VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING COLLEGE

CIVIL ENGINEERING [VR23]

SCHEME OF INSTRUCTIONS

B.Tech. PROGRAMME [VR23]

B.Tech. Degree Programs Applicable for the batch of students admitted from the Academic Year 2023-24

VELAGAPUDI RAMAKRISHNA
SIDDHARTHA ENGINEERING COLLEGE
(Autonomous, Accredited with 'A+' grade by NAAC)
Affiliated to Jawaharlal Nehru Technological University Kakinada
Approved by AICTE & ISO 21001: 2018 Certified
Kanuru, Vijayawada -520 007, Andhra Pradesh
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VELAGAPUDIRAMAKRISHNASIDDHARTHAENGINEERINGCOLLEGESCHEMEOF INSTRUCTIONFOR FOURYEAR UG PROGRAMME [VR23]

GROUP-A(AI&DS, AI&ML,CSE,IT)(with effect from **2023-24**)

SEMESTER I **CONTACTHOURS:27**

S. No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	23BS1101	Basic Science	Linear Algebra & Calculus	3	0	0	3
2.	23BS1102	Basic Science	Engineering Physics	3	0	0	3
3.	23ES1103A	Engineering Science	Basic Civil and Mechanical Engineering	3	0	0	3
4.	23ES1104	Engineering Science	Introduction to Programming	3	0	0	3
5.	23HS1105	Humanities and Social Science	Communicative English	2	0	0	2
6.	23BS1151	Basic Science	Engineering Physics Lab	0	0	2	1
7.	23ES1152	Engineering Science	Computer Programming Lab	0	0	3	1.5
8.	23HS1153	Humanities and Social Science	Communicative English Lab	0	0	2	1
9.	23ES1154	Engineering Science	Engineering Workshop	0	0	3	1.5
10.	23ES1155	Engineering Science	IT Workshop	0	0	2	1
11.	23BS1156	Basic Science	NSS/NCC/Community Service	-	-	1	0.5
			Total :	**14**	**0**	**13**	**20.5**
12.	23MC1106	Mandatory Course	Induction Program				

Category	**Credits**
Basic Science Courses	3 +3+1 + 0.5 =7.5
Engineering Science Courses	3 +3+1.5+1.5 + 1 = 10
Humanities and Social Science Courses	2+ 1=3
Mandatory Courses	0
TOTALCREDITS	**20.5**

SEMESTER II **CONTACTHOURS:26**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	23BS2101	Basic Science	Differential Equations & Vector Calculus	3	0	0	3
2.	23BS2102B	Basic Science	Chemistry	3	0	0	3
3.	23ES2103B	Engineering Science	Basic Electrical and Electronics Engineering	3	0	0	3
4.	23PC2104A	Professional Core	Data Structures	3	0	0	3
5.	23ES2105	Engineering Science	Engineering Graphics	1	0	4	3
6.	23BS2151B	Basic Science	Chemistry Lab	0	0	2	1
7.	23PC2152A	Professional Core	Data Structures Lab	0	0	3	1.5
8.	23ES2153	Engineering Science	Basic Electrical and Electronics Workshop	0	0	3	1.5
9.	23BS2154B	Basic Science	Health and wellness, Yoga and Sports	-	-	1	0.5
			Total	**13**	**0**	**13**	**19.5**

Category	**Credits**
Basic Science Courses	3+3+1+0.5=7.5
Engineering Science Courses	3+3+1.5= 7.5
Professional Courses	3+1.5 = 4.5
Humanities and Social Science Courses	0
Mandatory Courses	0
TOTALCREDITS	**19.5**

VELAGAPUDIRAMAKRISHNASIDDHARTHAENGINEERINGCOLLEGESCHE MEOF INSTRUCTIONFOR FOURYEAR UG PROGRAMME [VR23]

GROUP-B (CE,ME, ECE,EEE, EIE) (with effect from**2023-24**)

SEMESTER I **CONTACTHOURS: 26**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	23BS1101	Basic Science	Linear Algebra & Calculus	3	0	0	3
2.	23BS1102A	Basic Science	Engineering Chemistry (CE,ME)	3	0	0	3
	23BS1102B		Chemistry (ECE, EEE, EIE)				
3.	23ES1103B	Engineering Science	Basic Electrical and Electronics Engineering	3	0	0	3
4.	23ES1104	Engineering Science	Introduction to Programming	3	0	0	3
5.	23ES1105	Engineering Science	Engineering Graphics	1	0	4	3
6.	23BS1151A	Basic Science	Engineering Chemistry Lab (CE,ME)	0	0	2	1
	23BS1151B		Chemistry Lab (ECE, EEE, EIE)				
7.	23ES1152	Engineering Science	Computer Programming Lab	0	0	3	1.5
8.	23ES1153	Engineering Science	Basic Electrical and Electronics Workshop	0	0	3	1.5
9.	23BS1154B	Basic Science	Health and wellness, Yoga and Sports	-	-	1	0.5
			Total :	**13**	**0**	**13**	**19.5**
10.	23MC1106	Mandatory Course	Induction Program				

Category	**Credits**
Basic Science Courses	3 +3+1 + 0.5=7.5
Engineering Science Courses	3+3+3 +1.5 + 1.5= 12
Humanities and Social Science Courses	0
Mandatory Courses	0
TOTALCREDITS	**19.5**

SEMESTER II **CONTACTHOURS: 27**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	23BS2101	Basic Science	Differential Equations & Vector Calculus	3	0	0	3
2.	23BS2102	Basic Science	Engineering Physics	3	0	0	3
3.	23ES2103A	Engineering Science	Basic Civil and Mechanical Engineering	3	0	0	3
4.	23PC2104B	Professional Core	Engineering Mechanics (CE, ME)	3	0	0	3
	23PC2104C		Network Analysis (ECE, EIE)				
	23PC2104D		Electrical Circuit Analysis - I (EEE)				
5.	23HS2105	Basic Science	Communicative English	2	0	0	2
6.	23BS2151	Basic Science	Engineering Physics Lab	0	0	2	1
7.	23PC2152B	Professional Core	Engineering Mechanics & Building Practices (CE)	0	0	3	1.5
	23PC2152C		Network Analysis & Simulation Lab (ECE, EIE)				
	23PC2152D		Electrical Circuit Analysis Lab (EEE)				
	23PC2152E		Engineering Mechanics Lab (ME)				
8.	23HS2153	Basic Science	Communicative English Lab	0	0	2	1
9.	23ES2154	Engineering Science	Engineering Workshop	0	0	3	1.5
10.	23ES2155	Engineering Science	IT Work shop	0	0	2	1
11.	23BS2156	Basic Science	NSS/NCC/Community Service	-	-	1	0.5
			Total :	**14**	**0**	**13**	**20.5**

Category	**Credits**
Basic Science Courses	3 +3+ 1+0.5=7.5
Engineering Science Courses	3 +1.5+ 1= 5.5
Humanities and Social Sciences	2+ 1= 3
Mandatory Courses	0
Professional Core	3 + 1.5 = 4.5
TOTALCREDITS	**20.5**

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SEMESTER III **CONTACT HOURS: 27**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	23BS3101A	BS	Mechanics of Solids	3	0	0	3
2	23HS3102	BS & H	Universal Human Values 2 Understanding Harmony	2	1	0	3
3	23ES3103A	ES	Engineering Geology	1	0	2	2
4	23CE3304	PC	Surveying and Geomatics	3	0	2	4
5	23CE3305	PC	Fluid Mechanics	3	0	0	3
6	23TP3106	Soft Skills-1	Logic and Reasoning	0	0	2	1
7	23MC3107B	Audit Course	Environmental Science	2	0	0	-
8	23CE3308	PC	Concrete Technology	2	0	2	3
9	23CE3651	Skill Enhancement Course	Computer Aided Civil Engineering Drawing	0	0	2	1
			Total	**16**	**1**	**10**	**20**

Category	Credits
Basic Science Courses	3
Engineering Science Courses	2
Humanities and Social Sciences	3
Mandatory Courses	0
Skill Enhancement Courses	2
Professional Core	4+3+3
TOTALCREDITS	**20**

SEMESTER IV **CONTACT HOURS: 29**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	23HS4101	Management Course	Engineering Economics and Management	2	0	0	2
2	23BS4102A	ES/BS	Probability and Statistics for Engineers	3	0	0	3
3	23CE4303	PC	Structural Analysis	3	0	0	3
4	23CE4304	PC	Geotechnical Engineering	3	0	2	4
5	23CE4305	PC	Hydraulics and Hydraulic Machines	3	0	2	4
6	23TP4106	Soft Skills-2	English for Professionals	0	0	2	1
7	23MC4107A	MC	Building Materials and Construction	2	0	0	-
8	23CE4651	Skill Enhancement Course	Autodesk, Rivet and Excel for Engineers	0	0	2	1
9	23ES4152	ES	Design Thinking & Innovation	1	0	2	2
10	23CE4353	PC Lab 1	Strength of Materials Lab	0	0	2	1
			Total	**17**	**0**	**12**	**21**

Mandatory Community Service Project Internship of 08 weeks duration during summer vacation

Category	Credits
Basic Science Courses	3
Engineering Science Courses	2
Management Courses	2
Mandatory Courses	0
Skill Enhancement Courses	1 + 1
Professional Core	3 + 4 + 4 + 1
TOTALCREDITS	**21**

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SEMESTER V **CONTACTHOURS: 33**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	23CE5301	Program Core	Water Resources Engineering	3	0	0	3
2	23CE5302	Program Core	Environmental Engineering	2	0	2	3
3	23CE5303	Program Core(Group B)	Design of Concrete Structures	3	0	0	3
4	23CE5404	ProgramElective1		3	0	0	3
5	23CE5205	Open Elective/Job oriented elective-1	A) Geospatial Technologies B) Building Services Engineering	2	0	2	3
6	23CE5351	ProgramCoreLab1	Computer Applications in Civil Engineering Lab1	0	0	3	1.5
7	23CE5352	Program Core Lab 2	Advanced Surveying Lab	0	0	3	1.5
8	23TP5106	SoftSkills–3	Personality Development	0	0	2	1
9	23CE5354	Internship/Project(6weeks)	EPICS/Internship	0	0	4	2.0
10	23CE5607	SkillOrientedcourse-2	Building Information Modeling(BIM)	0	0	2	1.0
11	23MC5108 B	Mandatory Course (AICTE suggested)	Biology for Engineers / Foreign Languages (German/French)/Law for Engineers/Sanskrit Bhasa/ Yoga & Meditation/ Psychology	2	0	0	-
			Total	15	0	18	22
Honors/Minor Courses				3	0	0	3

Category	Credits
Program Core Courses	12.0
Humanities and Social Sciences	0
Program Elective Courses	3
Open Elective Courses	3
Skill Oriented courses	2
Internship/Project	2.0
Mandatory Course	0
TOTALCREDITS	22

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SEMESTER VI **CONTACTHOURS: 30**

S. No	Course Code	Course Category	Course Name	L	T	P	Credits
1	23CE6301	Program Core	Design of Steel Structures	3	0	0	3
2	23CE6302	Program Core	Transportation Engineering	3	0	2	4
3	23CE6403	ProgramElective2		3	0	0	3
4	23CE6404	Program Elective 3		3	0	0	3
5	23CE6205	Open Elective /Job oriented elective-2 **(NPTEL)**		3	0	0	3
6	23CE6408	Program Elective 4		3	0	0	3
7	23CE6351	ProgramCoreLab1	STAAD and ETABS	0	0	2	1
8	23HS6152	Humanities & Social Science	English and Communication Skills Lab	0	0	2	1
9	23TP6106	SoftSkills–4	Quantitative Aptitude	0	0	2	1
10	23CE6554	Internship/Project	Mini Project–I	0	0	2	1
11	23MC6107 B	Mandatory Course (AICTE suggested)	Technical Paper Writing & IPR	2	0	0	0
			Total	20	0	10	23

Industrial/Research Internship six weeks(Mandatory) during summer vacation				
Honors/Minor Courses	3	0	0	3

Note: Open Elective Courses 2 is self–learning. Students may opt from any MOOCS platform. They have to submit the certificate before the last instruction day of VI Semester.

Category	Credits
Program Core Courses	8
Humanities and Social Sciences	0
Program Elective Courses	9
Open Elective Courses	3
Skill Oriented courses	2
Mandatory Course	0
Internship/Project	1
TOTALCREDITS	23

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SEMESTER VII **CONTACTHOURS: 29**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	23CE7301	Program Core	Estimation, Specifications and Contracts	3	0	2	4
2.	23CE7302	Program Core	Foundation Engineering	3	0	0	3
3.	23CE7403	ProgramElective5		3	0	0	3
4.	23CE7205	Open Elective/ Job Oriented Elective-3	A) Green Buildings and Sustainability B) Advanced Construction Materials C) Quality Control and Quality Assurance	3	0	0	3
5.	23CE7206	Open Elective/ Job Oriented Elective-4 **(NPTEL/ SELF LEARNING)**		3	0	0	3
6.	23CE7607	Advanced Skill Course	Computer Aided Construction Management	2	0	2	3
7.	23CE7551	Internship/Project	Mini Project-II	0	0	3	1.5
8.	23CE7552	Internship/ Project	Industrial/Research Internship	0	0	3	1.5
9.	23MC7108B	Audit Course	Constitution of India	2	0	0	0
			Total	19	0	10	22

Note: Open Elective Courses 4 is 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	7
Program Electives	3
Open Electives	6
Skill Oriented Courses	3
Internship/Project	3
TOTALCREDITS	22

SEMESTER VIII **CONTACTHOURS:24**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1.	23CE8551	Internship/Project	Major Project and Internships (6 Months)	0	0	24	12
			Total	0	0	24	12

LIST OF OPEN ELECTIVES:

SEMESTER – V

23CE5205: Open Elective/Job oriented elective - 1

A) Geospatial Technologies
B) Building Services Engineering

SEMESTER – VI

23CE6205: Open Elective /Job oriented elective - 2

SEMESTER – VII

23CE7205: Open Elective /Job oriented elective – 3

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

23CE7206: Open Elective /Job oriented elective – 4

Note: Open Elective Courses 2 is self–learning. Students may opt from any MOOCS platform. They have to submit the certificate before the last instruction day of VI Semester.

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

DEPARTMENT OF CIVIL ENGINEERING
V. R. SIDDHARTHA ENGINEERING COLLEGE
(Autonomous)
VIJAYAWADA – 520 007

LIST OF COURSES OFFERED UNDER MINORS

S.No	Course Code	Course Name	L	T	P	Credits
Fourth Semester						
1	23CEM4701	Introduction to Civil Engineering – Concepts and Materials	3	0	0	3
Fifth Semester						
2	23CEM5701	Methodology for Civil Engineering Construction	3	0	0	3
Sixth Semester						
3	23CEM6701	System Design For Sustainability	3	0	0	3
4	23CEM6702	Ecology And Environment	3	0	0	3
Seventh Semester						
5	23CEM7701	Infrastructure And Transportation System Planning	3	0	0	3
6	23CEM7702B	NPTEL-Mandatory (Course Based on Availability)	3	0	0	3

Note : *5 courses, 5x3=15 credits,* ***One Mandatory NPTEL Course****- 3 credits, total 18 credits*

LIST OF COURSES OFFERED UNDER HONORS

S. No.	Course Code	COURSE NAME	L	T	P	Credits
FOURTH SEMESTER						
1	23CEH4801A	Stability of Structures	3	0	0	3
2	23CEH4801B	Sustainable Construction Methods	3	0	0	3
3	23CEH4801C	Design of Formwork	3	0	0	3
FIFTH SEMESTER						
4	23CEH5801A	Engineering Rock Mechanics	3	0	0	3
5	23CEH5801B	Advanced Steel Design	3	0	0	3
6	23CEH5801C	Geospatial Data Processing	3	0	0	3
SIXTH SEMESTER						
7	23CEH6801A	Traffic Analysis and Design	3	0	0	3
8	23CEH6801B	Transportation Economics	3	0	0	3
9	23CEH6801C	Advanced Foundation Engineering	3	0	0	3
10	23CEH6801B1	NPTEL Mandatory (Course Based on Availability)	3	0	0	3
SEVENTH SEMESTER						
11	23CEH7801A	Geo Synthetics and Reinforced Soil Structures	3	0	0	3
12	23CEH7801B	Intelligent Transportation Systems	3	0	0	3
13	23CEH7801C	Environmental Impact Assessment	3	0	0	3
14	23CEH6802B1	NPTEL Mandatory(Course Based on Availability)	3	0	0	3

Note:
Can opt One course in Each Semester, 4x3=12 Credits, additionally ***2 Mandatory NPTEL Courses****, 2x3= 6 Credits, total 18 Credits.*
For Eligibility & Registration: Must follow all the academic regulations related to Honors & Minors

PROGRAMELECTIVES:

SEMESTER V(P.E-I)

S.No	Course Code	Course	Subject	L	T	P	Credits
1	23CE5404/A	ProgramElective-1	Advanced structural analysis	3	0	0	3
2	23CE5404/B	ProgramElective-1	Town planning & Architecture	3	0	0	3
3	23CE5404/C	ProgramElective-1	Air pollution and Control	3	0	0	3
4	23CE5404/D	ProgramElective-1	Environmental Geotechnology	3	0	0	3
5	23CE5404/E	ProgramElective-1	Forensics in Civil Engineering	3	0	0	3

SEMESTER VI(P.E-II)

S.No	Course Code	Course	Subject	L	T	P	Credits
1	23CE6403/A	ProgramElective-2	Advanced Design of concrete structures	3	0	0	3
2	23CE6403/B	ProgramElective-2	Advanced Environmental Engineering	3	0	0	3
3	23CE6403/C	ProgramElective-2	Railway and Tunnel Engineering	3	0	0	3
4	23CE6403/D	ProgramElective-2	Groundwater Hydrology	3	0	0	3
5	23CE6403/E	ProgramElective-2	Plumbing - Water and Sanitation	3	0	0	3

SEMESTER VI (P.E-III)

