleepers, Types of ballast, cross section of ballast, coning of wheels, sleeper density, length of rails.</p>
	<p>UNIT-IV GEOMETRIC FEATURES AND OPERATION: Super elevation or cant, cant deficiency, cant excess, negative super elevation concept, types of transition curves, gradient types.</p> <p>POINTS AND CROSSINGS: Switches, crossings, working principle of turnout, classification of signals, interlocking.</p>
Text Books	<p>[T1]Sk Khanna, CEG Justo, A Veeraragavan, Highway Engineering, Nem Chand & Bros, 10th Edition, 2018</p> <p>[T2]Satish Chandra, MM Agarwal, Railway Engineering, Oxford University Press, 2nd Edition 2013</p>
Reference Books	<p>[R1]Saxena, S.C. and Arora. S, Railway Engineering, Dhanpat Rai, NDLS, 2009</p>
E-resources and other digital material	<p>[1]Dr. K.S. Reddy, Dr. Bhargava Maitra, IIT Kharagpur- Introduction to Transportation Engineering— “https://nptel.ac.in/courses/105/105/105105107/”</p> <p>[2]Dr Tom V Mathew, IIT Bombay- Transportation Engineering I - “https://nptel.ac.in/courses/105/101/105101087/”</p> <p>[3]Prof Rajat Rastogi, IIT/Roorke – Transportation Engineering II— “https://archive.nptel.ac.in/courses/105/107/105107123/”</p>

20CEM7704B	CONSTRUCTION PLANNING AND EXECUTION		
Course Category:	Minors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes		Upon successful completion of the course, the student will have an ability to:													
		CO 1	evaluate planning process of various construction projects and apply various software in various construction process												
		CO 2	understand scheduling of various construction projects and apply PERT and CPM networking methods.												
		CO 3	apply the various types of construction contracts and understand the elements of quality planning and the implication												
		CO 4	analyse the various legal requirements and understand the various safety concepts and requirements applied to construction projects.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2 -Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	2	2	2	2					2	2	3	2		2
	CO 2	2	2	2						2	3	3	2		2
	CO 3	2	2					2	2	2	2	3			2
	CO 4	2	2					2	2	2	2	3			2
Course Content		UNIT – I PLANNING: Steps involved in Planning; Objectives; Principles; Advantages; Limitations; Stages of planning.													
		IT APPLICATIONS IN CONSTRUCTION: Construction process – Computerization in Construction – Computer aided Cost Estimation – Developing application with database software.													
		UNIT – II SCHEDULING: Preparation of construction schedules; Methods of scheduling; Bar charts; Mile stone charts; Controlling; Job layout; Factors affecting job layout; Project work break down.													

	<p>PERT AND CPM: Advanced planning and scheduling concepts – Computer applications – Case study.</p>
	<p>UNIT – III CONSTRUCTION CONTRACTS: Indian Contracts Act – Elements of Contracts – Types of Contracts – Features – Suitability – Design of Contract Documents – International Contract Document – Standard Contract Document – Law of Torts.</p> <p>QUALITY MANAGEMENT: Introduction – Definitions and objectives – Factor influencing construction quality - Responsibilities and authority.</p>
	<p>UNIT – IV LEGAL REQUIREMENTS: Insurance and Bonding – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning, Local Government Laws for Approval.</p> <p>SAFETY MANAGEMENT: Accidents and their Causes – Human Factors in Construction Safety - Costs of Construction Injuries – Occupational and Safety Hazard Assessment – Legal Implications, Owners responsibility and safety – owners responsibility clause.</p>
Text Books	<p>[T1]Ming Sun and Rob Howard, “Understanding I.T. in Construction, Spon Press, Taylor and Francis Group, 2004.</p> <p>[T2]Feigenbaum,L., “Construction Scheduling with Primavera Project Planner: Prentice Hall Inc., 2002.</p> <p>[T3]George J.Ritz , “Total Construction Project Management”, McGraw-Hill Inc,1994.</p>
Reference Books	<p>[R1]Gajaria G.T., “Laws Relating to Building and Engineering Contracts in India”,4th Edition, M.M.Tripathi Private Ltd., Bombay, 2000.</p> <p>[R2] Jimmie Hinze, “Construction Contracts”, 3 rd Edition, McGraw Hill, 2010.</p> <p>[R3] Joseph T. Bockrath, “Contracts and the Legal Environment for Engineers and Architects”, 7 th Edition McGraw Hill, 2010.</p> <p>[R4] Paulson, B.R., “Computer Applications in Construction”, McGraw Hill, 1995.</p>
E-resources and other digital material	<p>[1]Prof. Arbind Kumar Singh - Construction Planning and Management, IIT Guwahati, https://nptel.ac.in/courses/105103093</p> <p>[2] Dr.SudhirMisra - NOC: Principles of Construction Management, IIT Kanpur https://nptel.ac.in/courses/105104161</p>

