CURRICULUM

FOR

UNDERGRADUATE PROGRAMME
B.TECH

IN

CIVIL ENGINEERING
(3RD- 8TH SEMESTER)

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA
TRIPURA (WEST)

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA
CIVIL ENGINEERING DEPARTMENT
SYLLABUS FOR B.TECH
THIRD SEMESTER

Theory Subjects:

Sl. No	Subject Code	Name of the Subject	L	T	P	Total Periods/ week	Total Credit
01	UCE03B01	Mechanics of Solids	02	01	×	03	03
02	UCE03B02	Engineering Geology	03	00	×	03	03
03	UCE03B03	Mechanics of Fluid	02	01	×	03	03
04	UCE03B04	Value Education, Ethics and Environmental studies	03	00	×	03	03
05	UCE03C01	Mathematics - III	02	01	×	03	03
06	UCE03C02	Humanities-III	02	01	×	03	03

Practical/Sessional Subjects:

Sl. No	Subject Code	Name of the Subject	L	T	P	Total Periods/week	Total Credit
07	UCE03P01	Engineering Geology Laboratory	×	×	02	02	01
08	UCE03P02	Fluid mechanics Laboratory	×	×	02	02	01
09	UCE03P03	Civil Engineering Drawing	×	×	03	03	1.5

Total Contact Lectures per week= (18+07) =25

Total Credit =21.5

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA

CIVIL ENGINEERING DEPARTMENT

SYLLABUS FOR B.TECH

FOURTH SEMESTER

Theory Subjects:

Sl. No	Subject Code	Name of the Subject	L	T	P	Total Periods/week	Total Credit
01	UCE04B01	Structural Analysis - I	02	01	×	03	03
02	UCE04B02	Design of Structures -I	02	01	×	03	03
03	UCE04B03	Data Structures and Numerical Methods	02	01	×	03	03
04	UCE04B04	Building Materials, Construction and Services	03	00	×	03	03
05	UCE04B05	Surveying	02	01	×	03	03
06	UCE04E01	H.S.S Elective	02	01	×	03	03

Practical/Sessional Subjects:

Sl. No	Subject Code	Name of the Subject	L	T	P	Total Periods/week	Total Credit
07	UCE04P01	Material Testing Laboratory	×	×	02	02	01
08	UCE04P02	Surveying Field works	×	×	04	04	02
09	UCE04P03	Computer Programming Laboratory	×	×	02	02	01

Total Contact Lectures per week= (18+08) =26
Total Credit=22

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA

CIVIL ENGINEERING DEPARTMENT

SYLLABUS FOR B.TECH

FIFTH SEMESTER

Theory Subjects:

Sl. No	Subject Code	Name of the Subject	L	T	P	Total Periods/week	Total Credit
01	UCE05B01	Structural Analysis-II	02	01	×	03	03
02	UCE05B02	Design of Structures-II	02	01	×	03	03
03	UCE05B03	Water Resources Engineering -I	02	01	×	03	03
04	UCE05B04	Geotechnical Engineering-I	02	01	×	03	03
05	UCE05B05	Transportation Engineering-I	02	01	×	03	03
06	UCE05B06	Environmental Engineering -I	02	01	×	03	03

Practical/Sessional Subjects:

Sl. No	Subject Code	Name of the Subject	L	T	P	Total Periods/week	Total Credit
07	UCE05P01	Structural Engineering Laboratory -I	×	×	02	02	01
08	UCE05P02	Geotechnical Engineering Laboratory -I	×	×	02	02	01
09	UCE05P03	Transportation Engineering Laboratory -I	×	×	02	02	01
10	UCE05P04	Environmental Engineering Laboratory	×	×	02	02	01

Total Contact Lectures per week= (18+08) =26

Total Credit=22

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA
CIVIL ENGINEERING DEPARTMENT
SYLLABUS FOR B.TECH
SIXTH SEMESTER

Theory Subjects:

Sl. No	Subject Code	Name of the Subject	L	T	P	Total Periods/week	Total Credit
01	UCE06B01	Civil Engineering Estimation, Costing and Specification	02	01	×	03	03
02	UCE06B02	Design of Structures - III	02	01	×	03	03
03	UCE06B03	Water Resources Engineering-II	02	01	×	03	03
04	UCE06B04	Geotechnical Engineering-II	02	01	×	03	03
05	UCE06B05	Transportation Engineering-II	02	01	×	03	03
06	UCE06B06	Environmental Engineering.-II	02	01	×	03	03

Practical/Sessional Subjects:

Sl. No	Subject Code	Name of the Subject	L	T	P	Total Periods/week	Total Credit
07	UCE06P01	Structural Engineering Laboratory –II	×	×	02	02	01
08	UCE06P02	Geotechnical Engineering Laboratory -II	×	×	02	02	01
09	UCE06P03	Transportation Engineering Laboratory -II	×	×	02	02	01
10	UCE06P04	Water Resources Engineering Laboratory	×	×	02	02	01

Total Contact Lectures per week= (18+08) = 26

Total Credit =22

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA
CIVIL ENGINEERING DEPARTMENT
SYLLABUS FOR B.TECH
SEVENTH SEMESTER

Theory Subjects:

Sl. No	Subject Code	Name of the Subject	L	T	P	Total Periods/week	Total Credit
01	UCE07E01 to UCE07E08	Departmental Elective –I	02	01	×	03	03
02	UCE07E09 to UCE07E16	Departmental Elective –II	02	01	×	03	03
03	UCE07E17 to UCE07E24	Departmental Elective –III	02	01	×	03	03
04	UCE07E25 to UCE07E34	Open Elective	02	01	×	03	03
05	UCE07B01	Construction Planning and Management	02	01	×	03	03

Practical/Sessional Subjects:

Sl. No	Subject Code	Name of the Subject	L	T	P	Total Periods/week	Total Credit
07	UCE07P01	Structural Design and drawing	×	×	03	03	1.5
08	UCE07P02	Project-I	×	×	04	04	02
09	UCE07P03	Comprehensive Viva Voce	×	×	00	00	01
10	UCE07P04	Seminar	×	×	02	02	02

Total Contact Lectures per week= (15+09) = 24

Total Credit =21.5

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA
CIVIL ENGINEERING DEPARTMENT
SYLLABUS FOR B.TECH
EIGHTH SEMESTER

Theory Subjects:

Sl. No	Subject Code	Name of the Subject	L	T	P	Total Periods/week	Total Credit
01	UCE08E01 to UCE08E08	Departmental Elective –IV	02	01	×	03	03
02	UCE08E09 to UCE08E16	Departmental Elective –V	02	01	×	03	03
03	UCE08E17 to UCE08E26	Departmental Elective –VI	02	01	×	03	03

Practical/Sessional Subjects:

Sl. No	Subject Code	Name of the Subject	L	T	P	Total Periods/week	Total Credit
06	UCE08P01	Project: II	×	×	06	06	03
07	UCE08P02	Comprehensive Viva-voce	×	×	00	00	01

Total Contact Lectures per week= (09+04) = 13

Total Credit = 13

Total Credit (3rd to 8thSemester) = 122

ELECTIVE SUBJECTS

DEPARTMENTALELECTIVE I

Sl.No	SubjectCode	Name of the Subject	L	T	P	Number of lecture/Week	Total Credit
01	UCE07E01	Reinforced Earth Structure	02	01	×	03	03
02	UCE07E02	Alternative Building Materials	02	01	×	03	03
03	UCE07E03	Pre Stressed Concrete Design	02	01	×	03	03
04	UCE07E04	Advanced RCC Design	02	01	×	03	03
05	UCE07E05	Ground Improvement Techniques	02	01	×	03	03
06	UCE07E06	Environmental Geotechnique	02	01	×	03	03
07	UCE07E07	Geotechnical Investigation and Practices	02	01	×	03	03
08	UCE07E08	Sustainability Concept in Geotechnical Engineering	02	01	×	03	03

DEPARTMENTALELECTIVE II

Sl.No	SubjectCode	Name of the Subject	L	T	P	Number of lecture/Week	Total Credit
01	UCE07E09	Water Resources Planning and Management	02	01	×	03	03
02	UCE07E10	River Engineering and Flood Control	02	01	×	03	03
03	UCE07E11	Design of Hydraulics Structures	02	01	×	03	03
04	UCE07E12	Hydro Power Engineering	02	01	×	03	03
05	UCE07E13	Industrial Pollution and Control	02	01	×	03	03
06	UCE07E14	EIA and Auditing	02	01	×	03	03
07	UCE07E15	Water and Wastewater Treatment Process I	02	01	×	03	03
08	UCE07E16	Environmental Chemistry and Microbiology	02	01	×	03	03

DEPARTMENTALELECTIVE III

Sl.No	SubjectCode	Name of the Subject	L	T	P	Number of lecture/Week	Total Credit
01	UCE07E17	Advanced Railway Engineering	02	01	×	03	03
02	UCE07E18	Advanced Transportation Engineering	02	01	×	03	03
03	UCE07E19	Hill Roads	02	01	×	03	03
04	UCE07E20	Urban Transport Planning	02	01	×	03	03
05	UCE07E21	Advanced Structural Analysis	02	01	×	03	03
06	UCE07E22	Numerical Methods and Applications in Civil Engineering	02	01	×	03	03
07	UCE07E23	Retrofitting and Rehabilitation of Structures	02	01	×	03	03
08	UCE07E24	Masonry Structures	02	01	×	03	03

DEPARTMENTALELECTIVE IV

Sl.No	SubjectCode	Name of the Subject	L	T	P	Number of lecture/Week	Total Credit
01	UCE08E01	Rock Mechanics & Tunnelling	02	01	×	03	03
02	UCE08E02	Seismology and Seismic Design of Foundation	02	01	×	03	03
03	UCE08E03	Geographic Information System and its Application	02	01	×	03	03
04	UCE08E04	Foundation Design and Detailing	02	01	×	03	03
05	UCE08E05	Stochastic Hydrology	02	01	×	03	03
06	UCE08E06	Computational Hydraulics	02	01	×	03	03
07	UCE08E07	Open Channel Flow and Sediment Transport	02	01	×	03	03
08	UCE08E08	Ground Water Development and Management	02	01	×	03	03

DEPARTMENTALELECTIVE V

Sl.No	SubjectCode	Name of the Subject	L	T	P	Number of lecture/Week	Total Credit
01	UCE08E09	Air and Water Quality Modelling	02	01	×	03	03
02	UCE08E10	Global Warming and Climate Change	02	01	×	03	03
03	UCE08E11	Environmental Planning and Management	02	01	×	03	03
04	UCE08E12	Water and Wastewater Treatment Processes-II	02	01	×	03	03
05	UCE08E13	Traffic Safety Engineering	02	01	×	03	03
06	UCE08E14	Pavement Engineering	02	01	×	03	03
07	UCE08E15	Advanced Airport Planning and Design	02	01	×	03	03
08	UCE08E16	Pavement Materials and Construction	02	01	×	03	03

DEPARTMENTALELECTIVE VI

Sl.No	SubjectCode	Name of the Subject	L	T	P	Number of lecture/Week	Total Credit
01	UCE08E17	Finite Element Method of Structural Analysis	02	01	×	03	03
02	UCE08E18	Earthquake Resistant Design of Structures	02	01	×	03	03
03	UCE08E19	Bridge Engineering	02	01	×	03	03
04	UCE08E20	Geometric Design of Transportation Facilities	02	01	×	03	03
05	UCE08E21	Foundation in Problematic Soil, Under Ground Construction and Retaining Structure	02	01	×	03	03
06	UCE08E22	Applied Geomechanics	02	01	×	03	03
07	UCE08E23	Environmental Quality and Pollution Monitoring Techniques	02	01	×	03	03
08	UCE08E24	Rural Water Supply and Sanitation	02	01	×	03	03
09	UCE08E25	Computational Methods in Hydrology	02	01	×	03	03
10	UCE08E26	Water Shed Management	02	01	×	03	03

OPEN ELECTIVE

Sl. No	Subject Code	Name of the Subject	L	T	P	Number of lecture/Week	Total Credit
1	UCE07E25	Disaster Management and mitigation	02	01	×	03	03
2	UCE07E26	Sustainable Engineering	02	01	×	03	03
3	UCE07E27	Air pollution and Noise pollution	02	01	×	03	03
4	UCE07E28	Municipal Solid Waste Management	02	01	×	03	03
5	UCE07E29	Rural Infrastructure Development	02	01	×	03	03
6	UCE07E30	Satellite Digital Image Analysis	02	01	×	03	03
7	UCE07E31	Civil Engineering Materials	02	01	×	03	03
8	UCE07E32	Data Structures & Programming Methodology	02	01	×	03	03
9	UCE07E33	Application of Machine Learning in Time-Series Analysis	02	01	×	03	03
10	UCE07E34	Soft Computing	02	01	×	03	03

SYLLABUS FOR B.TECH

EIGHTH SEMESTER
(STUDENTS OPTED PROJECT IN INDUSTRY)

Sl. No	Name of the Subject	Total Credit
01	Industrial Project	10
02	Project Seminar	02
03	Comprehensive Viva-voce	01
Total		13

ONLINE COURSES FOR 8TH SEMESTER IN-HOUSE STUDENTS

Sl No.	Name of Subjects (NPTEL courses)
1	Foundation Engineering
2	Theory of Elasticity
3	Matrix Method of Structural Analysis
4	Advanced Concrete Technology
5	Modern Construction materials
6	Reinforced Concrete Road Bridges
7	Integrated Waste Management for a Smart City
8	Wastewater Treatment and Recycling
9	Glass in buildings : Design and applications
10	Glass Processing Technology
11	Environmental Engineering-Chemical Processes
12	Fire Protection, Services and Maintenance Management of Building
13	Geoenvironmental Engineering (Environmental Geotechnology); Landfills, Slurry Ponds & contaminated Sites
14	Remote Sensing and Digital Image Processing of Satellite Data
15	Fluid Inclusion in Mineral Principles, Methodology, Practice and Application
16	Unsaturated Soil Mechanics
17	Introduction to Accounting and Finance for Civil Engineers
Sl No.	**Name of Subjects (MOOCs via NPTEL courses)**
18	Earth Sciences for Civil Engineering Part - I & II
19	Project Planning & Control
20	HSE for Offshore and Petroleum Engineers
21	Probability Methods in Civil Engineering
22	Geology and Soil Mechanics
23	Landscape Architecture and Site Planning - Basic Fundamentals
24	Digital Land Surveying and Mapping (DLS & M)
25	Waste to Energy Conversion

CURRICULUM

FOR

UNDERGRADUATE PROGRAMME
B.TECH

IN

CIVIL ENGINEERING
(3RD- 8TH SEMESTER)

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA
TRIPURA (WEST)

DETAIL
COURSE CURRICULUM

FOR

UNDERGRADUATE PROGRAMME
B.TECH

IN

CIVIL ENGINEERING
(3rd SEMESTER)

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA
TRIPURA (WEST)

MECHANICS OF SOLIDS
(UCE03B01)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To obtain fundamental understanding of the concepts of stress and strain and their relationship within linear elastic zone.
2. To understand the bending of beams and resulting stress across the beam sections under different loading and support conditions.
3. To obtain an understanding on the torsion.
4. To understand on the elastic stability of columns with different support conditions.

Course Content:

Unit-1

Stress: Types of forces, Definition of stress, Stress tensor, plane stress, differential equations of stress equilibrium, Principal stresses, maximum shear stress, Mohr's Circle, stress invariants, Stresses due to impact.

Strain: Definition of strain, strain tensor, Plane strain, Saint Venant's equation of compatibility, Principal strains, strain invariants, Poisson's ratio, volumetric strain, thermal strain and deformation, strain rosettes.

Stress-Strain Relationships: Hooke's Law, constitutive relations, deformation of axially loaded bars, elastic constants, generalized Hook's law for isotropic materials, Navier's Equations, Elastic strain energy, introduction to Tresca and Von-Mises theory of failure, Octahedral shear stresses.

Unit-2

Torsion: Torsion of circular elastic bars, torsion equation, introduction to warping of non-circular bars, power transmitted by shaft and hollow circular sections.

Unit-3

Bending Moment and Shear force: Beams and support conditions, Types of supports and loads, shear force and bending moment, their diagrams for simply supported beams, cantilevers and overhanging beams.

Bending Stress and Shear Stress: Theory of simple bending–Stress distribution at a cross section due to Bending Moment and Shear Force, Curved bars, Unsymmetrical bending, Product moment of inertia, shear centre, introduction to thin and thick walled cylinder.

Unit-4

Deflection of beams: Moment curvature relation of beam, differential equation of beam. Slope and deflection for determinate structures using integration, moment area and conjugate beam method.

Unit-5

Elastic Stability of Columns: Short and Long Column, stability of a long column, Euler's Theory of Columns, differential equations of beam- columns, Derivation of Buckling Load for different end conditions, Rankine's Formula.

Reference:-

Sl No.	Name of Book	Author	Publisher
1	Elements of Strength of Materials	Timosenko, S. P., andYoung, D.H.	Affiliated East-WestPress Pvt. Ltd
2	Strength of Materials	Srinath, L.S, Desai.	Tata McGraw-Hill.
3	Engineering Mechanics of Solids	Popov, E.P.	PHI
4	Solid Mechanics	Kazimi, S. M.A	Tata McGraw-Hill
5	Introduction to Solid Mechanics	Shames, H	PHI
6	Strength of Materials	Shaneloy, F.R	McGraw Hill
7	Strength of Materials Vol. I	Timoshenko, S	McGraw Hill
8	Advanced Mechanics of Solids	Srinath, L.S.	Tata McGraw-Hill

Course Outcome:

1. Students will be able to identify the type of force, type of supports and the reactions on beams.
2. Students will be able to draw shear force and bending moment diagram of a beam.
3. Students will be able to identify the stress developed in beams due to bending.
4. Students will be able to analyze the deflection of beams.
5. Students will be able to understand on the torsion of solid circular shaft and resulting shear stress on the cross section.
6. Students will be able to compute the buckling load of short and long columns with different end conditions.

To establish the correlation between Cos & POs

Table 1

No of course outcome (CO)	Course Outcome
UCE03B01.1	Students will be able to identify the type of force, type of supports and the reactions on beams.
UCE03B01.2	Students will be able to draw shear force and bending moment diagram of a beam.
UCE03B01.3	Students will be able to identify the stress developed in beams due to bending.
UCE03B01.4	Students will be able to analyze the deflection of beams.

UCE03B01.5	Students will be able to understand on the torsion of solid circular shaft and resulting shear stress on the cross section.
UCE03B01.6	Students will be able to compute the buckling load of short and long columns with different end conditions.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE03B01.1	3	3	2	1	1	-	-	-	-	-	-	1
UCE03B01.2	3	3	2	1	1	-	-	-	-	-	-	1
UCE03B01.3	3	3	2	1	1	-	-	-	-	-	-	1
UCE03B01.4	3	3	2	1	1	1	-	-	-	-	-	1
UCE03B01.5	3	3	2	1	1	-	-	-	-	-	-	1
UCE03B01.6	3	3	2	1	1	1	-	-	-	-	-	1
Total	**18**	**18**	**12**	**6**	**6**	**1**	**-**	**-**	**-**	**-**	**-**	**6**
Average	**3**	**3**	**2**	**1**	**1**	**0.17**	**-**	**-**	**-**	**-**	**-**	**1**
Equivalent Avg. Attainment	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

To establish the correlation between Cos & PSOs

Table 3

CO	PSO1	PSO2
UCE03B01.1	3	2
UCE03B01.2	3	3
UCE03B01.3	3	3
UCE03B01.4	3	2
UCE03B01.5	3	3
UCE03B01.6	3	3
Total	**18**	**16**
Average	**3**	**2.67**
Equivalent Avg. Attainment	**3**	**3**

ENGINEERING GEOLOGY

(UCE03B02)

Total Credit: 03 **Contact Periods: 03(3L+0T+0P)**

Courses Objective:

1. Origin, internal and surface structures of the earth.
2. Identification of the minerals types of clay minerals, their properties and effects on engineering project.
3. Types of rock (Igneous, Sedimentary, and Metamorphic), Civil engineering importance of rock forming minerals. Sedimentary processes (Weathering, erosion, deposition), Metamorphism and volcanic eruptions.
4. Geological structures (Joint, veins, crack, faults, and fold), reasons of formation for each type and their side effects on the engineering projects.
5. Types of Dams and Tunnels. Types of maps, how we can draw the topographic map by using computer programming.
6. Types of Mass wasting, factors increasing instability and methods of stabilization.
7. Study ground water, factors affecting on the variation of water table depth. Methods of searching for ground water.

Course Content:

Unit-1

Introduction: Application of Earth Science in Civil Engineering Practices, Understanding the earth, internal structure and composition.

Mineralogy: Mineral properties, composition and their use in the manufacture of construction materials – Quartz Group (Glass); Feldspar Group (Ceramic wares and Flooring tiles); Kaolin (Paper, paint and textile); Asbestos (AC sheets); Carbonate Group (Cement) ; Gypsum (POP, gypsum sheets, cement); Mica Group (Electrical industries); Ore minerals - Iron ores (Steel); Chromite (Alloy); Bauxite (aluminum); Chalcopyrite (copper).

Unit -2

Petrology: Formation, Classification and Engineering; Properties. Rock as construction material, concrete aggregate, railway ballast, roofing, flooring, cladding and foundation. Deformation of rocks, Development of Joints, Folds, Faults and Unconformities. Their impact in the selection of sites for Dams, Reservoirs, Tunnels, Highways and Bridges, Rock Quality Determination(RQD), Rock Structure Rating (RSR),Igneous Rocks - Granite, Gabbro, Dolerite, Basalt; Sedimentary rocks - Sandstone, Shale, Limestone, Laterite; Metamorphic rocks - Gneiss, Quartzite, Slate, Charnockite: Decorative stones - Porphyries, Marble and Quartzite.

Unit -3

Geomorphology: Landforms – Classification, Rock weathering, types and its effects on Civil Engineering Projects. Study of Geo-morphological aspects in the selection of sites for Dams, Reservoirs, Tunnels, Highways and Bridges. Watershed management, Floods and their control, River valley, Drainage pattern – parameters and development; Coastlines and their engineering considerations.

Unit -4

Seismology: Earthquake - Causes and Effects,, Seismic waves, Engineering problems related to Earthquakes, Earthquake intensity, Richter Scale, Seismograph, Seismic zones- World and India, Tsunami – causes and effects. Early warning system. Reservoir Induced Seismicity; Landslides – causes and their control.

Unit -5

Hydrogeology: Hydrological cycle, Occurrence of Groundwater in different terrains -Weathered, Hard and Stratified rocks; Determination of Quality aspects - SAR, RSC and TH of Groundwater. Groundwater Pollution, Groundwater Exploration- Electrical Resistivity and Seismic methods, Resistivity curves, Water Bearing Formations, Aquifer types and parameters - Porosity, Specific yield and retention, Permeability, Transmissibility and Storage Coefficient. Springs and Artesian Wells, Artificial Recharging of Groundwater, Sea water intrusion and remedies.