S.No	Course Code	Course	Subject	L	T	P	Credits
1	23CE6404/A	ProgramElective-3	Analysis and Design of High Rise Building	3	0	0	3
2	23CE6404/B	ProgramElective-3	Solid Waste Management	3	0	0	3
3	23CE6404/C	ProgramElective-3	Ground Improvement Techniques	3	0	0	3
4	23CE6404/D	ProgramElective-3	Urban Transport Planning	3	0	0	3
5	23CE6404/E	ProgramElective-3	Open channel flow & River Engineering	3	0	0	3

SEMESTER VI(P.E-IV)

S.No	Course Code	Course	Subject	L	T	P	Credits
1	23CE6408/A	ProgramElective-4	Prefabricated Structures	3	0	0	3
2	23CE6408/B	ProgramElective-4	Construction Equipment and Automation	3	0	0	3
3	23CE6408/C	ProgramElective-4	Instrumentation and Sensor Technology in Civil Engineering	3	0	0	3
4	23CE6408/D	ProgramElective-4	Airport and Harbour Planning	3	0	0	3
5	23CE6408/E	ProgramElective-4	Design and Drafting using REVIT	3	0	0	3

SEMESTERVII–(PE-V)

S.No	Course Code	Course	Subject	L	T	P	Credits
1	23CE7403/A	ProgramElective-5	Design of Prestressed Concrete	3	0	0	3
2	23CE7403/B	ProgramElective-5	Repair and Rehabilitation of Structures	3	0	0	3
3	23CE7403/C	ProgramElective-5	Disaster Preparedness & Planning Management	3	0	0	3
4	23CE7403/D	ProgramElective-5	Pavement design and Construction	3	0	0	3
5	23CE7403/E	ProgramElective-5	Rural Water Supply and Sanitation	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		Prefabricated Structures	Design of Prestressed Concrete
2	Geotechnical Engineering	Environmental Geotechnology		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	Urban Transport Planning	Airport and Harbour Planning	Pavement Design and Construction
5	Hydrology &Water Resources Engineering		Groundwater Hydrology	Open channel flow & River Engineering		
6	Industry Oriented Courses			Analysis and Design of High Rise Buildings	Design and Drafting using REVIT	
7	Miscellaneous	Town planning &Architecture	Plumbing - Water and Sanitation		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

CREDIT DISTRIBUTION - Category wise and Semester wise

	BS	ES	HS	PC	PE	OE	SC/SO	PROJ	Total
Sem-1	7.5	12	0	0	0	0	0	0	**19.5**
Sem-2	7.5	5.5	3.0	4.5	0	0	0	0	**20.5**
Sem-3	3	2.0	3.0	10	0	0	2	0	**20**
Sem-4	3	4	0	12.0	0	0	2	0	**21**
Sem-5	0	0	0	12.0	3	3	2	2.0	**22**
Sem-6	0	0	0	8.0	9	3	2	1	**23**
Sem-7	0	0	0	7	3	6	3	3	**22**
Sem-8	0	0	0	0	0	0	0	12	**12**
Total	**21**	**23.5**	**6.0**	**53.5**	**15**	**12**	**11**	**18**	**160**

SCHEME OF INSTRUCTIONS

23BS3101A	MECHANICS OF SOLIDS

Course Category:	**Basic Science**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture - Tutorial - Practice:**	**3-0-0**
Prerequisites:	**Engineering 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	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	PO 10	PO 11	PO 12	PSO 1	PSO 2
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.

	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. 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.
	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. 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.
	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. 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;
Text books	[T1] Er.R.K.Rajput, "Strength of Materials(Mechanics of solids)", S.Chand& Company Ltd, New Delhi. [T2] S.Ramamrutham& R Narayan, "Strength of Materials", DhanpatRai Publishing Co.(P) Ltd, New Delhi.
Reference books	[R1] S SBhavikatti, "Structural Analysis", V K Publishers. [R2] S P Timoshenki& D H Young, "Theory of structures". [R3] E P Popov, "Mechanics of materials", Prentice-hall of India Pvt. Ltd., New Delhi.
E-resources and other digital material	http://nptel.ac.in/courses/105105108/

23HS3102	UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

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 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. (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).
	UNIT – II: UNDERSTANDING HARMONY IN THE HUMAN BEING – HARMONY IN MYSELF: 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). 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. (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).
	UNIT – III: UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY – HARMONY IN HUMAN-HUMAN RELATIONSHIP: 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. 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. (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).
	UNIT – IV: 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. 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. (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 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	[R1] JeevanVidya: EkParichaya, A. Nagaraj, JeevanVidyaPrakashan, Amarkantak (1999). [R2] Human Values, A. N. Tripathi, New Age International Publishers, New Delhi (2004). [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). [R4] The story of my experiments with truth: Mahatma Gandhi Autobiography, Mohandas Karamchand Gandhi, B. N. Publishing (2008). [R5] Small is beautiful: A study of economics as if people mattered, E. F. Schumacher, Vintage Books, London (1993). [R6] Slow is beautiful: New Visions of Community, Cecile Andrews, New Society Publishers, Canada (2006). [R7] Economy of Permanence, J. C. Kumarappa, Sarva-Seva-SanghPrakashan, Varanasi (2017). [R8] Bharat Mein Angreji Raj, PanditSunderlal, PrabhathPrakashan, Delhi (2018). [R9] Rediscovering India, Dharampal, Society for Integrated Development of Himilayas (2003). [R10] Hind Swaraj or Indian Home Rule, M. K. Gandhi, Navajivan Publishing House, Ahmedabad (1909). [R11] India Wins Freedom: The Complete Version, MaulanaAbulKalam Azad, Orient Blackswan(1988). [R12] The Life of Vivekananda and the Universal gospel, Romain Rolland, AdvaithaAshrama, India (2010). [R13] Mahatma Gandhi: The Man who become one with the Universal Being, Romain Rolland, Srishti Publishers & Distributors, New Delhi (2002).
E-resources and other digital material	https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLAx6AhQ https://fdp-si.aicte-india.org/download.php#1

23ES3103A	ENGINEERING GEOLOGY

Course Category:	**Engineering Science**	**Credits:**	**2**
Course Type:	**Theory & 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:	
	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	PO 11	PO 12	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 - Scope of geological studies in various Civil engineering projects; Mineralogy-Introductiontomineralogy,MineralIdentificationbyPhysicalproperties. 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

Sedimentary rocks – Formation –Classification and Textures, Metamorphic rocks and metamorphism – Formation –Classification and Texture, Engineering concerns of rocks

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

UNIT-II

EARTH PROCESS

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

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

LAB EXCERSISE-III- Identification of structural features on Models.

UNIT-III

GEOLOGICAL AND GEOPHYSICAL INVESTIGATION METHODS

1. MAPS AND THEIR INTERPRETATION- Topographic Map and Geological Map

LAB EXCERSISE-IV- Practicing topographic map cross section**,** Practicing geological maps and cross section

2. GEOPHYSICAL METHODS- Principles of exploration geophysical Methods Electrical Resistivity method- Interpretation, Seismic refraction method- Interpretation

LAB EXCERSISE-**V**-Electrical Resistivity survey for civil engineering application

UNIT-IV

GEOLOGICAL INVESTIGATIONS FOR MAJOR PROJECTS

1. DAMS - Types and purpose of 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.

2.ENVIRONMENTAL GEOLOGY—Environmental impact on mining construction materials- aggregate waste disposal- Impact of environment on the construction of dams, reservoirs.

Text books	[T1] F.G. Bell, Fundamental of Engineering Geology , BS Publications PVT Ltd, Hyderabad. [T2] Parbin Singh, " Engineering and General Geology ", Katson Publication House, 1987. [T3] Principals of Engineering Geology by K.V.G.K. Gokhale – B.S publications [T4] Engineering Geology by N.Chennkesavulu, Mc-Millan, India Ltd. 2005. [T5] Environmental Geology by K.S Valdia, TaTaMcGraHill, NewDelhi
Reference books	[R1] Krynine and Judd, " Engineering Geology and Geo techniques " McGraw Hill Book Company, 1990. [R2] Legeet, " Geology and Engineering ", McGraw Hill Book Company, 1998. [R3] Blyth, " Geology for Engineers ", ELBS, 1995. [R4] GoodmanR.F-Introduction to rockmechanics, JohnWiley, Chichestor [R5] S.K Duggal et.al Engineering Geology –McGraw Hill Education, 2002. [R6] E.A Keller-Environmental Geology- Prientice Hall .N.Jercy
E-resources and other digital material	NPTEL Courses

23CE3304	SURVEYING & GEOMETICS

Course Category:	**Program Core**	**Credits:**	**4**
Course Type:	**Theory**	**Lecture - Tutorial - Practice:**	**3 - 0- 2**
Prerequisites:	**Basic Mathematics**	**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 measure linear distances and areas using chain and compass surveying.
	CO2	Understand and apply the concept of levelling to determine the elevations and contours.
	CO3	Understand the principles of theodolite survey and measure horizontal and vertical angles using theodolite survey.
	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	2	2	1	1	3			1	3	3	1	1	2	2
CO2	2	2	1	1	3			1	3	3	1	1	2	2
CO3	2	2	1	1	3			1	3	3	1	1	2	2
CO4	2	2			2			1	3	3	1	1	2	2
CO5	1				2							3		

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 uneven or a sloping ground; Chain & Tape corrections.

LABORATORY TESTS:

Determine the area of a given parcel of land by using cross staff and chain survey

- Determine the distance between two points with obstacles in between

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.

CONTOURING:

Contouring; contour interval; Characteristics of contours; Methods of locating contours; Interpolation and Sketching of contours; Uses of contour maps.

LABORATORY TESTS:

- Determination of elevations of various points remote from each other

  (Differential leveling)
- Survey and plot the longitudinal and cross sections of a given embankment
- Prepare a contour map of existing ground using an auto level.

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.

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

LABORATORY TESTS:

- Measurement of horizontal angle by using Repetition method.
- Measurement of horizontal angles by using Reiteration method.
- Measurement of vertical angles using a Vernier theodolite.

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.

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.

	LABORATORY TESTS: • Measurement of bearings of an open traverse with prismatic compass and computation of correct included angles. • Measurement of bearings of a closed traverse with prismatic compass and computation of area.
Text books Reference books	[T1] Surveying, Volume-1 by K. R. Arora; Standard Book House. [T2] Advanced Surveying by SatheeshGopi, R. Sathikumar, N. Madhu; Pearson Education [R1] Surveying, Volime-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/

23CE3305	FLUID MECHANICS

Course Category:	**Programme Core**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture - Tutorial - Practice:**	**3 - 0- 0**
Prerequisites:	**Mathematics, Engineering Physics Engineering 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 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.
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	PSO 1	PSO 2
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 and inclined plane surfaces.

UNIT II:

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 onedimensional flows; Irrotational and rotational flows; Stream line; Path line; Streak line; Continuity equation; Velocity potential and stream function.

	DYNAMICS OF FLUID FLOW: Euler's equation of motion; Bernoulli'sequation; Momentum principle; Application of Momentum equation; Force exerted on a pipe bend.
	UNIT III: 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. MEASUREMENT OF FLOW THROUGH ORIFICES: Flow through orifices; Determination of coefficients for an orifice; Flow through small orifice and large rectangular orifice. UNIT – IV ANALYSIS OF FLOW THROUGH PIPES: Energy losses in pipelines; Darcy – Weishbach equation; Minor losses in pipelines; Pipes in series and parallel. 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.
Text books	[T1] P.N. Modi& S.N. Seth, "Hydraulics & Fluid Mechanics", 18th ed., Standard Book House, New Delhi, 2015. [T2] A.K. Jain, "Fluid Mechanics", 11th ed., Khanna Publishers, New Delhi, 2014.
Reference books	[R1] R. K. Bansal, "Fluid Mechanics and Hydraulic Machines", 9thet.,Laxmi Publications; New Delhi, 2015. [R2] Rajput R.K., "Fluid Mechanics and Hydraulic Machines", 3rd ed., S.Chand and Company Ltd., New Delhi, 2014. [R3] K. Subramanya, "Theory and Applications of Fluid Mechanics", 3rd ed., Tata McGraw Hill Publishing Company, New Delhi, 2013.
E-resources and other digital material	www.nptel.ac.in / courses/ 105101082/ www.nptel.ac.in/courses/105103095/

23CE3308	CONCRETE TECHNOLOGY

Course Category:	**Programme Core**	**Credits:**	**3**
Course Type:	**Theory & 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 mix deign 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	UNIT – I 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(wetandDry 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. LABORATORY TESTS (As per IS Specifications): Fineness of cement, consistency, initial and final setting time, Specific gravity and compressive strength of cement. AGGREGATES: Classification of Aggregates; Properties of aggregates Grading of Aggregates; IS: 383 requirements for aggregates; Alkali – Aggregate reaction. LABORATORY TESTS (As per IS Specifications): Sieve analysis, specific gravity, bulk density of both fine and coarse aggregate, bulking of sand.
	UNIT – II WATER: General; Quality of water; Use of sea water; IS: 456 requirements. MORTAR: Functions of sand in mortar; Classification of mortars;Uses of mortar; Properties of good mortar mix and mortar; Selection of mortar. ADMIXTURES IN CONCRETE: General; Air–entraining agents; Plasticizers; Accelerators; Retarders; Miscellaneous admixtures for damp proofing and Surface hardening; Introduction to mineral admixtures. 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. LABORATORY TESTS (As per IS Specifications): workability tests on fresh concrete: slump cone, compaction factor.
	UNIT – III MANUFACTURE OF CONCRETE: Batching of concrete; Mixing; Transporting Concrete; Placing concrete; Compaction of concrete; Curing of concrete; Finishing. 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. 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).
	UNIT – IV 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, technology for sustainable development.

	SPECIAL CONCRETES & CONCRETING METHODS: Light weight concrete and No fines concrete; High strength and high performance of concrete; Polymer concrete and Fiber reinforced concrete; Gunite or shotcrete; Ferro cement; Vacuum concrete, Vacuum Dewatered Concrete, Self compacting concrete, Self healing Concrete. CONCRETE MIX DESIGN: Concept of mix design; List of Mix design methods; Indian standard method of mix design (IS10262-2019).
Text books	[T1] Concrete Technology by M. S. Shetty; S. Chand & Company (Pvt.) Ltd., New Delhi. [T2] Properties of Concrete by A. M. Neville; Published by Dorling Kindersley (India) Pvt. Ltd. Licensees of Pearson Education in south Asia, New Delhi.
Reference books	[R1] Concrete Technology by A.R.Santhakumar; Oxford University press,New Delhi.. [R2] Concrete Technology by M. L. Gambhir; Tata McGraw – Hill Publishing Company Ltd., New Delhi.
E-resources and other digital material	http:/nptel.ac.in/courses/105102012

23CE3651	COMPUTER AIDED CIVIL ENGINEERING DRAWING

Course Category:	Skill Enhancement Course	Credits:	1
Course Type:	Laboratory	Lecture - Tutorial - Practice:	0-0-2
Prerequisites:	Engineering Graphics	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 knowledgeofVariousmeasurementsand dimensionsofa building components
	CO2	understandprinciplesofplanning,principlesofarchitectureandbuildin g Bye-laws.
	CO3	apply the principles of planning to secure building plansasper Building bye-laws
	CO4	analyze the requirements of user to draw the plan, elevation, sectional view of the building as per principlesof planningand 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

PARTA

INTRODUCTION AND THEORY CONCEPTS EXPLANATION FOR THE FOLLOWING:

Principlesofplanning&architecture

Buildingbye-laws &NationalBuildingCode

Conventionalsigns and Symbols &Line diagrams

Plan, Elevation,Sectionof aBuilding and site plan

StandarddimensionsofDoors, windows andmeasurementsofdifferentrooms and various structural components

	(MANUALDRAWING) 1. Drawing practice of conventional 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 DESIGN LINE DIAGRAMS AND DRAW PLAN, ELEVATION & SECTION OF THE FOLLOWING: 4.Residentialbuilding Drawing- Single bedroom,Living room, Kitchen(Load bearingwall structure) 5. Elevations of various types of Buildings in explanation PART-B **AUTOCAD DRAWING** 1. AutoCAD Commands introduction and practice Design Line Diagrams and Prepare the approval drawings for local authority with setbacks by drawing Plan, Elevation, Sectionofthefollowing 2. Single storied ResidentialDoublebedroom building (Load bearing structure) 3. Dog legged Stair case 4. RCC Two storied framedstructurebuildingwithstaircase 5. Single storied Rural hospital building/school building Plan
Text books	[T1] Buildingplanning,designingandschedulingbyGurucharanSingh andJagdishSingh. –StandardPublishers-Delhi. [T2] BuildingDrawingbyM.G. Shah, C.M. Kale andS.Y.Patki; TataMcGrawHillPublishingCo.Ltd., New Delhi.
Reference books	[R1] National Building Code, Bureau of Indian Standards, New Delhi, 2005. [R2] Planning & Designing Buildings by Yashwant S. Sane; Allies Book Stall, Pune [R3]Residential Interior Design: A Guide To Planning Spaces 3rd Edition by Maureen Mitton (Author), Courtney Nystuen (Author)
E-resources and other digital material	www.floorplanner.com

23TP3106	LOGIC & REASONING

Course Category:	**Institutional 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	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, 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. 4. Binary logic. 5. Data sufficiency
	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, [T2] Reasoning Guru Verbal & Non-Verbal Reasoning by Vikramjeeth, Multilingual Edition-2023. ISBN :978-9358706000
Reference books	----
E-resources and other digital material	----

23MC3107B	ENVIRONMENTAL SCIENCE

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)		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							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 StudiesDefinition, scope and importanceNeed 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 and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. (e)ENERGY RESOURCES: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. (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.
	UNIT II ECOSYSTEMS 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) BIODIVERSITY AND ITS CONSERVATION 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.