HONORS

20CEH4801A		STABILITY OF STRUCTURES														
Course Category:		Honors							Credits:					4		
Course Type:		Theory							Lecture - Tutorial - Practice:					3-1-0		
Prerequisites:		20CE5404/A – Advanced Structural Analysis.							Continuous Evaluation:					30		
									Semester end Evaluation:					70		
									Total Marks:					100		
Course outcomes		Upon successful completion of the course, the student will have:														
		CO 1	analyze the buckling of columns, beam-columns and find critical loads using energy and non-energy methods													
		CO 2	analyze the lateral buckling of beams by energy and non-energy methods													
		CO 3	analyze the buckling of rectangular plates and find critical compressive loads for various boundary conditions													
		CO 4	analyze the buckling of axially loaded cylindrical shells													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
	CO 1	3	2		1	1				1				3		
	CO 2	3	2		1	1				1				3		
	CO 3	3	2		1	1				1				3		
	CO 4	3	2		1	1				1				3		
Course Content		UNIT – I BUCKLING OF COLUMNS Introduction; Methods of finding critical loads; Critical loads for straight columns with different end conditions and loading; Inelastic buckling of axially loaded columns; Energy methods; Prismatic and non-prismatic columns under discrete and distributed loading. BEAM COLUMNS Theory of Beam column – Stability analysis of beam column with different types of loads.														
		UNIT – II BEAMS UNDER PURE BENDING Cantilever and simply supported beams of rectangular and I sections.														

	BEAMS UNDER TRANSVERSE LOADING Energy methods; Solution of simple problems.
	UNIT – III PLATES SIMPLY SUPPORTED ON ALL EDGES Plates simply supported on all edges and subjected to constant compression in one or two directions. PLATES SIMPLY SUPPORTED ALONG TWO OPPOSITE SIDES Plates simply supported along two opposite sides perpendicular to the direction of compression and having various edge conditions along the other two sides.
	UNIT – IV BUCKLING OF AXIALLY COMPRESSED CYLINDRICAL SHELLS Introduction to buckling of axially compressed cylindrical shells, failure of axially compressed cylindrical shells. CRITICAL LOAD OF AN AXIALLY LOADED CYLINDER Linear theory of cylindrical shells-donnell equations, critical load of an axially loaded cylinder.
Text books	[T1] Theory of elastic stability by Timoshenko & Gere, McGraw Hill, 1961. [T2] Background to buckling by Allen and Bulson, McGrawHill, 1980.
Reference books	[R1] Elastic stability of structural elements by N.G.R.Iyengar, Macmillan India Ltd., 2007. [R2] Principles of Structural stability theory by AlexandarChajes, 1974.
E-resources and other digital material	https://nptel.ac.in/courses/105105166 https://youtu.be/ZSQ_5lRj5gI https://nptel.ac.in/courses/105108141

20CEH4804B	SUSTAINABLE CONSTRUCTION METHODS		
Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will have an ability to:														
		CO 1	understand the green buildings and sustainable design aspects													
		CO 2	understand the water conservation and energy efficiency													
		CO 3	evaluate the sustainable materials and wellbeing of residents													
		CO 4	apply principles of green rating systems in construction													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
	CO 1	1		1				2	1						1	
	CO 2	1		1				2	1						1	
	CO 3	1		1			2	2	1						2	
	CO 4	1		1				2	1						2	
Course Content		UNIT – I														
		INTRODUCTION														
		Green building, Global warming, requirement of Green Building, Benefits of green buildings.														
		SUSTAINABLE DESIGN														
		Local building requirements, soil erosion control, natural topography, vegetation, heat island effect, roof & non-roof, passive architecture, basic house hold amenities, green education & awareness.														
		UNIT – II														
		WATER CONSERVATION														
		Water efficient plumbing fixtures, rain water harvesting, landscape design, management of irrigation system, recycle and reuse of waste water, water quality.														
		ENERGY EFFICIENCY														
		HCFC free equipment, minimum energy performance, enhance energy														

	<p>performance, alternate water heating systems, on-site renewable energy – common lighting, energy efficiency in common area equipment, integrated energy monitoring system.</p> <p>UNIT – III MATERIALS & RESOURCES Separation of house-hold waste, green procurement policy, local materials, eco friendly wood based materials, alternate construction material, handling of construction & demolition material.</p> <p>RESIDENT HEALTH & WELLBEING Minimum day lighting, Ventilation design, no smoking policy, enhanced day lighting, enhanced ventilation design, cross ventilation.</p> <p>UNIT-IV CONSTRUCTION AND OPERATIONS Construction, Occupancy & Operations.</p> <p>GREEN RATING SYSTEMS IGBC, LEED, GRIHA, BEE, benefits of rating systems, procedure to get IGBC certification.</p>
Text books	<p>[T1] IGBC Green homes rating system Version 3.0 – A bridged reference guide, September 2019</p> <p>[T2] Jerry Yudelson, “Green building through Integrated design”, McGraw Hill, 2009</p> <p>[T3]Gautham R K, “Green Homes”, BSP Books Private Limited, New Delhi, 2009.</p>
Reference books	<p>[R1] “Sustainable building technical manual- Green building design, constructions and operation”, Produced by Public Technology Inc., USGreen Building Council</p>
E-resources and other digital material	---