References:

Sl No.	Name of Book	Author	Publisher
1	A Text Book of Geology	P.K. Mukerjee	World Press Pvt., Ltd. Kolkatta.
2	Text Book of Engineering and General Geology	Parbin Singh	Published by S.K. Kataria and Sons, New Dehli.
3	Principles of Engineering Geology and Geotechnics	Dimitri P Krynine and William R Judd	CBS Publishers and Distributors, New Delhi.
4	Principles of Engineering Geology	K V G K Gokhale	BS Publications, Hyderabad
5	Text book of Remote Sensing and Geographical Information System	M Anji Reddy	BS Publications, Hyderabad.
6	Ground water Assessment, development and Management	K.R. Karanth	Tata Mc Graw Hills

7	Groundwater Hydrology	K. Todd	Tata Mac Grow Hill, New Delhi.
8	Engineering Geology	S.K Duggal, H.K Pandey and N Rawal	McGraw Hill Education (India) Pvt, Ltd. New Delhi.

Course Outcome:

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

1. Student will be able to learn the most common igneous, sedimentary and metamorphic rocks and also learn the different branches of geology.
2. Student will be able to describe and interpret the geological structures in the geological maps and cross sections and also learn the geotechnical considerations of groundwater movement.
3. Students will be able to learn the different testing methods of rocks, Weathering and erosion of rocks, RQD and Bore hole problems.
4. Students will be able to learn the various geological considerations for the construction of Dam, Reservoir and Tunnels.
5. Student will be able to learn the importance of Seismic method and electrical resistivity method to civil engineering projects.
6. Student will be able to learn the engineering seismology i.e. causes of earthquakes; seismic waves; magnitude, Intensity and energy release; characteristics of strong earthquake ground motions etc.

To establish the correlation between COs &POs

Table 1

No. of Course Outcome(CO)	Course Outcome
UCE03B02.1	Student will be able to learn the most common igneous, sedimentary and metamorphic rocks and also learn the different branches of geology.
UCE03B02.2	Student will be able to describe and interpret the geological structures in the geological maps and cross sections and also learn the geotechnical considerations of groundwater movement.
UCE03B02.3	Student will be able to learn the different testing methods of rocks, Weathering and erosion of rocks, RQD and Bore hole problems
UCE03B02.4	Student will be able to learn the various geological considerations for the construction of Dam, Reservoir and Tunnels.
UCE03B02.5	Student will be able to learn the importance of Seismic method and electrical

	resistivity method to civil engineering projects and also learn the engineering seismology.
UCE03B02.6	Student will be able to learn the engineering seismology i.e. causes of earthquakes; seismic waves; magnitude, intensity and energy release; characteristics of strong earthquake ground motions etc

Table 2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: "-"**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE03B02.1	3	2	1	2	1	2	1	1	2	1	2	3
UCE03B02.2	3	2	1	2	1	2	1	1	2	1	2	3
UCE03B02.3	3	2	1	2	1	2	1	1	2	1	2	3
UCE03B02.3	3	2	1	2	1	2	1	1	2	1	2	3
UCE03B02.5	3	2	1	2	2	2	2	2	1	1	2	3
UCE03B02.6	3	2	2	2	2	2	2	2	2	1	2	3
Total	18	12	6	12	8	12	8	8	11	6	10	18
Average	3	2	1	2	1.33	2	1.33	1.33	1.83	1	1.67	3
Equivalent Avg. attainment	3	2	1	2	1	2	1	1	2	1	2	3

Table 3

To establish the correlation between COs &PSOs

CO	PSO1	PSO2
UCE03B02.1	3	2
UCE03B02.2	3	3
UCE03B02.3	3	4
UCE03B02.4	2	4
UCE03B02.5	2	4
UCE03B02.6	2	4
Average	2.5	3.5
Equivalent Avg. Attainment	3	4

MECHANICS OF FLUID

(UCE03B03)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To know about the properties of fluids and the applications of fluid mechanics.
2. To formulate and analyze problems related to calculation of forces in fluid structure interaction.
3. To know about applications of momentum and energy equations, determination of laminar and turbulent flows.
4. To know the concept of pipe flow measurements, types of flow measurements and dimensional analysis.
5. To understand the application of boundary layer over rough surfaces, drag and lift studies.

Course Contents:

Unit-1

Fluid properties: Scope of fluid mechanics, definition of fluid, fluid continuum concept, fluid properties and classification of fluids.

Fluid statics: Fluid pressure at a point and its measurements, manometry, hydrostatic forces on plane and curved surfaces, buoyancy and floatation, relative equilibrium under linear acceleration and constant rotation.

Unit -2

Fluid Kinematics: Velocity field, classification of fluid flows based on space and time, one-, two- and three- dimensional flows. Eulerian and Lagrangian approaches, stream lines, path lines and streak lines, stream tubes, continuity equation, translation, linear deformation, rotation and angular deformation of fluid elements, vorticity, rotational and irrigational flows, circulation, velocity potential and stream functions, flow net and its characteristics , local , convective and substantial acceleration of fluid particles.

Unit -3

Fluid Dynamics: Concept of control mass and control volume, Reynolds transport theorem, conservation of mass, momentum equation, Euler's equation, Navier-Stokes equations. Derivation of Bernoulli's equations from Euler's equation and applications of momentum and

energy equations (pitot tube, weirs and sudden head loss due to expansion), energy and momentum correction factors.

Fundamentals of Laminar and Turbulent flows: Reynolds experiment, critical Reynolds number and its determination, laminar flow through pipes and Hagen-Poiseuille equation, laminar flow through porous media, quoettes flow, measurement of viscosity, causes, characteristics and factors affecting turbulence, types of turbulence, shear and pressure relationships, Darcy-Weisbach equation for turbulent flow through pipe, shear stress velocity distribution in pipes.

Unit -4

Pipe flow problems: Friction loss in pipes, minor losses in pipes, concept of equivalent length and diameter of pipes, siphons, parallel and compound pipe lines, branching of pipe lines, pipe networks and methods of analysis, three reservoir problem, water hammer and methods of analysis.

Fluid flow measurement: Flow measuring devices: nozzle, Venturimeter and bend meters, notches, weirs and Pitot tubes, orifices and mouthpieces.

Unit -5

Dimensional analysis and modelling: Dimensions, different systems of units, dimensional homogeneity, Buckingham's pi-theorem, non-dimensional numbers and their physical significance. Geometric, kinematic and dynamic similarities, model laws, model testing and its analysis, scale effects, undistorted and distorted models.

Boundary layer: Boundary layer concept, applications of boundary layer in various fields, thicknesses of boundary layer, laminar and turbulent boundary layers, laminar sub layer, application of Momentum equation, stream lined and bluff bodies, integral momentum equation, Prandtl's boundary layer equations. Boundary layer on rough surfaces, boundary layer separation and methods to avoid separation, wake, concepts of drag and lift on submerged bodies, types of drags and its determination.

References:

Sl No.	Name of Book	Author	Publisher
1	Engineering Fluid Mechanics	Garde R. J. and Mirajgaoker A. G	Scitech Publications (India)Pvt. Ltd., Chennai, 2003.
2	Introduction to Fluid Mechanics	Fox W.R. and McDonald, A.T.	Wiley andSons Inc., New York, 1998.
3	Fluid Flow in Pipes and Channels	Asawa G L	CBS Publishers, New Delhi, 2008

4	Fluid Mechanics including Hydraulic Machines	Jain A K	Khanna Publishers, New Delhi, 2000.
5	Fluid Mechanics	Streeter V.L., Bedford K. and Wylie E. B.	McGraw Hill Book Company Ltd., New York, 1998.
6	Fluid Mechanics	F M White	Tata McGraw Hill Publication 2011.
7	Mechanics of Fluids	Shames	McGraw Hill Book Co., New Delhi, 1988.
8	Fluid Mechanics	Streeter V.L., Benjamin Wylie	McGraw Hill Book Co., New Delhi, 1999.

Course Outcome:

1. Know the fundamental concepts of fluid properties like continuum, velocity field, viscosity, pressure, etc. Will be able to understand flow path lines, streamlines; laminar and turbulent flows.
2. Have understanding to apply basic equation of fluid statics to determine forces acting on submerged planar and curved surfaces, manometers, buoyancy and stability.
3. Use of conservation laws in differential forms and apply them to determine velocities, pressures and acceleration, etc. and understand the kinematics and dynamics of fluid.
4. Apply principles of dimensional analysis and similitude to carry out model studies for fluid flow problems.
5. Analyse pipe flow problems and measurement of flow through various flow measuring devices.
6. Applications of boundary layer equations in laminar and turbulent flows, understand the concepts of viscous boundary layers, mechanics of viscous flow about immersed boundaries relating to flow separation, wakes, drag coefficients, determination of drag forces, etc.

To establish the correlation between Cos & POs

Table 1

No of course outcome (CO)	Course Outcome
UCE03B03.1	Know the fundamental concepts of fluid properties like continuum, velocity field, viscosity, pressure, etc. Will be able to understand flow path lines, streamlines; laminar and turbulent flows.
UCE03B03.2	Have understanding to apply basic equation of fluid statics to determine forces acting on submerged planar and curved surfaces, manometers, buoyancy and stability.

UCE03B03.3	Use of conservation laws in differential forms and apply them to determine velocities, pressures and acceleration, etc. and understand the kinematics and dynamics of fluid.
UCE03B03.4	Apply principles of dimensional analysis and similitude to carry out model studies for fluid flow problems.
UCE03B03.5	Analyse pipe flow problems and measurement of flow through various flow measuring devices.
UCE03B03.6	Applications of boundary layer equations in laminar and turbulent flows, understand the concepts of viscous boundary layers, mechanics of viscous flow about immersed boundaries relating to flow separation, wakes, drag coefficients, determination of drag forces, etc.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE03B03.1	3	3	1	1	1	-	-	-	-	-	-	2
UCE03B03.2	3	3	2	1	1	-	-	-	-	-	-	1
UCE03B03.3	3	3	3	1	1	-	-	-	-	-	-	2
UCE03B03.4	2	3	3	2	1	-	-	-	-	-	-	1
UCE03B03.5	2	2	2	1	2	-	-	-	-	-	-	1
UCE03B03.6	3	3	2	2	1	1	-	-	-	-	-	2
Total	16	17	13	8	7	1	-	-	-	-	-	9
Average	2.67	2.83	2.17	1.33	1.17	1.00	-	-	-	-	-	1.50
Equivalent Avg. Attainment	3	3	2	1	1	1	-	-	-	-	-	2

To establish the correlation between Cos & PSOs

Table 3

CO	PSO1	PSO2
UCE03B03.1	3	2
UCE03B03.2	3	3
UCE03B03.3	2	2
UCE03B03.4	2	1
UCE03B03.5	2	2
UCE03B03.6	3	2
Total	**15**	**12**
Average	**2.5**	**2**
Equivalent Avg. Attainment	**3**	**2**

VALUE EDUCATION, ETHICS AND ENVIRONMENTAL STUDIES

(UCE03B04)

Total Credit: 03 **Contact Periods: 03 (3L+0T+0P)**

Courses Objective:

1. To understand the concept of value education in engineering profession
2. To grasp the significance of engineering ethics
3. To understand the values, responsibilities, laws and moral justification
4. To understand the nature and scope of environmental education with regards to technology revolution & globalization
5. To understand the concept of environmental ecology and education
6. To solve the global ethical issues

Course Content:

Unit-1

Engineering Profession, Technology & Society. Engineering Professionals–Training, Skillset, Life skills, Innovation and Creativity. Making sense of Engineering Ethics, Issues in Engineering ethics, Failures, Ethical obligations of Engineering professional, concept of safe exit. Steps in resolving Ethical Dilemmas, Dilemma son right-wrong or better-worst solutions, Codes of ethics, Rights ethics, Duty ethics, Virtue ethics, Self-realization and self-interest.

Unit-2

Safety and risk, Assessing and Reducing risk, Risk, Cost and Management, Severity and Probability of risk. Workplace Responsibilities–Teamwork, Confidentiality and Conflicts of interest, Rights of Engineers, Whistle blowing. Engineering as Social Experimentation.

Unit-3

Human values, Value system, Degeneration of values, acquiring values, Attitudes, Truthfulness and Trust worthiness, Integrity and Ingenuity. Engineers as– Manager, Consulting Engineer, Expert Witness & Advisors and Moral Leaders, Discrimination–Antidiscrimination Laws and moral justification, preferential treatment, Sexual Harassment, Occupational Crime. Ethics Audit.

Unit-4

International Trade, Technology Revolution & Globalization, Multinational Corporations, Corporate Governance and Social responsibility. Environmental ethics– Challenges of Environmental ethics, Anthropocentrism, Sustainable Development, Ecosystem, and Energy concerns, Ozone Depletion and Pollution.

Unit-5

Global ethical issues. Other Global issues–Computer ethics and the internet, Media ethics, War ethics, Bio ethics, Research ethics, Intellectual Property Rights.

Reference:-

Sl No.	Name of Book	Author	Publisher
1	Ethics in Engineering	Mike W. Martin and Roland Schinzinge	McGraw Hill Education (India)Pvt. Ltd, New Delhi
2	Professional Ethic	R. Subramania	Oxford University Press
3	Professional Ethics in Engineering	V.Jayakuma	Laxmi Publication
4	Professional Ethics and Human Value	M.Govindaraja	PH
5	Human Values and Professional Ethic	R.R Gau	Excel Publication

Course Outcome:

1. Students will be able to understand the importance of value education in engineering profession
2. Students will be able to understand the significance of engineering ethics
3. Students will be able to understand rights and responsibilities of engineers
4. Students will be able to understand the nature and scope of environmental education

5. Students will be able to understand the concept of environmental ecology and education
6. Students will be able to solve global issues like computer ethics, media ethics, war ethics, bio ethics, research ethics etc.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE03B04.1	Students will be able to understand the importance of value education in engineering profession
UCE03B04.2	Students will be able to understand the significance of engineering ethics
UCE03B04.3	Students will be able to understand rightsand responsibilities of engineers
UCE03B04.4	Students will be able to understand the nature and scope of environmental education
UCE03B04.5	Students will be able to understand the concept of environmental ecology and education
UCE03B04.6	Students will be able to solve global issues like computer ethics, media ethics, war ethics, bio ethics, research ethics etc.

Table- 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE03B04.1	2	2	2	2	-	3	3	3	3	3	3	3
UCE03B04.2	2	2	2	2	-	3	3	3	3	3	3	3
UCE03B04.3	-		-	2	-	3	3	3	3	3	3	3
UCE03B04.4	2	2	3	3	3	3	3	3	3	3	3	3
UCE03B04.5	3	3	3	3	-	3	3	3	2	3	3	3
UCE03B04.6	3	3	3	3	3	3	3	3	3	3	3	2
Total	**12**	**12**	**13**	**15**	**6**	**18**	**18**	**18**	**17**	**18**	**18**	**17**
Average	**2**	**2**	**2.16**	**2.5**	**1**	**3**	**3**	**3**	**2.83**	**3**	**3**	**2.83**
Eq. Av Attainment	**2**	**2**	**2**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
UCE03B04.1	4	4
UCE03B04.2	4	4
UCE03B04.3	4	4
UCE03B04.4	4	4
UCE03B04.5	4	4
UCE03B04.6	4	4
Total	**24**	**24**
Average	**4**	**4**
Equivalent Avg. Attainment	**4**	**4**

MATHEMATICS-III

(UCE03C01)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. The main objective of this course is to provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like disease modelling, climate prediction and computer networks etc.
2. Apply probability theory via Bayes' Rule
3. Describe the properties of discrete and continuous distribution functions.
4. Use method of moments and moment generating functions.
5. Apply the Central Limit Theorem.
6. Use statistical tests in testing hypotheses on data.
7. Introduce students to partial differential equations, and to solve linear Partial Differential with different methods.
8. Introduce students to some physical problems in Engineering and Biological models that results in partial differential equations.
9. Introduce the Fourier series and its application to the solution of partial differential equations.

Course Content:

Unit-1

Classical and Axiomatic construction of the theory of Probability, Conditional Probability and basic formulae, Random variables, Probability Mass Function Probability density function and Probability distribution function, functions of a random variable. Standard univariate discrete and continuous distributions and their properties. Mathematical expectations, moments, moment

generating function. Multivariate distributions, marginal and conditional distributions, Conditional expectations.

Unit-2

Fourier series, Half range Series.

Series solution of ordinary differential equation of second order. Ordinary points and regular singular points.

Methods of least squares and curve fittings.

Unit-3

Partial derivatives, Chain Rule, Differentiation of implicit functions, Exact differentials.

Tangent planes and Normal planes. Maxima, Minima and Saddle points. Simple problems in extremum of functions with constraints. Methods of Lagrange multipliers.

Unit-4

Multiple-double and triple integrals. Jacobians and transformation of co-ordinates. Applications to areas, volumes, centre of pressure. Improper integrals. Test of convergence. Beta and Gamma functions.

Vector differentiation and Integration. Gradient, divergence and Curl-applications.

Unit-5

Functions of complex variable. Limits and Continuity and Differentiations. Analytic functions. Cauchy-Riemann equations, Conjugate functions, applications to two dimensional problems, Cauchy's Integral theorem, Taylor's and Laurent's expansions, Branch Points Zeros, Poles, Residues, Simple problems on Contour integration.

Reference:-

Sl No.	Name of Book	Author	Publisher
1	Advanced Engineering Mathematics	1957.E.Kreyszig	5th Ed., Willey Eastern
2	Advanced Engineering Mathematics	H.K. Das	S.Chand and Company.
3	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers.
4	Schaum's Outline Series	Spiegel, Murrary R	McGraw Hill Book Company.

Course Outcome:

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

1. Students will be able to understand the basic concepts of probability, random variables, probability distribution, and moments and moment generating functions.

2. Students will be able to define the basic discrete and continuous distributions such as normal, binomial, Poisson, and make be able to apply them and simulate them in simple cases.
3. Students will be able to explain the concepts of two-dimensional random variables, independence, jointly distributed random variables and conditional distributions, and use generating functions to establish the distribution of linear combinations of independent random variables. Also State the central limit theorem, and apply it.
4. Students will be able to explain the concepts of random sampling, statistical inference and sampling distribution, and state and use basic sampling distributions. Hypothesis testing and its application in real life problems.
5. Students will be able to find the Fourier series representation of a function of one variable, and find the solution of the wave, diffusion and Laplace equations using the Fourier series.
6. Students familiarize with the fundamental concepts of Partial Differential Equations (PDE) which will be used as background knowledge for the understanding of specialized courses in Engineering. Students will master how solutions of PDEs are determined by conditions at the boundary of the spatial domain and initial conditions at time zero.

To establish the correlation between Cos & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE03C01.1	Understand the basic concepts of probability, random variables, probability distribution, and moments and moment generating functions.
UCE03C01.2	Define the basic discrete and continuous distributions such as normal, binomial, Poisson, and make be able to apply them and simulate them in simple cases.
UCE03C01.3	Explain the concepts of two dimensional random variable, independence, jointly distributed random variables and conditional distributions, and use generating functions to establish the distribution of linear combinations of independent random variables. Also State the central limit theorem, and apply it.
UCE03C01.4	Explain the concepts of random sampling, statistical inference and sampling distribution, and state and use basic sampling distributions. Hypothesis testing and its application in real life problems.
UCE03C01.5	Find the Fourier series representation of a function of one variable, and

	find the solution of the wave, diffusion and Laplace equations using the Fourier series.
UCE03C01.6	Students familiarize with the fundamental concepts of Partial Differential Equations (PDE) which will be used as background knowledge for the understanding of specialized courses in Engineering. Students will master how solutions of PDEs are determined by conditions at the boundary of the spatial domain and initial conditions at time zero.

Table-2

1: Slight(low) 2: Moderate(medium) 3: Substantial (high) 4. No correlation '-'

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE03C01.1	3	3	2	1	-	-	-	-	-	1	1	2
UCE03C01.2	2	2	2	1	2	-	-	-	-	1	1	1
UCE03C01.3	3	2	3	2	1	1	-	-	-	-	1	1
UCE03C01.4	3	3	2	2	3	1	-	1	1	1	1	2
UCE03C01.5	2	2	2	1	1	1	-	-	-	1	1	1
UCE03C01.6	3	2	2	2	1	1	-	-	1	1	1	1
Total	**16**	**14**	**13**	**9**	**8**	**4**	**-**	**1**	**2**	**5**	**6**	**8**
Average	**2.67**	**2.33**	**2.17**	**1.5**	**1.33**	**0.67**	**-**	**0.17**	**0.33**	**0.83**	**1**	**1.33**
Eq. Av Attainment	**3**	**2**	**2**	**2**	**1**	**1**	**-**	**0**	**0**	**1**	**1**	**1**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE03C01.1	2	2
UCE03C01.2	1	1
UCE03C01.3	2	1
UCE03C01.4	1	2
UCE03C01.5	1	2
UCE03C01.6	2	2
Total	**9**	**10**
Average	**1.5**	**1.67**
Eq. Average Attainment	**2**	**2**

HUMANITIES-III

ENGINEERINGECONOMICS AND COSTING
(UCE03C02)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To make the Engineering student know about the basic concepts and law of Economics and their application to understand the behavior of agents present in the market. The subject will address the requirement of evaluating the commercial viability of projects undertaken by graduate engineers
2. To make the Engineering student know about the basic concepts of cost and costing, Accounts and financial statements and their application to understand the issue of commercial viability of any projects.

Course Content:

Unit-1

Introduction: Definition of Economics, subject matter, scope and nature of Economics, Engineering

Economics and its importance, Basic concepts, goods, utility, wealth, value, consumption, human wants.

Demand and supply: Concept law and elasticity, Determinant of elasticity, measurement of elasticity.

The Theory of production and cost: Factors of production, production function, Marginal products, Law of variable proportions, Returns to scale. Accounting cost and Economics costs.

Unit-2

The of Firm and Pricing in various market structures: Meaning of market, determination of output, revenue and profit in perfect and imperfect competitions.

National income, Money and Banking, Inflation: Concept and measurement of National income; Function of money, Central Bank, its functions, balance sheet and essential of sound Banking. Meaning of inflation and deflation, methods of control.

Economic Reforms, Growth and Development: Rationale of Economic Reforms in India, Meaning of Growth and Development, concept of Planning. Economic systems Capitalism, socialism and mixed economy.

Unit-3

Double entry system of Book-keeping: Cash Book, Bank Reconciliation Statement, Journal and Ledger.

Depreciation Accounting: Final accounts-manufacturing account, trading account, profit and loss account, balance sheet.

Unit-4

Elements of cost:

Direct materials, direct labour, direct expenses, overheads-production, office and administration, selling and distribution, practical problems.

Unit-5

Maintenance of stores:

Bin card, store ledger, LIFO, FIFO, simple and weighted average, standard cost method, practical problems.

References:-

Sl No.	Name of Book	Author	Publisher
1	Modern Economics	H. .L. Ahuja	S. Chand.
2	Ïndian Economics	K. K. Dewett and M.L .Sharma	S. Chand.
3	Modern Accountancy	Mukherjee &Hanif	Tata Mc Graw Hill Publishing Co. Ltd. April.
4	Financial Accounting	Tulsian	Tata Mc Graw Hill Publishing Co. Ltd. April.
5	Financial Accounting	Larson	Tata Mc Graw Hill Publishing Co. Ltd. April.
6	Cost Accounting	B. Banerjee	World Press.
7	Cost Accounting	Jawaharlal	Tata Mc Graw Hill Publishing Co. Ltd. April.