	UNIT III ENVIRONMENTAL POLLUTION 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 SOLID WASTE MANAGEMENT: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. DISASTER MANAGEMENT: Floods, earthquake, cyclone and landslides.
	UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT: From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. 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. ENVIRONMENT PROTECTION ACT Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. PUBLIC AWARENESS Human Population and the Environment, Population growth, variation among nations, Population explosion—Family Welfare Programme. ENVIRONMENT AND HUMAN HEALTH Human rights, Value education, HIV/AIDS, Women and Child Welfare. Role of Information Technology in environment and human health. FIELD WORK/ CASE STUDIES 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.
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	[R1] AnjaneyuluY. Introduction to Environmental sciences, B S Publications PVT Ltd, Hyderabad [R2] Anjireddy.M Environmental science & Technology, BS Publications PVT Ltd, Hyderabad. [R3] Benny Joseph, 2005, Environmental Studies, The Tata McGraw- Hill publishing company limited, New Delhi. [R4] Principles of Environmental Science. &Engg. P.Venu Gopala Rao, 2006, Prentice-Hall of India Pvt. Ltd., New Delhi. [R5] Ecological and Environmental Studies – Santosh Kumar Garg, Rajeswari Garg (or) Rajani Garg, 2006, Khanna Publishers, New Delhi. [R6] Essentials of Environmental Studies, Kurian Joseph & R Nagendran, Pearson Education publishers, 2005. [R7] A.K Dee – Environmental Chemistry, New Age India Publications. [R8] BharuchaErach- Biodiversity of India, Mapin Publishing Pvt.Ltd..
E-resources and other digital material	https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

23HS4101	ENGINEERING ECONOMICS AND MANAGEMENT

Course Category:	**Management Course**	**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	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					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.

	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.
	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.
Text books	[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.
Reference books	[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.
E-resources and other digital material	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/

23BS4102A	PROBABILITY AND STATISTICS FOR ENGINEERS

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	PO 10	PO 11	PO 12	PSO 1	PSO 2
	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: DiscreteRandom Variable , Expectation, Variance and Standard deviation of discrete random variable, Binomial distribution, Poisson distribution.														

	UNIT II: PROBABILITY DENSITIES: ContinuousRandom 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

23CE4303	STRUCTURAL ANALYSIS

Course Category:	**Program Core**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture - Tutorial - Practice:**	**3-0-0**
Prerequisites:	**Mechanics of Solids** **20BS3101A**	**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	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	PSO 2
	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.

UNIT – II

ANALYSIS OF INDETERMINATE STRUCTURES USING ENERGY METHODS

	: BEAMS Strain Energy Method for analysis of continuous beams up to two spans. ANALYSIS OF INDETERMINATE STRUCTURES USING ENERGY METHODS :FRAMES Analysis of rigid frames up to first degree of redundancy.
	UNIT – III ANALYSIS OF INDETERMINATE STRUCTURES: FORCE METHOD Propped cantilever by consistent deformation method; Fixed beams for different loadings. 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.
	UNIT – IV APPROXIMATEMETHODSOFANALYSISFORMULTISTORYFRAMES: KANI'SMETHOD 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. APPROXIMATEMETHODSOFANALYSISFORMULTISTORYFRAMES: : ANALYSIS OF LATERAL LOADS Portal method and cantilever method.
Text books	[T1] Analysis of structures by Volume I –17thEdition by Vazirani&Ratwani; & Volume –II 16th Edition by Vazirani&Ratwani, Khanna Publications; Delhi,2015. [T2] Structural Analysis by S.S. Bhavikatti, Volume-I and II, 4thEdition, Vikas Publishing house PVT Ltd,2014.
Reference books	[R1] Structural analysis by Hibbeler, 6thEdition, Pearson India Education Services PvtLtd.2015 [R2] Structural Analysis by R.Vaidyanathan Volume-I and II, 3rdEdition, Laxmi Publications (P) Ltd,2012. [R3] Theory of structures by S. Ramamrutham, 9thEdition, DhanapatRai Publications,2014. [R4] Basic Structural Engineering by C.S Reddy, Tata McGraw Hill, ThirdEdition. [R5] Theory of structuresVol–IbyG.S. Panditand S.P. Gupta and R.Gupta by Tata McGraw Hill Ltd., New Delhi.
E-resources and other digital material	Structural Analysis–I - http:// nptel.ac.in/courses/105101085 Structural Analysis - I - http://nptel.ac.in/courses/105105166 Structural Analysis - II - http://nptel.ac.in/courses/105101086

23CE4304	GEOTECHNICAL ENGINEERING

Course Category:	**Program Core**	**Credits:**	**4**
Course Type:	**Theory & Practice**	**Lecture - Tutorial - Practice:**	**3-0-2**
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 origin of soil and basic inter-relationships of soil components
CO2	Determine the index properties of soil and classify the soil based on the index properties
CO3	Understand the Soil-Water Interactions
CO4	Understand and determine compressibility and shear strength characteristics 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	PSO 2
CO1	3	3												
CO2	3	3		2						1			3	3
CO3	3	3		2	3					1			3	3
CO4	3	3		2	3					1			3	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:

Index Properties – Introduction, Particle Size Distribution Curve and its uses, Relative Density,Plasticity of soils, Consistency Limits and uses, Plastic, consistency and liquidity indices; Flow index & toughness index; Sensitivity; Thixotropy; Activity of soils. Unified soil classification system; Indian standard soil classification system

Experiments:

1. Determination of water content by oven drying method

	2. Determination of specific gravity by Density bottle & Pycnometer 3. Grain Size analysis – Mechanical analysis – wet and dry soil 4. Determination of liquid limit and plastic limit of soil 5. Determination of in-situ dry density of soil by Core cutter method and by sand replacement method 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; Factors affecting permeability; Permeability of stratified soil deposits. EFFECTIVE STRESS PRINCIPLE: Effective stress principle; Effective stress in a soil mass under different loading conditions – effect of depth of water table, surcharge loading, capillary water Experiments: 6. Determination of permeability by Constant head and Variable head methods
	UNIT – III SEEPAGE THROUGH SOILS Quick sand conditions; Characteristics of flow net; Uses of flow nets; Seepage through earth dams with horizontal filter; Uplift pressure; Flow net for anisotropic soils. 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. Experiments: 7. Standard proctor compaction test- Determination of OMC, MOD
	UNIT – IV CONSOLIDATION OF SOILS: Introduction; Initial and secondary consolidation; Spring analogy for primary consolidation; Terazaghi'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 voids ratio methods; Consolidation test results; Determination of coefficient of consolidation-square root of time and logarithmic time fitting methods SHEAR STRENGTH OF SOILS: Introduction; Mohr – coulomb theory; Different types laboratory of shear strength tests; Different drainage conditions and their field applicability; Mohr - coulomb failure criterion; Shear characteristic of cohesive and cohesion less soils Experiments: 8. Determination of shear parameters (C and φ) of soil by direct shear test 9. Unconfined compression test- Determination of C and φ 10. Determination of Shear strength of soil by Vane shear test

Text books	[T1] Soil Mechanics and Foundation Engineering by K.R. Arora; Standard Publishers & Distributors, NaiSarak, New Delhi. [T2] Basic and Applied Soil Mechanics by GopalRanjan and A.S.R. Rao; New Age International Ltd., New Delhi.
Reference books	[R1] Geotechnical Engineering by C. Venkata Ramaiah; published by New Age International Ltd., New Delhi. [R2] Geotechnical Engineering by V. N. S. Murthy; Marcel Dekker Inc., New York. [R3] Soil Mechanics and Foundation Engineering by B. C. Punmia; Laxmi Publications, Delhi. [R4] Relevant Indian Standard Code Books – IS2720 series; SP 36-part 1.
E-resources and other digital material	Introduction to Soil Mechanics - http://nptel.ac.in/courses/105103097/ Soil Mechanics - http://nptel.ac.in/courses/105101084/ **Geotechnical Engineering Laboratory - https://nptel.ac.in/courses/105101160/**

23CE 4305	HYDRAULICS & HYDRAULIC MACHINES

Course Category:	**Programme Core**	**Credits:**	**4**
Course Type:	**Theory & Practice**	**Lecture - Tutorial - Practice:**	**3 - 0 - 2**
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	evaluate the flow through pipes and open channel.
	CO3	evaluate an equation for a phenomenon using dimensional analysis.
	CO4	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	PSO 1	PSO 2
	CO1	3	2	3										3	
	CO2	3	3	3											3
	CO3	3	2	3											3
	CO4	3	3	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.

	Laboratory tests: 1. Determine Chezy's and Manning's coefficient for free surface flow in a rough/smooth surfaced rectangular channel. 2. Characterise the state of fluid flow by Reynolds's Number 3. Determination of flow-rate in an open channel using V Notch. UNIT II: GRADUALLY VARIED FLOW: Dynamic equation; Types of Surface Profiles; Computation of surface profiles by single step method; Back water Curves and Draw down curves. 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. Laboratory tests: 4. Validate Bernoulli's energy principle experimentally along a conduit. 5. Determine the coefficient of discharge for a Venturimeter/ Orificemeter 6. Workout the flow rate of a liquid using Orifice/Mouthpiece for steady flow in water tanks.
	UNIT III: DIMENSIONAL ANALYSIS AND SIMILITUDE: Dimensional homogeneity; Rayleigh's method; Buckingham – Pi theorem; Geometric, Kinematic and dynamic similarities; Scale effect. 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. Laboratory tests: 7. Measurement of force due to impact of jet on Flat/Curved vanes used in Hydropower projects. 8. Determination of minor loss of head in pipes a) Due to bends b) Sudden contractions c) Sudden expansion. 9. Estimation of friction factor and major head loss for a given pipe system
	UNIT – IV 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. CENTRIFUGAL PUMPS: Types of pumps, Manometric head; Losses and efficiencies; Working Principle and Work done; Priming; Velocity triangles; Multistage pumps; Specific speed; Cavitation. Laboratory tests: 10. Find the overall efficiency of single stage centrifugal pump. 11. Find the Performance studies on Reciprocating pump. 12. Conduct Performance test for Francis turbine at constant head and determine efficiency. Demonstration Experiments: Conduct Performance test for Kaplan / Pelton at constant head and determine efficiency
Text books	[T1] P.N. Modi& S.N. Seth, "Hydraulics & Fluid Mechanics", 18th ed., Standard Book House, New Delhi, 2015. [T2] A.K. Jain, "Fluid Mechanics", 11th ed., Khanna Publishers, New Delhi, 2014.
Reference	[R1] Jagadhishlal, "Hydraulic Machines",9th ed., Metropoliton Company, New Delhi, 2012.

books	[R2] R. K. Bansal, "Fluid Mechanics and Hydraulic Machines", 9th ed., Laxmi Publications; New Delhi, 2015. [R3] Rajput R.K., "Fluid Mechanics and Hydraulic Machines", 3rd ed., S.Chand and Company Ltd., New Delhi, 2014. [R4] K. Subramanya, "Flow in Open Channels" – 3rd ed., Tata McGraw Hill Publishing Company, New Delhi, 2013.
E-resources and other digital material	www.nptel.ac.in / courses/ 105103096/ www.nptel.ac.in / courses/ 105106114/

23CE4353	STRENGTH OF MATERIALS LAB

Course Category:	**Programme core lab**	**Credits:**	**1**
Course Type:	**Laboratory**	**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	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	PSO 2
	CO1	3	3		3	1				2	2		1		2
	CO2	3	3		3	1				2	2		1		2

Course Content	1. Study the stress-strain characteristics of mild steel/tor steel by Universal testing machine. 2. Determine the ultimate shear strength of mild steel rod in single and double shear. 3. Find the Brinnel's hardness number and Rockwell's hardness number of the givenmaterial. 4. Find the Young's modulus of the given material (Wood/Steel/Aluminum) byconducting bending test on simply supported beam. 5. Find the Young's modulus of the given material by conducting bending test oncantilever beam and propped cantilever. 6. Find the impact resistance of the given material by conducting Charpy test and IZODtest on Impact testing machine. 7. Find the modulus of rigidity by conducting torsion test on solid circular shaft. 8. Determine the modulus of rigidity of the material of the spring. 9. Determine the ductility of steel wire. 10. 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

Text books	14. Deflection Test on Beams: Load deformation characteristics, Young‘s Modulus, Maxwell‘s Reciprocal law verification. [T1] Strength of Materials by S Ramamrutham& R Narayan; DhanpatRai 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

23TP4106	ENGLISH FOR PROFESSIONALS

Course Category:	**Programme Core**	**Credits:**	**1**
Course Type:	**Practice**	**Lecture - Tutorial - Practice:**	**0-0-2**
Prerequisites:	**Basic understanding of the language skills viz Listening, Speaking, Reading and Writing.**	**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	Understand how to listen, reflect, and speak while communicating with others.
	CO2	Recall the fundamentals of language in terms of grammar and vocabulary in communication.
	CO3	Apply English language skills in various speaking contexts to present ideas with clarity and accuracy.
	CO4	Analyze the different parts in Versant Test and answer them.

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				
	CO2	2									3				
	CO3	2								2	3				
	CO4	2									3				

Course Content

COURSE CONTENT

1. CONVERSATION STARTERS

Introduction – Seeking Permissions – Asking for Directions – Making Requests – Offering Help – Expressing Thanks – Conveying Apologies – Starting a Conversation with a Stranger – Practice.

2. FUNCTIONAL CONVERSATIONS

Introducing Self – Introducing Others – Starting a Group Introduction – Icebreaker Introduction – Introducing a Formal Setting – Practice Exercises.

	3. GRAMMAR Verbs – Tenses – Sentence Structures – Spotting the Errors. **4.** JUST A MINUTE Introduction – Significance – Fluency – Coherence – Avoiding Errors – Communication Skills – Confidence – Practice. **5.** VOCABULARY Idioms – Phrases – Significance – Meanings – Usage – Practice. **6.** ELOCUTION Definition – Importance – Key Components – Voice Modulation – Articulation – Posture and Gestures – Practice. **7.** EXTEMPORE Introduction – Significance – Developing Quick Thinking – Communication Skills – Confidence – Practice. **8.** DEBATE Introduction – Understanding the Structure – Purpose of a Debate – Developing Basic Debating skills – Do's and Don'ts – Practice. **9.** VERSANT TEST Overview of the Versant Test – Purpose and Importance – Format of the Test – Types of Questions – Practice. 10. STORY TELLING Know Your Audience – Choose a Story – Set the Scene – Introduce the Characters – Build Suspense – Describe the Conflict – Show the Resolution – Share the moral/message – Use Vivid Language – Practice Delivery – Invite Reflection/Discussion – Follow Up.
Text books	[T1] English for Professionals Lab Manual
Reference books	[R1] Wren & Martin. English Grammar and Composition. S.Chand & Company, 2023. [R2] Dale Carnegie. The Quick and Easy way to Effective Speaking. Rupa Publications, 2016. [R3] Richard A. Spears. McGraw-Hill's Dictionary of American Idioms and Phrasal Verbs. McGraw Hill, 2005. [R4] Kamalesh Sadanand. A Spoken English. VOL 1&2, Orient BlackSwan, Second Edition, 2014.
E-resources and other digital material	[1] https://www.pearson.com/languages/hr-professionals/versant.htmlSoftx [2] https://www.ted.com/talks [3] https://shortstoryproject.com/

23CE4651	AUTODESK REVIT AND EXCEL FOR ENGINEERS

Course Category:	**Skill Enhancement Course**	**Credits:**	**1**
Course Type:	**Laboratory**	**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	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 (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						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

B: Excel for Engineers

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	[T1] Auto desk Rivet structures manual. [T2] Exploring Autodesk Revit 2020 for structures,10th edition,byProf. Sham Tickoo, Purdue University Northwest, USA [T3] MS Excel user manual.
Reference books	[R1] Autodesk Revit 2021 Structure Fundamentals by By ASCENT publications Published August 10, 2020, ISBN: 978-1-63057-358-4 | ISBN 10: 1630573582
E-resources and other digital material	https://www.coursera.org/learn/autodesk-revit-for-structural-design-exam-prep

23MC4107A	Building Materials and Construction

Course Category:	Mandatory Course	Credits:	-
Course Type:	Theory	Lecture - Tutorial - Practice:	2-0-0
Prerequisites:	---	Continuous Evaluation: Semester end Evaluation: Total Marks:	40+40+3+17 100

Course Outcomes	On successful completion of the course, the student will be able to:														
	CO1	Understand physical properties, manufacturing processes and benefits of building materials that are used in structural and non-structural components.													
	CO2	Understand application of protective materials for structural members.													
	CO3	Distinguish different types of constructional procedures for different components of a building.													
	CO4	Apply the knowledge of different support systems for construction and repairs.													
Contribution of Course Outcomes Towards achievement of Program Outcomes (L – Low, M-Medium,H–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	L		M		L		M	L						H
	CO2	L		L				M							M
	CO3	L		M		M	M								H
	CO4	L		M		M	H					`			H
Course Content	UNIT – I STONES: Qualities of a good building stone; Stone quarrying; Tools for blasting; Materials for blasting; Process of blasting; Common building stones of India. BRICKS: Composition of good brick earth; Manufacture of bricks; Qualities of good bricks; Tests for bricks; Classification of bricks; STEEL: General; Manufacture of steel; Uses of steel; Market forms of steel;														
	UNIT – II TIMBER: Definition; Structure of a tree; Qualities of good timber; Decay of timber; Preservation of timber; Seasoning of timber; Advantages of timber construction; Indian timber trees. PAINTS, VARNISHES AND DISTEMPERS: General; Painting; Varnishing; Distempering; Wall paper; White washing; Colour washing; Emulsion Paints.														

	UNIT – III BRICK MASONRY: Technical terms; Types of bonds in brickwork- Stretcher, header, English, Flemish. STONE MASONRY: Technical terms; Classification of stone masonry. WALLS AND LINTELS: Classification of walls, Classification of Lintels- timber, stone, brick, steel, reinforced concrete lintels.
	UNIT – IV DAMPNESS AND DAMP PROOFING: Causes of dampness; Methods of preventing dampness; Damp proofing materials FLOORS: Technical terms; Types of flooring materials. ROOFS: Technical terms; Types of roofs; Trusses- king post, queen post, combination of king post & queen post trusses, mansard roof truss; Steel sloping roofs; Roof covering materials; Types of flat roofs; SCAFFOLDING, SHORING, UNDER PINNING AND FORM WORK: Types of scaffolding; Types of shoring; Methods of underpinning; Types of form work;
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-resources and other digital material	

23ES4152	DESIGN THINKING AND INNOVATION

Course Category:	**Engineering Science lab**	**Credits:**	**1.5**
Course Type:	**Laboratory**	**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	PSO 1	PSO 2
	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. *Demonstrate the functioning of the prototype along with presentations of the same. d. Product Innovation: Innovation towards product design Case studies. * 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. 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). 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. 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 Inclinometer. 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. 5. Painting – Paint a given surface in this order - putty, primer and painting. 6. Flooring – Suggest a suitable flooring and install in the given space. 7. Plumbing – Design pipeline layout for the given plan and utilize proper fittings. 8. Formwork – Suggest proper formwork for footings, stair case, 9. Apply basic techniques for masonry and concreting works – different types of brick bonds, plumb, alignment, brick quantity estimation 10. Estimation of material contents for cement mortar and plastering.
Text books	[T1] Building construction by B. C. Punmia -Laxmi Publications, New Delhi [T2] Design thinking for strategic Innovation, IdrisMootee, 2013, John Wiley & Sons [T3] Design thinking – The guidebook – Facilitated by the Royal Civil Service Commission, Bhutan
Reference books	[R1] Design Methods: A Structured Approach for Driving Innovation in Your Organization, Vijay Kumar, First Edition, 2012, Wiley [R2] Human-Centered Design Toolkit: An Open-Source Toolkit to Inspire New Solutions in the Developing World, IDEO, Second Edition, 2011, IDEO.
E-resources and other digital material	---

MINORS & HONORS

23CEM 4701	INTRODUCTION TO CIVIL ENGINEERING- CONCEPTS AND MATERIALS

Course Category:	**Minor**	**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 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	PSO 1	PSO 2
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 ofIndia.