20CEH4801C	DESIGN OF FORMWORK
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Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	---	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will have an ability to:													
		CO 1	apply a right material for manufacturing false work and form work suiting specific												
		CO 2	analyze the pressure of concrete on form work												
		CO 3	evaluate the adequacy of decking, form work and false work.												
		CO 4	understand the sequence of construction of civil engineering structures and safety steps involved in the design of form work and false work.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1		1			2	1	1		1	1				2
	CO 2	2	2	1		2								2	
	CO 3	3	3	3			1			1				3	1
	CO 4	1	2			1	2	1		1	1			2	
Course Content		UNIT – I													
		INTRODUCTION													
		Formwork and false work, Temporary work systems, Construction planning and site constraints.													
		MATERIALS OF FORMWORK													
		Materials and construction of the common formwork and false work systems, Special and proprietary forms.													
		UNIT – II													
		FORM WORK													
		Formwork – Design: Concrete pressure on forms, Design of timber and steel forms													
		ANALYSIS OF FORMWORK													
		Loading and moment of formwork.													

	<p>UNIT – III DESIGN OF DECKS Types of beam, decking and column formwork, Design of decking</p> <p>FALSE WORKS False work design, Effects of wind load, Foundation and soil on false work design.</p>
	<p>UNIT – IV SPECIAL FORMS The use and applications of special forms.</p> <p>CONSTRUCTION SEQUENCE AND SAFETY IN USE OF FORMWORK Sequence of construction, Safety use of formwork and false work.</p>
Text books	<p>[T1] Robert L. Peurifoy and Garold D. Oberiender, “Formwork for Concrete Structures”, McGraw-Hill, 1996 .</p> <p>[T2] TudorDinescu and ConstantinRadulescu, “Slip Form Techniques”, Abacus Press, Turn Bridge Wells, Kent, 2004.</p>
Reference books	<p>[R1] Austin, C.K., “Formwork for concrete”, Cleaver - Hume Press Ltd., London, 1996</p> <p>[R2] Michael P. Hurst, “Construction Press”, London and New York., 2003</p>
E-resources and other digital material	Open web

20CEH5802A	ENGINEERING ROCK MECHANICS		
Course Category:	Honors	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	20ES3102A - Engineering Geology	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course outcomes		Upon successful completion of the course, the student will have an ability to:													
		CO 1	evaluate rock masses based on classification systems												
		CO 2	apply the field and laboratory testing on rocks to evaluate engineering properties												
		CO 3	analyze rocks based on the failure criteria of rocks under various stress fields												
		CO 4	evaluate the bearing capacity and foundation on rocks and understand various slope stability methods												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	3	2	2			3		3		3				1
	CO 2	3	2	2			3		3		3				1
	CO 3	3	2	2			3		3		3				1
	CO 4	3	2	2			3		3		3				1
Course Content		UNIT – I INTRODUCTION TO ROCK MECHANICS AND CLASSIFICATION OF ROCKS Objectives of rock mechanics, Fields of application of rock mechanics. Geological Classification of igneous, sedimentary and metamorphic rocks based on texture and stratification ROCK MASS CLASSIFICATIONS Rock Quality Designation (RQD), Rock Structure Rating (RSR), Rock Mass Rating (RMR).													

	<p>UNIT – II LABORATORY TESTS - PHYSICO —MECHANICAL PROPERTIES OF ROCKS -Compressive strength, Tensile strength, Direct shear test, Triaxial shear test, Slake durability test, Schmidt rebound hardness test</p> <p>FIELD TESTS - PHYSICO —MECHANICAL PROPERTIES OF ROCKS Uniaxial jacking test- Pressure meter tests Hydraulic fracturing- Flat jack test Stress.Electric resistivity method- Seismic refraction method</p>
	<p>UNIT – III FAILURE CRITERIA FOR ROCK AND ROCK MASSES Mohr-Coulomb Yield Criterion, Hoek-Brown Criterion,</p> <p>STRENGTH AND DEFORMABILITY OF JOINTED ROCK MASS Shear strength of Rock joints, Deformability of Rock joints, Concept of joint compliance</p>
	<p>UNIT – IV FOUNDATION ON ROCKS Estimation of bearing capacity, Settlement in rocks, Pile foundation in rocks.</p> <p>STABILITY OF ROCK SLOPES AND METHODS TO IMPROVE ROCK MASS RESPONSES Modes of failure.Groutingin Rocks, Rock bolting, Rock Anchors.</p>
Text books	<p>[T1]Goodman-Introduction to Rock mechanics,Willey International(1980). [T2]Ramamurthy, T. - Engineering in Rocks for slopes, foundations and tunnels, Prenice Hall of India.(2007) [T3] Rock mechanics in engineering practice: Stag and Zienkiewiz,John wiley& sons</p>
Reference books	<p>[R1] Jaeger, J. C. and Cook, N. G. W. — Fundamentals of Rock Mechanics,Chapman and Hall, London.(1979). [R2] Hoek, E. and Brown, E. T. Underground Excavation in Rock, Institution of Mining and Metallurgy, 1982. [R3]Brady, B. H. G. and Brown, E. T. - Rock Mechanics for Underground Mining, Chapman & Hall, 1993. [R4] Rock mechanics for engineers: Varma, B.P,Khanna Publishers</p>
E-resources and other digital material	Nil