Course Outcome:

1. Be able to identify and explain economic concepts and theories related to the behavior of economic agents present in market.
2. Be able to analyse the impact of various government policies in production and profitability of the company.
3. Be able to identify the basic features of alternative representations of human behavior in economics.
4. Be able to understand the impact various decisions or transactions will have on the company's statements and financial health.
5. Be able to comfortably communicate with senior financial and non-financial leaders about financial statement issues and the financial impact of business decisions.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE03C02.1	Be able to identify and explain economic concepts and theories related to the behavior of economic agents present in market.
UCE03C02.2	Be able to analyse the impact of various government policies in production and profitability of the company.
UCE03C02.3	Be able to identify the basic features of alternative representations of human behavior in economics.
UCE03C02.4	Be able to understand the impact various decisions or transactions will have on the company's statements and financial health.
UCE03C02.5	Be able to comfortably communicate with senior financial and non-financial leaders about financial statement issues and the financial impact of business decisions.

Table-2

1: Slight (L) 2: Moderate (M) 3: Substantial (H) 4.NO CORELATION-"-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE03C02.1	-	2	1	-	-	3	-	-	1	-	-	-
UCE03C02.2	-	3	2	1	-	2	-	2	2	-	3	2
UCE03C02.3	-	-	-	2	-	2	-	--	2	-	-	-
UCE03C02.4	-	3	2	1	-	-	-	1	-	-	3	-
UCE03C02.5	-	3	2	1	-	-	-	1	-	1	-	-
Total	**-**	**11**	**7**	**5**	**-**	**7**	**-**	**4**	**5**	**1**	**6**	**2**
Average	**-**	**2.2**	**1.4**	**1.0**	**-**	**1.4**	**-**	**0.8**	**1.0**	**0.2**	**1.2**	**0.4**
Eq Av Attainment	**-**	**2**	**1**	**1**	**-**	**1**	**-**	**1**	**1**	**0**	**1**	**0**

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE03C02.1	2	3
UCE03C02.2	3	2
UCE03C02.3	3	2
UCE03C02.4	3	3
UCE03C02.5	3	3
Total	**14**	**13**
Average	**2.80**	**2.60**
Equivalent Avg. Attainment	**3**	**3**

ENGINEERING GEOLOGY LABORATORY
(UCE03P01)

Total Credit: 01 **Contact Periods: 02 (0L+0T+2P)**

Courses Objective:

1. Types of rock (Igneous, Sedimentary, and Metamorphic), Civil engineering importance of rock forming minerals. Sedimentary processes (Weathering, erosion, deposition), Metamorphism and volcanic eruptions.
2. Types of Mass wasting, factors increasing instability and methods of stabilization.
3. Study ground water, factors affecting on the variation of water table depth. Methods of searching for ground water
4. To acquire practical knowledge on geology and on various types of rocks and minerals.

Course Content:

Unit-1

Megascopic Identification of minerals and rocks

Unit-2

Microscopic identification of some related minerals and rocks.

Unit-3

Interpretation of geological maps

(i) Drawing the geological selection of geological maps

(ii) Inter relation of geological maps and section with respect to subsurface structure

Unit-4

Problems of locating sites of dams, tunnels, highways.

Course Outcome:

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

1. Identify the main and most common igneous, sedimentary and metamorphic rocks encountered by foundations and construction.
2. To describe and interpret the geological structures in the geological maps and sections.
3. This course provides students the opportunity to expand their understanding of the application of geology by focusing the use of geological principles in the investigation of engineering project.
4. This course provides students with an insight into the role of engineering geology in major engineering projects, and as such, it also highlights the importance of such projects to society.
5. Students will also examine the role of a risk management approach to engineering projects and appreciate their legal and ethical responsibility in providing advice of such projects.
6. To distinguish the characteristics of the most important geological formations and problems that may arise in the various public works.

To establish the correlation between COs & POs

Table1

No. of Course Outcome (CO)	Course Outcome
UCE03P01.1	Identify the main and most common igneous, sedimentary and metamorphic rocks encountered by foundations and construction.
UCE03P01.2	To describe and interpret the geological structures in the geological maps and cross sections.
UCE03P01.3	This course provides students the opportunity to expand their understanding of the application of geology by focusing the use of geological principles in the investigation of engineering project.
UCE03P01.4	This course provides students with an insight into the role of engineering geology in major engineering projects, and as such, it also highlights the importance of such projects to society.
UCE03P01.5	Students will also examine the role of a risk management approach to engineering projects and appreciate their legal and ethical responsibility in providing advice of such projects.
UCE03P01.6	To distinguish the characteristics of the most important geological formations and problems that may arise in the various public works.

Table2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
UCE03P01.1	3	2	2	1	2	2	1	1	2	2	2	2
UCE03P01.2	2	2	2	2	2	2	2	2	2	2	2	2
UCE03P01.3	2	2	2	2	2	2	2	1	2	2	2	2
UCE03P01.4	3	2	2	2	1	2	1	1	2	2	2	3
UCE03P01.5	3	2	2	2	3	2	1	3	2	1	2	3
UCE03P01.6	3	3	2	2	2	3	1	2	2	1	3	2
Total	**16**	**13**	**12**	**11**	**12**	**16**	**7**	**10**	**12**	**10**	**13**	**14**
Average	**2.7**	**2.2**	**2.0**	**1.8**	**2.0**	**2.2**	**1.3**	**1.7**	**2.0**	**1.7**	**2.2**	**2.3**
Eq. Av Attainment	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**2**

To establish the correlation between COs &PSOs
Table 3

CO	PSO1	PSO2
UCE03P01.1	2	3
UCE03P01.2	2	2
UCE03P01.3	3	2
UCE03P01.4	1	3
UCE03P01.5	3	3
UCE03P01.6	1	2
Total	**12**	**15**
Average	**2**	**2.5**
Equivalent Avg. Attainment	**2**	**3**

FLUID MECHANICS LABORATORY

(UCE03P02)

Total Credit: 01 **Contact Periods: 02 (0L+0T+2P)**

Course Objectives:

1. Illustrate physical concepts of fluid flows and explore the fundamental principles of fluid mechanics through experiment.
2. Demonstrate and analyze hydraulic phenomena using hands-on physical devices
3. To help the students acquire knowledge about flow through pipes, open channel flows
4. Develop the ability for team work, ability to design, conduct experiments, analyze and interpret data.

Course Contents:

Unit-1

Calibration of V notch and rectangular notch; Venturimeter, Orifice meter,

Unit-2

Verification of Bernoulli's theorem,

Unit-3

Determination of friction factor of given pipe system for laminar flow & turbulent flow for single and multiple pipes,

Unit-4

Reynolds experiment: Establishment of laminar, transition & turbulent flows,

Unit-5

Characteristics of free and forced Vortex, measurement of velocity, Hydraulic jump.

Course Outcomes:

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

1. Able to determine fluid flow properties and understand Bernoulli's theorem experimentally.
2. Able to determine the coefficient of discharge of various notches and flow meters like venturimeter and orifice meter.
3. Apply the concept of fluid mechanics to design various pipe and open channel systems.
4. Able to determine energy losses in hydraulic jumps.
5. Understand the various flow conditions, flow characteristics in open channel flows.
6. Able to determine the loss of energy in different section of an open channel flow.

To establish the correlation between COs & POs

Table 1

No. of Course Outcome (CO)	Course Outcome
UCE03P02.1	Students will be able to determine fluid flow properties and understand Bernoulli's theorem experimentally.
UCE03P02.2	Students will be able determine the coefficient of discharge of various notches and flow meters like venturimeter and orifice meter.
UCE03P02.3	Students will be able to apply the concept of fluid mechanics to design various pipe and open channel systems.
UCE03P02.4	Students will be able to determine energy losses in hydraulic jumps
UCE03P02.5	Students will be able to understand the various flow conditions, flow characteristics in open channel flows.
UCE03P02.6	Students will be able to determine the loss of energy in different section of an open channel flow.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE03P02.1	2	1	1	3	2	1	2	1	2	1	2	2
UCE03P02.2	2	1	1	3	2	1	2	1	2	1	2	2
UCE03P02.3	2	1	1	3	2	1	2	1	2	1	2	2

UCE03P02.4	2	1	1	3	2	1	2	1	2	1	2	2
UCE03P02.5	2	1	1	3	2	1	2	1	2	1	2	2
UCE03P02.6	2	1	1	3	2	1	2	1	2	1	2	2
Total	**12**	**6**	**6**	**18**	**12**	**6**	**12**	**6**	**12**	**6**	**12**	**12**
Average	**2**	**1**	**1**	**3**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**2**
Equivalent Avg. Attainment	**2**	**1**	**1**	**3**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**2**

To establish the correlation between Cos & PSOs

Table 3

CO	PSO1	PSO2
UCE03P02.1	3	3
UCE03P02.2	3	3
UCE03P02.3	3	3
UCE03P02.4	3	3
UCE03P02.5	3	3
UCE03P02.6	3	3
Total	**18**	**18**
Average	**3**	**3**

CIVIL ENGINEERING DRAWING

(UCE03P03)

Total Credit: 1.5 **Contact Periods: 03 (0L+0T+3P)**

Courses Objective:

1. To read, understand and construct basic civil engineering drawing.
2. To understand fundamentals of structural drawing.
3. To draw plan, elevation and section of different civil Engineering structures.
4. To understand different recommendations related to different civil Engineering structures.

Course Content:

Drawings Related to Different Building Elements:

Following drawings are to be prepared for the data given

a) Cross section of Foundation, masonry wall, RCC columns with isolated footings.

b) Different types of bonds in brick masonry

c) Different types of staircases – Dog legged, Open well

d) Lintel and chajja

e) RCC slabs and beams

f) Cross section of a pavement

g) Septic Tank and sedimentation Tank

h) Layout plan of Rainwater recharging and harvesting system

i) Cross sectional details of a road for a Residential area with provision for all services

Building Drawings:

Principles of planning, Planning regulations and building bye-laws, factors affecting site selection, Functional planning of residential and public buildings, design aspects for different public buildings. Recommendations of NBC. Drawing of Plan, elevation and sectional elevation including electrical, plumbing and sanitary services for:

1. Single and Double story residential building

2. Hostel building

3. Hospital building

4. School building

Course Outcome:

1. Students will able to know how to draw layout of plan considering building by-laws, elevation and section drawing for single storey building and masonry- closers and bats. ,
2. Students will able to know how to draw double storey residential building with dog legged stairs.
3. Students will able to get the idea of drawing School building, library building (plan, elevation and section), pavement, Septic Tank and sedimentation Tank and Rainwater recharging and harvesting system.
4. Students will able to get the idea of drawing primary health centre
5. Students will able to use modern graphic tools to draw various types of building drawings, Prepare report and able to present it.

To establish the correlation between COs &POs

Table 1

No. of Course Outcome(CO)	Course Outcome
UCE03P03.1	Students will able to know how to draw layout of plan considering building by-laws, elevation and section drawing for single storey building and masonry- closers and bats.
UCE03P03.2	Students will able to know how to draw double storey residential building with dog legged stairs.
UCE03P03.3	Students will able to get the idea of drawing School building, library building (plan, elevation and section), pavement, Septic Tank and sedimentation Tank and Rainwater recharging and harvesting system.
UCE03P03.4	Students will able to get the idea of drawing primary health centre.
UCE03P03.5	Students will able to use modern graphic tools to draw various types of building drawings, Prepare report and able to present it.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 4. No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
UCE03P03.1	2	2	2	2	2	1	1	1	2	1	1	3
UCE03P03.2	2	2	2	2	2	1	1	1	2	2	1	3
UCE03P03.3	3	2	2	2	2	1	1	1	1	2	2	3
UCE03P03.4	2	2	2	2	2	1	1	1	1	1	1	3
UCE03P03.5	2	2	2	2	2	1	1	1	1	1	1	3
Total	**11**	**10**	**10**	**10**	**10**	**5**	**5**	**5**	**7**	**7**	**6**	**15**
Average	**2.2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1.4**	**1.4**	**1.2**	**3**
Eq. Avg. Attainment	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**3**

To establish the correlation between COs &PSOs

Table 3

CO	PSO1	PSO2
UCE03P03.1	3	3
UCE03P03.2	3	3
UCE03P03.3	2	3
UCE03P03.4	3	3
UCE03P03.5	2	3
Total	**13**	**15**
Average	**2.6**	**3**
Equivalent Avg. Attainment	**3**	**3**

DETAIL
COURSE CURRICULUM

FOR

UNDERGRADUATE PROGRAMME
B.TECH

IN

CIVIL ENGINEERING
(4th SEMESTER)

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA
TRIPURA (WEST)

STRUCTURAL ANALYSIS-I
(UCE04B01)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objectives:

1. To obtain fundamental understanding of different type of structures and their characteristics based on which their analysis procedures are determined.
2. To understand different analysis procedures of plane determinate truss.
3. To obtain an understanding on the strain energy stored in the structures due to different type of stress resultants and to use this concept to determine structural deflection by using different methods.
4. To obtain an understanding on rolling load and influence line diagram for determinate and indeterminate structures.
5. To understand different methods for analysis of Cable, Arch, indeterminate beams and simple framed structures.

Course Content:

Unit-1

Introduction: Classification of Structures, Stress resultants, Static and Kinematic Indeterminacy.

Analysis of Plane Truss: Classification of Pin jointed Determinate Trusses, Analysis of determinate plane Trusses by method of joints and sections.

Unit -2

Strain Energy: Strain energy due to axial load, bending and shear, theorem of minimum potential energy, principle of virtual work, law of conservation of energy, 1stand 2ndCastiglione's Theorem, Betti's & Maxwell's reciprocal theorem, Deflection of Beams using Strain Energy Method and Unit load method.

Rolling Load and Influence Lines: Rolling loads, influence line diagram (ILD) for beams and trusses, absolute maximum bending moment.

Unit -3

Analysis of Arches and Cables: Analysis of Arches, three hinged parabolic arch, moving loads & influence lines. Analysis of Cables under point loads and UDL, analysis of Suspension bridges.

Unit -4

Indeterminate Structures- Compatibility Methods: Analysis of Fixed beam, Continuous beam and simple frames with and without translation of joints by method of Consistent Deformation. Three moments Theorem for continuous beams, Analysis of Propped Cantilever, Two-hinged Arches.

Unit -5

Beams curved in elevation and plan, bending and torsion in horizontally curved beam, calculation of deflection using Castigliano's method.

References:-

Sl. No.	Name of Book	Author	Publisher
1.	Structural Analysis, Fifth Edition	Aslam Kassimali	CENGAGE Learning, USA
2.	Basic Structural Analysis	Reddy, C. S.	Tata McGraw Hill
3.	Elementary Structural Analysis	Norris and Wilbur	Tata McGraw-Hill
4.	Theory & Analysis of Structures Vol. I&II	Jain, O. P. and Jain B. K.	Nem Chand &Bors.,Roorkee, India
5.	Structural Analysis	Coates, R. C., Coutie, M. G. & Kong, F. K.	English Language & Book Society & Nelson
6.	Structural Analysis	Ghali, A & Neville, M.	Chapman & Hall
7	Structural Analysis vol – I & II	Devdas Menon	Alpha Science

Course Outcome:

1. Students will be able to classify different type of structures.
2. Students will be able to determine the stress resultants, degrees of freedom, static and kinematic indeterminacy of a structure.
3. Students will be able to analyze a plane determinate truss.
4. Students will be able to derive the expression of strain energy of a structural component due to different stress resultants and also the deflection of beams from the strain energy function.
5. Students will be able to draw the influence line diagrams for determinate and indeterminate structures.
6. Students will be able to analyze indeterminate beams and simple plane frames by applying different method of analysis.

To establish the correlation between COs & POs

Table 1

No of Course Outcome (CO)	Course Outcome
UCE04B01.1	Students will be able to classify different type of structures.
UCE04B01.2	Students will be able to determine the stress resultants, degrees of freedom, static and kinematic indeterminacy of a structure.
UCE04B01.3	Students will be able to analyze a plane determinate truss.
UCE04B01.4	Students will be able to derive the expression of strain energy of a structural component due to different stress resultants and also the deflection of beams from the strain energy function.
UCE04B01.5	Students will be able to draw the influence line diagrams for determinate and indeterminate structures.
UCE04B01.6	Students will be able to analyze indeterminate beams and simple plane frames by applying different method of analysis.

To establish the correlation between COs & POs

Table 2

CORRELATION LEVELS:

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: -**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE04B01.1	2	2	-	1	-	-	-	-	-	-	-	1
UCE04B01.2	3	1	-	1	1	-	-	-	-	-	-	1
UCE04B01.3	3	2	-	1	1	-	-	-	-	-	-	1
UCE04B01.4	3	2	-	1	1	-	-	-	-	-	-	1
UCE04B01.5	3	2	-	1	1	-	-	-	-	-	-	1
UCE04B01.6	3	2	1	1	1	-	-	-	-	-	-	1
Total	**17**	**11**	**1**	**6**	**5**	-	-	-	-	-	-	**6**
Average	**2.83**	**1.83**	**0.16**	**1**	**0.83**	-	-	-	-	-	-	**1**
Equivalent Avg. Attainment	**3**	**2**	**0**	**1**	**1**	-	-	-	-	-	-	**1**

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
UCE04B01.1	2	2
UCE04B01.2	2	3
UCE04B01.3	2	1
UCE04B01.4	3	2
UCE04B01.5	2	3
UCE04B01.6	3	3
Total	**14**	**14**
Average	**2.33**	**2.33**
Equivalent Avg. Attainment	**2**	**2**

DESIGN OF STRUCTURES- I

(UCE04B02)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To know about the working stress, ultimate strength and limit state method of design, I.S. specifications.
2. To analysis and Design of Sections in Bending and torsion
3. To know how to design Columns, slabs and staircase, Footing.
4. To know bond, anchorage and side face reinforcement of structure.

Course Content:

Unit-1

Introduction to Limit State Design and Serviceability: Introduction to working stress method, Difference between Working stress and Limit State Method of design, Modular Ratio and Factor of Safety. Philosophy and principle of limit state design with assumptions. Partial Safety factors, Characteristic load and strength. Stress block parameters, concept of balanced section, under reinforced and over reinforced section.

Unit -2

Limiting deflection, short term deflection, long term deflection, Calculation of deflection of singly reinforced beam only. Cracking in reinforced concrete members, calculation of crack width of singly reinforced beam. Side face reinforcement, slender limits of beams for stability.

Unit -3

Limit State Analysis of Beams: Analysis of singly reinforced, doubly reinforced and flanged beams for flexure and shear.

Limit State Design of Beams: Design of singly and doubly reinforced beams, Design of flanged beams for shear, design for combined bending and torsion as per IS-456.

Unit -4

Limit State Design of Slabs and Stairs: Introduction to one way and two way slabs, Design of cantilever, simply supported and one way continuous slab. Design of two way slabs for different boundary conditions. Design of dog legged and open well staircases. Importance of bond, anchorage length and lap length.

Unit -5

Limit State Deign of Columns and Footings: Analysis and design of short axially loaded RC column. Design of columns with uniaxial and biaxial moments, Design concepts of the footings. Design of Rectangular and square column footings with axial load and also for axial load & moment.

References:-

Sl No.	Name of Book	Author	Publisher
1	Reinforced Concrete Design	Unnikrishnan Pillai and Devdas Menon	McGraw Hill, New Delhi
2	Design of Concrete Structures	Subramanian	Oxford university Press
3	Reinforced Concrete Vol. 1 (Elementary Reinforced Concrete)	H J Shah	Charotar Publishing House Pvt. Ltd.
4	Limit State design of reinforced concrete	P C Varghese	PHI, New Delhi
5	Reinforced Concrete Design	W H Mosley, R Husle, J H Bungey	MacMillan Education, Palgrave publishers
6	Reinforced and Pre-Stressed Concrete	Kong and Evans	Springer Publications
7	Introduction to Design for Civil Engineers	A W Beeby and Narayan R S	CRC Press
8	Reinforced Concrete Structures	Robert Park and Thomas Paulay	John Wiley & Sons, Inc.

Course Outcome:

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

1. Understand Design Philosophy and classification of it and which design method is the most useful one in which condition.
2. Know the several types of structural members and their uses in Civil Engineering field.
3. Know about I.S. Codes which are used for design.
4. Design various members (such as beams, columns, slabs, staircase, footing etc.) in several environmental conditions.
5. To know the torsional effects in analysis of different structural components of structures like beams, columns etc.

To establish the correlation between COs & POs

Table 1

No of course outcome (CO)	Course Outcome
UCE04B02.1	Understand Design Philosophy and classification of it and which design method is the most useful one in which condition
UCE04B02.2	Know the several types of structural members and their uses in Civil Engineering field
UCE04B02.3	Know about I.S. Codes which are used for design
UCE04B02.4	Design various members (such as beams, columns, slabs, staircase, lintel etc.) in several environmental condition
UCE04B02.5	To know the torsional effects in analysis of different structural components of structures like beams, columns etc

Table 2

CORRELATION LEVELS:

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE04B02.1	3	2	2	2	2	3	3	3	3	2	1	3
UCE04B02.2	3	2	2	2	2	3	3	3	3	2	1	2
UCE04B02.3	3	3	2	2	2	3	3	3	3	2	1	3
UCE04B02.4	3	3	2	2	2	3	3	3	2	2	1	3
UCE04B02.5	3	3	3	3	3	3	3	3	3	2	1	2
UCE04B02.6	3	3	3	2	2	1	1	1	3	1	1	2
TOTAL	**15**	**16**	**14**	**13**	**13**	**16**	**16**	**16**	**17**	**11**	**6**	**15**
AVERAGE ATTAINMENT	**2.5**	**2.6**	**2.8**	**2.1**	**2.1**	**2.6**	**2.6**	**2.6**	**2.8**	**1.8**	**1**	**2.5**
EQUIVALENT AVARAGE ATTAINMENT	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**3**

To establish the correlation between Cos & PSOs

Table 3

CO	PSO1	PSO2
UCE04B02.1	4	2
UCE04B02.2	4	3
UCE04B02.3	3	3
UCE04B02.4	3	2
UCE04B02.5	4	2
UCE04B02.6	4	2
TOTAL	**22**	**14**
AVERAGE ATTAINMENT	**3.6**	**2.3**
EQUIVALENT AVARAGE ATTAINMENT	**4**	**2**

DATA STRUCTURES AND NUMERICAL METHODS
(UCE04B03)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To develop the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques.
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To obtain an understanding of different methods for solving polynomials, trigonometric, linear simultaneous and transcendental equations which also include knowledge about the error that might be encountered.
5. To obtain an understanding on the different methods of numerical differentiation, numerical integration and linear & nonlinear regression analysis.
6. To obtain basic understanding of writing computer codes corresponding to the numerical methods learned in either of C or C++ or FORTRAN languages.

Course Content:

Unit-1

Introduction: Definition, Interrelationship of Data structure and algorithms, Abstract Data Types.

Arrays: Representation of arrays and concepts on different types of array.

Stacks and Queues: Fundamental of stacks and queues.

Unit-2

Link Lists: Concepts on Singly linked list doubly linked.

Trees: Binary trees and its representation arrays, Tree traversals (preorder, in order, and post order).

Sorting and Searching: Concepts on different Types of Sorting and Searching Techniques.

Object Oriented Programming: Concepts of object oriented programming.

Unit-3

Approximations and round off errors, Truncation errors, determination of roots of polynomials and transcendental equations by Newton-Rapson method, Bisection method and Secant method.