	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; CharotarPublishing 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/

23CEM5701	METHODOLOGY FOR CIVIL ENGINEERING CONSTRUCTION

Course Category:	**Minor**	**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 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)		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	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.

	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.
	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. ORGANISING FOR CONSTRUCTION Importance, general principles, types of organization structures, forms of business organizations.
	UNIT – IV MATERIALS MANAGEMENT Importance, Objectives, Costs, functions of material management, uses, stores management, material procurement, maintaining stocks, material handling. QUALITY CONTROL IN CONSTRUCTION Elements of quality, Organisation for quality control, Quality assurance techniques, Documentation, Quality control circles, variation.
Text books	[T1] Dr.S.Seetharaman, ”Construction Engineering and Management”, 5th 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	---

23CEM6701	SYSTEM DESIGN FOR SUSTAINABILITY

Course Category:	**Minor**	**Credits:**	**3**
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	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	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 Systemsand Integrating S.PSS with DE

	UNIT – II SUSTAINABLE PRODUCT-SERVICE SYSTEM (S.PSS) Introduction to S.PSS; 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; S.PSS Applied to DRE: Sustainability Potential Benefits
	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 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
	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 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 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
Text books	[T1] FabrizioCeschin , İdilGaziulusoy, Design for Sustainability A Multi- level Framework from Products to Socio- technical Systems , Taylor and Francis, 2020. [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.

Reference books	[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. [R2] Elisa Bacchetti, Towards sustainable energy for All Designing Sustainable Product-Service System applied to Distributed Renewable Energy, Politecnico di Milano, Milano, Italy 2017
E-resources and other digital material	Quality as Driver for Sustainable Construction—Holistic Quality Model and Assessment.pdf

23CEM6702	ECOLOGY AND ENVIRONMENT

Course Category:	**Minor**	**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 issues concerned with ecology, environment and sustainability.
	CO2	evaluate the quantity andqualityofwater 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))		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					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.

	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.
	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. DISTRIBUTIONSYSTEMS Methods of supply; Layouts, Plumbing-pipes and fittings; Traps; One pipe and Two pipe systems. UNIT – IV ENVIRONMENTAL POLLUTION Environmental Pollution and their effects. Water pollution, Land pollution, Air pollution, Public Health aspects. 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.
Text books	[T1] Benny Joseph, " Environmental Studies", Tata Mc Graw Hill, 2005 [T2] IgnaciMuthu 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.
Reference books	[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.
E-resources and other digital material	https://nptel.ac.in/courses/127106004 (Ecology and environment by Dr. Abhijit P. Deshpande, IIT Madras).

23CEM7701	INFRASTRUCTURE AND TRANSPORTATION SYSTEM PLANNING

Course Category:	Minor	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 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	PSO 1	PSO 2
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.

	UNIT-III INTRODUCTION TO RAILWAYS Historic development of railways in India, Classification of Indian Railways, Different gauges in Indian Railways 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.
	UNIT-IV GEOMETRIC FEATURES AND OPERATION Super elevation or cant, cant deficiency, cant excess, negative super elevation concept, types of transition curves, gradient types. POINTS AND CROSSINGS Switches, crossings, working principle of turnout, classification of signals, interlocking.
Text books	[T1] Sk Khanna, CEG Justo, A Veeraragavan, Highway Engineering, Nem Chand & Bros, 10th Edition, 2018 [T2] Satish Chandra, MM Agarwal, Railway Engineering, Oxford University Press, 2nd Edition 2013
Reference Book	[R1] Saxena, S.C. and Arora. S, Railway Engineering, Dhanpat Rai, NDLS, 2009
E-resources and other digital material	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/

23CEM7702B	**NPTEL-Mandatory (Course Based on Availability)**

23CEH4801A	STABILITY OF STRUCTURES

Course Category:	**Honors**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture - Tutorial - Practice:**	**3-0-0**
Prerequisites:	**23CE5404/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	PO3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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. 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

23CEH4801B	SUSTAINABLE CONSTRUCTION METHODS

Course Category:	**Honors**	**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 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)

	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		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

	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 performance, alternate water heating systems, on-site renewable energy – common lighting, energy efficiency in common area equipment, integrated energy monitoring system
	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. RESIDENT HEALTH & WELLBEING Minimum day lighting, Ventilation design, no smoking policy, enhanced day lighting, enhanced ventilation design, cross ventilation
	UNIT-IV CONSTRUCTION AND OPERATIONS Construction, Occupancy & Operations GREEN RATING SYSTEMS IGBC, LEED, GRIHA, BEE, benefits of rating systems, procedure to get IGBC certification
Text books	[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.
Reference books	[R1] "Sustainable building technical manual- Green building design, constructions and operation", Produced by Public Technology Inc., US Green Building Council
E-resources and other digital material	---

23CEH4801C	DESIGN OF FORMWORK

Course Category:	**Honors**	**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 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

(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
CO1		1			2	1	1		1	1				2
CO2	2	2	1		2								2	
CO3	3	3	3			1			1				3	1
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

ANALYSIS OF FORMWORK

Loading and moment of formwork.

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

23CEH5801A	ENGINEERING ROCK MECHANICS

Course Category:	**Honors**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture - Tutorial - Practice:**	**3-0-0**
Prerequisites:	**23ES3103A - 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	PO3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO 1	PSO 2
	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).

	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 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
	UNIT – III FAILURE CRITERIA FOR ROCK AND ROCK MASSES Mohr-Coulomb Yield Criterion, Hoek-Brown Criterion, STRENGTH AND DEFORMABILITY OF JOINTED ROCK MASS Shear strength of Rock joints, Deformability of Rock joints, Concept of joint compliance
	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.
Text books	[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
Reference books	[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
E-resources and other digital material	---

23CEH5801B	ADVANCED STEEL DESIGN

Course Category:	**Honors**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture - Tutorial - Practice:**	**3-0-0**
Prerequisites:	**23CE6301 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:	
	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.

	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

23CEH5801C	GEOSPATIAL DATA PROCESSING

Course Category:	**Honors**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture - Tutorial - Practice:**	**3 - 0-0**
Prerequisites	**NIL**	**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	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 (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
	CO1	3	2	3		3									3
	CO2	3	2	3		3									3
	CO3	3	2	3		3								2	
	CO4	3	2	3		3								2	
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, Georeferencing, 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.DataDigitization (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,SSManugula, VeerannaBommakanti,, Educreation Publishing, 2018 [T2] Text Book of Remote Sensing and Geographical Information Systems, M. Anji Reddy, BS Publications/BSP Books, 4th 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/

23CEH6801A	TRAFFIC ANALYSIS AND DESIGN

Course Category:	**Honors**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture - Tutorial - Practice:**	**3-0-0**
Prerequisites:	**23CE6302 Transportation 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:	
	CO1	understand traffic engineering studies, analyse the data and present the results.
	CO2	evaluate traffic and road facilities, and intersection control measures for smooth traffic movement.
	CO3	analyse appropriate traffic control and management measures.
	CO4	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
CO1	3	2	1	3	1	1			1					
CO2	3	3							1				3	
CO3	3			2	2	3			1					3
CO4	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
	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. TRAFFIC MANAGEMENT MEASURES Speed, vehicle, parking, enforcement regulations, mixed traffic regulation, various management techniques . 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. 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.
Text books	[T1] Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna publishers, 2011. [T2] The Institute of Transportation Engineers, Traffic Engineering Handbook, 7th edn, 2016.
Reference books	[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
E-Reference	Nil

23CEH6801B	TRANSPORTATION ECONOMICS

Course Category:	**Honors**	**Credits:**	**3**
Course Type:	**Program Elective**	**Lecture - Tutorial - Practice:**	**3-0-0**
Prerequisites:	**23CE6302 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	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	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	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.

	UNIT – II **ECONOMIC ANALYSIS METHODS** Generation and screening of project **A**lternatives **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.
	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. **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.
	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. **EVOLUTION OF POLICY** Evolution of transport policy in India with focus on case studies regarding different modes.
Text books	[T1] McCarthy, P. S., Transportation Economics, Massachusetts: Blackwell Publishers. 2001 [T2] Winfrey R, Highway Economic Analysis, International Textbook Company, 1969.
Reference books	[R1] Kenneth J. Button, Transport Economics, Elgar, 2010 [R2] David A. Hensher, Ann M. Brewer, Transport: An Economics and Management Perspective, Oxford University Press, 2001. [R3] Emile Quinet, Roger Vickerman, Principles of Transport Economics, Edward Elgar Pub, 2005 [R4] Road User Cost Study, Central Road Research Institute [R5] Dickey J.W, Project Appraisal for Developing Countries, John Wiley, 1984
E-resources and other digital material	https://www.civil.iitb.ac.in/~dhingra

23CEH6801C	ADVANCED FOUNDATION ENGINEERING

Course Category:	Honors	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
Prerequisites:	23CE7302 Foundation 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:	
	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	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	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

	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. 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;
	UNIT – IV WELL FOUNDATIONS Open wells; Design of pier foundations and well foundations; Lateral stability of well foundations; R.C.C. designs of wells PNEUMATIC CAISSONS Introduction to Pneumatic Caissons, construction of piers;
Text books	[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, Indianedition, 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.
Reference books	[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.
E-resources and other digital material	nptel.ac.in/courses/105107120 nptel.ac.in/courses/105101083

23CEH6801B1	**NPTEL Mandatory (Course Based on Availability)**

23CEH7801A	GEO SYNTHETICS AND REINFORCED SOIL STRUCTURES

Course Category:	**Honors**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture - Tutorial - Practice:**	**3-0-0**
Prerequisites:	**23CE4304 Geotechnical 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:	
	CO1	analyze the properties of geosynthetics
	CO2	understand functions and applications of geosynthetics
	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)	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	3
CO2	3	3	3		3								3	3
CO3	3	3	3		3								3	3
CO4														

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
	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 INTERNAL STABILITY ANALYSIS OF REINFORCED SOIL WALLS Internal Stability Analysis of Reinforced Soil Walls- Testing requirements for Reinforced Soil Retaining Walls- Design of Gabions. 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. GEOSYNTHETICS FOR LANDFILLS Geosynthetics for construction of municipal waste landfills-Geosynthetics for construction of hazardous waste landfills
Text books	[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.
Reference books	[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.
E-resources and other digital material	https://nptel.ac.in/courses/105/101/105101143/[J. N. Mandal, Geosynthetics Engineering]

23CEH7801B	INTELLIGENT TRANSPORTATION SYSTEMS

Course Category:	**Honors**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture - Tutorial - Practice:**	**3 - 0– 0**
Prerequisites:	**23CE6302 Transportation 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:	
	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	PSO 1	PSO 2
	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", 1st ed, CRC Press, Boca Raton, 2000. [T2] Sussman. J, "Perspective on Intelligent Transport System ITS", 1st 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)" 1st 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/

23CEH7801C	ENVIRONMENTAL IMPACT ASSESSMENT

Course Category:	**Honours**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture - Tutorial - Practice:**	**3 - 0- 0**
Prerequisites:	**23MC3107B – 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:													
	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 (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	3					2						1		2
	CO2	3	2							3					2
	CO3	3	2										1		2
	CO4						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 the assessment of soil and groundwater - Delineation of study area - Identification of activities. 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.
	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. 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.
	UNIT – IV ENVIRONMENTAL ACTS Post audit activities - The Environmental protection act - The water act - The air act - Wild life act. CASE STUDIES Case studies and preparation of environmental impact assessment statement for various industries.
Text books	[T1] Anjaneyulu, VallManickam, "Environmental Impact Assessment Methodologies", 2nd Edition ,B.S. Publications, 2007. [T2] Glynn. J, and Gary W. Heinke, "Environmental Science and Engineering", PHI, NDLS, 1996.
Reference books	[R1] Barthwal, R. R., "Environmental Impact Assessment", New Age International Publications [R2] Dhameja,S.K., Environmental Engineering and Management, Kataria, NDLS, 2010. [R3] Bhatia,H.S., A Text Book of Environmental Pollution and Control, Galgotia NDLS, 2003.
E-resources and other digital material	https://nptel.ac.in/courses/120/108/120108004/

23CEH6802B1	**NPTEL Mandatory(Course Based on Availability)**

23CE5301 WATER RESOURCES ENGINEERING

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 irrigation methods, crop water requirements, and water assessment.
	CO2	Understand hydrologic processes, runoff, unit hydrographs, and well irrigation.
	CO3	Design irrigation channels, analyze waterlogging, and apply canal lining.
	CO4	Evaluate reservoir capacity and summarize various types of hydraulic 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	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	3						2			1				
CO2	3		2	2									2	
CO3	3		2	2									3	
CO4	3		3		2		2			1			3	

Course Content

UNIT – I

1. 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 method; Contour Farming; Sub-surface irrigation; Sprinkler Irrigation; Drip irrigation.

2. WATER REQUIREMENT OF CROPS:

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.

UNIT – II

3. HYDROLOGY:

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 **4. WELL IRRIGATION:** 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. **UNIT-III** **5. IRRIGATION CHANNELS – SILT THEORIES & DESIGN PROCEDURE:** 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 6. **WATERLOGGING, CANAL LINING** Waterlogging, causes, effects and remedial measures. Lining of Irrigation canals, Types of lining; Design of lined canal **UNIT-IV** **7. DAMS IN GENERAL:** 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. **8. RESERVOIR PLANNING:** 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 from the mass inflow curve; Determination of safe yield from a reservoir of a given capacity; Life of reservoir.
Text books	1. B.C. Punmia, Pande B.B. Lal, Ashok Kumar Jain, Arun Kumar Jain – Irrigation and Water Power Engineering, Laxmi Publications, 2016 2. S.K. Garg – Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 2019 3. K. Subramanya – Engineering Hydrology, Tata McGraw-Hill, 2013 4. Jain, Reddy, & Sharma – Water Resources Engineering, New Age International, 2017
Reference books	1. Linsley, R.K., Franzini, J.B., Freyberg, D.L. & Tchobanoglous, G. – Water Resources Engineering, McGraw-Hill, 1992 2. David Keith Todd & Larry W. Mays – Groundwater Hydrology, Wiley India, 2004 3. S.K. Garg – Hydrology and Water Resources Engineering, Khanna Publishers, 2019

E-resources and other digital material	www.nptel.ac.in/couses/105104103

23CE5302 ENVIRONMENTAL ENGINEERING

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0- 2
Prerequisites:	23BS1102A – Engineering Chemistry 23MC3107B – 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:	
	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)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	1			2		1				1		1		1
CO2	3		2	3		2	2		1	2			1	1
CO3	2	2				1			1			1	2	
CO4	3	2	3	3		3	2			1		1	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.

Laboratory tests:

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.

UNIT II

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. **DISTRIBUTION SYSTEMS** Methods of supply; Layouts; Distribution reservoirs; Capacity of balancing tank; Methods of analysis of distribution systems, Plumbing-pipes and fittings; Traps; One pipe and Two pipe systems. Laboratory tests: 4. Determination of acidity of water sample. 5. Determination of turbidity of water sample. 6. Determination of optimum dose of coagulant. **UNIT III** **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, sewer appurtenances types. **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. Laboratory tests: 7. Determination of temporary and permanent hardness of water sample. 8. Determination of chloride concentration of water sample. 9. Determination of sulphate content in a given water sample. **UNIT – IV** **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. **SEWAGE DISPOSAL** Methods; Disposal by dilution; Self-purification process; Oxygen sag; Zones of pollution of river; Disposal by irrigation. Laboratory tests: 10. Determination of dissolved oxygen of water sample. 11. Determination of biochemical oxygen demand (BOD) of waste water. 12. Determination of chemical oxygen demand (COD) of waste water.
Text books	[1] Duggal K.N., "Elements of public health engineering", S. Chand & Company Ltd., New Delhi, 2014. [2] Birdie G.S. and Birdie J. S., "Water Supply and Sanitary Engineering", 9th ed., Dhanpat Rai Publishing Company, New Delhi, 2015.

Reference books	[1] Garg S. K., "Environmental Engineering Vol. I& II- Water supply engineering", Khanna Publishers, New Delhi, 2017. [2] Gurucharan Singh, "Water Supply and Sanitary Engineering", Standard Publishers Distributors, Delhi, 2009. [3] CPHEEO and Ministry of Urban Development, "Manual on Water Supply & Treatment", Govt. of India, New Delhi,2005.
E-resources and other digital material	[1] www. https://nptel.ac.in/courses/103107084 - Environmental Engineering, Dr. V. C. Srivastava, IIT, Roorkee – [2] www nptel.ac.in/courses/105105048 - Wastewater management, Dr. M. M. Ghangrekar, IIT, Kharagpur

23CE5303 Design of Concrete Structures

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	23CE3308 Concrete Technology	**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 for a section for R.C. beams
	CO2	evaluate a section for R.C. flanged beam & R.C slabs
	CO3	analyse 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	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	2		3		3		1		2	1			3	
CO2	2		3		3		1		2	1			3	
CO3	2		3		3		1		2	1			3	
CO4	2		3		3		1		2	1			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.