20CEH5801B	ADVANCED STEEL DESIGN
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Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	Design of Steel Structures	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will have an ability to:													
		CO 1	analyse safe section for Tension members with lug angle and Built up Compression Members												
		CO 2	analyse safe section for Plate girders												
		CO 3	analyse for safe section for gantry girders												
		CO 4	analyse safe section for eccentric connections												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	2		2		3	1				1		1	3	
	CO 2	2		2		3	1				1		1	3	
	CO 3	2		2		3	1				1		1	3	
	CO 4	2		2		3	1				1		1	3	
Course Content		UNIT - I TENSION MEMBERS (IS800-2007) Design of tension members with Lug angles with bolted and welded connections.													
		COMPRESSION MEMBERS (IS800-2007) Design of axially loaded built up compression members with Laced and Battened columns with bolted and welded connections.													
		UNIT - II INTRODUCTION TO GANTRY GIRDER Introduction, Various loads, Load effects, explanation of how to calculate loads, Calculation of Maximum SF and Maximum BM using influence lines, Deflections													

	DESIGN OF GANTRY GIRDER Design of Gantry Girder, Problems on design of gantry girder.
	UNIT - III INTRODUCTION TO PLATE GIRDERS Introduction to plate girder, Elements eccentric depth, Design of web and flanges, Design of plate girders without stiffeners, Problems DESIGN OF PLATE GIRDERS Design of plate girders with stiffeners, Design of plate girders with intermediate stiffeners, Problems on plate girders with intermediate stiffeners
	UNIT - IV SEATED CONNECTIONS Introduction to Connections, Unstiffened seated connections-bolted and welded, Stiffened seated connection-bolted and welded BRACKET CONNECTIONS Bracket Connections, type1-bolted and welded, Bracket connection type2-bolted and welded.
Text books	[T1] Duggal, S.K., Limit State Design of Steel Structures, McGraw-Hill, NDLS, 2019. [T2] Bhavikatti, S.S., Design of Steel Structures-By Limit State Method as per IS:800-2007, I. K. IBH Pvt. Ltd., NDLS, 2019.
Reference books	[R1] Subramanian, N., Design of Steel Structures-Limit State Method Oxford University press, HYB, 2018. [R2] Ram, K.S.S., Design of Steel Structures, Pearson Education India, NDLS, 2015. [R3] Chandra, R. and Gehlot, V., Limit State Design of Steel Structures, Scientific Publishers, NDLS, 2010.
E-resources and other digital material	https://nptel.ac.in/courses/105105162 https://nptel.ac.in/courses/105106113

20CEH5804C	GEOSPATIAL DATA PROCESSING		
Course Category:	Honors	Credits:	4
Course Type:	Theory and practical	Lecture - Tutorial - Practice:	3-0-2
Prerequisites:	NIL	Continuous Evaluation: Semester end Evaluation: Total Marks:	30 70 100

Course outcomes		Upon successful completion of the course, the student will have an ability to:													
		CO 1	understand the concepts of Geographical information systems and apply them in various engineering applications.												
		CO 2	evaluate appropriate remote sensing data products for mapping, monitoring and management applications.												
		CO 3	apply various image processing techniques and their applications.												
		CO 4	apply RS and GIS techniques for solving Engineering applications.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	3	2	3		3	3	3		3	3		3		3
	CO 2	3	2	3		3	3	3		3	3		3		3
	CO 3	3	2	3		3	3	3		3	3		3	2	
	CO 4	3	2	3		3	3	3		3	3		3	2	
Course Content		<p>UNIT-I GEOGRAPHICAL INFORMATION SYSTEM Components of GIS, Types of Data, coordinate systems, Geographic coordinate system, Projected coordinate system, Maps and scales, Types of Maps and scales, Projections, Types of Projections, Georeferencing, Data structures, GIS analysis functions.</p> <p>DATA EDITING AND STORAGE Raster and vector data models, Digitization, Data editing, Errors and corrections, data presentation and generation of thematic maps, spatial database management systems, Data representation, Data storage, Entity relationship models.</p> <p>PRACTICE 1. Introduction to Arc GIS and Georeferencing, projections and re-projections</p>													