Unit-4

Solutions of linear simultaneous linear algebraic equations by Gauss Elimination, and Gauss-Siedel iteration methods. Curve fitting- linear and nonlinear regression analysis. Backward, Forward and Central difference relations and their uses in Numerical differentiation and integration.

Unit-5

Numerical solution of ordinary differential equations by Euler, Modified Euler, Runge-Kutta and Predictor-Corrector method. Numerical integration by Trapezoidal rule, Simpson's rule and Gauss quadrature methods. Programming for the numerical methods mentioned above using either of C or C++ or FORTRAN languages.

Reference:-

Sl No.	Name of Book	Author	Publisher
1.	Data Structure	S. Lipschutz	Schaum's Outline Series, TataMcGraw-Hill
2.	Data Structure	Tannenbaum	PHI
3.	An Introduction To Data Structures With Applications,	Tremblay J.P. and Sorenson P.J	Tata Mcgraw Hill
4.	Fundamentals of Data Structures	Horowitz S. and Sahani S.	Computer Science Press.
5.	Numerical Methods	Shastry S.S	Prentice Hall Inc India.
6.	Numerical Methods	Nobel Ben.	New York International Publications.
7.	Numerical Methods For Engineering	Station Ralph G.	Englewood CliffsN.J.,Prentice Hall Inc.,

Course Outcome:

1. Students will be able to analyze algorithms and correctness of algorithms.
2. Students will be able to summarize searching and sorting techniques.
3. Students will be able to describe stack, queue and linked list operation.
4. Students will be able to solve polynomials, trigonometric, transcendental equations and simultaneous linear algebraic equations by various methods considering errors that may come in the result.

5. Students will be able to solve differential equations and perform integration numerically using different methods.
6. Students will be able to write complete computer programs corresponding to different numerical techniques learned in the course and represent the resulting data in a comprehensive manner.

To establish the correlation between Cos & POs

Table 1

No of course outcome (CO)	Course Outcome
UCE04B03.1	Students will be able to analyze algorithms and correctness of algorithms.
UCE04B03.2	Students will be able to summarize searching and sorting techniques.
UCE04B03.3	Students will be able to describe stack, queue and linked list operation.
UCE04B03.4	Students will be able to solve polynomials, trigonometric, transcendental equations and simultaneous linear algebraic equations by various methods considering errors that may come in the result.
UCE04B03.5	Students will be able to solve differential equations and perform integration numerically using different methods.
UCE04B03.6	Students will be able to write complete computer programs corresponding to different numerical techniques learned in the course and represent the resulting data in a comprehensive manner.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE04B03.1	3	3	2	2	1	-	-	-	-	-	-	1
UCE04B03.2	3	3	3	2	2	-	-	-	-	-	-	1
UCE04B03.3	3	3	2	1	1	-	-	-	-	-	-	1
UCE04B03.4	3	3	2	1	2	1	-	-	-	-	-	1
UCE04B03.5	3	3	3	2	1	-	-	-	-	-	-	1
UCE04B03.6	3	3	2	2	1	1	-	-	-	-	-	1
Total	**18**	**18**	**14**	**10**	**8**	**2**	**-**	**-**	**-**	**-**	**-**	**6**
Average	**3**	**3**	**2.33**	**1.67**	**1.33**	**0.33**	**-**	**-**	**-**	**-**	**-**	**1**
Equivalent Avg. Attainment	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

To establish the correlation between Cos & PSOs

Table 3

CO	PSO1	PSO2
UCE04B03.1	3	2
UCE04B03.2	3	2
UCE04B03.3	3	3
UCE04B03.4	3	2
UCE04B03.5	3	2
UCE04B03.6	3	3
Total	**18**	**14**
Average	**3**	**2.33**
Equivalent Avg. Attainment	**3**	**2**

BUILDING MATERIALS, CONSTRUCTION AND SERVICES

(UCE04B04)

Total Credit: 03 **Contact Periods: 03 (3L+0T+0P)**

Courses Objective:

1. To obtain fundamental knowledge of different building materials used for the construction of Civil Engineering Structures.
2. To understand different building rules and laws for building construction.
3. To learn about the components of concrete, mix design, and selection of cement types for construction of specific structures.
4. To get the idea of various equipment used for building construction and services.

Course Content:

Unit-1

Building Materials: Basic materials: Bricks, Stone, Timber, Plywood and Steel.

Cement and admixtures: Types of Portland cement-hydration-setting and hardening process-Special hydraulic cement- Chemical and mineral admixtures.

Aggregates: Shape and texture-bond strength-specific gravity-bulk density and moisture content of aggregates-bulking of sand-deleterious substances in aggregates-alkali- aggregate-reaction-sieve analysis and grading curves-fineness modulus-practical grading-gap grades aggregates.

Unit -2

Fresh Concrete: Rheological aspects such as workability– flow ability, compatibility and mobility of concrete- factors affecting workability- Determination of workability, segregation-bleeding& laitance.

Strength of concrete: Compressive strength and factors affecting it -behaviors of concrete under various stress states – testing of hardened concrete – cube and cylindrical test-platen affect-flexure test-splitting test, stress strain relation and modulus of elasticity-shrinkage-creepof concrete and its effect.

Unit -3

Non-destructive test such as rebound hammer, USPV, core cutting.

Durability of concrete: Corrosion of rebar's, sulphate attack, frost action, deterioration by fire, concrete in sea water, acid attack and carbonation.

Mix-Design: Basic consideration-cost-workability-strength and durability, method of mix design and acceptance criteria of mix design.

Advances in construction materials: High strength concrete, High performance concrete, Fiber reinforced concrete, Concrete containing polymers, Heavy weight and light weight concrete.

Unit -4

Building Construction:

Masonry: Brick Masonry, Stone Masonry, Bonds, Types of walls, partition and cavity walls

Floors and Roofs: Types of floors, Construction details and selection criteria, Types of roof and roof covering, Treatment for water proofing.

Doors and windows: Sizes and locations, Materials.

Painting: Classification, composition and uses.

Temporary construction: Shuttering, Scaffolding and centering.

Unit -5

Services: Water Supply and Drainage: Plumbing in buildings, Water supply in high rise buildings, Hot water supply, sanitary fittings and house drainage system, Refuse disposal from individual house and high rise buildings.

Acoustics: Criteria and terminology, acoustics auditorium and classroom.

Other services: Air-conditioning and ventilation in industrial houses and public buildings, firefighting arrangements in houses and high rise buildings, Electrical services and Electrical installation and wirings.

Reference:-

Sl No.	Name of Book	Author	Publisher
1.	A text book of Building Construction.	Arora, S.P., Bindra, S.P.	Dhanpat Rai and Sons.
2.	Building Construction.	Jha, J & Sinha, S.K.	Khanna Publishers, Delhi.
3.	A text Book of Engineering Materials.	Kulkarni, C.J.	Ahmedabad Book Depot,Ahmedabad.

Course Outcome:

1. Students will be able to know the use of different materials and their quality for building construction and services.
2. The students will be learn about mix designs and also the beneficial use of admixtures.
3. The students will be able to understand compressive strength characteristics of concrete, factors affecting strength of concrete and also can check the quality of harden concrete.
4. The students will be learn about different types of roof, roof covering and their construction details and selection criteria.
5. The students will be gain knowledge of water supply and drainage system required for construction of houses and public buildings.
6. The students will be familiar with the measures required for air-conditioning and ventilation in industrial houses and public buildings and firefighting arrangements.

To establish the correlation between COs & POs
Table 1

No. of Course Outcome (CO)	Course Outcome
UCE04B04.1	Students will be able to know the use of different materials and their quality for building construction and services.
UCE04B04.2	The students will be learn about mix designs and also the beneficial use of admixtures.
UCE04B04.3	The students will be able to understand compressive strength characteristics of concrete, factors affecting strength of concrete and also can check the quality of harden concrete.
UCE04B04.4	The students will be learn about different types of roof, roof covering and their construction details and selection criteria.
UCE04B04.5	The students will be gain knowledge of water supply and drainage system required for construction of houses and public buildings.
UCE04B04.6	The students will be familiar with the measures required for air-conditioning and ventilation in industrial houses and public buildings and firefighting arrangements.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE04B04.1	2	2	2	1	1	2	2	2	2	1	2	2
UCE04B04.2	3	2	3	2	2	2	2	2	3	1	2	3
UCE04B04.3	3	2	3	1	2	2	1	2	1	1	2	2
UCE04B04.4	2	2	1	2	1	2	2	2	1	1	2	2
UCE04B04.5	1	2	2	1	1	2	2	2	1	1	2	3
UCE04B04.6	1	2	2	1	2	2	3	2	2	1	2	3
Total	**12**	**12**	**13**	**8**	**9**	**12**	**12**	**12**	**10**	**6**	**12**	**15**
Average	**2**	**2**	**2.17**	**1.33**	**1.5**	**2**	**2**	**2**	**1.67**	**1**	**2**	**2.5**
Equivalent Avg. Attainment	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**3**

To establish the correlation between Cos & PSOs

Table 3

CO	PSO1	PSO2
UCE04B04.1	2	2
UCE04B04.2	3	2
UCE04B04.3	3	2
UCE04B04.4	2	2
UCE04B04.5	3	2
UCE04B04.6	2	2
Total	**15**	**12**
Average	**2.5**	**2**
Equivalent Avg. Attainment	**3**	**2**

SURVEYING

(UCE04B05)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To understand the field information to be collected before starting any project work.
2. To understand essentials related to field data collection etc.
3. To study the different methods of surveying and levelling.
4. To study the advanced surveying techniques and to use advanced surveying instruments.

Course Content:

Unit-1

Introduction and basic concepts: Introduction, classification of surveying, Principles.

Linear Measurements: Chain & Tape.

Chain Surveying, Principle, offsets, basic problem in chaining, Obstacles in chaining

Compass Surveying: Principle, Bearings, Magnetic declination, Local attraction, Error in compass surveying.

Unit-2

Levelling: Introduction, definition, basic terms, instruments, Permanent adjustment of Level, Method of Levelling. Digital leveling instrument.

Unit-3

Area and Volumes: Area from field measurements, Area from plans, Planimeter, Area of cross-section, Measurement of volumes, Mass diagram.

Theodolite Surveying: Introduction, Types of Theodolite, Temporary adjustments, Measurement of various angels, Fundamental lines and desire relations, Sources of Error in theodolite work. Permanent adjustment of Theodolite, Traversing, Balancing of traverse, Calculation of traverse area.

Unit-4

Contouring: Definition, uses, characteristics, Method of contouring, Contour Gradient, Ghat tracer.

Trigonometrically levelling: Introduction, Base of the object accessible, Base of the object inaccessible.

Curve: Introduction, Classification, Elements of curves and notation, Designation of curve, setting of horizontal and vertical curve.

Unit-5

Introduction advanced surveying techniques, GPS, GIS and Total Station.

Reference:-

Sl No.	Name of Book	Author	Publisher
1	Surveying Vol. I & II	Agor, R.	Khanna publications
2	Surveying Vol. I & II	Arora, K.R	Standard Book House
3	Solving Problems in Surveying	Bannister	Longman
4	Engineering Surveying Technology	A. and Baker, R Bannister A. and Baker, R	Khanna publications Delhi,
5	Surveying Vol. I & II	Punmia, B.C	Laxmi publications Delhi,.
6	Surveying I, II	Kanetkar, T.P.	Pune Vidyarthi Griha Prakashan.

Course Outcome:

1. Students will be able to understand parameters to be collected from field.
2. Students will be given a broad idea regarding different parameters related to field survey.
3. Students will be given a broad idea regarding different methods of surveying and their uses.
4. Students will be able to analyze data collected after surveying and levelling.
5. Students will be able to conduct survey for any project.

To establish the correlation between COs & POs

Table1

No. of Course Outcome (CO)	Course Outcome
UCE04B05.1	Students will be able to understand parameters to be collected from field.
UCE04B05.2	Students will be given a broad idea regarding different parameters related to field survey.
UCE04B05.3	Students will be given a broad idea regarding different methods of surveying and their uses.
UCE04B05.4	Students will be able to analyze data collected after surveying and levelling.
UCE04B05.5	Students will be able to conduct survey for any project.

Table 2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and '-' for NO CORELATION

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE04B05.1	2	2	2	2	-	1	1	2	2	-	2	2
UCE04B05.2	2	2	2	2	-	1	1	2	2	-	2	2
UCE04B05.3	2	2	2	2	-	1	1	2	2	-	2	2
UCE04B05.4	2	2	2	2	2	1	-	2	1	-	-	2
UCE04B05.5	2	2	2	2	-	1	1	2	2	-	2	2
Total	**10**	**10**	**10**	**10**	**2**	**5**	**4**	**10**	**9**	**-**	**8**	**10**
Average	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**1.8**	**-**	**2**	**2**
Eq. Av Attainment	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**-**	**2**	**2**

To establish the correlation between Cos & PSOs

Table 3

CO	PSO1	PSO2
UCE04B05.1	3	3
UCE04B05.2	3	3
UCE04B05.3	3	3
UCE04B05.4	3	3
UCE04B05.5	3	3
Total	**18**	**18**
Average	**3**	**3**
Equivalent Avg. Attainment	**3**	**3**

H.S.S ELECTIVE
MANAGEMENT AND MANAGERIAL ECONOMICS
(UCE04E01)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To make the Engineering student know about the basic concepts, functions, principles and techniques of management and their application, which complement the technical skills to execute their capabilities successfully.

2. To make the Engineering student know about the basic concepts of finance in carrying out any project

Course Content:

Unit-1

Basic Concepts and Functions of Management: Planning, Nature, Purpose and Objectives of Planning, Organizing: Nature and Purpose, Authority and Responsibility, Stuff bug, Supply of Human Resources, Performance Appraisal, and Controlling: System and Process of Controlling, Control Techniques.

Unit -2

Human Resources Management & Marketing Management: Nature and scope of human Resource Planning, Training and development, Recruitment and Selection, Career Growth, Grievances, Motivation and its type, Needs for Motivation, Reward and punishment, Models of Motivation, Leaders: Kinds of Leader, Leadership styles, Roles and Function of Leaders, Conflict Management, Kinds and cause of Conflict, Settlement of Conflict, Group and Team Working, Organizational Design and Development.

Unit -3

Marketing Environment: Consumer Markets and Buyer Behavior Marketing Mix, Advertising and Sales Promotion, Channels of Distribution.

Financial Management: Need of finance, kinds and sources of capital shares and debentures, fixed and working capital, capital structure of a firm, operating and financial leverage, EBIT and EPS analysis, and financial ratio analysis: users and natures, liquidity coverage ratios, practical problems.

Unit -4

Investment decisions and forecasting of working capital: Kinds of capital Budgeting decisions, evaluation of proposals, capital discounting and Non-discounting based methods. Practical problem, definition and importance of working capital. Working capital operating cycle, factors affecting working capital, inventory management, introduction to cash and receivables managements, practical problems.

Cost and Cost control: Elements of costs, types of cost – Direct and indirect, variable and fixed, labour cost, material cost, overhead cost. Cost control technique, budget- meaning, kinds, budgetary control, break even analysis, Practical problems.

Basic Concepts and Economic forecasting: Introduction, definition, meaning, subject matter and scope of business economics or managerial economics. Demand analysis and forecasting. Demand estimation methods.

Unit -5

Game theory and Pricing: Game theory and strategic behavior, pricing: determinants of price, pricing under different market structures, perfect competition, monopoly and monopolistic competition, pricing method in practice, peak load crisis, cost plus or markup pricing.

Risk and capital Budgeting: Risk and decision making, risk management, Decision Tree analysis, Capital budgeting: meaning, process, the cost of capital, mergers and acquisitions, evaluation of investment decisions, Break Even analysis.

Reference:-

Sl No.	Name of Book	Author	Publisher
1.	Financial Management,	M.Y.Khan and P.K.Jain,	Tata McGraw Hill,
2.	Fundamental of business Organisation and Management.	Y.K.Bhusan	S.Chand and Sons.
3.	Marketing Management	Plilip Kotler	Prentice Hall of India.
4.	Human Resource And Management.	Fred Luthans	Tata McGraw Hill.
5.	Organisational Behavior. Concepts, Controversies, and Applications.	Stephen P. Rabbins	Prentice Hall, New Gersy
6.	Managerial Economics.	Suma Damodaran	Oxford University Press
7.	Managerial Economics.	D.N.Dwivedi's	Vikash Publishing house Pvt. Ltd.

Course Outcome:

1. Be able to understand the principles of management and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
2. Be able to make a plan how to organize, control and motivate people.
3. Be able to understand the Cost analysis in the context of short and long term decision making and the use of discounted cash flow analysis.
4. Be able to identify and explain economic concepts and theories related to the markets, industry and firm structures.
5. Be able to pursue the larger objectives of the firm besides profit maximization.

To establish the correlation between COs &POs
Table 1

No. of Course Outcome(CO)	Course Outcome
UCE04E01.1	Be able to understand the principles of management and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
UCE04E01.2	Be able to make a plan how to organize, control and motivate people.
UCE04E01.3	Be able to understand the Cost analysis in the context of short and long term decision making and the use of discounted cash flow analysis.
UCE04E01.4	Be able to identify and explain economic concepts and theories related to the markets, industry and firm structures.

UCE04E01.5	Be able to pursue the larger objectives of the firm besides profit maximization.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE04E01.1	-	2	1	-	-	2	-	1	3	-	2	-
UCE04E01.2	-	2	1	1	-	2	-	2	3	2	-	-
UCE04E01.3	-	3	1	1	-	-	-	1	-	-	3	-
UCE04E01.4	-	2	1	2	-	2	-	1	-	-	-	-
UCE04E01.5	-	2	1	1	-	1	-	1	-	-	-	-
Total	**-**	11	5	5	-	7	-	6	6	2	5	**-**
Average	**-**	**2.2**	**1**	**1.25**	**-**	**1.75**	**-**	**1.2**	**3**	**1**	**2.5**	**-**
Equivalent Avg. attainment	**-**	2	1	1	-	2	-	1	3	1	3	**-**

To establish the correlation between COs &PSOs

Table 3

CO	PSO1	PSO2
UCE04E01.1	2	2
UCE04E01.2	2	2
UCE04E01.3	2	2
UCE04E01.4	2	2
UCE04E01.5	2	2
Total	**10**	**10**
Average	**2**	**2**
Equivalent Avg. Attainment	**2**	**2**

MATERIAL TESTING LABORATORY

(UCE04P01)

Total Credit: 01 **Contact Periods: 02 (0L+0T+2P)**

Course Objective:

1. Determination of Fineness and Specific Gravity of cement, coarse aggregate and fine aggregate.
2. Determination of consistency, initial and Final Setting times of standard Cement Paste.
3. Determination of Compressive, tensile and flexural Strength of Cement
4. Soundness test of cement.
5. Mix Design: IS Code method and workability of cement by slump test and compaction factor test.
6. Determination of percentage of voids, Bulk density, moisture content and water absorption of coarse and Fine Aggregates.
7. Preparing and curing concrete specimens for tests & Determination of compressive strength of concrete cubes.
8. Study of stress - strain characteristics of concrete and tests for tensile strength of concrete.
9. Water absorption and compressive strength of bricks.
10. Tensile and bend test of M.S. and HYSD bars.

Course Content:

Unit-1

Fineness of cement by sieving.

Unit-2

Water content for standard consistency of cement.

Unit-3

Initial and final setting times of cement.

Unit-4

Fineness of cement by air permeability method.

Unit-5

Soundness of Cement by Le-Chatalier's Apparatus.

Unit-6

Soundness of cement by Autoclave test method.

Unit-7

Compressive strength of cement.

Unit-8

Tensile strength of cement.

Unit-9

Moisture content and bulking of fine aggregate.

Unit-10

Gradation & Fineness modulus of coarse and fine aggregates.

Unit-11

Crushing Strength test of Coarse aggregate.

Unit-12

Soundness Test of Coarse Aggregate.

Unit-13

Water absorption, compressive strength of Bricks.

Unit-14

Workability of cement concrete by (a) Slump test and (b) compaction factor test.

Unit-15

Concrete mix design for a given concrete strength and slump by I.S. Code method.

Unit-16

Flexural strength of concrete.

Unit-17

Tensile and bend test of M.S and HYSD bar.

Course Outcome:

1. Understand the physical and engineering properties of ingredients of concrete i.e. cement, fine aggregate and coarse aggregate.
2. Understand the engineering property of mild steel and HYSD bars.
3. Conduct Quality Control tests on fresh & hardened concrete.
4. Design of concrete mix.
5. Identify the class of brick by conducting compressive strength test, water absorption.

To establish the correlation between COs &POs

Table 1

No. of Course Outcome(CO)	Course Outcome
UCE04P01.1	Understand the physical and engineering properties of ingredients of concrete i.e. cement, fine aggregate and coarse aggregate.
UCE04P01.2	Understand the engineering property of mild steel and HYSD bars.
UCE04P01.3	Conduct Quality Control tests on fresh & hardened concrete.
UCE04P01.4	Design of concrete mix.
UCE04P01.5	Identify the class of brick by conducting compressive strength test, water absorption test etc.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE04P01.1	3	-	3	3	1	2	-	3	3	-	2	3
UCE04P01.2	3	-	3	3	2	2	-	3	3	-	2	3
UCE04P01.3	3	-	3	3	3	2	-	3	3	-	2	3
UCE04P01.4	3	-	3	3	2	2	-	3	3	-	2	3
UCE04P01.5	3	-	3	3	3	2	-	3	3	-	2	3
Total	**15**	**-**	**15**	**15**	**11**	**10**	**-**	**15**	**15**	**-**	**10**	**15**
Average	**3**	**-**	**3**	**3**	**2.2**	**2**	**-**	**3**	**3**	**-**	**2**	**3**
Equivalent Avg. attainment	**3**	**-**	**2**	**3**	**2**	**3**	**-**	**3**	**3**	**-**	**2**	**3**

To establish the correlation between COs &PSOs

Table 3

CO	PSO1	PSO2
UCE04P01.1	3	3
UCE04P01.2	3	3
UCE04P01.3	3	3
UCE04P01.4	3	3
UCE04P01.5	3	3
Total	**3**	**20**
Average	**3**	**3.33**
Equivalent Avg. Attainment	**3**	**3**

SURVEYING FIELD WORKS

(UCE04P02)

Total Credit: 02 **Contact Periods: 04 (0L+0T+4P)**

Course Objective:

1. To obtain knowledge about the methods of measurements in lateral and vertical directions manually and digitally.
2. To obtain the idea about terrain condition of site by using different methods.
3. To obtain knowledge about coordinates of different locations by using suitable method.
4. To understand the concept of curve setting on roads.

Course Content:

Unit-1

Chain Surveying and Compass Surveying.

Unit-2

Levelling and Contouring.

Unit-3

Plane Table Surveying including Two- and Three-point Problems.

Unit-4

Theodolite Traversing and Topographic Mapping (i.e. plotting of the details of well contour area).

Unit-5

Curve Setting and Tangential Tacheometry.

Unit-6

Use of Hand GPS and Total Station.

Course Outcome:

1. Students will be able to learn lateral distance measurement by using chain and compass surveying methods.
2. Students will be able to understand the use of levelling and contouring methods for measuring vertical heights and terrain conditions respectively.
3. Students will be able to know the concept of plane table surveying for the measurement of area with plenty of details.
4. Students will be able to understand the use of theodolite traversing and topographic mapping.
5. Students will be able to know the method of curve setting and Tangential Tacheometry.
6. Students will be able to learn the use and application of GPS and Total Station.