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.

UNIT II:
DESIGN OF FLANGED BEAM (IS456-2000)
T-Beams introduction, Analysis and Design of singly reinforced flanged sections

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). **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. **DESIGN OF COLUMNS FOR COMBINED ACTION (IS456-2000)** Design of short columns subjected to combined axial load and uniaxial Moment. **UNIT – IV** **Classification of foundations;** Different types of shallow foundations and deep foundations. General aspects of footings. **DESIGN OF ISOLATED FOOTING (IS456-2000)**. Design and detailing of Isolated Column footings.
Text books	Shah H.J., "Reinforced Concrete Vol-1", 11th ed., Charotar Publication House , Gujarat , 2016. Jain A.K, "Reinforced Concrete (Limit State Design)", 7th ed Nem Chand & Bros., Roorkee Uttarakhand, 2012.
Reference books	Varghese P.C, "Limit state designed of reinforced concrete", 2nd et. Printice Hall of India; New Delhi, 2004. ArtherH.Nilson, "Design of concrete structures", 1st ed., Tata McGraw-Hill Publishing Co. Ltd, New Delhi, 2017. IS 456-2000 PLAIN AND REINFORCED CONCRETE CODE OF PRACTICE
E-resources and other digital material	www.nptel.ac.in/courses/105105105 (Dr.Dhang. N, IIT/ Kharagpur – Design of Reinforced Concrete Structures) www.nptel.ac.in/courses/105105104 (Dr. J.N. Bandopadhyay, IIT/ Kharagpur – Design of Reinforced Concrete Structures)

23CE5404/A ADVANCED STRUCTURAL ANALYSIS

Course Category:	Programme Elective-I	**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	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1										3	
CO2	3	3	1										3	
CO3	3	3	1										3	
CO4	2	2	1										3	

Course Content

UNIT I:UNIT – I

ARCHES

Eddy's Theorem; Analysis of three hinged and two hinged Parabolic and Circular arches for Static loads.

CABLES

Analysisofcablesunderuniformlydistributedandconcentratedloads;Shape of the cable under self - weight; Effect of temperature changes in suspension cables.

UNIT II:

MATRIX METHODS OF ANALYSIS

Static Indeterminacy; Matrix Methods; Flexibility and Stiffness; Flexibility Matrix; Stiffness Matrix; Relationship between Flexibility and Stiffness Matrix.

FLEXIBILITY METHOD (FORCE METHOD)

Analysis of continuous beams and rigid jointed plane frames (Single bay, single storey with vertical legs only) by flexibility method.

	UNIT III: **STIFFNESS METHOD (DISPLACEMENT METHOD)** Notations, Kinematic Indeterminacy, Generating Stiffness Matrices and analysis of continuous beams by Stiffness method. **STIFFNESS METHOD FOR PORTAL FRAMES** Analysis of rigid Jointed frames by stiffness method with matrix approach. **UNIT – IV:** **PLASTICANALYSISOFSTRUCTURES** 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. **FINITEELEMENTANALYSIS** 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.
Text books	[T1] Structural Analysis–Amatrix approach by Pandit. G.S&Gupta. S.P, Tata Mc.Graw Hill Publishing Co.Ltd. New Delhi, 2008. [T2] Basic Structural Analysis by Reddy. C. S, Mc Graw Hill Education, 3rd Edition, 2010. [T3] Finite Element Analysis–Theory and Programming by Krishna Murthy. C.S, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2013.
Reference books	[R1] Analysis of structuresVol.2 by Prof Vazirani. V. N, Ratwani. M. M, Duggal. Sk, 16th Edition, Khanna Publishers, New Delhi, 2016. [R2] Indeterminate Structural Analysis by Wang. C. K, 5th Edn Mc Graw Hill Education, New Delhi, 2014.
E-resources and other digital material	http://onlinecourses.nptel.ac.in/courses/105106050

23CE5404/B Town planning & Architecture

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	Analyze the principle of architecture by understanding History.
CO2	Understand basics of Landscape Design and urban infrastructure systems.
CO3	Apply the principle of urban design.
CO4	Apply the techniques used in planning of urban infrastructure systems.

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	PO 11	PO 12	PSO 1	PSO 2
CO1	1				1	1								
CO2	1				1	1							1	
CO3	1				1	1								
CO4	1				1	1							1	

Course Content

UNIT I:

1.0 HISTORY OF ARCHITECTURE:

Indian – Indus valley, Vedic, Buddhist, Indo-Aryan, Dravidian and
Mughal periods: European – Egyptian, Greek, Roman, medieval and renaissance periods construction and Architectural styles; vernacular and traditional architecture. Principles of Architecture.

2.0 ENVIRONMENTAL STUDIES IN BUILDING SCIENCE:

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

UNIT II:

3.0 LANDSCAPE DESIGN:

Principles of landscape design and site planning; history of landscape styles; landscape elements and materials.

	4.0 Urban Infrastructure, Services and Amenities: Green building rating system-GRIHA and LEED Basic understanding of sustainable Development, green infrastructure; urban rainwater harvesting; power supply and communication systems -- guidelines; **UNIT III:** **5.0 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. **6.0 CITY PLANNING:** Evolution of cities; principles of city planning; planning regulations, Development controls – FAR, densities and building byelaws; sustainable development. **UNIT – IV** **7.0 TECHNIQUES OF PLANNING:** 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. **8.0 CONCEPTS OF CITY MASTER PLANNING AND SATELLITE TOWNS** Definition importance, feature-Various phases in the preparation of master plan and satellite towns-advantages-Examples -Hyderabad master plan and Noida satellite town.
Text books	[T1] N. V Modak and V.N Ambdekar, Town and country planning and housing, Orient Longman Ltd. [T2] Brown, P. Indian Architecture (Buddhist and Hindu period), Taraporevala , CSTM, 2015. [T3] Bandopadhyay, A. Text book of Town Planning, Books and Allied, HRH, 2000
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.
E-resources and other digital material	E1: https://nptel.ac.in/courses/124/105/124105001/ E2: https://nptel.ac.in/courses/124/105/124105004/ www.european-science.com

23CE5404/C AIR POLLUTION AND CONTROL

Course Category:	Program Elective - 1	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	23MC3107B – 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	identify the various types of air pollutants and their effects
	CO2	understand the dispersion phenomenon of air pollutants with regard to meteorological parameters
	CO3	evaluate the sampling of pollutants from chimney stacks and ambient atmosphere
	CO4	analyze various types of air pollution controlling equipment

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	PO 11	PO 12	PSO 1	PSO 2
CO1	3													2
CO2	3													2
CO3	3	3		1										2
CO4	3		3	1		1	1							2

Course Content

UNIT I

INTRODUCTION TO AIR POLLUTION

Composition of air, Air pollution-definition, Prominent air pollution disasters or episodes, Sources of air pollution, Stationary and mobile sources.

CLASSIFICATION AND EFFECTS OF AIR POLLUTION

Classification of air pollutants - Natural Contaminants; Particulate Matter, Aerosols and Gaseous pollutants; Primary and secondary pollutants, Effects of air pollutants on human health; Effects on plants and economic effects.

UNIT II

METEOROLOGY AND AIR POLLUTION

Meteorological factors influencing dispersion of air pollutants; Wind direction and wind speed, Atmospheric stability, temperature inversions, Mixing height, precipitation and humidity.

MEASUREMENT OF METEOROLOGICAL PARAMETERS

	Wind direction recorder, Wind speed recorder, Humidity Measurement, Temperature measurement; Wind Rose diagram; Plume behavior. **UNIT III** **STACK SAMPLING** Stack sampler; Sampling Procedure, Sampling point, size, Isokinetic Conditions, sampling of Particulate matter and Gases. **AMBIENT AIR SAMPLING** Sampling methods- Sedimentation, filtration, impingement methods, electrostatic precipitation and thermal precipitation. Sampling suspended particulates by high volume sampler. Sampling SO2 and NOx and Carbon Monoxide gases. Indian standard methods of analysis of SO2 and NOx gases Air Quality and Emission standards. **UNIT – IV** **METHODS OF CONTROLLING AIR POLLUTION** Measures to control air pollutants in atmosphere, Control of Particulate matter by equipments – Settling chamber, inertial separators, fabric filters, wet scrubbers, Electrostatic Precipitators. **CONTROL OF GASEOUS POLLUTANTS** Controlling methods of Gaseous Emissions - combustion, adsorption, absorption, closed collections and recovery systems - Control of SO_2 and NO_x gases.
Text books	[1] Rao M. N. and Rao H. N., "Air Pollution and Control", Tata McGraw Hill, NDLS,2007. [2] Suresh S. K., "Environmental Engineering and Management", 2nd ed., Kartarai& Sons, 2005.
Reference books	[1] Trivedi R. K., "An Introduction to Air pollution", B.S. Publications, 2005. [2] Wark and Warner, "Air pollution", Addison-Wesley, NDLS, 2010.
E-resources and other digital material	[1]www.http://nptel.ac.in/courses/webcourse-contents/ ITdelhi/Environmental%20Air%20Pollution/

23CE5404/D ENVIRONMENTAL GEOTECHNOLOGY

Course Category:	Program 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 fundamental principles of environmental geotechnology to real-world scenarios.
	CO2	Utilize key concepts to design various components of waste containment facilities.
	CO3	Assess and implement remediation strategies for contaminated sites.
	CO4	Analyze and explore geotechnical applications for waste reuse.

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	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 and scope of Environmental Geotechnology
- Sources and types of contaminants
- Impact of subsurface contamination

SOURCES AND CHARACTERISTICS OF WASTES

- Waste characterization and its environmental concerns
- Waste management strategies
- Engineered waste disposal facilities

	UNIT-II: SOIL-WATER INTERACTION • Soil mineralogy characterization and its role in soil behaviour • Soil-water interaction and double-layer concepts • Forces of interaction between soil particles **CONTAMINANT TRANSPORT** • Soil-water-contaminant interactions and their implications • Factors affecting contaminant retention and transport **UNIT-III: CONTAMINATED SITE ASSESSMENT** • Need for site characterization • Characterization methods: Electromagnetic resistivity, ground-penetrating radar, electrochemical and electro-optical sensing methods **CONTAINMENT FACILITY** • Principles and concept of waste containment • Site selection criteria for containment facilities • Components and design of waste containment systems **UNIT-IV: CONTAMINATED SITE REMEDIATION** • Methods for subsurface contamination remediation • Selection and planning of remediation techniques • Bio-remediation, incineration, soil washing, electro-kinetics, and soil heating **RECYCLING AND REUSE** • Geotechnical reuse of waste materials • Waste characteristics for soil replacement • Suitability of waste materials for geotechnical construction
Text books	**[T1]**Gulhati, S.K. and Datta, M., Geotechnical Engineering, McGraw Hill India, New Delhi, 2005. **[T2]** Sharma, H.D. and Reddy, K.R., Geoenvironmental Engineering, John Wiley, NY, USA, 2004.
Reference books	**[R1]** Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic, Netherlands, 2001. **[R2]** Reddy, L.N. and Inyang, H.I., Geoenvironmental Engineering: Principles and Applications, CRC Press, FL, USA, 2000. **[R3]** Mohamed, A.M.O. and Antia, H.E., Geoenvironmental Engineering, Elsevier, Netherlands, 1998.
E-resources and other digital material	https://nptel.ac.in/courses/105102160/ https://nptel.ac.in/courses/105103025/

23CE5205 GEOSPATIAL TECHNOLOGIES

Course Category:	Open Elective	**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	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	Understand large scale maps 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	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1					3				1	2		1		
CO2					3	3			1	2		1		
CO3					3				1	2		1		
CO4		3												3

Course Content

UNIT I

INTRODUCTION TO GIS

Introduction to GIS, History of GIS, Early developments in GIS, Applications of GIS

MAP AND MAP SCALES

Introduction to Maps, History of Maps, Map Scales, Types of Maps, Map and Globe

UNIT II

GEOREFERENCING AND PROJECTION

Understanding Earth ,Coordinate System, Map Projection, Transformation, Georeferencing

SPATIAL DATABASE MANAGEMENT SYSTEMS

Introduction, Data Storage, Database Structure Models, Database Management system, Entity Relationship.

	UNIT III **DATA MODELS AND DATA STRUCTURES** Introduction, GIS Data Model, Vector Data Structure, Raster Data structure ,Geo database and metadata. **SPATIAL DATA INPUT AND EDITING** Primary Data, Secondary Data, Data Editing, Data types – Spatial and Non Spatial (attribute) data. **UNIT IV** **MODELLING IN GIS:** Introduction to Web GIS, Digital Terrain Modelling, Digital Elevation Modelling, Triangular Irregular Network. **APPLICATIONS OF GIS:** Multidisciplinary applications of GIS.
Text books	[1]. Anji Reddy M., Remote Sensing & Geographical Information Systems by, BPS Publications-Hyderabad,4th edition 2011. [2]. Basudeb Bhatta., Remote Sensing & GIS, Oxford University Press, New Delhi 2011
Reference books	[1]. Lillesand TM ., Kiefer RW., Remote sensing and Image interpretation ; John Willey and sons.7th edition, 2015 [2]. Chandra AM ., Ghosh SK Remote sensing and Geographical information System ;Narosa Publishing House, Second Edition New Delhi,2015
E-resources and other digital material	**NPTEL: https://nptel.ac.in/courses/105/102/105102015**

23CE5205/B - BUILDING SERVICES ENGINEERING

Course Category:	Open Elective	**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 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	PO10	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.

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: Staircases, doors and windows - Guidelines for staircase planning; Guidelines for selecting doors and windows.

UNIT II:

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 be caused by Air Conditioning systems.

THERMAL INSULATION:

Heat transfer: Thermal Insulating Materials; Thermal Insulation Methods; Insulation of Walls,

	Roofs, Doors & Windows. **UNIT III:** **PLUMBING SERVICES:** Types of plumbing; Plumbing fittings and accessories; Water Meters; Drainage – Sanitary Fittings: Bathtubs, wash basins, sinks, flushing cisterns, water closets; Principles governing design of building drainage; Guidelines for laying of Gas supply systems. **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. **UNIT – IV** **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, Firefighting pump; Dry risers and wet risers, Automatic sprinklers. **ANTI-TERMITE TREATMENT:** Preconstruction treatment, Post construction treatment; Construction of anti-termite groove in buildings for termite prevention.
Text books	**[T1]:** Building Construction by B. C. Punmia; Ashok Kumar Jain; Arun Kumar Jain, 2005; Laxmi Publications, New Delhi **[T2]:** Building Construction by Janardhan Jha; S.K. Sinha; 2007; Jain Book Agency, New Delhi.
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/

23CE5351 Computer Applications in Civil Engineering Lab1

Course Category:	Program Core	**Credits:**	1.5
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 3
Prerequisites:	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	determine the cross-sectional, reinforcement requirements and create structural drawings for various elements using AutoCAD.
	CO2	apply Microsoft Excel to develop spread sheets/Mat Lab to solve 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	PO10	PO 11	PO 12	PSO 1	PSO 2
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)
7. R.C.C Beam-Column joint
8. Isolated and Combined footing

PART-B:PROGRAMMING

Students are required to write & execute the programs using Microsoft Excel language

1. Design of singly reinforced beam for flexure by LSM.
2. Design of doubly reinforced beam for flexure by LSM.
3. Design of R.C.C column of rectangular section for axial load by LSM

Text books	[T1] Venugopal. K, "Engineering Drawing and Graphics and AUTOCAD", 1st ed., New Age International Publishers, 2001. [T2] Anand R. K."Computer Application in Civil Engineering", 1st ed.,Vayu education of India, New Delhi, 2013. [T3] Dr. Ritu Agarwal & Khushbu Naruka Dr. Hari Singh Parihar, "Computer Application in Civil Engineering ", 1st ed., Neelkanth Publishers, 2012.
Reference books	[R1] Jeyapoovan. T, "Engineering Graphics using AUTOCAD", 1st ed.,Vikas Publishing House Pvt. Ltd., 2000.
E-resources and other digital material	----

23CE5352 ADVANCED SURVEYING LAB

Course Category:	Programme Core	**Credits:**	1.5
Course Type:	Lab 2	**Lecture - Tutorial - Practice:**	0 - 0- 3
Prerequisites:	23CE3304 Surveying & Geomatics	**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	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	2				3					1			1	2
CO2	2				3									2
CO3	2		2		3					1			1	2
CO4	2				3					1				2

Course Content

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.
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	[T1] Duggal S K, "Surveying Volume-1", 2nd ed., Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2004. [T2] Dr. Arora K R, " Surveying Volume-2", 15th ed., Standard Book House, New Delhi, 2018
Reference books	[R1] Satheesh Gopi, Sathi Kumar R, Madhu N, "Advanced Surveying", 2nd ed., Pearson, 2017
E-resources and other digital material	https://nptel.ac.in/courses/105107158

23TP5106 PERSONALITY DEVELOPMENT

20CE5354 ENGINEERING PROJECT IN COMMUNITY SERVICES (EPICS)/ INTERNSHIP

Course Category:	Internship/ Project(6weeks)	**Credits:**	2.0
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0 - 0- 4
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 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 presentations kills
	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

(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	PO 11	PO 12	PSO 1	PSO 2
CO1	2			2	2	3	3	2	3	3				1
CO2														
CO3	2			2	2	3	3	2	3	3				1
CO4														

Course Content

Engineering Project In Community Services (EPICS):

- 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.