	<p>2. Creating a shape file, clip and attribute data manipulation.</p>
	<p>UNIT-II INTRODUCTION TO REMOTE SENSING Introduction, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, and vegetation), Resolution, image registration and elements of visual interpretation techniques.</p> <p>DATA ACQUISITION AND PLATFORMS Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms-IRS, Landsat, Sentinel, SPOT, CARTOSAT, etc. sensors, sensor resolutions (spatial, spectral, radiometric and temporal), Optical, Thermal and Microwave, signal to noise ratio, LiDAR data acquisition and processing.</p> <p>PRACTICE 3.DataDigitization (Draw, edit, delete and update)</p>
	<p>UNIT-III IMAGE CLASSIFICATION TECHNIQUES Supervised Classification, Unsupervised classification, ANN and SVM classification techniques</p> <p>SPECTRAL INDICES Vegetation indices, water related indices, Digital elevation model, Digital terrain model, Triangulated irregular networks.</p> <p>PRACTICE 4. Data Analysis – Overlay, Buffer 5. Generation of DEM and DTM using raster data.</p>
	<p>UNIT-IV APPLICATIONS IN SCIENCE DOMAIN Applications of Remote sensing in various Engineering and Science domains such as Agriculture, Forest, Soil, Geology</p> <p>APPLICATIONS IN ENGINEERING DOMAIN LU/LC, Water Resources, Urban, Disaster Management, etc.</p> <p>PRACTICE 6.Assignment on Application of Geospatial techniques in Civil Engineering.</p>
Text books	<p>[T1]Photogrammetry, GIS & Remote Sensing, <u>SSManugula</u>, VeerannaBommakanti, Educreation Publishing, 2018</p> <p>[T2]Text Book of Remote Sensing and Geographical Information Systems, M.Anji Reddy, BS Publications/BSP Books, 4th edition, 2012</p>
Reference books	<p>[R1]Remote Sensing and Image Interpretation, Lillesand, T.M, R.W. Kiefer and J.W. Chipman, Wiley India Pvt. Ltd., New Delhi,7th Edition 2015</p> <p>[R2]Remote Sensing and GIS, BasudebBhatta, Oxford UniversityPress,2nd Edition, 2011</p>

E-resources and other digital material	https://nptel.ac.in/courses/105/103/105103193/ https://nptel.ac.in/courses/105/101/105101206/ https://nptel.ac.in/courses/105/107/105107206/
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20CEH6803A	TRAFFIC ANALYSIS AND DESIGN		
Course Category:	Honors	Credits:	4
Course Type:	Program Elective	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	20CE6302	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will have:														
		CO 1	understand traffic engineering studies, analyse the data and present the results.													
		CO 2	evaluate traffic and road facilities, and intersection control measures for smooth traffic movement.													
		CO 3	analyse appropriate traffic control and management measures.													
		CO 4	apply the principles of queuing theory to analyse delay at signalized and unsignalized intersections.													
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
	CO 1	3			3					1						
	CO 2	3	3								1			3		
	CO 3	3					3								3	
	CO 4	3	3							1					3	
Course Content		UNIT – I TRAFFIC ENGINEERING STUDIES AND ANALYSIS Sampling in Traffic Studies, Adequacy of Sample Size; Objectives, Methods of Study, Equipment. DATA COLLECTION, ANALYSIS AND INTERPRETATION Case Studies of (a) Speed (b) Speed and Delay (c) Volume (d) Origin and Destination (e) Parking (f) Accident & other Studies														
		UNIT – II DESIGN OF TRAFFIC ENGINEERING FACILITIES Control of Traffic Movements through Time Sharing and Space Sharing Concepts.														
		DESIGN OF ISLANDS Design of Channelising Islands, T, Y, Skewed, Staggered, Roundabout, Mini-roundabout and other forms of AT-Grade Crossings including provision for safe crossing of Pedestrians and Cyclists; Grade Separated Intersections, their Warrants and Design Features; Bus Stop Location and Bus Bay Design														

	<p>UNIT – III TRAFFIC REGULATION AND MANAGEMENT Traffic Signs, Markings and Signals; Principles of Signal Design, Webster's method of Signal Design, Redesign of Existing Signals including Case Studies; Signal System and Coordination.</p> <p>TRAFFIC MANAGEMENT MEASURES Speed, vehicle, parking, enforcement regulations, mixed traffic regulation, various management techniques.</p> <p>UNIT – IV TRAFFIC STREAM MODELS Fundamental Equation of Traffic Flow, Speed-Flow-Concentration Relationships, Normalised Relationship, Fluid Flow Analogy Approach, Shock Wave Theory, Platoon Diffusion and Boltzman Like Behaviour of Traffic Flow, Car-Following Theory, Linear and Non-Linear Car-Following Models, Acceleration Noise.</p> <p>QUEUING ANALYSIS Fundamentals of Queuing Theory, Demand Service Characteristics, Deterministic Queuing Models, Stochastic Queuing Models, Multiple Service Channels, Models of Delay at Intersections and Pedestrian Crossings.</p>
Text books	<p>[T1] Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna publishers, 2011.</p> <p>[T2] The Institute of Transportation Engineers, Traffic Engineering Handbook, 7th edn, 2016.</p>
Reference books	<p>[R1].IRC-SP41: Guidelines for the Design of At-Grade Intersections in Rural & Urban Areas</p> <p>[R2].Pignataro, L., Traffic Engineering – Theory & Practice, John Wiley, 1973.</p> <p>[R3].Salter, R J., Highway Traffic Analysis and Design, ELBS, 1996</p>
E-resources and other digital material	Nil

20CEH6803B	TRANSPORTATION ECONOMICS
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Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	20CE6302	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will have:													
		CO 1	understanding the economic principles and estimating the various cost components in transportation												
		CO 2	apply the possible project alternatives for the economic analysis and applying the appropriate economic analysis method												
		CO 3	analysing Demand and Supply modelling												
		CO 4	attaining Knowledge on Regulation and Policy making of Economic Evaluation												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	3	3											3	3
	CO 2	3	3			3				1					
	CO 3	3			3										
	CO 4	3							3		1				3
Course Content		UNIT – I TRANSPORT COSTS AND BENEFITS Principles of economic analysis, Fixed and variable cost, cost of improvement, maintenance cost, cost estimating methods, accounting for inflation, external costs. CONSEQUENCES OF TRANSPORT PROJECTS, ROAD USER CONSEQUENCES Reduced vehicle operation costs, value of travel time savings, value of increased comfort and convenience, cost of accident reduction, reduction in maintenance cost, non-user consequences – travel time.													
		UNIT – II ECONOMIC ANALYSIS METHODS Generation and screening of project Alternatives													