To establish the correlation between COs & POs

Table1

UCE04P02.1	Students will be able to learn lateral distance measurement by using chain and compass surveying methods.
UCE04P02.2	Students will be able to understand the use of levelling and contouring methods for measuring vertical heights and terrain conditions respectively.
UCE04P02.3	Students will be able to know the concept of plane table surveying for the measurement of area with plenty of details.
UCE04P02.4	Students will be able to understand the use of theodolite traversing and topographic mapping.
UCE04P02.5	Students will be able to know the method of curve setting and Tangential Tacheometry.
UCE04P02.6	Students will be able to learn the use and application of GPS and Total Station.

To establish the correlation between COs & POs

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E19.1	3	3	2	2	1	2	-	1	2	-	1	2
UCE07E19.2	3	3	2	3	3	2	-	1	3	-	2	3
UCE07E19.3	3	2	1	2	2	2	-	1	2	-	1	2
UCE07E19.4	3	2	1	3	3	2	-	1	2	-	2	3
UCE07E19.5	3	3	2	2	3	2	-	1	3	-	2	3
UCE07E19.6	3	2	1	3	3	2	-	1	2	-	2	3
Total	**18**	**15**	**9**	**15**	**15**	**12**	**-**	**6**	**14**	**-**	**10**	**16**
Average	**3**	**2.5**	**1.5**	**2.5**	**2.5**	**2**	**-**	**1**	**2.33**	**-**	**1.67**	**2.67**
Equivalent Avg. Attainment	**3**	**3**	**2**	**3**	**3**	**2**	**-**	**1**	**2**	**-**	**2**	**3**

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
UCE07E19.1	3	2
UCE07E19.2	3	2
UCE07E19.3	3	3
UCE07E19.4	3	2
UCE07E19.5	3	2
UCE07E19.6	3	3
Total	**18**	**14**
Average	**3**	**2.33**
Equivalent Avg. Attainment	**3**	**2**

COMPUTER PROGRAMMING LABORATORY
(UCE04P03)

Total Credit: 01 **Contact Periods: 02 (0L+0T+2P)**

Course Objectives:

1. To know object-oriented programming concepts.
2. To know programming languages like C++/Java.
3. To know how to get the output of different numerical method problems through programming languages.
4. To compare the output of Numerical Method problems analytically and through programming.

Course Content:

Unit-1

Development of computer programme using object oriented programming concepts such as, C++ and JAVA .

Writing Programme for the following numerical methods

Unit-2

Bisection, Newton- Raphson, Secant method

Unit-3

Least square regression

Unit-4

Gauss elimination and Gauss- Siedel iteration methods.

Unit-5

Trapezoidal and Simpson's rule

Unit-6

Euler; modified Euler, Runge- Kutta method.

Course Outcome:

1. Students will be able to get idea about object-oriented programming concepts
2. Students will be able to understand programming languages like C++/Java.
3. Students will be able to write down the program Bisection, Newton- Raphson, Secant method using C++/Java
4. Students will be able to write down the program of Least square regression using C++/Java
5. Students will be able to write down the program of for linear simultaneous equations like gauss elimination &Gauss- Siedel iteration method using C++/Java.
6. Students will be able to write down the program of Numerical integration by Trapezoidal and Simpson's rule using C++/Java
7. Students will be able to write down the program of Numerical differentiation by Euler; modified Euler, Runge- Kutta method using C++/Java.

To establish the correlation between COs & POs
Table 1

No of course outcome (CO)	Course Outcome
UCE04P03.1	Students will be able to get idea about object-oriented programming concepts
UCE04P03.2	Students will be able to understand programming languages like C++/Java.
UCE04P03.3	Students will be able to write down the program Bisection, Newton-Raphson, Secant method using C++/Java
UCE04P03.4	Students will be able to write down the program of Least square regression using C++/Java
UCE04P03.5	Students will be able to write down the program of for linear simultaneous equations like gauss elimination &Gauss- Siedel iteration method using C++/Java.
UCE04P03.6	Students will be able to write down the program of Numerical integration by Trapezoidal and Simpson's rule using C++/Java
UCE04P03.7	Students will be able to write down the program of Numerical differentiation by Euler; modified Euler, Runge- Kutta method using C++/Java

Table 2

CORRELATION LEVELS:

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: '-'

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE04P03.1	3	2	3	3	3	-	-	-	-	-	-	2
UCE04P03.2	3	2	3	3	3	-	-	-	-	-	-	2
UCE04P03.3	3	2	2	2	3	-	-	-	-	-	-	2
UCE04P03.4	3	2	2	2	3	-	-	-	-	-	-	2
UCE04P03.5	3	2	2	2	3	-	-	-	-	-	-	2
UCE04P03.6	3	2	2	2	3	-	-	-	-	-	-	2
UCE04P03.7	3	2	2	2	3	-	-	-	-	-	-	2
Total	15	10	12	12	15	-	-	-	-	-	-	10
Average	3	2	2.4	2.4	3	-	-	-	-	-	-	2
Equivalent Avg. Attainment	3	2	2	2	3	-	-	-	-	-	-	2

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
UCE04P03.1	3	2
UCE04P03.2	3	2
UCE04P03.3	2	1
UCE04P03.4	2	1
UCE04P03.5	2	1
UCE04P03.6	2	1
UCE04P03.7	2	1
Total	16	9
Average	2.28	1.28
Equivalent Avg. Attainment	2	1

DETAIL
COURSE CURRICULUM

FOR

UNDERGRADUATE PROGRAMME
B.TECH

IN

CIVIL ENGINEERING
(5th SEMESTER)

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA
TRIPURA (WEST)

STRUCTURAL ANALYSIS-II

(UCE05B01)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To obtain fundamental understanding of the concepts of rotation and translation of joints.
2. To understand the concept of contribution of bending moment due to external load, rotation and translation of joints.
3. To obtain an understanding of various classical methods of analysis and their relative advantages and limitations.
4. To understand the concept of elastic and plastic analysis of structure.

Course Content:

Unit-1

Slope Deflection Method: Introduction, Development of slope-deflection equations, analysis of continuous beams, analysis of frames, box culverts.

Unit -2

Moment Distribution Method: Introduction, Definition of terms- Distribution factor, carry over factor, analysis of fixed and continuous beams, simple and portal frames with and without translation of joints, box culverts.

Unit -3

Cables and Suspension Bridge : Introduction, cables, stiffening girders, two and three-hinged stiffening girders, influence lines for bending moments, shear force in stiffening girders.

Analysis of Multi storey building frame: Analysis of multistory frames by approximate methods- substitute method, portal and cantilever methods.

Unit -4

Plastic Analysis: Introduction, stress-strain curve, plastic analysis of simple beams and portal frames.

Unit -5

Matrix Method: Introduction to stiffness and flexibility method, Direct stiffness method, Nodal and global coordinate transformation matrix, element stiffness matrix for truss members, Beam element, Frame element, Assembly of element stiffness matrix, element load vector, Global load vector, Application of direct stiffness method in case of plane truss, Beam and Portal frame.

References:-

Sl. No	Name of books	Author	Publisher
1	Basic structural Analysis	Reddy, C.S	Tata McGraw Hill
2	Indeterminate structural Analysis	Kinney,J.S	McGraw Hill Book Company
3	Indeterminate structural Analysis	Wang, C.K.	McGraw Hill Book Company
4	Structural Analysis Vol- II	Pandit and Gupta	McGraw Hill Book Company
5	Structural Analysis	R.C. Hibbeler	Pearson

Course Outcome:

1. Students will be able to find out amount of rotation and translation of joints in indeterminate structure due to loading.
2. Students will be able to find out end moment of the member, shear force, bending moment at any cross section of indeterminate structure.
3. Students will be able to identify the critical section in shear and bending.
4. Students will be able to analyze the complete frame structure.
5. Students will be able to analyze cable and suspension bridges, further they will be able to get idea about plastic analysis and failure mechanism.
6. Students will be able to analyze structural members such as beams, frames, trusses using Matrix method of analysis.

To establish the correlation between COs &POs

Table 1

No. of Course Outcome(CO)	Course Outcome
UCE05B01.1	Students will be able to find out amount of rotation and translation of joints in indeterminate structure due to loading.
UCE05B01.2	Students will be able to find out end moment of the member, shear force, bending moment at any cross section of indeterminate structure.
UCE05B01.3	Students will be able to identify the critical section in shear and bending.
UCE05B01.4	Students will be able to analyze the complete frame structure.
UCE05B01.5	Students will be able to analyze cable and suspension bridges, further they will be able to get idea about plastic analysis and failure mechanism.
UCE05B01.6	Students will be able to analyze structural members such as beams, frames, trusses using Matrix method of analysis.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE05B01.1	3	3	3	3	3	-	-	-	3	-	-	3
UCE05B01.2	3	3	3	3	3	-	-	-	3	-	-	3
UCE05B01.3	3	3	3	3	3	-	-	-	3	-	-	3
UCE05B01.4	3	3	3	3	3	-	-	-	3	-	-	3
UCE05B01.5	3	3	3	3	3	-	-	-	3	-	-	3
UCE05B01.6	3	3	3	3	3	-	-	-	3	-	-	3
Total	**18**	**18**	**18**	**18**	**18**	**-**	**-**	**-**	**18**	**-**	**-**	**18**
Average	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**3**
Equivalent Avg. atainment	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**3**

To establish the correlation between COs &PSOs

Table 3

CO	PSO1	PSO2
UCE05B01.1	4	3
UCE05B01.2	4	3
UCE05B01.3	4	3
UCE05B01.4	4	3
UCE05B01.5	4	3
UCE05B01.6	4	3
Total	**24**	**18**
Average	**4**	**3**
Equivalent Avg. Attainment	**4**	**3**

DESIGN OF STRUCTURES-II

(UCE05B02)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To understand the behavior and design of elements in steel structures using current design code.
2. To obtain an understanding on the methodology of analyzing and designing of elements of steel structures.
3. To apply the knowledge from statics, mechanics of solid, and structural analysis to gain further understanding in the relationship between analysis and design of steel structures.
4. To learn the design of connections between the elements of steel structures.
5. To learn the design of steel structural elements including tension members, compression members under combined loads.
6. To learn the design of steel beams.

Course Content:

Unit -1

Introduction: Advantages and Disadvantages of Steel Structures, Limit state method Limit State of Strength, Structural Stability, Serviceability Limit states, Failure Criteria of steel, Design Consideration, Loading and load combinations, IS code provisions, Specification and Sectional classification.

Unit -2

Plastic Behaviour of Structural Steel: Introduction, Plastic theory, Plastic Hinge Concept, Plastic collapse load, load factor, Shape factor, Theorem of plastic collapse, Methods of Plastic analysis, Plastic analysis of Continuous Beams.

Unit -3

Design of Connections: Bolted Connections: Introduction, Types of Bolts, Behaviour of bolted joints, Design of High Strength friction Grip(HSFG) bolts, Design of lap and butt joints, Bracket connection, Welded Connections: Introduction, Types and properties of welds, Effective areas of welds, Weld Defects, Simple welded joints for truss member, Advantages and Disadvantages of Bolted and Welded Connections, Welded bracket.

Unit -4

Design of Tension Members: Introduction, Types of Tension members, Slenderness ratio, Modes of Failure, Design of Tension members and Lug angles, Splices, Gussets.

Design of Compression Members: Introduction, Failure modes, Behaviour of compression members, Sections used for compression members, Effective length of compression members, Design of compression members and built up compression members, Design of Laced and Battened Systems. Design of column splices.

Unit -5

Design of Beams: Introduction, Beam types, Lateral Stability of beams, factors affecting lateral stability, Behaviour of Beams in Bending, Design strength of laterally supported beams in Bending, Design of Laterally unsupported Beams, Shear Strength of Steel Beams.

References:-

Sl No.	Name of Book	Author	Publisher
1.	Design of Steel Structures	S.S. Bhavikatti,	I.K.International Publishing House Pvt. Ltd., New Delhi, Bangalore.
2.	Design of Steel Structures	Duggal S K	Tata McGraw Hill, New Delhi
3.	Design of Steel Structures	Dayarathnam P	S Chand and Company Ltd., New Delhi.
4.	Design of Steel Structures	Kazim S M A and Jindal R S	Prentice Hall of India, New Delhi.
5.	IS 800-2007: General Construction in Steel Code Practice (Third revision), Bureau of Indian Standards, New Delhi.		
6.	Steel Structure Design and Behaviour	. Charles E Salman, Johnson &Mathas	Pearson Publications
7.	Behaviour and Design of Steel Structures to EC -III	Nether Cot, et.al,	CRC Press.

Course Outcome:

1. Students completing this course understand the fundamental principles of structural steel design and contemporary methodologies used in the design and analysis of steel structural elements.
2. They develop professional competencies in the design and application of steel members in relevant civil engineering structures.
3. Students are able to solve technical problems on various steel structural design and application through critical thinking and discussions.
4. Students also learn to communicate their outcomes of design in writing in a discipline-appropriate format.

To establish the correlation between COs & POs

Table 1

No of course outcome (CO)	Course Outcome
UCE05B02.1	Students completing this course understand the fundamental principles of structural steel design and contemporary methodologies used in the design and analysis of steel structural elements.
UCE05B02.2	They develop professional competencies in the design and application of steel members in relevant civil engineering structures.
UCE05B02.3	Students are able to solve technical problems on various steel structural design and application through critical thinking and discussions.
UCE05B02.4	Students also learn to communicate their outcomes of design in writing in a discipline-appropriate format.

Table 2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: -**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE05B02.1	3	3	3	1	1	-	2	-	-	-	-	1
UCE05B02.2	3	3	3	3	2	-	2	3	-	-	-	-
UCE05B02.3	3	3	3	3	1	-	2	3	-	3	-	1
UCE05B02.4	3	3	-	1	1	-	2	-	-	3	-	1
Total	**12**	**12**	**9**	**8**	**5**	**-**	**8**	**6**	**-**	**6**	**-**	**3**
Average	**3**	**3**	**2.25**	**2**	**1.25**	**-**	**2**	**1.5**	**-**	**1.5**	**-**	**0.75**
Equivalent Avg. Attainment	**3**	**3**	**2**	**2**	**1**	**-**	**2**	**2**	**-**	**2**	**-**	**1**

To establish the correlation between Cos & PSOs

Table 3

CO	PSO1	PSO2
UCE05B02.1	3	3
UCE05B02.2	3	3
UCE05B02.3	3	3
UCE05B02.4	3	3
Total	**12**	**12**
Average	**3**	**3**
Equivalent Avg. Attainment	**3**	**3**

WATER RESOURCE ENGINEERING–I

(UCE05B03)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objectives:

1. To serve as an introduction to the field of engineering hydrology covering the fundamentals such as hydrological cycle, precipitation characteristics, catchment water losses.
2. To understand and study measurements of various abstraction processes like evaporation, transpiration and infiltration occurring in catchment, hydrographs and hyetographs, climate change.
3. To understand change in hydrograph characteristics using routing methods, study hydrologic frequency analysis.
4. To know the basic principles and movement of open channel flow, ground water, well yields and pumping tests.
5. To give basic concepts of reservoir capacity determination, sedimentation and losses.

Course Content:

Unit-1

Surface water hydrology: Understanding of hydrologic cycle, water availability, water balance, precipitation mechanisms, measurement of precipitation, Infiltration, Evaporation and transpiration, Runoff, Hyetographs.

Unit -2

Hydrographs, stream flow measurement, Derivation of UH, S-curve, Change of unit period of UH, Developing synthetic unit hydrograph, rainfall-runoff relationships, Flow duration curves, Floods, Flood routing, Computation of storage volume of reservoirs, reservoir losses, reservoir sedimentation and control.

Unit -3

Ground water hydrology: Darcy's law, Gradient of hydraulic head, Aquifer properties, hydraulic conductivity of heterogonous aquifer and anisotropy aquifer, Well Hydraulics, Governing equations of groundwater flow.

Unit -4

Solute Transport: Advection-Dispersion, Diffusion: Fick's Law, Dispersion in 1-D Column solute transport: Governing Equation, Fickian Model of Dispersion, Reactive transport, Seawater Intrusion, Ground water flow models.

Unit -5

Open channel flow: Basic concepts, classification of open channel flow,Specific Energy and Specific Force, Uniform Flow, Flow resistance in channel flows, normal depth, section factor for uniform flow computation, design of channels, most efficient cross-section in rigid boundary channels, Hydraulic jumps.

References:-

Sl No.	Name of Book	Author	Publisher
1.	Engineering Hydrology	K Subramanya	Tata-McGrawHill Co. New Delhi.
2.	Groundwater Hydrology	D. K. Todd	John Wiley and Sons
3.	Ground and Surface Water Hydrology	L. W. Mays	Wiley Publications
4.	Hand book of Applied Hydrology	V. T. Chow	McGraw-Hill Publn Company, New York.
5.	Ground Water	H. M. Raghunath	
6.	Groundwater	R.A. Freeze and J.A. Cherry	ISBN 0-13-365312-9, Prentice-Hall
7.	Flow in Open Channel	K. Subramanya	Tata McGraw Hill, New Delhi.
8.	Flow through Open Channel	K. G. Rangaraju	Tata McGraw Hill, New Delhi.
9.	Open Channel Flow	F. M. Henderson	MacMillanPublishing Company, 1996

Course Outcomes:

1. Students will be able to understand basic hydrologic concepts, measure and analyze precipitation, evaporation, evapotranspiration etc. and perform hydrologic modeling.
2. Students will be able to understand the components of hyetographs, mass curve and their analysis, observation and measurement of flows and runoff in rivers and channels.
3. Students will be able to apply standard techniques, computational tools, and data for conducting frequency analysis on hydrologic data to determine flood return period.
4. Students will conceptualize open channel flow and design of open channel, components of groundwater flow, understand aquifer properties –permeability, transmissivity and storage, and identify geological formations capable of storing and transporting groundwater Students will be able to analyze the complete frame structure.
5. Students will be able to To know different methods of measurement of discharge, design flood estimation, perform flood routing, estimate flood peaks, fix capacity reservoir of reservoirs.
6. Students will be able to understand the components of hydrographs, unit hydrograph, synthetic unit hydrograph, and instantaneous unit hydrograph and theiranalysis, observation and measurement of flows in rivers and channels.

To establish the correlation between Cos & Pos

Table 1

No of course outcome (CO)	Course Outcome
UCE05B03.1	Students will be able to understand basic hydrologic concepts, measure and analyze precipitation, evaporation, evapotranspiration etc. and perform hydrologic modelling.
UCE05B03.2	Students will be able to understand the components of hyetographs, mass curve and their analysis, observation and measurement of flows and runoff in rivers and channels.
UCE05B03.3	Students will be able to apply standard techniques, computational tools, and data for conducting frequency analysis on hydrologic data to determine flood return period.
UCE05B03.4	Students will be able to conceptualize open channel flow and design of channel, components of groundwater flow, understand aquifer properties – permeability, transmissivity and storage, and identify geological formations capable of storing and transporting groundwater.
UCE05B03.5	Students will be able to know different methods of measurement of discharge, design flood estimation, perform flood routing, estimate flood peaks, fix capacity reservoir of reservoirs.
UCE05B03.6	Students will be able to understand the components of hydrographs, unit hydrograph, synthetic unit hydrograph, and instantaneous unit hydrograph and their analysis, observation and measurement of flows in rivers and channels.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE05B03.1	3	3	2	2	2	1	2	1	1	1	2	2
UCE05B03.2	3	3	2	2	2	1	2	1	1	1	2	2
UCE05B03.3	3	3	2	2	2	1	2	1	1	1	2	2
UCE05B03.4	3	3	2	2	2	1	2	1	1	1	2	2
UCE05B03.5	3	3	2	2	2	1	2	1	1	1	2	2
UCE05B03.6	3	3	2	2	2	1	2	1	1	1	2	2
Total	**18**	**18**	**12**	**12**	**12**	**6**	**12**	**6**	**6**	**6**	**12**	**12**
Average	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**2**	**2**
Equivalent Avg. Attainment	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**2**	**2**

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
UCE05B03.1	3	3
UCE05B03.2	3	3
UCE05B03.3	3	3
UCE05B03.4	3	3
UCE06B03.5	3	3
UCE06B03.6	3	3
Total	**18**	**18**
Average	**3**	**3**

GEOTECHNICAL ENGINEERING - I

(UCE05B04)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To understand the different physical properties of soils
2. To understand the idea of effective stress, permeability and seepage through soil
3. To understand the compaction and consolidation behavior of soil
4. To understand the shear strength behaviour of soil
5. To understand the earth pressure theory and it application to retaining wall problems
6. To understand the slope stability analysis.

Course Content:

Unit-1

Introduction: Introduction to Geotechnical Engineering; Soil formation and soil types. Soil Properties: Basic Definitions; Phase relations; Index properties of soil-soil grain and soil aggregate properties of coarse grained and fine grained soils .Soil Classification: Indian Standard Soil Classification System

Unit -2

Principle of Effective Stress and related phenomena: Principle of effective stress; Capillarity; Seepage force and quick sand condition; Total pressure and elevation heads.

Permeability: One dimensional flow; Permeability of soils-Darcy's law; Laboratory methods of determination; Permeability as a function of soil type, void ratio, soil fabric, and effective stress; Pumping out test for field determination of permeability.

Seepage through soils: Two dimensional flow problems-steady flow, confined flow and unconfined flow; Flow nets and their characteristics; Uplift pressure; Exit gradient; Failure due to piping; Criteria for design of filters; Quick Sand; Liquefaction.

Unit -3

Compaction Behavior: Clay minerals (basic concepts) and soil structure; Compaction- Theory of compaction; Laboratory compaction tests; Different methods of compaction control.

Compressibility and Consolidation behavior: Compressibility-Effects of soil type, stress history and effective stress on compressibility; Consolidation-Factors affecting consolidation and compressibility parameters; Normally consolidated and over consolidated soils; Different forms of primary consolidation equation; Transient flow condition; Terzaghi's theory of one-dimensional consolidation and time-rate of consolidation; Evaluation of compressibility and consolidation parameters from consolidation parameters from consolidometer test data.

Unit -4

Shear Strength Behaviour: Introduction; Stress at a point and Mohr's stress circle; Mohr-Coulomb failure criterion; Laboratory tests for shear strength determination; Effective stress and total stress shear strength parameters; UU, CU and CD tests and their relevance to field problems; Shear strength characteristics of normally consolidated and preconsolidated clays; Shear strength characteristics of sands.

Unit -5

Earth Pressures and Retaining Structures: Earth pressure at rest; Active and passive earth pressure computations using Rankine's and Coulomb's earth pressure theories; Culmann's graphical construction; Additional Earth pressure due to surcharge and earthquake loading. Stability analysis for retaining walls; Choice of backfill material and importance of drainage. Bracing for open cuts- Recommended design diagrams of earth pressure for typical soils.

Stability of Slope: Introduction; Basis of Analysis; Different factors of safety; Types of slope failures; Stability of an infinite slope in cohesive soils and cohesion less oil; Wedge failure; Culmann's method, Friction circle method; Swedish circle method; Stability of slope under steady seepage condition; Stability of slope during construction; Bishop's simplified method; Improving of Stability of Slope.