Text books

Reference books	
E-resources and other digital material	

23CE5607 BUILDING INFORMATION MODELING (BIM)

Course Category:	Skill Oriented Course -2	**Credits:**	1
Course Type:	Lab	**Lecture - Tutorial - Practice:**	0 - 0- 2
Prerequisites:	23CE4651 - Autodesk, Rivet and Excel for Engineers	**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 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	PO10	PO 11	PO 12	PSO 1	PSO 2
	CO1			2		3				3	3	3		2	
	CO2			2		3				3	3	3		2	
Course Content	1. Modeling of Architectural Components for a structure using Revit Architecture. 2. Modeling of Structural Components for a structure using Revit Structures. 3. Modeling 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	[T1] Auto desk Rivet structures manual. [T2] Exploring Autodesk Revit 2020 for structures, 10th edition, by Prof. Sham Tickoo, Purdue University Northwest, USA. [T3] Commercial Design using Autodesk Revit Architecture 2015, Daniel John Stine, SDC													

	Publications ISBN #: 978-1-58503-512-0
Reference books	[R1] Autodesk Revit 2021 Structure Fundamentals by By ASCENT publications Published August 10, 2020, ISBN: 978-1-63057-358-4 | ISBN 10: 1630573582
E-resources and other digital material	https://www.coursera.org/learn/autodesk-revit-for-structural-design-exam-prep

23MC5108B MANDATORY COURSE

23CE6301 DESIGN OF STEEL STRUCTURES

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	Analyze the adequacy of bolted& welded connections
	CO2	Evaluate the adequacy of laterally supported and unsupported steel beams
	CO3	Analyze the adequacy of bolted & welded connections in tension and compression members.
	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	PO10	PO 11	PO 12	PSO 1	PSO 2
	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:

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. **UNIT III:** **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. **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. **UNIT – IV** **COLUMN BASE (IS800-2007)** Introduction to column bases and gusseted base, types of column bases. Allowable stress in Bearing. **SLAB BASE** Design of slab base with bolted and welded connections
Text books	[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.
Reference books	[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.
E-resources and other digital material	https://nptel.ac.in/courses/105105162. https://nptel.ac.in/courses/105106112.

23CE6302 TRANSPORTATION ENGINEERING

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 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 the best alternative route for highways
	CO2	Apply the studies to regulate traffic control and management
	CO3	Evaluate geometrics of highway elements and pavement layers
	CO4	Experiment and Analyse Pavement materials

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	PO 11	PO 12	PSO 1	PSO 2
CO1	3		3											
CO2				3		1								3
CO3	3	3	3										3	
CO4	2		3	3			2		3	3				3

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.

PAVEMENT MATERIALS

Aggregates and their characterization, Bituminous materials, desirable properties and tests on Aggregates and Bituminous materials, aggregate blending concepts, Marshal Stability Test

Practice:

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.

UNIT II:

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,

HIGHWAY VERTICAL ALIGNMENT

Design of Vertical Alignment, Grades and Grade Compensation.

Practice:

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

UNIT III:

TRAFFIC STUDIES

Introduction, Road User Characteristics, Vehicle Characteristics, Traffic Volume Studies objectives, methods, presentation of data, 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.

DESIGN OF TRAFFIC CONTROL DEVICES

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.

Practice:

7. Traffic volume study at mid block section
8. Traffic volume study at intersection
9. Speed studies

UNIT – IV:
DESIGN OF FLEXIBLE PAVEMENTS

Types of Pavement Structures, Design Factors, Design of Flexible Pavements- IRC Method using code IRC-37

DESIGN OF RIGID PAVEMENT

Design of Rigid Pavement- Wheel Load stresses, Temperature Stresses, Frictional Stresses. Using code IRC-58

	Practice: 10.Determine the grade of bitumen using different methods (penetration test and viscosity test) 11.Perform different tests on bitumen and discuss the suitability of bitumen in flexible pavement construction. 12. Determine CBR of soil sample.
Text books	**Text Books for Theory** [1].Khanna, S. K., Justo, C. E. G., Veeraragavan, A." Highway Engineering Revised 10th Edition Nem Chand Bros . Roorkee 2017. [2]. Kadyali, L R "Principles and Practices of Highway Engineering", Khanna Publishers, New Delhi, 2004.
Reference books	[1].Principles of Transportation Engineering by Partha Chakraborthy & Animesh Das; PHI Learning Pvt. Ltd.; New Delhi, Second edition 2017 [2].Ministry of Road Transport and Highways- Specifications for Roads and Bridge Works, Fifth Revision, IRC, New Delhi, India-2013 [3].IRC 37:2012- Guidelines for the design of flexible pavements (Third Revision) [4].IRC58-2015 Guidelines for the Design of Plain Jointed Rigid Pavements for Highway [5] 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://nptel.ac.in/downloads/105101087/ https://nptel.ac.in/courses/105105107/

23CE6403/A Advanced Design of concrete structures

Course Category:	Program Elective2	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	23CE5303 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:													
	CO1	evaluate sectional details for staircase and flat slab.												
	CO2	analyse for safe for foundation and retaining wall.												
	CO3	evaluate safe section for water tanks												
	CO4	analyse 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	PS O1	PS O2
	CO1	3		2		1		2		1	2			3	
	CO2	3		2		1		2		1	2			3	
	CO3	3		2		1		2		1	2			3	
	CO4	3		2		1		2		1	2			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. **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. **UNIT – IV** **DESIGN OF COMPOSITE STRUCURES** 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
Text books	S. Ramamrutham and R. Narayan, "Design of Reinforced Concrete Structures", 15th ed., Dhanpat Rai Publishing Co. Pvt. Ltd., New Delhi, 2010. B.C. Punmia, Ashok Kumar Jain, and Arun Kumar Jain, "Limit State Design of Reinforced Concrete", 1st ed., Laxmi Publications, New Delhi, 2007. B.C. Punmia, Ashok Kumar Jain, and Arun Kumar Jain, "Reinforced Concrete Structures", 5th ed., Laxmi Publications, New Delhi, 2010.
Reference books	V.L. Shah and S.R. Karve, "Limit State Theory and Design of Reinforced Concrete", 9th ed., Structures Publications, Pune, 2023. Kim S. Elliott, "Precast Concrete Structures", 2nd ed., CRC Press, Boca Raton, 2017. Kim S. Elliott and Colin Jolly, "Multi-Storey Precast Concrete Framed Structures", 2nd ed., Wiley-Blackwell, Chichester, 2013. **Codes of Practice:** IS 456:2000- Code of Practice for Plain and Reinforced Concrete SP16 – Design aids of IS 456:2000 IS 13920 (1993) Ductile Designing of Reinforced Concrete Structures subjected to Seismic Forces.
E-resources and other digital material	www.nptel.ac.in/courses/105105105 (Dr.N.Dhang, IIT/ Kharagpur – Design of Reinforced Concrete Structures) www.nptel.ac.in/courses/105105104(Dr. J.N. Bandopadhyay, IIT/ Kharagpur – Design of Reinforced Concrete Structures)

23CE6403/B ADVANCED ENVIRONMENTAL ENGINEERING

Course Category:	Programme Elective -II	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	23MC3107B – Environmental Studies 23CE5302- Environmental 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:	
	CO1	evaluate the protection of water bodies against contamination on disposal of waste water.
	CO2	apply new concepts of wastewater treatment and 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 air pollutants, 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	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	3		1									1		
CO2	3		3				2							2
CO3	3		2			2	1							3
CO4	1					2	1					1		

Course Content

UNIT I

STREAM SANITATION

Characteristics of the treatment plant effluents: Patterns 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 WASTEWATER TREATMENT SYSTEMS

Introduction, Biological kinetics of waste water, Stabilization ponds. Aerated lagoons, Oxidation ditch, Extended aeration process.

UNIT II

INDUSTRIAL WASTEWATER TREATMENT: SUGAR PLANT AND DAIRY

Introduction, Characteristics and treatment of industrial effluents. Difference between Industrial wastewater and Domestic wastewater. Sugar and Dairy Industry; Quantity of liquid waste; characteristics of liquid waste. Processing and Manufacturing Units, Methods of its treatment and disposal.

	PULP AND PAPER INDUSTRY Quantity of liquid waste; characteristics of liquid waste. Processing and Manufacturing Units, Methods of its treatment and disposal. **UNIT III** **NEW CONCEPTS IN BIOLOGICAL WASTEWATER 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. **UNIT – IV** **METEOROLOGY AND CONTROL OF AIR POLLUTION BY EQUIPMENT:** Atmospheric stability and temperature in versions; 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.
Text books	[1] Garg S. K., "Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2017. [2] A. D. Patwardhan, "Industrial Wastewater Treatment", Prentice hall of India, 2008. [3] M. N. Rao, A. K. Datta, "Wastewater treatment", Oxford and IBH, third edition. [4] M. N. Rao, H. V. N. Rao, " Air pollution", Tata Magraw hill, 2009
Reference books	[1] An Introduction to Air pollution by Trivedi, R.K., B.S.Publications, 2005 [2] Air pollution by Wark and Warner, Addison-Wesley Publications, 1998. [3] Environmental engineering and management, (2nd Edition) Suresh, Kartarai S. K. & Sons 2005. [4] Metcalf & Eddy, Wastewater engineering Treatment disposal reuse, Tata McGraw Hill.
E-resources and other digital material	[1] http://nptel.ac.in/courses/webcourse-contents/IIT- delhi Environmental Air Pollution/

23CE6403/C RAILWAY AND TUNNEL ENGINEERING

Course Category:	Program Elective	**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	understand the components of the Railway Track
	CO2	Apply geometric design principles to railway tracks and understand points, crossings, and signaling systems.
	CO3	Demonstrate the general aspects of tunneling, construction stages and essential safety measures in tunneling.
	CO4	Apply knowledge of tunneling methods for different soil and rock conditions and understand the process and materials used in tunnel lining.

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	PO 11	PO 12	PSO 1	PSO 2
CO1	3													3
CO2	3	3	2										3	
CO3	3	2				2								2
CO4	3		2				3							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 **POINTS AND CROSSINGS & SIGNALLING** Turnouts components and its working principle, Classification of signals, Classification of stations and yards **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, problems in tunneling. **STAGES IN TUNNEL CONSTRUCTION** Investigations at tunnel site, setting out of tunnel, excavation, safety precautions in tunneling **UNIT – IV** **TUNNELLING METHODS FOR SOFT SOIL** Methods of tunneling – for soft soil (American method, English method, Belgian method & Liner plates method) **TUNNELLING METHODS FOR ROCK** Methods of tunneling – for rock(drift method, heading and bench method, cantilever car dump method), objectives of lining, materials for lining
Text books	[1] Saxena, S.C. and Arora. S, "Railway Engineering", Dhanpat Rai Publications, NDLS, 2009. [2] Srinivasan, R "Harbour Dock and Tunnel Engineering", 29th ed., Charotar Publishing House Pvt Ltd, Anand, 2018.
Reference books	[1] Agarwal.MM, Satish Chandra, "Railway Engineering", 2nd ed., Oxford University Press; New Delhi, 2013.
E-resources and other digital material	[1] Prof Rajat Rastogi, IIT/Roorke – Transportation Engineering II– "https://archive.nptel.ac.in/courses/105/107/105107123/"

23CE6403/D PLUMBING - WATER AND SANITATION

Course Category:	Program Core	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 2
Prerequisites:	**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	Select proper plumbing materials and systems.
	CO 2	Supervise code based plumbing installations.
	CO 3	Understand methods to handling water to sewer
	CO 4	Protect health and safety of end users.

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

Course Content

UNIT I:

Water Supply Plumbing:

Storage, hot and cold water distribution system, backflow prevention, air gap, cross connection control, pressure and velocity, pipe materials and jointing methods, alternative materials, hangers and supports, workmanship, prohibited fittings and practices, protection of pipes and structures, pressure controls, unions, thermal expansion, types of valves, installation and testing, disinfection, protection of underground pipes, color codes and arrow marking, introduction to Water Supply Fixture Units (WSFU) and sizing.

Hot water systems, individual and centralized systems, geysers, heaters, heat pumps, energy

	sources, solar hot water systems, types, boilers, hot water generators, hot water consumption pattern, introduction to sizing of systems. **UNIT II:** **Pumping Systems & Codal Provisions** Terminology, pump heads, types of Pumps, applications, pump selection, pump characteristics, pumps and motors, pump efficiency, motor efficiency, Hydro Pneumatic Systems (HPS), Zoning, Storm Water and Drainage Pumps, introduction to starters and control panels. Scope, purpose; codes and standards in the building industry, UIPC-I, NBC and other codes, Local Municipal Laws, approvals, general regulations, standards, water supply, sewerage system, drainage system, workmanship, water conservation, protection of pipes and structures, waterproofing. **UNIT III:** **Sanitary Plumbing Fixtures , Fittings and Traps** Definitions of plumbing fixtures, fittings, appliances and appurtenances; maximum flow rates, water closets, bidets, urinals, flushing devices, washbasins, bath/shower, toilets for differently abled, kitchen sinks, water coolers, drinking fountain, clothes washer, dish washer, mop sink, overflows, strainers, prohibited fixtures, floor drains, floor slopes, location of valves, hot water temperature controls, installation standard dimensions in plan and elevation. Traps required, trap arms, developed length, trap seals, venting to traps, trap primers, prohibited traps, building traps. **UNIT – IV** **Interceptors, Indirect Waste and Vents :** Discharge for indirect waste piping, nature of contents or systems, proper methods to install indirect waste piping, air gap and air break, sink traps, dish washers, drinking fountains, waste receptors, sterile equipment, appliances, condensers, point of discharge, venting. Vent requirement, purpose of venting, trap seal protection, materials, vent connections, flood rim level, termination, vent stacks, water curtain and hydraulic jump, cleanouts, venting of interceptors, introduction to vent sizing. one pipe and two pipe systems, different pipe materials and jointing methods, special joints, hangers and supports, protection of pipes and structures, alternative materials, workmanship, prohibited fittings and practices, hydraulic jump, change in direction of flow, T and Y fittings, cleanouts, pipe grading, fixtures below invert level, suds relief.
Text books	[1]Elements of Water Pollution Control Engineering, O.P. Gupta, Khanna Book Publishing, New Delhi. [2] A Guide to Good Plumbing Practices, a book published by IPA. [3]Water Pollution, Berry, CBS Publishers.
Reference books	[1]Uniform Illustrated Plumbing Code-India (UIPC-I) published by IPA and IAPMO (India) [2] National Building Code (NBC) of India [3]IS 17650 Part 1 and Part 2 for Water Efficient Plumbing Products

	[4]Water Efficient Products-India (WEP-I) published by IPA and IAPMO (India) [5]Water Efficiency and Sanitation Standard (WE.Stand) published by IPA and IAPMO (India)
E-resources and other digital material	https://archive.nptel.ac.in/courses/105/105/105105201/ https://nptel.ac.in/courses/105107207

23CE6404/A ANALYSIS AND DESIGN OF HIGH-RISE BUILDING

Course Category:	Programme Elective III	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 – 0 – 0
Prerequisites:	23CE5303 – 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:	
	CO1	Understand the historical evolution and necessity of tall buildings
	CO2	Evaluate different types of loads and their impact on the design of tall structures
	CO3	Explore various structural systems and their applications in high-rise buildings
	CO4	Apply advanced analysis to ensure the stability and safety of high-rise 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	PSO 2
CO1	1													
CO2	1		1	1									2	
CO3	1		1	1									2	
CO4	1	2	1	1									2	

Course Content

UNIT 1:

INTRODUCTION

History of tall buildings, Need for tall buildings, Factors affecting height, Growth and structural form, Design criteria: Loading, Strength & stability, Stiffness & Drift limitations, Human comfort criteria, Creep, Shrinkage & Temperature effects, Fire, Foundation settlement, and soil structure interaction

UNIT 2:

LOADS

Gravity loading: Dead and Live load calculation, Impact and Construction loads, Wind loading: Static and Dynamic approaches, Earthquake loading: Equivalent lateral force, Modal analysis, Combination of loading in various design philosophies

UNIT 3:

STRUCTURAL SYSTEMS

Structural Forms: Braced-frame, Rigid-frame, Infilled-frame, Shear wall, Wall-frame, Framed-tube,

	Outrigger braced, Core and Hybrid Structures, Introduction to various flooring systems in concrete and steel **UNIT 4:** ANALYSIS & DESIGN Approaches to analysis, Modeling for approximate analysis, modeling for accurate analysis – Plane frames, Plane Shear walls, 3D Frame and wall structures, Stability analysis: overall buckling analysis of frames, overall buckling analysis of wall frames
Text books	[T1] Smith, B. S., & Coull, A., "Tall Building Structures: Analysis and Design". Wiley, 1991. [T2] Taranath, B. S., "Tall Building Design: Steel, Concrete, and Composite Systems", CRC Press, 2016
Reference books	[R1] Chong, K. P., & Leonard, J. W., "Design and Analysis of Tall and Complex Structures", CRC Press, 2008.
E-resources and other digital material	https://www.youtube.com/watch?v=-syqppgcoVE

23CE6404/B SOLID WASTE MANAGEMENT

Course Category:	Program Elective 3	**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 sources and composition of Municipal Solid Waste.
	CO2	Understand methods of collection, separation, transport and disposal of Municipal Solid Waste.
	CO3	Understand the handling methods of Bio-medical waste.
	CO4	Understand the methods of disposal and recycling of plastic and e-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	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	1		1			1	2				1			2
CO2	1		1			1	2				1			2
CO3	1		1			1	2				1			2
CO4	1		1			1	2				1			2

Course Content

UNIT I:

SOURCES, TYPES AND COMPOSITION OF MUNCIPAL 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.

UNIT II:

COLLECTION OF MUNCIPAL SOLID WASTE

Methods of collection, equipment, types of vehicles, man power requirement.

TRANSFER AND TRANSPORT OF MUNCIPAL SOLID WASTE

Need for Transfer operations, Transfer Stations, Selection of Location of Transfer Stations, Transport means and methods.