	<p>DIFFERENT METHODS OF ECONOMIC ANALYSIS annual cost and benefit ratio methods, discounted cash flow methods, shadow pricing techniques, determination of IRR and NPV, examples of economic analysis, application economic theory in traffic assignment problem.</p>
	<p>UNIT – III TRANSPORT DEMAND The Basic Framework- measuring the demand in a spatial and temporal setting. Traditional Four-Stage Demand Model; modern approaches to modelling demand and practical issues in demand estimation.</p> <p>TRANSPORT SUPPLY The nature of output in transport, output and costs, economies of size, density and scope, empirical estimation of transport cost functions- the approaches and illustrations.</p>
	<p>UNIT – IV REGULATION AND POLICY Theory of Regulation, Deregulation and Privatisation in Transport. Approaches to privatisation of transport infrastructure and services and a competition policy for transport. Evolution of transport policy in India with focus on case studies regarding different modes.</p> <p>EVOLUTION OF POLICY Evolution of transport policy in India with focus on case studies regarding different modes.</p>
Text books	<p>[T1] McCarthy, P. S., Transportation Economics, Massachusetts: Blackwell Publishers. 2001</p> <p>[T2] Winfrey R, Highway Economic Analysis, International Textbook Company, 1969.</p>
Reference books	<p>[R1] Kenneth J. Button, Transport Economics, Elgar, 2010</p> <p>[R2] David A. Hensher, Ann M. Brewer, Transport: An Economics and Management Perspective, Oxford University Press, 2001.</p> <p>[R3] Emile Quinet, Roger Vickerman, Principles of Transport Economics, Edward Elgar Pub, 2005</p> <p>[R4] Road User Cost Study, Central Road Research Institute</p> <p>[R5] Dickey J.W, Project Appraisal for Developing Countries, John Wiley, 1984</p>
E-resources and other digital material	<p>https://www.civil.iitb.ac.in/~dhingra</p>

20CEH6802C	ADVANCED FOUNDATION ENGINEERING		
Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	20CE6404/B Foundation Engineering	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will have an ability to:													
		CO 1	apply various bearing capacity determination techniques and												
		CO 2	analysis for determination of bearing capacity and settlement of shallow foundation												
		CO 3	evaluate safe capacity of pile foundation for all types of loads												
		CO 4	analyse section for stability of well foundation / caisson.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	3	3				2			1	2		2		2
	CO 2	3	3				2			1	2		2		2
	CO 3	3	3				2			1	2		2		2
	CO 4	3	3				2			1	2		2		2
Course Content		UNIT – I BEARING CAPACITY OF SHALLOW FOUNDATIONS Vesic method, IS Code method; Effect of Water Table; Footings with Eccentric or Inclined Loads, Footings on Layered Soils.													
		ESTIMATION OF BEARING CAPACITY BASED ON FIELD TESTS Bearing Pressure using SPT & CPT													
		UNIT – II CONCEPT OF SETTLEMENT CLASSIC THEORIES Immediate Settlement, Consolidation Settlement; Secondary Compression Settlement.													
		SETTLEMENT ESTIMATION - EMPIRICAL METHODS Settlement of foundations on Sands-Schmertmann													

	<p>UNIT – III PILES IN COMPRESSION Static capacity of piles, Point Bearing Resistance with SPT and CPT ;Ultimate Capacity of Pile Groups in Compression, Settlement; Pile Load Test; Negative Skin Friction.</p> <p>SPECIAL PILES AND SETTLEMENTS OF PILE Laterally Loaded Piles -Ultimate Lateral Resistance; Batter Piles; Under Reamed Piles; Mini and Micro Piles, Pullout& Lateral Load; Efficiency; Settlements of Pile Groups;</p> <p>UNIT – IV WELL FOUNDATIONS Open wells; Design of pier foundations and well foundations; Lateral stability of well foundations; R.C.C. designs of wells</p> <p>PNEUMATIC CAISSONS Introduction to Pneumatic Caissons, construction of piers;</p>
Text books	<p>[T1] Das, B. M. Principles of Foundation Engineering 5th Edition Nelson Engineering, 2004.</p> <p>[T2] Coduto, D.P. Foundation Design Principles and Practices, 2nd edition, Pearson, Indian edition, 2012. Phi Learning, 2008.</p> <p>[T3] Bowles, J. E. Foundation Analysis & Design 5th Edition McGraw-Hill Companies, Inc., 1996.</p> <p>[T4] Poulos, H. G. & Davis, E. H. Pile Foundation Analysis and Design, John Wiley & Sons Inc, 2008.</p>
Reference books	<p>[R1] Reese, L. C. & Van Impe, W. F. Single Piles and Pile Groups under Lateral Loading -Taylor & Francis Group (Jan 2000)</p> <p>[R2] Rowe, R. K. Geotechnical & Geo-environmental Engineering Hand Book -Springer, 2001.</p> <p>[R3] Tomlinson, M. J. Foundation Design and Construction, PHI, 2003.</p>
E-resources and other digital material	<p>nptel.ac.in/courses/105107120</p> <p>nptel.ac.in/courses/105101083</p>