References:-

Sl No.	Name of Book	Author	Publisher
1.	Basic and Applied Soil Mechanics	Gopal Ranjan and Rao, A.S.R	New Age International, New Delhi
2.	Soil Mechanics in Engineering Practice	Terzaghi, K ,and Peck, R.B	John Wiley, New York, 1968.
3.	Soil Mechanics and Foundation Engineering	Arora, K.R	Standard Publishers Distributors, New Delhi-110006.
4.	Soil Mechanics and Foundations	Dr. B. C. Punmia Laxmi	Publications (P) Ltd., New Delhi
5.	Textbook of Soil Mechanics and Foundation Engineering	V. N. S. Murthy	CBS Publishers & Distributers, New Delhi
6.	Advanced Soil Mechanics	Das, B. M	Taylor and Francis

Course Outcome:

1. Students will be able to describe soils and determine their physical characteristics such as grain size, water content, and void ratio to classify different type of soils
2. Students will be able to understand the concept of total, effective stresses and pore water pressures.
3. Students will be able to determine the soil permeability
4. Students will be able to understand the compaction and consolidation characteristics of soils
5. Students will be able to determine the shear strength characteristics of soils
6. Students will be able to understand the concept of earth pressure and its application to retaining wall
7. Students will be able to understand the concept of slope stability analysis.

To establish the correlation between COs &POs
Table 1

No. of Course Outcome (CO)	Course Outcome
UCE05B04.1	Students will be able to describe soils and determine their physical characteristics such as grain size, water content, and void ratio to classify different type of soils
UCE05B04.2	Students will be able to understand the concept of total, effective stresses and pore water pressures.
UCE05B04.3	Students will be able to determine the soil permeability
UCE05B04.4	Students will be able to understand the compaction and consolidation characteristics of soils
UCE05B04.5	Students will be able to determine the shear strength characteristics of soils
UCE05B04.6	Students will be able to understand the concept of earth pressure and its application to retaining wall
UCE05B04.7	Students will be able to understand the concept of slope stability analysis.

Table 2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: 0**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE05B04.1	3	3	2	1	1	3	2	1	1	1	0	3
UCE05B04.2	3	3	2	1	1	3	2	1	1	1	0	3
UCE05B04.3	3	3	2	1	1	3	2	1	1	1	0	3
UCE05B04.4	3	3	2	1	1	3	2	1	1	1	0	3
UCE05B04.5	3	3	2	1	1	3	2	1	1	1	0	3
UCE05B04.6	3	3	2	1	1	3	2	1	1	1	0	3
UCE05B04.7	3	3	2	1	1	3	2	1	1	1	0	3
Total	**21**	**21**	**14**	**7**	**7**	**21**	**14**	**7**	**7**	**7**	0	**21**
Average	**3**	**3**	**2**	**1**	**1**	**3**	**2**	**1**	**1**	**1**	0	**3**
Equivalent Avg. attainment	**3**	**3**	**2**	**1**	**1**	**3**	**2**	**1**	**1**	**1**	0	**3**

To establish the correlation between COs &PSOs
Table 3

CO	PSO1	PSO2
UCE05B04.1	4	3
UCE05B04.2	3	3
UCE05B04.3	4	3
UCE05B04.4	4	3
UCE05B04.5	3	3
UCE05B04.6	4	4
UCE05B04.7		
Total	**22**	**19**
Average	**3.67**	**3.17**
Equivalent Avg. Attainment	**4**	**3**

TRANSPORTATION ENGINEERING - I
(UCE05B05)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To obtain the knowledge about importance, planning and geometric design of highway.
2. To obtain idea about different highway materials and their design specifications.
3. To obtain the knowledge about construction procedures of different types of pavement.
4. To obtain the concept about role of air transportation, airport planning, layout and geometric design of airport.

Course Content:

Unit-1

Role of Transportation Engineering, Modes of transportation-Their importance and limitations; Importance of highway transportation; Highway Planning-Principle of Highway Planning, Road development and Financing

Unit-2

Highway Alignment- Requirements, Engineering surveys for highway locations

Geometric Design- Cross section elements, Width, Camber, Design speed, Sight distances, Requirements and design of horizontal and vertical alignments

Unit-3

Pavement Materials and Design: Specifications and tests on pavement materials, factors effecting pavement design, design of flexible and rigid pavements as per IRC.

Unit-4

Construction of Highway Pavements- Different types of road; Pavement construction- Types of pavement, Earth work, Sub grade, Water bound macadam, Bituminous macadam, Earthen roads, Bituminous surfacing: Rigid pavement joint, Highway Drainage- Surface Drainage and Sub-soil drainage; Maintenance and Strengthening.

Unit-5

Airport Engineering: Role of Air transportation, Airport classification - aerodrome, airfield, airport, Elements of Airport engineering, Airport planning and layout- Site selection, Terminal Building, Airport Geometric design-Runway, Taxiway, Wind rose, Runway orientation.

References:-

Sl No.	Name of Book	Author	Publisher
1.	Traffic Engineering and Transport Planning	Kadiyali L.R.	Khanna Publishers, New Delhi,India, 1997.
2.	Highway Engineering	Khanna, S.K .and C.E.G. Justo	Nem Chand and Bros, Roorkee, India, 2001

3.	Ministry of Road Transport and Highways. Specifications for Road and Bridge Works, Fourth Edition		IRC
4.	IRC Codes of Practice		IRC
5.	Principles of Transportation Engineering	Chakroborty, P. and A. Das	Prentice Hall of India Pvt. Ltd, New Delhi, India, 2005
6.	Pavement Analysis and Design	Huang, Y.H.	Pearson Prentice Hall, New Jersey, USA,2004

Course Outcome:

1. Students will be able to understand the role and importance of highways in transportation engineering and highway planning.
2. Students will be able to learn the requirement and survey related to highway alignment and geometric design of highway.
3. Students will be able to understand the tests & specification of highway materials and its design aspects.
4. Students will be able to learn the construction procedures of different types of pavement.
5. Students will be able to understand the role and classification of airport.
6. Students will be able to understand the planning and geometric design of airport.

To establish the correlation between COs & POs

Table1

UCE05B05.1	Students will be able to understand the role and importance of highways in transportation engineering and highway planning
UCE05B05.2	Students will be able to learn the requirement and survey related to highway alignment and geometric design of highway
UCE05B05.3	Students will be able to understand the tests & specification of highway materials and its design aspects
UCE05B05.4	Students will be able to learn the construction procedures of different types of pavement
UCE05B05.5	Students will be able to understand the role and classification of airport
UCE05B05.6	Students will be able to understand the planning and geometric design of airport

To establish the correlation between COs & POs

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: '-'

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE05B05.1	2	1	1	2	2	2	2	2	3	2	2	2
UCE05B05.2	3	3	3	2	3	3	2	2	2	2	2	3
UCE05B05.3	2	2	2	2	3	2	3	1	2	2	3	2
UCE05B05.4	3	2	2	2	3	2	2	2	3	2	2	3
UCE05B05.5	3	2	2	2	1	2	1	2	2	2	2	2
UCE05B05.6	3	3	3	2	3	3	2	2	3	2	3	3
Total	**16**	**13**	**13**	**12**	**15**	**14**	**12**	**11**	**15**	**12**	**14**	**15**
Average	**3**	**2.17**	**2.17**	**2**	**2.5**	**2.33**	**2**	**1.83**	**2.5**	**2**	**2.33**	**2.5**
Equivalent Avg. Attainment	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**3**

To establish the correlation between Cos & PSOs

Table 3

CO	PSO1	PSO2
UCE05B05.1	2	2
UCE05B05.2	4	3
UCE05B05.3	3	3
UCE05B05.4	3	3
UCE05B05.5	3	2
UCE05B05.6	4	3
Total	**19**	**16**
Average	**3.17**	**2.67**
Equivalent Avg. Attainment	**3**	**3**

ENVIRONMENTAL ENGINEERING - I
(UCE05B06)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To make the students conversant with Environment and its components.
2. To make the students conversant with sources of water and its demand.
3. To understand the basic characteristics of water and its determination.
4. To provide adequate knowledge about the water treatment processes and its design.
5. To have adequate knowledge on distribution network and pumping.
6. To study the effect of air pollution and its control measures.

Course Content:

Unit-1

General: Environment and its components, Role of an Environmental Engineer.

Water Demand: Various types of water demands, total requirement of water for a city, per capita demand, factors affecting per capita demand, variation in demand, design capacities for various water supply components, design flows, design periods, and design population, population forecasting methods.

Unit -2

Sources of water: Hydrological cycle, surface sources of water, storage reservoir and surface sources of supply, quality and quantity of surface water and their usefulness for public water supplies, sub surface or underground water sources, geological factors governing the occurrence of ground water, zones of underground water, ground water yield, recuperation test, aquifer and their types, infiltration galleries, infiltration wells and springs, tube wells, yield of wells and tube wells by Thiem's and Dupuit's equilibrium formula, well loss and specific capacity of wells,

Intakes and pumps: Factors governing the location of an intake, intake tower, canal intake, types of pumps for lifting water, factors affecting the selection of a particular type of pump, pumping stations.

Unit -3

Quality of Water: Physical, chemical and biological water quality parameters (WQP), sources, measurement techniques and effect of WQPs, permissible limits of WQPs as per Indian standards, water borne diseases and their control.

Treatment of Water: Historical overview of water treatment, water treatment process (theory and application): screening, plain sedimentation, sedimentation aided with coagulation, filtrations, disinfection, water softening, Aeration, miscellaneous treatment units.

Unit -4

Distribution of Water: Methods of distribution of water, layout of distribution networks, distribution reservoirs, distribution systems, distribution system components, capacity and pressure requirements, design of distribution system, hydraulic analysis of distribution systems, pumping required for water supply systems.

Unit -5

Air Pollution: Definition of air pollution, natural and manmade air pollution, types of pollutants, their sources and impacts, lapse rate and inversion, dispersion of air pollutants into the atmosphere, typical plume behaviors, predicting pollutants concentration through dispersion models, design of plume rise and stack height, air pollution control, air quality standards and limits.

References: -

Sl No	Name of the Books	Author	Publisher
1.	Environmental Engineering	Peavy, H.S.,Rowe D.R	McGraw Hill Book and Tchobanoglous, Company,1985
2.	Water supply and sanitary Engineering	G.S.Birdie& J.S. Birdie	DhanpatRai Engineering publishing Company, New Delhi.
3.	Sewage Disposal and Air, Pollution Control Engineering	S.K.Garg	Khanna Publishers
4.	Environmental Engineering Vol. I	S.K.Garg	Khanna Publishers
5.	Water and Waste water Engg	Metcalf & Eddy	Tata McGraw Hill

Course Outcome:

1. Students will be able to analyze characteristics of water.
2. Students will be able to forecast the population and estimate water demand.
3. Students will be able to design various water treatment units.
4. Students will be able to design the water distribution network.
5. Students will be able to analyze characteristics of air.
6. Students will be able to design air pollution controlling devices.

To establish the correlation between COs &POs

Table 1

No. of Course Outcome (CO)	Course Outcome
UCE05B06.1	Students will be able to analyze characteristics of water.
UCE05B06.2	Students will be able to forecast the population and estimate water demand.
UCE05B06.3	Students will be able to design various water treatment units.
UCE05B06.4	Students will be able to design the distribution network.
UCE05B06.5	Students will be able to analyze characteristics of air.
UCE05B06.6	Students will be able to design air pollution controlling devices.

Table 2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: "-"**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE05B06.1	2	2	1	1	-	1	2	-	2	-	-	1
UCE05B06.2	2	2	1	1	-	1	2	-	2	-	-	1
UCE05B06.3	2	2	3	3	-	1	2	-	2	-	-	2
UCE05B06.4	2	2	3	3	-	1	2	-	2	-	-	2
UCE05B06.5	2	2	1	1	-	1	2	-	2	-	-	1
UCE05B06.6	2	2	3	3	-	1	2	-	2	-	-	2
Total	**12**	**12**	**12**	**12**	**-**	**6**	**12**	**-**	**12**	**-**	**-**	**9**
Average	**2**	**2**	**2**	**2**	**-**	**1**	**2**	**-**	**2**	**-**	**-**	**1.5**
Equivalent Avg. Attainment	**2**	**2**	**2**	**2**	**-**	**1**	**2**	**-**	**2**	**-**	**-**	**2**

To establish the correlation between COs &PSOs

Table 3

CO	PSO1	PSO2
UCE05B06.1	**3**	**3**
UCE05B06.2	**3**	**3**
UCE05B06.3	**3**	**3**
UCE05B06.4	**4**	**2**
UCE05B06.5	**2**	**3**
UCE05B06.6	**3**	**3**
Total	**18**	**17**
Average	**3**	**2.83**
Equivalent Avg. Attainment	**3**	**3**

STRUCTURAL ENGINEERING LABORATORY –I
(UCE05P01)

Total Credit: 01 **Contact Periods: 02 (0L+0T+2P)**

Courses Objective:

1. To know the instruments and their uses.
2. To know the material properties so that we can use them in specific field.
3. To know how to compare experimental results with their theoretical values.
4. To compare the experimental value and respected value using STAAD PRO software.

Course Content:

Unit-1

Clark Maxwell's Reciprocal theorem using a beam.

Unit-2

Elastic displacements of curved members.

Unit-3

Elastic properties of beams.

Unit-4

Behaviour of struts and columns.

Unit-5

Buckling load of strut at different load and support condition.

Unit-6

Deflection of a beam at different supporting condition.

Unit-7

Experimental and Analytical study of deformations in bar-beam combination.

Unit-8

Experimental and Analytical study of deflections in unsymmetrical bending.

Unit-9

Circular bending.

Unit-10

Bending moment variation of beam at different loading type and condition.

Unit-11

Shear force variation of beam at different loading type and condition.

Unit-12

Application of the analysis software.

Course Outcome:

1. Students will be able to analyze the beam analytically as well as experimentally and will be able to find out deflection, bending moment and other structural properties.
2. Students will be able to analyze the beam with help of software during the entire course.
3. Students will be able to analyze the buckling properties of different types of column.
4. Students will be able to use different types of softwares.

To establish the correlation between COs &POs

Table 1

No. of Course Outcome(CO)	Course Outcome
UCE05P01.1	Students will be able to analyze the beam analytically as well as experimentally and will be able to find out deflection, bending moment and other structural properties.
UCE05P01.2	Students will be able to analyze the beam with help of software during the entire course.
UCE05P01.3	Students will be able to analyze the buckling properties of different types of column.
UCE05P01.4	Students will be able to use different types of softwares.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE05P01.1	3	3	3	2	3	-	2	-	3	-	2	-
UCE05P01.2	3	3	3	2	3	-	2	-	3	-	2	-
UCE05P01.3	3	3	3	2	3	-	2	-	3	-	2	-
UCE05P01.4	3	3	3	2	3	-	2	-	3	-	2	-
UCE05P01.5	3	2	3	2	3	-	2	-	2	-	2	-
UCE05P01.6	2	3	2	2	3	-	2	-	3	-	2	-
Total	**17**	**17**	**17**	**12**	**18**	**-**	**12**	**-**	**17**	**-**	**12**	**-**
Average	**3.0**	**2.8**	**3.0**	**2.0**	**3.0**	**-**	**2.0**	**-**	**2.8**	**-**	**2.0**	**-**
Equivalent Avg. attainment	**3**	**3**	**3**	**2**	**3**	**-**	**2**	**-**	**3**	**-**	**2**	**-**

To establish the correlation between COs &PSOs

Table 3

CO	PSO1	PSO2
UCE05P01.1	3	2
UCE05P01.2	3	2
UCE05P01.3	3	2
UCE05P01.4	3	2
UCE05P01.5	2	3
UCE05P01.6	2	3
Total	**16**	**14**
Average	**2.66**	**2.33**
Equivalent Avg. Attainment	**3**	**2**

GEOTECHNICAL ENGINEERING LABORATORY-I
(UCE05P02)

Total Credit: 01 **Contact Periods: 02 (0L+0T+2P)**

Course Objective:

1. To indentify soils in geotechnical engineering practice.
2. To perform laboratory tests needed to determine soil design parameters.

Course Content:

Unit-1

Sieve analysis and Specific Gravity of Soil.

Unit-2

Hydrometer analysis and Field Density of Soil.

Unit-3

Atterberg Limits and Permeability test of Soil.

Unit-4

Relative Density Test of soil.

Unit-5

Determination of moisture content by Rapid Moisture Meter.

Unit-6

Standard Proctor and Modified Proctor test of Soil.

Course Outcome:

1. Students will be able to identify and classify soil based on standard geotechnical engineering practice.
2. Students will be able to perform and analyze the permeability tests.

To establish the correlation between COs &Pos

Table 1

No. of Course Outcome (CO)	Course Outcome
UCE05P02.1	Students will be able to identify and classify soil based on standard geotechnical engineering practice
UCE05P02.2	Students will be able to perform and analyze the permeability tests

Table 2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: 0**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE05P02.1	3	3	2	1	1	3	2	1	1	1	0	3
UCE05P02.2	3	3	2	1	1	3	2	1	1	1	0	3
Total	**6**	**6**	**4**	**2**	**2**	**6**	**4**	**2**	**2**	**2**	0	**6**
Average	**3**	**3**	**2**	**1**	**1**	**3**	**2**	**1**	**1**	**1**	0	**3**
Equivalent Avg. attainment	**3**	**3**	**2**	**1**	**1**	**3**	**2**	**1**	**1**	**1**	0	**3**

To establish the correlation between COs &PSOs

Table 3

CO	PSO1	PSO2
UCE05P02.1	4	3
UCE05P02.2	3	3
Total	**22**	**19**
Average	**3.67**	**3.17**
Equivalent Avg. Attainment	**4**	**3**

TRANSPORTATION ENGINEERINGLABORATORY-I
(UCE05P03)

Total Credit: 01 **Contact Periods: 02 (0L+0T+2P)**

Course Objective:

1. To know the instruments and their uses.
2. To know the material properties so that we can use them in specific field.
3. To know how to select the materials on the basis of result for different use in Civil Engineering field.
4. To compare the experimental value with IS values and use it judiciously.

Course Content:

Unit-1

Determination of Water absorption of road aggregates

Unit-2

Determination of Specific gravity of aggregates

Unit-3

Determination of Impact Test of aggregates

Unit-4

Los Angel's abrasion test

Unit-5

Devel's abrasion test

Unit-6

Test for Crushing Strength of Aggregates

Unit-7

Determination o f Flakiness and Elongation Indices of aggregates, Angularity number

Unit-8

Determination of Penetration of bitumen

Unit-9

Determination of Viscosity of bitumen (Saybolt)

Course Outcome:

1. Students will be able to learn procedure and purpose of Specific gravity and Water absorption of road aggregates.
2. Students will be able to learn procedure and purpose of Impact and Crushing Strength value of aggregates.
3. Students will be able to learn procedure and purpose of Los Angel's abrasion and Devel's abrasion Value of aggregates.

4. Students will be able to learn procedure and purpose Flakiness Index and Elongation Index, and Angularity number of aggregates.
5. Students will be able to learn procedure and purpose of Penetration of bitumen and Determination of Viscosity of bitumen (Saybolt).

To establish the correlation between COs &POs

Table 1

No. of Course Outcome(CO)	Course Outcome
UCE05P03.1	Students will be able to learn procedure and purpose of Water absorption test of road aggregates.
UCE05P03.2	Students will be able to learn procedure and purpose of Impact and Crushing Strength value of aggregates.
UCE05P03.3	Students will be able to learn procedure and purpose of Los Angel's abrasion and Devel's abrasion value of aggregates.
UCE05P03.4	Students will be able to learn procedure and purpose Flakiness Index and Elongation Index, and Angularity number of aggregates.
UCE05P03.5	Students will be able to learn procedure and purpose of Penetration of bitumen and Determination of Viscosity of bitumen (Saybolt).

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE05P03.1	3	2	2	2	2	1	1	1	2	2	2	3
UCE05P03.2	3	2	2	2	2	1	1	1	2	2	2	3
UCE05P03.3	3	2	2	2	2	1	1	1	2	2	2	3
UCE05P03.4	3	2	2	2	2	1	1	1	2	2	2	3
UCE05P03.5	3	2	2	2	2	1	1	1	2	2	2	3
Total	**15**	**10**	**10**	**10**	**10**	**5**	**5**	**5**	**10**	**10**	**10**	**15**
Average	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**3**
Equivalent Avg. attainment	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**3**

To establish the correlation between COs &PSOs

Table 3

CO	PSO1	PSO2
UCE05P03.1	3	3
UCE05P03.2	3	3
UCE05P03.3	3	3
UCE05P03.4	3	3
UCE05P03.5	3	3
Total	**15**	**15**
Average	**3**	**3**
Equivalent Avg. Attainment	**3**	**3**

ENVIRONMENTAL ENGINEERINGLABORATORY
(UCE05P04)

Total Credit: 01 **Contact Periods: 02 (0L+0T+2P)**

Course Objective:

1. To obtain the collection procedure and analysis of sound samples.
2. To obtain the characterizing parameters of water sample like turbidity, dissolved oxygen, color, conductivity, pH, alkalinity, acidity etc.
3. To obtain the alkalinity and acidity of water sample.
4. To obtain the hardness, chlorides content, residual chlorine, optimum dose of coagulants and heavy metals of water sample.
5. To familiarize the methods to estimate the organic strength of water and wastewater.
6. To measure the air pollutant concentration in indoor environment.

Course Content:

1. Collection and analysis of sound samples.
2. Determination of turbidity, colour and conductivity of water samples.
3. Determination of pH, alkalinity and acidity of water samples.
4. Determination total solid, total suspended solids, and total dissolve solids of water sample.
5. Determination of hardness, Sulphate and chlorides of water samples.
6. Determination of residual chlorine and chlorine demand of water samples.
7. Determination of Dissolved Oxygen of water/wastewater samples.
8. Determination of Most Probable Number (MPN) of Coliforms of water samples.
9. Determination of B.O.D of sewage sample.
10. Determination of C.O.D of sewage sample.
11. Determination of volatile and fixed solids of sewage sample.
12. Determination of optimum dose of coagulants of water samples.
13. Determination of iron and two heavy metals of water/wastewater samples.
14. Determination of Nitrate and Phosphate of water/wastewater samples.
15. Introduction to Spectrophotometric method for water/wastewater analysis.

Course Outcome:

1. Students will be able to learn about the sampling procedure and analysis of sound samples.
2. Students will be able to determine solid content, turbidity, color, conductivity, pH, alkalinity, acidity, hardness and chlorides of water sample.
3. Students will be able to determine residual chlorine, chlorine demand and Dissolved Oxygen of water sample.
4. Students will be able to determine BOD and COD and kjeldal Nitrogen content of sewage sample.
5. Students will be able to determine iron, chromium Nitrate and Phosphate.
6. Measurement of air pollutant concentration.

To establish the correlation between COs & POs

Table1

No. of Course Outcome (CO)	Course Outcome
UCE05P04.1	Students will be able to learn about the sampling procedure and analysis of sound samples.
UCE05P04.2	Students will be able to determine solid content, turbidity, color, conductivity, pH, alkalinity, acidity, hardness and chlorides of water sample.
UCE05P04.3	Students will be able to determine residual chlorine, chlorine demand and Dissolved Oxygen of water sample. Students will be able to determine turbidity, color and conductivity.
UCE05P04.4	Students will be able to determine BOD and COD and kjeldal Nitrogen content of sewage sample.
UCE05P04.5	Students will be able to determine iron, chromium Nitrate and Phosphate.
UCE05P04.6	Measurement of air pollutant concentration.