	UNIT III: **OFF-SITE PROCESSING, SEPARATION,TRANSFORMATION** Size Reduction, Separation, Density separation, Magnetic Separation, Pyrolysis, Composting, and Incineration. **DISPOSAL OF SOLID WASTE** Disposal of Solid Waste – Sanitary land Fills, Site selection, Planning, Design and operation of Sanitary landfills, Leachate collection. **UNIT IV:** **BIO-MEDICAL WASTE MANAGEMENT** Sources & generation of Bio-medical Waste, Biomedical Waste Management. **PLASTIC AND E-WASTE MANAGEMENT** Dangers of Plastics, Recycling of Plastic waste, Disposal of plastic waste. Health Hazards of E-waste, E- waste Management.
Text books	[T1] Goerge,T. Hilary,T. & Samuel, A.V. Integrated Solid waste management, Mc Graw Hill Indian Edition, 2014. [T2] Amalendu,B. Design of Land Fills and Integrated Solid waste management , John Wiley & Sons 3RD Edition, 2004.
Reference books	[R1] CPCB Manual on solid waste Management, NDLS, 2016. [R2] Sasikumar,K. Sanoop,G. Solid waste management, PHI, NDLS, 2009 [R3] Urvashi,D. Solid waste management in India, NDLS, 2014
E-resources and other digital material	https://nptel.ac.in/courses/105103205“ https://www.coursera.org/learn/solid-waste-management#instructors”

23CE6404/C GROUND IMPROVEMENT TECHNIQUES

Course Category:	Program Elective	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 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	Understand need and methods of ground improvement techniques and apply suitable ground improvement technique for a given site													
	CO2	Evaluate the expansively of soils and suggest suitable improvement technique													
	CO3	Apply suitable stabilization method and grouting techniques													
	CO4	Understand various types of geosynthetics and reinforced earth concept													
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	PO 11	PO 12	PSO 1	PSO 2
	CO1	**3**	**2**	**3**		**3**						**3**			**3**
	CO2	**3**		**3**		**3**						**3**			**3**
	CO3	**3**	**2**	**3**								**3**		**2**	**3**
	CO4														

Course Content

UNIT I:

GROUND IMPROVEMENT METHODS IN GRANULAR SOILS

Need of Ground Improvement, Different methods of Ground improvement. In place densification by Dynamic Compaction, Vibroflotation, Compaction pile, Vibro-Compaction Piles and Blasting.

DENSIFICATION METHOD IN COHESIVE SOILS

Introduction, Preloading, Vacuum dewatering, Sand Drains, Stone columns, Prefabricated vertical drains.

UNIT II:

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 Sand cushion, CNS layer, Cushions using industrial by products, stabilization and lime slurry pressure injection. **UNIT – III:** **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. **GROUTING TECHNIQUES** Grouting in soil, Desirable characteristics of grout, Grouting pressure, Grouting methods. **UNIT IV:** **GEOSYNTHETICS** Introduction – Family of geosynthetics, Functions and applications of Geosynthetics, **REINFORCED EARTH** Principle of reinforced earth, Components of reinforced earth, factors governing design of reinforced earth walls, design principles of reinforced earth walls.
Text books	[T1] Hausmann, M.R., Engineering Principles of Ground Modification, McGraw-Hill International Editions, NY, US, 1990. [T2] Purushothama Raj, P., Ground Improvement Techniques, Laxmi Publications, 2007. [T3] Gopal Ranjan and Rao, A.S. R., Basic and applied soil mechanics, New Age Publishers, 2011.
Reference books	[R1] Chattopadhyay, B. C. and Maity, J., Ground Control and Improvement Techniques, PEEDOT, HWH, 2011. [R2] Korner, R. M., Design with Geosynthetics, Prentice Hall, NJ, US, 2002.
E-resources and other digital material	https://nptel.ac.in/courses/105108075/

23CE36404D URBAN TRANSPORT PLANNING

Course Category:	Program Elective	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	**23CE6302**	**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 various stages in transport Planning Process													
	CO2	Apply various methods for data collection													
	CO3	Apply and finalize the route choice and network design													
	CO4	Apply various methods for economic evaluation of transport projects													
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	PO 11	PO 12	PSO 1	PSO 2
	CO1			3											2
	CO2	3	3									3			2
	CO3	3	3	3		3									
	CO4	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

UNIT – II:
TRIP GENERATION

Factors governing trip generation and attraction rates - Multiple linear regression analysis, Category analysis - Critical appraisal of techniques.

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

23CE6205 OPEN ELECTIVE/ JOB ORIENTED ELECTIVE 2 (NPTEL)

23CE6408/A – PREFABRICATED ENGINEERING

Course Category:	Programme Elective	**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:														
	CO1	Understand the design principles and IS code specifications.													
	CO2	analyze and design shear walls.													
	CO3	analyze and design different types of floors and roof slabs.													
	CO4	design industrial 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	P1O	PO 11	PO 12	PSO 1	PSO 2
	CO1	3	2	3						1	1		1		2
	CO2	3	2	3						1	1		1		2
	CO3	2	2	3						1	1		2		2
	CO4	2	2	3						1	1		2		2

Course Content

UNIT I:

INTRODUCTION:
General Civil Engineering requirements, specific requirements for planning and layout of prefabricates plant. IS Code specifications.

DESIGN PRINCIPLES:
Modular coordination, standardization, Disuniting, of Prefabricates, production, transportation, erection, stages of loading and codal provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

UNIT II:

WALLS:
Prefabricated structures, long wall and cross wall large panel buildings, framed buildings with partial and curtain walls, single storey. Types of wall panels, Partition and load bearing walls, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behaviour and design, approximate design of shear walls.

	UNIT III: **FLOORS, STAIRS AND ROOFS:** Types of floor slabs, analysis and design example of cored and panel types and two-way systems, types of roof slabs and insulation requirements, Description of joints, their behaviour and reinforcement requirements, deflection control for short term and long-term loads, ultimate strength calculations in shear and flexure. **UNIT – IV** **DESIGN OF INDUSTRIAL BUILDINGS:** Components of single storey industrial sheds with crane gantry systems, design of R.C. Roof Trusses, roof panels, design of R.C. crane gantry girders, corbels and columns, wind bracing design.
Textbooks	**[T1]:** S. R. Damodara swamy & S. Kavitha, Basics of Dynamics and Aseismic Design, PHI Learning, 2009. **[T2]:** Pankaj Agarwal & Shrikhande, Earthquake resistant Design of Structures, PHI Learning, 2009. **[T3]:** Chopra A.K., "Dynamics of Structures - Theory and Applications to Earthquake Engineering", Second Edition, Pearson Education, 2007
Reference books	**[R1]:** PCI Design Handbook, 6th Edition, 2004. **[R2]:** Handbook on Precast Concrete for Buildings, ICI Bulletin 02, First Edition, 2016 **[R3]:** V. Soundararajan, R. Jagadeesh Kumar, S KalpanaDevi Prefabricated structures ARS publications
E-resources and other digital material	https://www.youtube.com/watch?v=wXNlCrqbOwg

23CE6408/B CONSTRUCTION EQUIPMENT AND AUTOMATION

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3-0-0
Prerequisites:	Building Materials and Construction	**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 feasibility of specific equipment in different project conditions and understand the working principles of equipments for earthwork and other construction activities
	CO2	Understand the procedures of concrete production and procedure of dewatering and grouting
	CO3	Apply the concept and procedure of automation in construction sector
	CO4	Understand the latest techniques of automation in construction sector

Contribution of Course Outcomes towards achievement of Program Outcomes

(L – Low, M - Medium, H – 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	1				3	2	1	3	2	3				1
CO 2	1				3	2	1	3	2	3				2
CO 3	2	2			3	3	1	3	2	3			1	2
CO 4	2	2			3	3	1	3	2	3			1	2

Course Content

UNIT – I

EQUIPMENT FOR EARTHWORK:

Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders, Earth Movers.

OTHER CONSTRUCTION EQUIPMENTS:

Equipment for Dredging, Trenching, Tunneling, Drilling, Blasting - Equipment for Compaction - Erection Equipment - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Foundation and Pile Driving Equipment – Equipment for Demolition, Road making Equipments

UNIT – II

MATERIALS HANDLING EQUIPMENT:

Cranes, Hoists, Forklifts and related equipment - Portable Material Bins – Conveyors – Hauling Equipment, Special concrete for repairs and pumping equipment;

	EQUIPMENT FOR PRODUCTION OF AGGREGATE AND CONCRETING Crushers and crushing Plants, Compressor, Feeders, Screening Equipment, Handling Equipment, Batching and Mixing Equipment, Hauling, Pouring and Pumping Equipment , Transporters.
	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 SYSTEMS** Fire sensors and fire control systems, HVAC components and applications, Access control systems
	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**: Print complex, layered parts and objects of homes, buildings, bridges and roads; Form work mould making;
Text books	[1] Sharma S.C. Construction Equipment and Management, Khanna, NDLS, 1988. [2] Construction Planning, Methods and Equipment, R.L Peurifoy, McGraw Hill, 2011.
Reference books	[1] Varma, M., Construction Equipment and its planning and application, Metropolitan, NDLS, 1983. [2] Automation in Construction Management: Automated management of Construction Materials Using RFID Technology, Javad Majrouhi Sardroud, Scholars' Press. [3] Robotics and Automation in Construction, Open access peer- reviewed edited volume.
E-resources and other digital material	[1] http://buildingsolutions.honeywell.com/en-US/Pages/default.aspx [2] http://www.isa.org [3] https://www.youtube.com/watch?v=T_CMr2KFSd4

23CE6408/C AIRPORT AND HARBOUR PLANNING

Course Category:	Program Elective	**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	Demonstrate knowledge of air transport modes, aircraft characteristics, airport classification and criteria for site selection
	CO2	Analyze airport obstructions and apply design principles to determine runway orientation and basic runway length
	CO3	Apply various methods to design flexible and rigid airfield pavements
	CO4	Demonstrate understanding of the types, features and functional requirements of harbors, ports, and docks.

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	PO 11	PO 12	PSO 1	PSO 2
	CO1	3						2							1
	CO2	3	3	2										3	
	CO3	3	2	3										3	
	CO4	3						3							

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 **UNIT – III** **FLEXIBLE PAVEMENT DESIGN** Various design factors, Design methods for flexible airfield Pavement- CBR Method, Mcleod Method and Burmister's Method **RIGID PAVEMENT DESIGN** Rigid pavement Design- PCA Method; LCN Method of pavement design. **UNIT – IV** **HARBOR AND PORT:** Types of Harbours, Site selection, features of harbor, definitions of break water, wharves, jetties, fender, piles, pier heads, mooring, types of break waters, port definition, requirements of port, facilities at port. **DOCKS:** Types of Docks- dry dock, floating dock, slip way, ship lift, Aprons, transit shed and ware houses
Text books	[1] SK Khanna, MG Arora & SS Jain, "Airport Planning and Design", Nemchand & Bros, Roorkee, 2012. [2] Subash C Saxena, "Airport Engineering: Planning and Design", CBS Publisher, 2012 [3] Srinivasan, R "Harbour Dock and Tunnel Engineering", 29th ed., Charotar Publishing House Pvt Ltd, Anand, 2018.
Reference books	[1] Rangwala, "Airport Engineering", Charotar Publishing House Pvt Ltd, Anand, 2012. [2] Hasmukh P Oza, Gautam H Oza, "Dock and Harbour Engineering", 8th Edition, Charotar Publishing House Pvt Ltd, Anand, 2012
E-resources and other digital material	[1] Prof Rajat Rastogi, IIT/Roorke – Transportation Engineering II– "https://archive.nptel.ac.in/courses/105/107/105107123/"

23CE6408/D IRRIGATION STRUCTURES

Course Category:	Program Core	**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	Understand diversion headworks, weir failures, and canal regulation structures.
	CO2	Understand cross-drainage works and river gauging techniques.
	CO3	Analyze stability and design of gravity dams.
	CO4	Understand earth dams, failure control, and spillways.

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	PO 11	PO 12	PSO 1	PSO 2
CO1													**2**	
CO2	**3**	**3**	**3**		**2**								**2**	
CO3	**3**	**3**	**3**		**2**					**2**			**3**	**3**
CO4										**2**				**2**

Course Content

UNIT – I

1. 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.

2. CANAL REGULATION WORKS:

Canal regulators; Off-take alignment; Head regulators and cross- Regulators; Canal escape.

UNIT – II

3. 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.

	4. RIVER GAUGING: Necessity; Selection of gauging sites; Methods of discharge measurement; Area Velocity method; Measurement of velocity; Floats – Surface floats, Sub–surface float or Double float, Twin float, Velocity rod or Rod float; Pitot tube; Current meter; Measurement of area of flow; Measurement of width - Pivot point method; Measurement of depth – Sounding rod, Echo-sounder. **UNIT – III** **5. STABILITY ANALYSIS OF GRAVITY DAMS:** Introduction; Forces acting on a gravity dam; modes of failure and stability analysis of gravity dams. **6. 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. **UNIT – IV** **7. EARTH DAMS:** Introduction; Types of earth dams; Causes of failure of earth dams and control measures; Criteria for safe design of earth dams; Section of an earth dam; Seepage control measures. **8. 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.
Text books	1. B.C. Punmia, Pande B.B. Lal, Ashok Kumar Jain, Arun Kumar Jain – Irrigation and Water Power Engineering, Laxmi Publications, 2016 2. S.K. Garg – Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 2019
Reference books	1. R.S. Varshney – Irrigation Engineering, Nem Chand & Bros, 2018 2. G.L. Asawa – Irrigation and Water Resources Engineering, New Age International, 2005 3. R.K. Sharma & T.K. Sharma – Irrigation Engineering, S. Chand & Company, 2017
E-resources and other digital material	https://nptel.ac.in/courses/105104103

23CE6351 COMPUTER APPLICATIONS IN CIVIL ENGINEERING LAB-II

Course Category:	Program Core Lab1	**Credits:**	1
Course Type:	Practical	**Lecture - Tutorial - Practice:**	0 - 0- 2
Prerequisites:	23CE5303 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:	
	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	PO10	PO 11	PO 12	PSO 1	PSO 2
	CO1	2		2		3		2		2	1			3	1
	CO2	3		1		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

Gurucharan Singh & Jagdish Singh, "Building Planning, Designing, and Scheduling", Standard Publishers, Delhi, 2019.

	M. Vignesh Kumar, "Structural Modeling, Analysis & Design Using STAAD Pro Software", 1st ed., Lambert Academic Publishing, 2015. Syed Mohd Abid, "ETABS for Beginners: A Comprehensive Guide to Structural Analysis and Design", 1st ed., Independently Published, 2023
Reference books	Krishnan Sathia, "Principles of Structural Analysis – Static and Dynamic Loads", 2nd ed., McGraw Hill, 2018. D. Trevor Jones, "Analysis and Design of Structures - A Practical Guide to Modeling", 1st ed., CRC Press, 2020. Jack Moehle, "Seismic Design of Reinforced Concrete Buildings", 1st ed., McGraw Hill, 2014.
E-resources and other digital material	https://www.bentley.com/en/products/brands/staad – Official STAAD.Pro Learning Resources https://www.csiamerica.com/products/etabs – Official ETABS Learning Resources https://nptel.ac.in/courses/105102201 – Design of Reinforced Concrete Structures

23HS6152 ENGLISH AND COMMUNICATION SKILLS LAB

Course Category:	Skills Enhancement Course	Credits:	1
Course Type:	Lab	Lecture - Tutorial - Practice:	0-0-2
Prerequisites:	Notable level of skill in language proficiency, including listening, speaking, reading, and writing, reaching a semi-advanced level.	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	Relate effective listening and reading skills essential for professional contexts.
	CO2	Demonstrate clear and persuasive spoken communication for argumentation and proficiency in public speaking.
	CO3	Apply sophisticated and creative written communication suitable for administrative and corporate documentation.
	CO4	Analyze comprehensive life skills by adeptly communicating in various personal and professional settings for career and personal growth opportunities.

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
	CO1										H		
	CO2								L	M	H		
	CO3										H		
	CO4									M	H		L

Course Content

1. Reading Comprehension

Understanding Main Idea – Analyzing Supporting Details – Drawing Inferences – Recognizing Text Structure – Critical Reading – Active Reading Strategies.

2. Listening Skills

Active Listening Techniques – Empathetic Listening – Avoiding Distractions – Clarification and Confirmation – Responding Appropriately – Reflective Listening– Note-taking Techniques – Summarizing and Analyzing – Ted Talks.

	3. Relationship Building Assertiveness – Adaptability – Emotional Intelligence – Conflict Management. **4. Professional Presentations** Planning and Preparation – Audience Analysis – Structuring Presentation – Visual Aids and Multimedia – Delivery Techniques – Handling Q&A Sessions – Overcoming Presentation Anxiety. **5. Cover Letter & Resume Writing** Cover Letter – Resume Formatting and Design – Creating a Professional and Eye-Catching Document – Highlighting Achievements – Tailoring Your Resume – Including Relevant Keywords. **6. Video Resume** Introduction – Professional Background – Visual Presentation – Personal Branding – Achievements and Accomplishments – Call to Action – Editing and Production. **7. Statement of Purpose (SOP)** Introduction **–** Educational Background and Training – Subject Matter Expertise – Relevant Skills and Attributes – Research Interests – Fit with the Program – Future Contribution. **8. Book/Film Review** Overview and Summary – Plot Analysis – Cinematography/Writing Style – Acting/Characterization –Themes and Messages – Audience Appeal – Final Thoughts and Recommendation. **9. Kinesics & Para Linguistic Features** Understanding Nonverbal Communication – Body Language – Vocal Cues – Cultural Variations – Emotional Expression – Deception Detection. **10. Life Skills – Poster Presentation** Introduction to Life Skills – Creative Thinking – Critical Thinking – Emotional Intelligence — Communicating Ideas Visually and Effectively.
Text Books	ADVANCED COMMUNICATION SKILLS LAB MANUAL

Reference Books	1. Sanjay Kumar and Pushp Lata. Communication Skills. Oxford University Press, New Delhi, 2011. 2. Nira Konar,English Language Laboratoties.PHI Learning Private Limited, New Delhi, 2011.
E-Resources	Softx & Walden Software

23TP6106 QUANTITATIVE APTITUDE

23CE6554 – MINI PROJECT I

Lecture :	0	Internal Assessment:	30 Marks
Tutorial :	0	Semester End Examination:	70 Marks
Practical :	2 hrs/Week	Credits:	1
Prerequisites:	20CE5354 EPICS		

Course Outcomes	Upon successful completion of the course, the student will be able to	
	CO1	identify the problem statement and define the scope and boundaries of the project.
	CO2	apply theoretical concepts, practical skills learned in the course to develop feasible solutions.
	CO3	prepare a report summarizing the project process, findings, and conclusions ethically - as per guidelines.
	CO4	demonstrate team work effectively with good communication and presentation skills.

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		2	1		2	1	1				1	2	
CO2	2	3	3	3	3	2	1		1			1	3	3
CO3	1	2			1			2		3				1
CO4	1				2				3	3	1		1	

Mini Project I could be done by a group of students; to collaborate under the guidance of a faculty member. The project necessitate conducting an extensive feasibility study , comprehensive literature survey and prepare a detailed project report with findings and conclusions during their VI semester.