20CEH7802A	GEOSYNTHETICS AND REINFORCED SOIL STRUCTURES
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Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3-1-0
Prerequisites:	Geotechnical Engineering	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will have an ability to:													
		CO 1	analyze the properties of geosynthetics												
		CO 2	understand functions and applications of geosynthetics												
		CO 3	evaluate a typical section for the construction of reinforced earth walls												
		CO 4	evaluate reinforced earth slopes and foundations												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	3	3	3		3						3		3	3
	CO 2	3	3	3		3						3		3	3
	CO 3	3	3	3		3						3		3	3
	CO 4	3	3	3		3						3		3	3
Course Content		UNIT – I													
		GEOSYNTHETICS													
		Introduction to Geosynthetics-Types of geosynthetics- Functions of Geosynthetics-Applications of Geosynthetics- Strength of reinforced soils													
		MANUFACTURING OF GEOSYNTHETICS													
		Manufacture of geotextiles- Manufacture of geogrids- Manufacture of geonets- Manufacture of geomembranes- Manufacture of geocomposites													
		UNIT – II													
		PROPERTIES OF GEOSYNTHETICS													
		Physical properties-Mechanical Properties-Hydraulic Properties-Endurance Properties-Degradation properties													
		TESTING OF GEOSYNTHETICS													
		Need for testing of Geosynthetics-Testing of geogrids-Testing of geonets-Testing of geomembranes-Testing of GCLs													

	<p>UNIT – III EXTERNAL STABILITY ANALYSIS OF REINFORCED SOIL WALLS Different Types of Soil Retaining Structures-Construction Aspects of Geosynthetic Reinforced Soil Retaining Walls-External Stability Analysis of Reinforced Soil Retaining Walls</p> <p>INTERNAL STABILITY ANALYSIS OF REINFORCED SOIL WALLS Internal Stability Analysis of Reinforced Soil Walls- Testing requirements for Reinforced Soil Retaining Walls- Design of Gabions.</p>
	<p>UNIT – IV STABILITY ANALYSIS OF REINFORCED SOIL EMBANKMENTS Stability analysis of reinforced soil Embankments resting on soft foundation soils-Stability analysis of reinforced soil slopes- Reinforced soil for supporting shallow foundations-Natural geosynthetics and their applications.</p> <p>GEOSYNTHETICS FOR LANDFILLS Geosynthetics for construction of municipal waste landfills-Geosynthetics for construction of hazardous waste landfills</p>
Text books	<p>[T1] Koerner, R.M. “Designing with Geosynthetics”, Prentice Hall, Eaglewood cliffs, NJ, 2005. [T2]Sanjay Kumar Shukla, Jian-Hua Yin, Taylor, “Fundamentals of Geosynthetics Engineering” & Francis, Milton Park, Abingdon, UK, 2010. [T3] Saran, S. “Reinforced Soil and Its Engineering Applications”, I.K. International Pvt Ltd, New Delhi, 2005.</p>
Reference books	<p>[R1] VenkatappaRao, G. and SuryanarayanaRaju, GVS. “Engineering with Geosynthetics”, Tata McGraw Hill Publishing Company Limited – New Delhi, 2008. [R2] Koerner, R.M. and Welsh, J. P. “Construction and Geotechnical Engineering using Synthetic Fabrics” by. John Willey and Sons, New York, 1993.</p>
E-resources and other digital material	<p>https://nptel.ac.in/courses/105/101/105101143/ [J. N. Mandal, Geosynthetics Engineering]</p>

20CEH7803B		INTELLIGENT TRANSPORTATION SYSTEMS													
Course Category:		Honors						Credits:						4	
Course Type:		Theory						Lecture - Tutorial - Practice:						3-1-0	
Prerequisites:		Transportation Engineering						Continuous Evaluation: Semester end Evaluation: Total Marks:						30 70 100	
Course outcomes		Upon successful completion of the course, the student will have an ability to:													
		CO 1	understand the basics of ITS and data collection techniques												
		CO 2	apply ITS for different functional areas												
		CO 3	apply ITS for different user needs and services												
		CO 4	understand the significance of ITS in developed and developing countries												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	2		2		2									2
	CO 2	2				2		2			2				2
	CO 3	2	2			2		2			2				2
	CO 4	2	2			2				2			2		2
Course Content		UNIT-I INTRODUCTION TO ITS: Definition of ITS, ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection. TELECOMMUNICATIONS IN ITS: Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System													
		UNIT-II ITS FUNCTIONAL AREAS Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO),													