Table2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE05P04.1	3	2	1	-	2	1	1	1	2	2	-	3
UCE05P04.2	3	2	1	-	2	1	1	1	2	2	-	3
UCE05P04.3	3	2	1	-	2	1	1	1	2	2	-	3
UCE05P04.4	3	2	1	-	2	1	1	1	2	2	-	3
UCE05P04.5	3	2	1	-	2	1	1	1	2	2	-	3
UCE05P04.6	3	2	1	-	2	1	1	1	2	2	-	3
Total	**18**	**12**	**6**	**-**	**12**	**6**	**6**	**6**	**12**	**12**	**-**	**18**
Average	**3**	**2**	**1**	**-**	**2**	**1**	**1**	**1**	**2**	**2**	**-**	**3**
Eq. Av Attainment	**3**	**2**	**1**	**-**	**2**	**1**	**1**	**1**	**2**	**2**	**-**	**3**

To establish the correlation between COs &PSOs

Table 3

CO	PSO1	PSO2
UCE05P04.1	**3**	**3**
UCE05P04.2	**3**	**3**
UCE05P04.3	**3**	**3**
UCE05P04.4	**3**	**3**
UCE05P04.5	**3**	**3**
UCE05P04.6	**3**	**3**
To tal	**18**	**18**
Average	**3**	**3**
Equivalent Avg. Attainment	**4**	**3**

DETAIL
COURSE CURRICULUM

FOR

UNDERGRADUATE PROGRAMME
B.TECH

IN

CIVIL ENGINEERING
(6th SEMESTER)

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA
TRIPURA (WEST)

CIVIL ENGINEERING ESTIMATION, COSTING AND SPECIFICATION

(UCE06B01)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To introduce the students in depth knowledge of professional practice as well the quantity analysis of construction works like, multistoried structures, water works &sanitary works, irrigation works, road estimates culverts, etc.
2. To get idea about the rate analysis of different items of work and process regarding the technical as well as administrative approval.
3. To learn about preparation of specification of construction items.
4. To learn about valuation technique and tendering procedure.

Course Content:

Unit-1

Types of estimate: Preliminary, detailed, supplementary, revised. Detail of measurement and calculation of quantities, bar bending schedule, abstract of cost of building work– slab, beam, foundation etc. Estimate of Earthwork (Road) in banking or cutting, bridges.

Sanction: Administrative approval, expenditure sanction, Technical sanction.

Unit -2

Rate Analysis: Factors affecting rate analysis, overhead expenses, procedure for rate analysis, schedule of rates, Task work: labour requirement for different works, material requirement for different works and Rate analysis of different Items of work.

Specification: General and detailed specification, Use of IS and IRC codes and building laws, different manuals and guidelines.

Unit -3

Valuation: Purpose of valuation, types of property-Depreciation, Sinking fund, Leasehold and free hold property, obsolescence, Gross income, Outgoing and Net income, Capitalized value and year's purchase. Rental method of valuations, and typical problems

Unit -4

DPR: Project survey and collection of technical and design data, preparation of DPR, Rules & regulation for execution.

Unit -5

Different types of tender- PNIT, DNIT, informal tender, earnest money, tendering procedure, rules and method of measurement, PWD accounts and procedure for works.

Reference:-

Sl No.	Name of Book	Author	Publisher
1.	Masonry and timber structures Design	Arya, A.S	Nemchand & brothers.
2.	Estimating and costing in civil engineering- Theory & Practice	Dutta, B.N	UBS publishers
3.	Different IRC and IS codes	---------	IRC, IS

Course Outcome:

1. Students will be able to learn the different types of estimation and details of measurement and calculation of quantities.
2. The students will be able to learn general and detailed specification of construction items, use of IS and IRC codes and building laws, different manuals and guidelines.
3. Students will be able to determine the genuine rate of different items of work and process regarding its technical as well as administrative approval.
4. Students will be able to learn about the technique of valuation of a property as well as purpose of valuation.
5. Students will be able to learn the different types tender and the rules and regulations regarding tendering procedure.
6. Students will be able to prepare a project report for a Civil Engineering construction project.

To establish the correlation between COs & POs
Table 1

No. of Course Outcome (CO)	Course Outcome
UCE06B01.1	Students will be able to learn the different types of estimation and details of measurement and calculation of quantities.
UCE06B01.2	The students will be able to learn general and detailed specification of construction items, use of IS and IRC codes and building laws, different manuals and guidelines.
UCE06B01.3	Students will be able to determine the genuine rate of different items of work and process regarding its technical as well as administrative approval.
UCE06B01.4	Students will be able to learn about the technique of valuation of a property as well as purpose of valuation.

UCE06B01.5	Students will be able to learn the different types tender and the rules and regulations regarding tendering procedure.
UCE06B01.6	Students will be able to prepare a project report for a Civil Engineering construction project.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: '-'

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE06B01.1	2	2	2	1	1	2	2	2	2	1	2	2
UCE06B01.2	3	2	2	2	1	2	2	2	2	2	2	2
UCE06B01.3	2	3	2	2	1	3	2	3	2	2	2	2
UCE06B01.4	2	3	2	2	1	2	2	2	2	2	2	2
UCE06B01.5	2	2	1	1	1	2	2	2	2	3	3	2
UCE06B01.6	2	2	2	2	2	2	2	2	2	2	2	2
Total	**13**	**14**	**11**	**10**	**7**	**13**	**12**	**13**	**12**	**12**	**13**	**12**
Average	**2.17**	**2.33**	**1.83**	**1.67**	**1.17**	**2.17**	**2**	**2.17**	**2**	**2**	**2.17**	**2**
Equivalent Avg. Attainment	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

To establish the correlation between Cos & PSOs

Table 3

CO	PSO1	PSO2
UCE06B01.1	2	2
UCE06B01.2	2	2
UCE06B01.3	2	2
UCE06B01.4	2	2
UCE06B01.5	2	2
UCE06B01.6	3	2
Total	**13**	**12**
Average	**2.17**	**2**
Equivalent Avg. Attainment	**2**	**2**

DESIGN OF STRUCTURES- III

(UCE06B02)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To know how to design column footings, retaining wall and water tank
2. To know how to design RC Portal Frames with fixed and hinged based supports.
3. Get a detailed picture of the properties of prestressed concrete, methods of prestressing, loss in prestressing and how to design of prestressed concrete beams.
4. To know how to design connections of steel beam to beam and beam to column.
5. To get an idea of designing Steel Roof Truss.
6. To know how to design different types of plate girder

Course Content:

(RCC Design)

Unit -1

Design of Footings: Design of rectangular slab type combined footing. Design of Retaining Walls: Design of cantilever Retaining wall and counter fort retaining wall. Design of Water Tanks: Design of circular water tanks resting on ground (Rigid and Flexible base). Design of rectangular water tanks resting on ground. As per IS: 3370 (Part IV)

Unit -2

Design of RC Portal Frames: Design of portal frames with fixed and hinged based supports.

Unit -3

Prestressed concrete: Introduction, Merits and demerits, Pretensioning and post tensioning method, Materials for prestressed concrete, Prestressed concrete beam/ load balancing concept, stress based concept for flexural design of prestressed concrete beam, Losses in prestressed concrete structures.

(Steel Design)

Unit-4

Design of Steel Connections: Beam to Beam Connections and Beam to Column Connection.

Design of Steel Roof Truss: Design of roof truss for different cases of loading. Design of purlin-unsymmetrical bending.

Unit -5

Plate Girder: Components, Requirement of vertical and horizontal stiffner, Design of bolted plate girder with intermediate stiffener, bearing stiffener. Design of welded plate girder with intermediate stiffener, bearing stiffener.

References: -

Sl No.	Name of the Books	Author	Publisher
1.	Structural Design and Drawing of Reinforced Concrete and Steel	N Krishna Raju	University Press
2.	Design of Steel Structures	Subramanian N	Oxford university Press, New Delhi
3.	Design of Steel Structures	K S Duggal	Tata McGraw Hill, New Delhi
4.	Reinforced Concrete Design	S N Sinha	McGraw Hill Publication
5.	Prestressed concrete structure	N. Krishnaraju	Tata McGraw Hill, New Delhi
6.	Design of prestressed concrete	T.Y. Lin	Wiley
7.	IS 1343- Code of practice for prestressed concrete	----------	----------

Course Outcome:

1. Students will be able to understand and design different types of column footing, various retaining wall and water tank.
2. Students will be able to understand and design RC portal frames with various base supports.
3. Students will get a detailed picture of prestressed concrete and will be able to design prestressed concrete beams.
4. Students will be able to understand anddesign steel connections of beam to beam and coloumn.
5. Students will be able to design Steel roof truss.
6. Students will be able to design plate girders.

To establish the correlation between COs & POs

Table 1

No of course outcome (CO)	Course Outcome
UCE06B02.1	Students will be able to understand and design different types of column footing, various retaining wall and water tank.
UCE06B02.2	Students will be able to understand and design RC portal frames with various base supports.
UCE06B02.3	Students will get a detailed picture of prestressed concrete and will be able to design prestressed concrete beams.
UCE06B02.4	Students will be able to understand and design steel connections of beam to
UCE06B02.5	Students will be able to design Steel roof truss.
UCE06B02.6	Students will be able to design plate girders.

Table 2

CORRELATION LEVELS:

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE06B02.1	3	2	1	1	1	-	-	-	-	-	-	1
UCE06B02.2	3	1	1	1	1	-	-	-	-	-	-	1
UCE06B02.3	3	2	1	1	1	-	-	-	-	-	-	1
UCE06B02.4	3	2	1	1	1		-	-	-	-	-	1
UCE06B02.5	3	3	1	1	1		-	-	-	-	-	1
UCE06B02.6	3	2	1	1	1		-	-	-	-	-	1
Total	18	12	6	6	6	0	0	0	0	0	0	6
Average	3	2	1	1	1	0	0	0	0	0	0	1
Equivalent Avg. Attainment												

To establish the correlation between Cos & PSOs

Table 3

CO	PSO1	PSO2
UCE06B02.1	3	2
UCE06B02.2	2	3
UCE06B02.3	2	3
UCE06B02.4	3	2
UCE06B02.5	3	3
UCE06B02.6	3	3
Total	16	16
Average	2.67	2.67
Equivalent Avg. Attainment	3	3

WATER RESOURCES ENGINEERING –II
(UCE06B03)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. The objective of this course is to impart the advanced knowledge in river mechanics and open channel flows that deals with the occurrence, distribution, movement and properties of flows in open channels.
2. To impart the knowledge of various techniques, and types of flows.
3. To learn about the dam structures and reservoir operations.

Course Content:

Unit-1

Introduction: Necessity of Irrigation in India, Advantages and disadvantages of Irrigation, Techniques of water distribution in farms. Quality of irrigation water, Crops and crop season, Consumptive use. Irrigation requirements, Estimation of consumptive use of water by climatic approaches. Irrigation efficiencies, Soil moisture-irrigation relationship.

Unit -2

Sediment transport:
Introduction, Sediment property, Threshold of sediment motion, Condition for significant suspension, Shields diagram, Exner equation of bed sediment conservation, Bed-load transport relations, Suspended-load transport.

Unit -3

Canal Irrigation: Classification of canals, Canal losses, Alignment of canals. Design of Irrigation Canals: Design of stable channels using Kennedy's and Lacey's theory, Garret's diagram, Cross section of irrigation canals, Lining of Irrigation Canals: Advantages and economics of lining, various types of lining, Design of lined canals.

Unit -4

Water logging: Causes and control of water logging, Reclamation of saline and alkaline land, Surface and Sub-surface drainage.

Cross-Drainage Structures: Types of CD works, Selection of a suitable type to suite a particular condition, Design consideration for CD works.

Canal Regulation structures: Canal Falls: Necessity, Proper location, Types, Design and detailing of one type of fall; Canal regulators and escapes.

Canal head works: Weirs and Barrages, Types of weirs and barrages, Layout of a diversion head work, Introduction of different components of a diversion head works, Design of weirs and barrages: Bligh's creep theory, Design of weir using Bligh's theory, Lane's weighted creep theory, Khosla's theory, Khosla's method of independent variables, Exit gradient.

Unit -5

River and River training works: Classification of Rivers, Behaviors of Rivers, River training and methods.

Dams: Typical cross section, Various forces acting on gravity dam, Combination of forces for design, modes of failure and criteria for structural stability, High and low gravity dam, Design of high dam, Typical section of low gravity dam, Earth and Rock fill Dams: Types, Causes of failure, Preliminary section of an earth dam, Preliminary section of an earth dam, Seepage control in earth dams, Spillways: Descriptive study of various types of spillways.

References: -

Sl No.	Name of the Books	Author	Publisher
1.	Irrigation Engineering and hydraulics structures	S. K. Garg	Khanna Publishers, 16th Edition.
2.	Irrigation Engineering	B. Singh	Nem Chand and Sons, Roorkee.
3.	Irrigation and Power Engineering	B. C. Punmia	Laxmi Publications
4.	Irrigation Water Power & Water Resources Engineering	Arora K R	Standard Publishers Distributors, Delhi.
5.	Theory and Design of Irrigation Structures	Varshney& Gupta	Nem Chand and Bros, Roorkee.
6.	Irrigation Engineering	I. E. Hook	John Wiley and Sons, New York.
7.	Irrigation	J. D. Zimmerman	John Wiley and Sons, New York.

Course Outcome (CO):

1. Demonstrate developing of water resources for the purpose of controlling and utilization of water for a variety of purposes intending to benefit of people of the region.

2. Illustrate the principal segments of water resources engineering which include irrigation, canal irrigation, sediment transport etc.
3. Recognize the characteristics of bed-load and suspended load in river hydraulics and composite roughness.
4. Apply knowledge of canal irrigation and waterlogging.
5. An ability to experience the performance of various river training works and Canal Regulation structures.
6. Develop an archive that will be accessible to understand concept of gravity and earthdam design and dam-break problem.

To establish the correlation between COs & POs

Table1

No. of Course Outcome (CO)	Course Outcome
UCE06B03.1	Demonstrate developing of water resources for the purpose of controlling and utilization of water for a variety of purposes intending to benefit of people of the region.
UCE06B03.2	Illustrate the principal segments of water resources engineering which include irrigation, canal irrigation, sediment transport etc.
UCE06B03.3	Recognize the characteristics of bed-load and suspended load in river hydraulics and composite roughness.
UCE06B03.4	Apply knowledge of canal irrigation and waterlogging.
UCE06B03.5	An ability to experience the performance of various river training works and Canal Regulation structures.
UCE06B03.6	Develop an archive that will be accessible to understand concept of gravity and earthen dam design and dam-break problem.

Table2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION-“ - “

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE06B03.1	3	2	2	2	1	2	1	2	1	2	2	1
UCE06B03.2	2	2	3	2	2	2	1	1	2	2	2	2
UCE06B03.3	3	1	2	1	3	1	2	1	2	2	2	2
UCE06B03.4	2	2	1	2	1	2	2	1	2	2	1	2

UCE06B03.5	3	2	2	2	2	2	2	1	2	2	2	1
UCE06B03.6	2	1	3	2	2	1	3	2	1	1	2	2
Total	15	10	13	11	11	10	11	8	10	11	11	10
Average	2.5	1.66	2.16	1.83	1.83	1.66	1.83	1.33	1.66	1.83	1.83	1.66
Equivalent Avg. Attainment	3	2	2	2	2	2	2	1	2	2	2	2

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
UCE06B03.1	4	3
UCE06B03.2	4	3
UCE06B03.3	4	3
UCE06B03.4	4	3
UCE06B03.5	4	3
UCE06B03.6	4	3
Total	24	18
Average	4	3
Equivalent Avg. Attainment	4	3

GEOTECHNICAL ENGINEERING-II

(UCE06B04)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To obtain fundamental understanding of the concepts of geo-static stress and stress due to applied load.
2. To know about the different types of foundations and their provision depending upon the type of soil which to be known through soil exploration.
3. To obtain an understanding about the load carrying capacity of different types of foundation including deep foundation and machine foundation.

4. To understand the effect of seismic behavior of soil in the analysis and design of foundation.

Course Content:

Unit-1

Introduction; Stress-Strain parameters; Geo-static Stresses; Vertical stress due to concentrated loads; Isobar diagram; Isobar diagram; Vertical Stress distribution on a horizontal plane; Influence Diagram; Vertical stress distribution due to line load, strip load, circular area, rectangular area; Newmark's Influence charts.

Unit -2

Soil Exploration

Purpose; Method of soil exploration; Boring, sampling; Standard penetration test; Static and dynamic cone tests; Correlation between penetration resistance and strength parameters; Plate load test.

Unit -3

Foundations Common types of foundations with examples; classification, Basis for design; Review of major soil parameters used in proportioning of foundations.

Shallow Foundations

Types and their selection; Terminology Bearing capacity- Terzaghi's Bearing Capacity theory, Types of shear failure; Computation of bearing capacity in cohesion less and cohesive soils; Effect of various factors on Bearing Capacity; Bearing Capacity from Standard Penetration Tests; Eccentrically loaded Foundations;

Unit -4

Settlement: Components of settlement; Limits of settlement; Accuracy in Foundation Settlement Prediction; Allowable Settlement; Allowable Soil Pressure; Plate Load Test; Estimation of settlement of footings and rafts on sands from Penetration and Plate load test data; Estimation of settlement of footing/ rafts on cohesive soils using consolidation test data; Proportioning of footings.

Pile Foundations:

Situations where adopted; Types of piles; Outline of steps involved in proportioning; Capacity and settlement of single and group of piles; Proportioning with field/lab data as input.

Well Foundations: Situations where adopted; Elements of wells; Types; Methods of construction; Tilt and shift; Remedial measures. Proportioning- Depth and size of wells on the basis of scour depth, bearing capacity and settlement; Terzaghi's lateral stability analysis.

Unit -5

Seismic Behavior of soils: Introduction, effect of soil shaking, Soil Liquefaction.

Introduction to Machine Foundation: Types of machines and their foundations; Terminology; Design criteria; Field methods of determining design parameters-Cyclic Plate load test; Block vibration test; Response of block foundation under vertical vibrations.

References: -

Sl No	Name of the Books	Author	Publisher
1.	Basic and Applied Soil Mechanics	Rao, A.S.R& Gopal Ranjan	New Delhi, 1998
2.	Soil Mechanics in Engineering Practice	Terzaghi, K, and Peck, R.B.,	John Wiley, New York, 1998
3.	Soil Mechanics and Foundation Engineering	Arora, K.R	Standard Publishers Distributors, New Delhi
4.	Foundation Analysis and Design	Bowles J.E.	McGraw-Hill, New York
5.	Textbook of Soil Mechanics and Foundation Engineering	V. N. S. Murthy	CBS Publishers & Distributers, New Delhi
6.	Geotechnical Engineering	Shashi K Gulhati and ManojDatta	Tata McGraw-Hill Publishing Company Limited, New Delhi

Course Outcome:

1. Students will be able to determine geo-static stress and stress due to applied load.
2. Students will be able to know the different methods of soil explorations and their uses.
3. Students will be able to learn about the different types of shallow foundations and their load carrying capacity.
4. Students will also be able to know about the deep foundations like pile foundation and well foundation.
5. Students will be able to understand the seismic behavior of soil.
6. Students will be able to know about the machine foundation.

To establish the correlation between Cos & POs

Table 1

No of course outcome (CO)	Course Outcome
UCE06B04.1	Students will be able to determine geo-static stress and stress due to applied load.

UCE06B04.2	Students will be able to know the different methods of soil explorations and their uses.
UCE06B04.3	Students will be able to learn about the different types of shallow foundations and their load carrying capacity.
UCE06B04.4	Students will also be able to know about the deep foundations like pile foundation and well foundation.
UCE06B04.5	Students will be able to understand the seismic behavior of soil.
UCE06B04.6	Students will be able to know about the machine foundation.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE06B04.1	3	2	2	1	1	1	2	1	1	1	1	2
UCE06B04.2	3	2	2	1	1	1	2	1	1	1	1	2
UCE06B04.3	3	2	2	1	1	1	2	1	1	1	1	2
UCE06B04.4	3	2	2	1	1	1	2	1	1	1	1	2
UCE06B04.5	3	2	2	1	1	1	2	1	1	1	1	2
UCE06B04.6	3	2	2	1	1	1	2	1	1	1	1	2
Total	**18**	**12**	**12**	**6**	**6**	**6**	**12**	**6**	**6**	**6**	**6**	**12**
Average	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**2**
Equivalent Avg. Attainment	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**2**

To establish the correlation between Cos & PSOs

Table 3

CO	PSO1	PSO2
UCE06B04.1	3	4
UCE06B04.2	3	4
UCE06B04.3	3	4
UCE06B04.4	3	4
UCE06B04.5	3	4
UCE06B04.6	3	4
Total	**18**	**24**
Average	**3**	**4**

TRANSPORTATION ENGINEERING - II
(UCE06B05)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To obtain fundamental understanding of the concepts of railway engineering
2. To understand the nature of railway points and crossings and safety
3. To understand the modern trends in railway engineering
4. To obtain an understanding on Docks, Harbours and its components
5. To understand the traffic engineering characteristics

Course Content:

Unit-1

Railway Engineering: Role of Railway Transportation, Elements of permanent track way: Rails, Rail Gauges, Sleepers, Ballast, Rail Joints, Fittings, Principal of Traction: Tractive effort, Train resistances, Geometric design: Gradients, Curves, Cant.

Unit-2

Points and Crossings: Turnouts, Diamond crossings, Crossovers, Stations and yards, Signals: Signalling and interlocking.

Unit-3

Safety in railways, Modernization of track for high speeds, Modern methods for Track maintenance.

Unit-4

Dock & Harbour Engineering:
Role of water transportation, Basic consideration-Ocean winds, Waves, Tides, Wharf, Pier, Harbour, Port, Layout of harbour, Port entrance, Dock: Wet, dry and floating docks, Break water-different types, dredging,

Unit-5

Traffic Engineering: Traffic characteristics – road user characteristics, Physical characteristics, Vehicular characteristics, Speed, Volume, Density and Capacity of urban roads and highways; traffic operations - regulation and control; Traffic Management, Traffic safety, Travel demand modelling.

References: -

Sl No	Name of the Books	Author	Publisher
1.	Railway Track Engineering	Mundry	Tata McGraw Hill

2.	Railway Track Engineering	Agarwal M.M	Prabha & Co.
3.	Harbour, Dock and Tunnel Engineering	Srinivasan,R	Charotar Publishing House
4.	Dock and Harbour Engineering	Oza, H.P.	Anand
5.	Airport Engineering	Bindra, S.P.	Charotar Publishing House

Course Outcome:

1. Students will be able to identify the role of railway engineering and elements of railway engineering.
2. Students will be able to understand about the points and crossings.
3. Students will be able to study the modernization in railway engineering.
4. Students will be able to understand the concepts in dock and harbour engineering.
5. Students will be able to understand the concepts of traffic engineering.
6. Students will be able to understand the role of traffic management.