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

23MC6107 B TECHNICAL REPORT WRITING AND IPR

Course Category:	Mandatory Course	**Credits:**	0
Course Type:	Theory	**Lecture - Tutorial - Practice:**	2 - 0- 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the significance of Technical Report writing.
	CO2	Develop Proficiency in writing technical reports.
	CO3	Understand the need of Bibliography and references for quality report writing
	CO4	Apply various forms of the intellectual properties for research work.

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	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3		3	1									
CO2	1	3		3	1									
CO3	1	3		3	1									
CO4	1	3		3	1									

Course Content

UNIT I:

Writing scientific and engineering papers

Title, Abstract, Introduction, Materials and Methods, Result, Discussion, Conclusion, References, Acknowledgements, Appendices, Hedging and Criticizing, Paraphrasing and Plagiarism.

UNIT II:

Effective use of charts, graphs and tables

Bar Chart, Line Chart, Pie Chart, Area Chart, Cylindrical Chart, Column Bars, Bubble Chart, Flow Diagram, Screen Capture, Tables

Writing Technical Reports

Objectives Of Technical Report, Types of Reports, Steps in Writing a Technical Report, Guidelines for Writing a Technical Report.

UNIT III:

Tables, Figures, Equations

Inserting Equations, Mathematical Symbols, Practical.

Inserting References- Introduction, The BibTeX file, Inserting the bibliography, Citing references, Styles, Practical.

	UNIT – IV: **Intellectual Property** The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999, The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act, 1957, Trade Secrets, Utility Models WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement.
Text books	[1] Barun K Mitra, Effective Technical Communication-A Guide for Scientists and Engineers, Oxford University Press,2006. [2] Ramappa, T., "Intellectual Property Rights Under WTO", 2nd Ed., S Chand, 2015.
Reference books	[1] Goldbort R (2006) Writing for Science, Yale University Press. [2] Day R.A. (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
E-resources and other digital material	https://archive.nptel.ac.in/courses/110/105/110105091/

MINORS

23CEM4701 INTRODUCTION TO CIVIL ENGINEERING – CONCEPTS AND MATERIALS

Course Category:	Minor	**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 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	PO10	PO 11	PO 12	PSO 1	PSO 2
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; CharotarPublishing 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-resources and other digital material	http://nptel.ac.in/courses/105102088/

23CEM5701 METHODOLOGY FOR CIVIL ENGINEERING CONSTRUCTION

Course Category:	Minor	**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 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)**		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2
	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.

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. **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. ORGANISING FOR CONSTRUCTION Importance, general principles, types of organization structures, forms of business organizations. **UNIT – IV:** MATERIALS MANAGEMENT Importance, Objectives, Costs, functions of material management, uses, stores management, material procurement, maintaining stocks, material handling. QUALITY CONTROL IN CONSTRUCTION Elements of quality, Organisation for quality control, Quality assurance techniques, Documentation, Quality control circles, variation
Text books	[T1] Dr.S.Seetharaman, ”Construction Engineering and Management”, 5th 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	----

23CEM6701 SYSTEM DESIGN FOR SUSTAINABILITY

Course Category:	Minor	**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 sustainable product-service systems (SPSS) and their application in distributed renewable energy systems,
	CO2	Apply SPSS to distributed renewable energy systems and exploring their sustainability.
	CO3	Understand methodologies for design for Sustainability, and role in promoting eco-efficiency and social equity,
	CO4	Acquire knowledge on methods and tools for system design for sustainable energy, and design strategies to real-world case studies.

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	PO 11	PO 12	PSO 1	PSO 2
CO1	1		1			2	3							2
CO2	1		1			2	3				1			2
CO3	1		1			2	3				1			2
CO4	1		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 agenda.

DISTRIBUTED ENERGY SYSTEMS

Distributed renewable energy systems and Integrating SPSS 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 SPSS applied to distributed renewable energy (DRE); SPSS applied to DRE: Sustainability Potential Benefits; SPSS applied to DRE: Sustainability Potential Benefits.

	UNIT III: **DESIGN FOR SUSTAINABILITY** 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. **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. **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 S.PSS + DRE Design Framework & Card ; The Energy System map innovation diagram for S.PSS& DRE; Concept Description Form for S.PSS and DRE Stakeholder Motivation and Sustainability Table. **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, bio mimicry design; design for base of a pyramid design; design for social innovation.
Text books	[T1] FabrizioCeschin, İdilGaziulusoy, Design for Sustainability A Multi- level Framework from Products to Socio- technical Systems, Taylor and Francis, 2020. [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.
Reference books	[R1] The Handbook of Design for Sustainability Stuart Walker (Author) , Stuart Walker (Anthology Editor) , Jacques Giard (Anthology Editor) , Helen Walker (Anthology Editor) [R2] Elisa Bacchetti, Towards sustainable energy for All Designing Sustainable Product Service System applied to Distributed Renewable Energy, Politecnico di Milano, Milano, Italy 2017
E-resources and other digital material	nptel.ac.in/courses/107/103/107103081.

23CEM6702 ECOLOGY AND ENVIRONMENT

Course Category:	Minor	**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	Analyse 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	Analyze the effect of various attributes of environmental pollution													
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						2					2	1	1
	CO2	2	3		3		1								2
	CO3	2	1	3			1							1	2
	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.

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 Water purity characteristics; analysis of water samples - physical, chemical and biological tests; Standards for drinking water as per W.H.O; Water borne diseases. UNIT III: WATER TREATMENT Fundamentals on water purification; sedimentation; coagulation and types of coagulants; sedimentation and coagulation tanks uses and importance; theory of filtration; slow sand and rapid sand filters; operation; disinfection methodologies DISTRIBUTIONSYSTEMS Methods of supply; Layouts, Plumbing-pipes and fittings; Traps; One pipe and Two pipe Systems. UNIT – IV ENVIRONMENTAL POLLUTION Environmental Pollution: Water pollution, Land and soil pollution, Air pollution, their impacts and on health and environment. SOLID WASTE MANAGEMENT Solid waste characteristics–basics on on-site handling, collection –separation and processing – Incineration- Composting-Solid waste disposal methods – Fundamentals of land filling.
Text books	[T1] Benny Joseph, " Environmental Studies", Tata Mc Graw Hill, 2005 [T2] IgnaciMuthu 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.
Reference books	[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.
E-resources and other digital material	https://nptel.ac.in/courses/127106004 (Ecology and environment by Dr. Abhijit P. Deshpande, IIT Madras).

23CEM7701 INFRASTRUCTURE AND TRANSPORTATION SYSTEM PLANNING

Course Category:	Minors	**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	Analyze and differentiate various types of roads and pavement structures.													
	CO2	Evaluate and understand different pavement materials and construction methods for effective pavement design.													
	CO3	Identify and describe the key components of a railway track system.													
	CO4	Understand and apply knowledge of geometric features in the design and layout of railway tracks.													
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	PO 11	PO 12	PSO 1	PSO 2
	CO1	2					2								
	CO2	2	2	2											
	CO3	2	2												
	CO4	2	2	2			2								
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. **UNIT-III** **INTRODUCTION TO RAILWAYS:** Historic development of railways in India, Classification of Indian Railways, Different gauges in Indian Railways. **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. **UNIT-IV** **GEOMETRIC FEATURES AND OPERATION**: Super elevation or cant, cant deficiency, cant excess, negative super elevation concept, types of transition curves, gradient types. **POINTS AND CROSSINGS:** Switches, crossings, working principle of turnout, classification of signals, interlocking
Text books	[1] Sk Khanna, CEG Justo, A Veeraragavan, Highway Engineering, Nem Chand & Bros, 10th Edition, 2018 [2] Satish Chandra, MM Agarwal, Railway Engineering, Oxford University Press, 2nd Edition 2013
Reference books	[1] Saxena, S.C. and Arora. S, Railway Engineering, Dhanpat Rai, NDLS, 2009
E-resources and other digital material	[1] Dr. K.S. Reddy, Dr. Bhargab Maitra, IIT Kharagpur- Introduction to Transportation Engineering – " https://nptel.ac.in/courses/105/105/105105107/" [2] Dr Tom V Mathew, IIT Bombay- Transportation Engineering I " https://nptel.ac.in/courses/105/101/105101087/" [3] Prof Rajat Rastogi, IIT/Roorke – Transportation Engineering II– "https://archive.nptel.ac.in/courses/105/107/105107123/"

23CEM7702B NPTEL (Mandatory Course Based on Availability)

HONORS

23CEH4801A **STABILITY OF STRUCTURES**

Course Category:	Program core	**Credits:**	3.0
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 0
Prerequisites:	Honors	**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

(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	PO 11	PO 12	PSO 1	PSO 2
CO1	1		3	2		1							2	
CO2	1		3	2		1							2	
CO3	1		3	2		1							2	
CO4	1		3	2		1							2	

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

Lateral Buckling of Beams:
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

	Buckling of Rectangular Plates: Plates simply supported on all edges and subjected to constant compression in one or two directions; 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 Shells:** Introduction to buckling of axially compressed cylindrical shells, Linear theory of cylindrical shells-donnell equations, critical load of an axially loaded cylinder, failure of axially compressed cylindrical shells
Text books	1. Theory of elastic stability by Timoshenko & Gere, McGraw Hill, 1961. 2. Background to buckling by Allen and Bulson, McGraw- Hill, 1980.
Reference books	1. Elastic stability of structural elements by N.G.R.Iyengar, Macmillan India Ltd., 2007. 2. Principles of Structural stability theory by Alexandar Chajes
E-resources and other digital material	https://nptel.ac.in/courses/105/105/105105108/

23CEH4801B SUSTAINABLE CONSTRUCTION METHODS

Course Category:	Honors	**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 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

(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	PO 11	PO 12	PSO 1	PSO 2
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

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 performance, alternate

	water heating systems, on-site renewable energy – common lighting, energy efficiency in common area equipment, integrated energy monitoring system **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. RESIDENT HEALTH & WELLBEING Minimum day lighting, Ventilation design, no smoking policy, enhanced day lighting, enhanced ventilation design, cross ventilation **UNIT – IV** CONSTRUCTION AND OPERATIONS Construction, Occupancy & Operations GREEN RATING SYSTEMS IGBC, LEED, GRIHA, BEE, benefits of rating systems, procedure to get IGBC certification
Text books	[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.
Reference books	[R1] "Sustainable building technical manual- Green building design, constructions and operation", Produced by Public Technology Inc., US Green Building Council
E-resources and other digital material	

23CEH4801C DESIGN OF FORMWORK

Course Category:	Honors	Credits:	3
Course Type:	Theory	Lecture - Tutorial - Practice:	3-0-0
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 (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
	CO1		1			2	1	1		1	1				2
	CO2	2	2	1		2								2	
	CO3	3	3	3			1			1				3	1
	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

ANALYSIS OF FORMWORK

Loading and moment of formwork.

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

23CEH5801A ENGINEERING ROCK MECHANICS

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 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	evaluate rock masses based on classification systems													
	CO2	apply the laboratory and field testing of rocks to assess their engineering properties													
	CO3	analyze rocks based on the failure criteria													
	CO4	evaluate the bearing capacity of foundations on rocks and understand stability of rock slopes													
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	PO 11	PO 12	PSO 1	PSO 2
	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).

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

FIELD TESTS - PHYSICO —MECHANICAL PROPERTIES OF ROCKS

Uniaxial jacking test, Pressure meter tests, Hydraulic fracturing, Flat jack test. Electric resistivity method, Seismic refraction method.

	UNIT III: **FAILURE CRITERIA FOR ROCK AND ROCK MASSES** Mohr-Coulomb Yield Criterion, Hoek-Brown Criterion. **STRENGTH AND DEFORMABILITY OF JOINTED ROCK MASS** Shear strength of Rock joints, Deformability of Rock joints, Concept of joint compliance. **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.
Text books	[T1] Goodman-Introduction to Rock mechanics, Willey International (1980). [T2] Nagaratnam Sivakugan, Sanjay Kumar Shukla and Braja M. Das-Rock Mechanics-An Introduction, CRC Press, (2013) [T3] Ramamurthy, T. - Engineering in Rocks for slopes, foundations and tunnels, Prentice Hall of India. (2007)
Reference books	[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] Rock mechanics for engineers: Varma, B.P, Khanna Publishers
E-resources and other digital material	https://archive.nptel.ac.in/courses/105/105/105105212/

23CEH5801/B Advanced Steel Design

Course Category:	Program Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 0- 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	analyze safe section for eccentric connections													
	CO2	analyze safe section for Tension members with lug angle and Built up Compression Members													
	CO3	analyze safe section for Plate girders													
	CO4	analyze for safe section for gantry girders													
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	PO 11	PO 12	PSO 1	PSO 2
	CO1	2		2		3	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:

SEATED CONNECTIONS

Introduction to Connections, Unstiffened seated connections-bolted and welded, Stiffened seated connection-bolted and welded

BRACKET CONNECTIONS

Bracket Connections, type I-bolted and welded, Bracket connection type2-bolted and welded

UNIT II:

TENSION MEMBERS (ISS00-2007)

Design of tension members with Lug angles with bolted and welded connections.

COMPRESSION MEMBERS (ISS00-2007)

Design of axially loaded built up compression members with Laced and Battened columns with

	bolted and welded connections. **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 III:** **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**.**
Text books	[Tl] 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	[Rl] 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

23CEH5801C GEOSPATIAL DATA PROCESSING

Course Category:	Honors	**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 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

(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	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3		3									3
CO2	3	2	3		3									3
CO3	3	2	3		3								2	
CO4	3	2	3		3								2	

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, Georeferencing, 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.

PRACTICE:

1. Introduction to Arc GIS and Georeferencing, projections and re-projections

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. **PRACTICE** 3.DataDigitization (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. **PRACTICE** 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 **PRACTICE** 6.Assignment on Application of Geospatial techniques in Civil Engineering.
Text books	[T1] Photogrammetry, GIS & Remote Sensing,SSManugula, VeerannaBommakanti,, Educreation Publishing, 2018 [T2] Text Book of Remote Sensing and Geographical Information Systems, M. Anji Reddy, BS Publications/BSP Books, 4th 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/

23CEH6801A TRAFFIC ANALYSIS AND DESIGN

Course Category:	**Honors**	**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	Understand traffic engineering studies, analyse the data and present the results.
	CO2	Evaluate traffic and road facilities, and intersection control measures for smooth traffic movement.
	CO3	Analyse appropriate traffic control and management measures.
	CO4	Apply the principles of queuing theory to analyse delay at signalized and Un signalized intersections.

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	PO 11	PO 12	PSO 1	PSO 2
CO1	3			3					1					
CO2	3	3								1			3	
CO3	3					3								3
CO4	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 **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. **Traffic Management measures** Speed, vehicle, parking, enforcement regulations, mixed traffic regulation, various management techniques. **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. **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.
Text books	[1] . Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna publishers, 2011. [2]. The Institute of Transportation Engineers, Traffic Engineering Handbook, 7th edn, 2016.
Reference books	[1]. IRC-SP41: Guidelines for the Design of At-Grade Intersections in Rural & Urban Areas [2]. Pignataro, L., Traffic Engineering – Theory & Practice, John Wiley, 1973. [3]. Salter, R J., Highway Traffic Analysis and Design, ELBS, 1996
E-resources and other digital material	https://archive.nptel.ac.in/courses/105/101/105101008/ https://archive.nptel.ac.in/courses/105/105/105105215/

23CEH6801B TRANSPORTATION ECONOMICS

Course Category:	Honors	**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	Understanding 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	Analysing Demand and Supply modelling
	CO4	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)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3											3	3
CO2	3	3			3				1					
CO3	3			3										
CO4	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 **A**lternatives

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.

	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. **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. **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. **Evolution of Policy** Evolution of transport policy in India with focus on case studies regarding different modes.
Text books	[1]. McCarthy, P. S., Transportation Economics, and Massachusetts: Blackwell Publishers. 2001 [2]. Winfrey R, Highway Economic Analysis, International Textbook Company, 1969.
Reference books	[1]. Kenneth J. Button, Transport Economics, Elgar, 2010 [2].David A. Hensher, Ann M. Brewer, Transport: An Economics and Management Perspective, Oxford University Press, 2001. [3]. Emile Quinet, Roger Vickerman, Principles of Transport Economics, Edward Elgar Pub, 2005 [4]. Road User Cost Study, Central Road Research Institute [5]. Dickey J.W, Project Appraisal for Developing Countries, John Wiley, 1984
E-resources and other digital material	https://archive.nptel.ac.in/courses/105/104/105104098/ https://www.civil.iitb.ac.in/~dhingra

23CEH6801C ADVANCED FOUNDATION ENGINEERING

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial - Practice:**	3 - 1- 0
Prerequisites:	24CE6404/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 different techniques for determining bearing capacity.
	CO2	Analyze shallow foundations to assess bearing capacity and settlement.
	CO3	Evaluate the safe load-carrying capacity of pile foundations under various loading conditions.
	CO4	Assess the stability of well foundations and caissons.

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	PO 11	PO 12	PSO 1	PSO 2
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.

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. **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. **UNIT – IV** **WELL FOUNDATIONS** Open wells; Design of pier foundations and well foundations; Lateral stability of well foundations; RCC designs of wells. **PNEUMATIC CAISSONS** Introduction to pneumatic caissons; Construction of piers.
Text books	[T1] Das, B. M., Principles of Foundation Engineering, 5th Edition, Nelson Engineering, 2004. [T2] Bowles, J. E., Foundation Analysis & Design, 5th Edition, McGraw-Hill Companies, Inc., 1996. [T3] Coduto, D. P., Foundation Design Principles and Practices, 2nd Edition, Pearson, Indian Edition, 2012; Phi Learning, 2008. [T4] Poulos, H. G. & Davis, E. H., Pile Foundation Analysis and Design, John Wiley & Sons Inc., 2008.
Reference books	[R1] Rowe, R. K., Geotechnical & Geo-environmental Engineering Handbook, Springer, 2001. [R2] Tomlinson, M. J., Foundation Design and Construction, PHI, 2003. [R3] Reese, L. C. & Van Impe, W. F., Single Piles and Pile Groups under Lateral Loading, Taylor & Francis Group, January 2000.
E-resources and other digital material	nptel.ac.in/courses/105107120 nptel.ac.in/courses/105101083

23CEH6801B1 NPTEL Mandatory Course based on Availability