	<p>ITS FUNCTIONAL AREAS IN TRANSPORTATION SYSTEM: Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).</p>
	<p>UNIT-III ITS USER NEEDS Travel and Traffic management, Public Transportation Management, Electronic Payment,</p> <p>ITS User Services Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.</p>
	<p>UNIT-IV AUTOMATED HIGHWAY SYSTEMS: Automated highway system - Vehicles in Platoons – Integration of Automated Highway Systems.</p> <p>ITS PROGRAMS IN THE WORLD: Overview of ITS implementations in developed countries, ITS in developing countries.</p>
Text books	<p>[T1]Ghosh. S, T. Lee, T.S Lee. “Intelligent Transportation Systems: New Principles and Architectures”, 1sted, CRC Press, Boca Raton, 2000. [T2]Sussman. J, “Perspective on Intelligent Transport System ITS”, 1sted, Artech House Publishers, Boston 2005.</p>
Reference books	<p>[R1]M.A. Chowdhury, & A. Sadek, “Fundamentals of Intelligent Transportation Systems Planning”, 1st ed, Artech House Publishers, Boston, 2003. [R2]J.Miles, K.Chen, C.J.C Miles, “ITS Hand Book 2000: Recommendations for World Road Association (PIARC)” 1sted, Artech House Publishers, Boston, 1999</p>
E-resources and other digital material	<p>[1] Prof Tom V Mathew, IIT Bombay- https://www.civil.iitb.ac.in/~vmtom/nptel/591_ITS_1/web/web.html [2] LelithaVanajakshi, GitakrishnanRamdurai, AshaAnand, IIT Madras- https://coeut.iitm.ac.in/ITS_synthesis.pdf [3]Prof Sussman J, MIT open Course ware- https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-212jan-introduction-to-intelligent-transportation-systems-spring-2005/lecture-notes/</p>

20CEH7804C	ENVIRONMENTAL IMPACT ASSESSMENT
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Course Category:	Honors	Credits:	4
Course Type:	Theory	Lecture - Tutorial - Practice:	3 - 1- 0
Prerequisites:	17MC4108B – Environmental studies	Continuous Evaluation:	30
		Semester end Evaluation:	70
		Total Marks:	100

Course outcomes		Upon successful completion of the course, the student will have an ability to:													
		CO 1	understand the Concept of EIA, EIA methodologies.												
		CO 2	analyze the effect on different sources on developmental activities.												
		CO 3	analyze the effect of development on flora and fauna.												
		CO 4	understand the different acts and case studies.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO 1	3					2			1	1		1		2
	CO 2	3	2				2	3		3	1				2
	CO 3	3	2					3			1		1		2
	CO 4						3	3		1	3		2		2
Course Content		UNIT I INTRODUCTION TO ENVIRONMENTAL IMPACT ASSESSMENT Basic concept-Salient Features of EIA, EIA Procedure – Analytical functions of EIA – classification and prediction of impacts -Elements of EIA - Factors affecting EIA – Impact evaluation and analysis - Preparation of environmental base map - Classification of environmental parameters.													
		EIA METHODOLOGIES Criteria for the selection of EIA Methodology – EIA methods - Adhoc methods, matrix methods, network method - Environmental medium quality index method, overlay methods and cost/benefit analysis.													
		UNIT II ENVIRONMENTAL IMPACT ASSESSMENT ON SOIL AND GROUND WATER Introduction, Prediction and assessment - Soil quality -Methodology for													

	<p>the assessment of soil and groundwater - Delineation of study area - Identification of activities.</p> <p>ENVIRONMENTAL IMPACT ASSESSMENT OF SURFACE WATER AND AIR Impact prediction - Assessment of impact significance - Identification and incorporation of mitigation measures - EIA in surface water, air and biological environment: Methodology for the assessment of impacts on surface water environment. Air pollution sources, Air pollution effect - Generalized approach for assessment of air pollution Impact.</p> <p>UNIT III ASSESSMENT OF IMPACT ON VEGETATION AND WILDLIFE Assessment of impact of developmental activities on vegetation and wildlife - Environmental impact of deforestation – Causes and effects of deforestation.</p> <p>ENVIRONMENTAL AUDIT Environmental audit and environmental legislation - Objectives of environmental audit - Types of environmental audit - Audit protocol - Stages of environmental audit - Onsite activities - Evaluation of audit data and preparation of audit report.</p> <p>UNIT – IV ENVIRONMENTAL ACTS Post audit activities - The Environmental protection act - The water act - The air act - Wild life act.</p> <p>CASE STUDIES Case studies and preparation of environmental impact assessment statement for various industries.</p>
Text books	<p>[T1]Anjaneyulu, VallManickam, “Environmental Impact Assessment Methodologies”, 2nd Edition ,B.S. Publications, 2007.</p> <p>[T2]Glynn. J, and Gary W. Heinke, “Environmental Science and Engineering”,PHI, NDLS, 1996.</p>
Reference books	<p>[R1]Barthwal, R. R., “Environmental Impact Assessment”, New Age International Publications</p> <p>[R2]Dhameja,S.K., Environmental Engineering and Management, Kataria, NDLS, 2010.</p> <p>[R3]Bhatia,H.S., A Text Book of Environmental Pollution and Control, Galgotia NDLS, 2003.</p>
E-resources and other digital material	<p>[1] https://nptel.ac.in/courses/120/108/120108004/</p>