To establish the correlation between COs & POs

Table- 1

No of course outcome (CO)	Course Outcome
UCE06B05.1	Students will be able to identify the role of railway engineering and elements of railway engineering
UCE06B05.2	Students will be able to understand the points and crossings.
UCE06B05.3	Students will be able to study the modernization in railway engineering
UCE06B05.4	Students will be able to understand the concepts in dock and harbour engineering
UCE06B05.5	Students will be able to understand the concepts of traffic engineering
UCE06B05.6	Students will be able to understand the role of traffic management

Table 2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: '-'**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE06B05.1	3	3	3	1	-	1	-	-	-	-	-	1
UCE06B05.2	3	3	3	1	-	1	-	-	-	-	-	1
UCE06B05.3	3	3	3	1	-	1	-	-	-	-	-	1
UCE06B05.4	3	3	3	1	-	1	2	-	-	-	-	1
UCE06B05.5	3	3	3	1	-	1	-	-	-	-	-	1
UCE06B05.6	3	3	3	1	-	1	-	-	-	-	-	1
Total	**18**	**18**	**18**	**6**	**-**	**6**	**2**	**-**	**-**	**-**	**-**	**6**

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
UCE06B05.1	3	3
UCE06B05.2	3	3
UCE06B05.3	3	3
UCE06B05.4	3	3
UCE06B05.5	3	3
UCE06B05.6	3	3
Total	**15**	**15**
Average	**3**	**3**
Equivalent Avg. Attainment	**3**	**3**

ENVIRONMENTAL ENGINEERING -II
(UCE06B06)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To obtain the basic characteristics of sewage and the inter relations between quality parameters.
2. To obtain the collection and transportation system of sewage.
3. To obtain the design strategy of sewers according to the available condition and material.

4. To obtain the sequential treatment process of sewage.
5. To obtain the environment friendly disposal of sewage.
6. To gain knowledge about solid waste characteristics and disposal.

Course Content:

Unit-1

General terms and estimating the design sewage discharge: Sewage, sewerage, Sewage treatment, types of sewerage systems, components of sewerage systems, estimating the sewage discharge, estimating the peak runoff, difference between design of water supply pipes and sewer pipes, maximum and minimum velocities to be generated in sewer.

Unit -2

Collection of Sewage: Separate, combined and partially separate system, components of sewerage systems, systems of layout, quantity of sanitary sewage and variations, quantity of storm water, rational method, shapes of sewer, circular and egg shaped sewer, hydraulic design of sewers: diameter, self-cleansing velocity and slopes, hydraulic characteristics of circular sewer sections running full and partially full condition, egg shaped sewers and hydraulically equivalent section.

Sewer appurtenances: Shapes of sewer pipes, sewer materials, laying and testing of sewer pipes, manhole, drop manhole, lamp hole, catch basins, inverted syphon, maintenance, cleaning and ventilation of sewer.

Sewage Characteristics:

Physical, and chemical characteristics of sewage, pH, turbidity, solids, DO, BOD, COD, TOC, nitrogen, phosphorus, and standards of disposal into natural watercourses and on land, permissible limits for sewage quality parameters as per Indian standards, BOD equation, population equivalents, relative stability, and bacteriological characteristics of sewage.

Unit 3

Disposal of sewage effluents:

Disposal of sewage by dilution, conditions favoring disposal by dilution, self-purification of streams, zones of pollution in a river stream, indices of self-purification, oxygen deficit of a polluted stream, Streeter-Phelps equation, stratification of lakes, eutrophication of lakes, sewage disposal by irrigation & sewage farming, sewage sickness.

Sewage Treatment: Preliminary, primary and secondary treatments, their purposes, sequence and efficiencies, Preliminary treatment: Screening and grit removal units, oil and grease removal by skimming tank, Primary treatment: sedimentation, rectangular and circular sedimentation tank, design of continuous

flow type sedimentation tank, detention time, short circuiting, constructional details, merits and demerits of coagulation process in sewage treatment,

Secondary Treatment: attached growth culture, contact bed, intermittent sand filter, trickling filter, and miscellaneous types of filters, working principle of trickling filter, construction and operation, operational troubles, types of trickling filters, design of conventional trickling filters, high rate trickling filters and recirculation, types of high rate trickling filters.

Unit -4

Suspended growth culture: Activated sludge process (ASP), flow diagram of ASP, aeration tank of ASP, methods of aeration, design consideration of ASP, hydraulic loading rate, F/M ratio, sludge age, sludge volume index, modification of basic activated sludge process.

Digestion and disposal of primary and secondary sludge, sludge and its moisture content, sludge digestion process, stages of sludge digestion process, factors affecting sludge digestion and their control, constructional details of digestion tank, design considerations.

Rotating biological contactors, oxidation ponds and stabilization ponds, constructional details and design, oxidation ditches or extended aeration lagoons, anaerobic stabilization units, septic tanks, constructional details and design considerations, disposal of effluent from septic tank, imhoff tank, design considerations, high rate anaerobic systems, UASB reactor, sequential batch reactor.

Unit -5

Sewage collection from houses: General principles governing the design of a sanitary plumbing system, functions and types of traps used in sanitary plumbing systems, systems of plumbing, two pipe, one pipe, single stack and partially ventilated single stack systems.

Municipal solid waste and its management: Types of solid wastes, sources, characteristics, generation, collection and transportation of municipal solid wastes, engineered systems for solid wastes management (reuse/ recycle energy recovery, treatment and disposal).

References:-

Sl No	Name of the Books	Author	Publisher
1.	Environmental Engineering	Peavy, H.S.,Rowe D.R	McGraw Hill Book and Tchobanoglous, Company,1985
2.	Water supply and sanitry Engineering	G.S.Birdie& J.S. Birdie	Dhanpat Rai Engineering publishing Company, New Delhi.

3.	Sewage Disposal and Air, , Pollution Control Engineering	S.K.Garg	Khanna Publishers
4.	Environmental Engineering Vol.I	S.K.Garg	Khanna Publishers
5.	Water and Waste water Engg	Metcalf & Eddy	Tata McGraw Hill

Course Outcome:

1. Students will be able to learn about the quality parameters and interrelations among Themselves.
2. Students will be able to find out the value all of the quality parameters of sewage.
3. Students will be able to make the layout and the design procedures of sewers.
4. Students will be able to learn the stepwise treatment procedures of sewage.
5. Students will be able to learn the efficient disposal techniques of sewage.
6. Students will be able to learn about solid waste characteristics and its various management techniques.

To establish the correlation between COs &POs

Table 1

No. of Course Outcome (CO)	Course Outcome
UCE06B06.1	Students will be able to learn about the quality parameters and interrelations among themselves.
UCE06B06.2	Students will be able to find out the value all of the quality parameters of sewage.
UCE06B06.3	Students will be able to make the layout and the design procedures of sewers.
UCE06B06.4	Students will be able to learn the stepwise treatment procedures of sewage.
UCE06B06.5	Students will be able to learn the efficient disposal techniques of sewage.
UCE06B06.6	Students will be able to learn about solid waste characteristics and its various management techniques.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
UCE06B06.1	2	2	-	-	-	2	2	-	-	-	-	3
UCE06B06.2	2	2	1	1	-	2	2	-	2	-	-	3
UCE06B06.3	3	3	3	3	-	2	2	-	2	-	-	3
UCE06B06.4	3	3	3	3	-	2	2	-	2	-	-	3
UCE06B06.5	3	3	3	3	-	2	2	-	2	-	-	3
UCE06B06.6	3	3	3	3	-	2	2	-	2	-	-	3
Total	**16**	**16**	**13**	**13**	**-**	**12**	**12**	**-**	**10**	**-**	**-**	**18**

Average	**2.66**	**2.66**	**2.16**	**2.16**	**-**	**2**	**2**	**-**	**1.66**	**-**	**-**	**3**
Equivalent Avg. Attainment	**3**	**3**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**-**	**-**	**3**

To establish the correlation between COs & PSOs
Table 3

CO	PSO1	PSO2
UCE06B06.1	3	2
UCE06B06.2	3	3
UCE06B06.3	4	3
UCE06B06.4	4	3
UCE06B06.5	4	3
UCE06B06.6	4	3
Total	**22**	**17**
Average	**3.66**	**2.83**
Equivalent Avg. Attainment	**4**	**3**

STRUCTURAL ENGINEERING LABORATORY –II
(UCE06P01)

Total Credit: 01 **Contact Periods: 02 (0L+0T+2P)**

Course Objective:

1. To understand about the components of concrete and effect on its properties due to shrinkage, moisture movement etc.
2. To get the idea of flexural, tensile, compressive strength of mortar.
3. To learn the stress-strain and other behavior of concrete and structural members.
4. To know the use of different softwares for validation of experimental results.
5. To understand the different tests and behavior of prestressed concrete.
6. To understand the concept of ultimate strength and deflection of RCC slab.

Course Content:

Unit 1
Compressive, Flexural and tensile strength of Mortar.

Unit2
Initial drying shrinkage, moisture movement, and coefficient of expansion of concrete.

Unit3
Stress strain curve of concrete.

Unit4
Behaviour of under reinforced and over reinforced R.C. beams in flexure.

Unit5
Behaviour of R.C. beams, with and without shear reinforcement in shear.

Unit6
Bond strength between steel bar and concrete (a) in a beam specimen and (b) by pull-out test.

Unit7
Validation of experimental results through commercially package softwares.

Unit8
Non-destructive testing of concrete.

Unit9
Behaviour of pre-stressed concrete beams in flexure.

Unit10
Ultimate strength and deflection of R.C.C. slab.

Course Outcome:

1. Students will be able to understand about the components of concrete and effect on its properties due to shrinkage, moisture movement and flexural, tensile, compressive strength of mortar.
2. Students will be able to determine the stress strain behavior of concrete.
3. Analysis the flexure in over and under reinforced R.C. beam and design the beam with and without reinforcement.
4. To determine the bond strength between steel and concrete by pull out test.
5. To determine various types of non-destructive test used in structure.
6. Analysis the .different structural member with their respective properties using STAAD.pro software.

To establish the correlation between Cos and POs

Table 1

No. of Course Outcome(CO)	Course Outcome
UCE06P01.1	Students will be able to understand about the components of concrete and effect on its properties due to shrinkage, moisture movement and flexural, tensile, compressive strength of mortar.
UCE06P01.2	Students will be able to determine the stress strain behavior of concrete.
UCE06P01.3	Analysis the flexure in over and under reinforced R.C. beam and design the beam with and without reinforcement.
UCE06P01.4	To determine the bond strength between steel and concrete by pull out test.

UCE06P01.5	To determine various types of non-destructive test used in structure.
UCE06P01.6	Analysis the .different structural member with their respective properties using STAAD.pro software.

Table 2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: "-"**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE06P01.1	3	3	3	2	2	1	1	1	2	1	1	1
UCE06P01.2	3	2	3	2	3	2	2	2	2	1	1	1
UCE06P01.3	3	3	3	3	3	2	2	2	1	1	1	1
UCE06P01.4	3	2	3	2	3	3	3	2	2	2	2	2
UCE06P01.5	3	3	2	3	3	3	3	2	2	2	2	1
UCE06P01.6	3	3	3	3	3	3	2	2	2	2	1	2
Total	**18**	**16**	**17**	**15**	**17**	**14**	**13**	**11**	**11**	**9**	**8**	**8**
Average	**3.000**	**2.66**	**2.83**	**2.50**	**2.83**	**2.33**	**2.16**	**1.83**	**1.83**	**1.50**	**1.33**	**1.33**
Eq. Avg Attainment	3	3	3	3	3	2	2	2	2	2	1	1

To establish the correlation between COs and PSOs

Table 3

CO	PSO1	PSO2
UCE06P01.1	**3**	**2**
UCE06P01.2	**3**	**3**
UCE06P01.3	**3**	**3**
UCE06P01.4	**2**	**3**
UCE06P01.5	**2**	**3**
UCE06P01.6	**3**	**3**

Total	**16**	**17**
Average	**2.66**	**2.83**
Equivalent Avg. Attainment	**3**	**3**

GEOTECHNICAL ENGINEERING LABORATORY-II

(UCE06P02)

Total Credit: 01 **Contact Periods: 02 (0L+0T+2P)**

Course Objective:

1. To know about the various important parameter of the soil for design and construction of different Civil Engineering structure.
2. To know about the different field tests and their utility.

Course Content:

Unit 1

Direct shear test- Performance of direct shear test, Plot the curves of direct shear test, Evaluate the shear strength values

Unit 2

Tri-axial test- To perform tri-axial test (drained and undrained conditions), Plot the curves of direct shear test, Evaluate the shear strength values

Unit 3

Standard Penetration Test- To determine the SPT value at different depths, to provide different corrections on observed SPT values, to find out the corresponding strength parameters on the basis of corrected SPT value

Unit 4

Static Cone Penetration Test- To evaluate the cone penetration resistance under constant loading.

Unit 5

Dynamic Cone Penetration Test- To evaluate dynamic cone penetration resistance. To evaluate the SPT value from the DCPT value

Unit 6

Plate Load Test- To perform the plate load test, to plot load settlement curve

Unit 7

Block Vibration Test -- To perform Block Vibration Test, to plot amplitude vs frequency curve and to evaluate resonant frequency and maximum amplitude.

Course Outcome:

1. Students will able to determine the shear strength of soil.
2. Students will able to determine the standard penetration no. and relative density by SPT test method.
3. Students will able to determine the shear parameter of soil.
4. Students will able to evaluate dynamic cone penetration resistance.
5. In case of machine foundation they can perform the block vibration test to evaluate resonant frequency, resonant amplitude etc.
6. Students will able to determine the bearing capacity of soil by the plate load test.

To establish the correlation between COs &POs

Table 1

No. of Course Outcome(CO)	Course Outcome
UCE06P02.1	Students will able to determine the shear strength of soil.
UCE06P02.2	Students will able to determine the standard penetration no. and relative density by SPT test method.
UCE06P02.3	Students will able to determine the shear parameter of soil.
UCE06P02.4	Students will able to evaluate dynamic cone penetration resistance.
UCE06P02.5	In case of machine foundation they can perform the block vibration test to evaluate resonant frequency, resonant amplitude etc.
UCE06P02.6	Students will able to determine the bearing capacity of soil by the plate load test.

Table 2

Slight (Low): 1Moderate: 2Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE06P02.1	3	3	2	2	3	1	2	2	3	2	2	2
UCE06P02.2	3	3	2	2	3	1	2	2	3	2	2	2
UCE06P02.3	3	3	2	2	3	1	2	2	3	2	2	2
UCE06P02.4	3	3	2	2	3	1	2	2	3	2	2	2
UCE06P02.5	3	3	2	2	3	1	2	2	3	2	2	2
UCE06P02.6	3	3	2	2	3	1	2	2	3	2	2	2
Total	**18**	**18**	**12**	**12**	**12**	**6**	**12**	**12**	**18**	**12**	**12**	**12**
Average	**3**	**3**	**2**	**2**	**3**	**1**	**2**	**2**	**3**	**2**	**2**	**2**

Equivalent Avg. attainment	**3**	**3**	**2**	**2**	**3**	**1**	**2**	**2**	**3**	**2**	**2**	**2**

To establish the correlation between COs &PSOs

Table 3

CO	PSO1	PSO2
UCE06P02.1	3	2
UCE06P02.2	3	2
UCE06P02.3	3	2
UCE06P02.4	3	2
UCE06P02.5	3	2
UCE06P02.6	3	2
Total	**18**	**12**
Average	**3**	**2**
Equivalent Avg. Attainment	**3**	**2**

TRANSPORTATION ENGINEERING LABORATORY- II
(UCE06P03)

Total Credit: 01 **Contact Periods: 02 (0L+0T+2P)**

Course Objective:

1. To know the instruments and their uses.
2. To know the material properties so that we can use them in specific field.
3. To know how to select the materials on the basis of result for different use in Civil Engineering field.
4. To compare the experimental value with IS values and use it judiciously.

Course Content:

Unit-1

Determination of Specific Gravity of bitumen

Unit-2

Determination of Ductility of bitumen

Unit-3

Determination of softening point of bitumen

Unit-4

Determination of Water content of bitumen

Unit-5

Determination of Loss on Heating of bitumen

Unit-6

Marshal Test

Unit-7

Determination of CBR value (Field)

Unit-8

Determination of CBR value (Lab)

Unit-9

Roughness Measurement by Merlin.

Unit-10

Roughness Measurement by Bump Integrator.

Course Outcome:

1. Students will be able to learn the procedure and purpose of Specific Gravity test and Ductility test of bitumen.
2. Students will be able to learn the procedure and purpose of Softening point and Water content of bitumen.
3. Students will be able to learn the procedure and purpose of Loss on Heating of bitumen.
4. Students will be able to learn the procedure and purpose of Marshal Test of bitumen.
5. Students will be able to learn the procedure and purpose of CBR value (Lab and Field Methods).
6. Students will be able to learn the procedure and purpose of Roughness Measurement (Using Merlin and Bump Integrator).

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE06P03.1	Students will be able to learn the procedure and purpose of Specific Gravity test and Ductility test of bitumen.
UCE06P03.2	Students will be able to learn the procedure and purpose of Softening point and Water content of bitumen.
UCE06P03.3	Students will be able to learn the procedure and purpose of Loss on Heating of bitumen.
UCE06P03.4	Students will be able to learn the procedure and purpose of Marshal Test of bitumen.

UCE06P03.5	Students will be able to learn the procedure and purpose of CBR value (Lab and Field Methods).
UCE06P03.6	Students will be able to learn the procedure and purpose of Roughness Measurement (Using Merlin and Bump Integrator).

Table-2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE06P03.1	3	2	2	2	2	1	1	-	2	2	2	3
UCE06P03.2	3	2	2	2	2	1	1	-	2	2	2	3
UCE06P03.3	3	2	2	2	2	1	1	-	2	2	2	3
UCE06P03.4	3	2	2	2	2	1	1	-	2	2	2	3
UCE06P03.5	3	2	2	2	2	1	1	-	2	2	2	3
UCE06P03.6	3	3	2	2	2	1	1	-	2	2	2	3
Total	**27**	**18**	**18**	**18**	**18**	**9**	**9**	**-**	**18**	**18**	**18**	**27**
Average	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**-**	**2**	**2**	**2**	**3**
Eq. Av Attainment	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**-**	**2**	**2**	**2**	**3**

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE06P03.1	3	3
UCE06P03.2	3	2
UCE06P03.3	3	3
UCE06P03.4	3	3
UCE06P03.5	3	3
UCE06P03.6	3	2
Total	**18**	**16**
Average	**3**	**2.7**

Equivalent Avg. Attainment	**3**	**3**

WATER RESOURCES ENGINEERINGLABORATORY
(UCE06P04)

Total Credit: 01 **Contact Periods: 02 (0L+0T+2P)**

Course Objective:

1. To learn the basic hydrological measurement technique – measurement of rainfall and rainfall intensities.
2. To determine the abstraction losses like evaporation, infiltration etc. through experiments and estimate the infiltration characteristics and evaporation in catchments.
3. Study of flow measurement in rivers and channels
4. Study of topographical and contour maps for watershed characterization.
5. To familiarize the students about various water resources modelling software for hydrologic and hydraulic design of small-scale rural or urban watersheds.

Course Content:

List of Experiments:

1. Rainfall Measurement
2. Measurement of rate of evaporation
3. Measurement of rate of infiltration of water in soil.
4. Measurement of velocity of flow in river, stream or flumes.
5. Delineation of catchment boundary and drainage network to determine the hydrological parameters using GIS.
6. Computer Aided (CAD) design in water resources engineering.

Course Outcome:

1. The students will be able to apply their knowledge about fluid mechanics in addressing problems in open channels.
2. The students will be able to know hydrological measurement technique – measurement of rainfall and rainfall intensities, abstractions in hydrological processes like evaporation, infiltration, etc.
3. The students will be able to measure velocity in rivers and streams using current meter, measure velocity in flow channels.

4. The students will be able to study topographical maps and delineate watersheds from the maps, evaluate catchment morphological characteristics.

5. The students will be able to make stream flow measurements in fields, runoff computations and determine precipitation intensities.

6. The students will develop skills to solve problems using current softwares.

To establish the correlation between COs & POs

Table-1

No of Course Outcome (CO)	Course Outcome
UCE06P04.1	The students will be able to apply their knowledge about fluid mechanics in addressing problems in open channels.
UCE06P04.2	The students will be able to know hydrological measurement technique – measurement of rainfall and rainfall intensities, abstractions in hydrological processes like evaporation, infiltration, etc.
UCE06P04.3	The students will be able to measure velocity in rivers and streams using current meter, measure velocity in flow channels.
UCE06P04.4	The students will be able to study topographical maps and delineate watersheds from the maps, evaluate catchment morphological characteristics.
UCE06P04.5	The students will be able to make streamflow measurements in fields, runoff computations and determine precipitation intensities.
UCE06P04.6	The students will develop skills to solve problems using current softwares like HEC-HMS, HEC-RAS, etc for hydrological modelling.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 4. No Correlation: -"~"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE06P04.1	3	2	2	1	3	2	1	-	3	2	-	3
UCE06P04.2	3	2	3	2	3	1	2	-	2	2	-	2
UCE06P04.3	2	2	2	2	3	1	2	-	3	2	-	2
UCE06P04.4	3	2	1	2	2	1	2	-	2	1	-	2
UCE06P04.5	2	2	2	1	2	1	1	-	3	1	-	2
UCE06P04.6	2	1	2	3	2	2	1	-	2	2	-	2
Total	**15**	**11**	**12**	**11**	**15**	**8**	**9**	**-**	**15**	**10**	**-**	**13**

Average	**2.50**	**1.83**	**2.00**	**1.83**	**2.50**	**1.33**	**1.50**	**0.00**	**2.50**	**1.67**	**0.00**	**2.17**
Equivalent Avg. Attainment	**3**	**2**	**2**	**2**	**3**	**1**	**2**	**-**	**3**	**2**	**-**	**2**

To establish the correlation between COs &PSOs
Table-3

CO	PSO1	PSO2
UCE06P04.1	2	3
UCE06P04.2	3	3
UCE06P04.3	3	3
UCE06P04.4	3	2
UCE06P04.5	3	4
UCE06P04.6	3	4
Total	**17**	**19**
Average	**2.83**	**3.17**
Equivalent Avg. Attainment	**3**	**3**

DETAILCOURSE CURRICULUM

FOR

UNDERGRADUATE PROGRAMME
B.TECH

IN

CIVIL ENGINEERING
(7^{th} SEMESTER)

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA
TRIPURA (WEST)

DEPARTMENTAL ELECTIVE- I

REINFORCED EARTH STRUCTURES
(UCE07E01)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To obtain fundamental understanding about reinforced earth, their uses and mechanics of analysis.
2. To understand the testing and design of reinforced earth retaining wall.
3. To understand the uses of reinforced earth in foundation and road.
4. To know in detail about the uses of reinforced earth other than Geotechnical Engineering.

Course Content:

Unit-1

Basics of Reinforced Earth Construction: Definition, Historical Background, Components, Mechanism and Concept, Advantages and Disadvantage of reinforced earth Construction, Sandwich technique for clayey soil.

Geosynthetics and Their Functions: Historical developments, Recent developments, manufacturing process woven & non-woven, Raw materials –Classification based on materials type – Metallic and Non-metallic, Natural and Man-made Geosynthetics.

Unit -2

Properties and Tests on Materials: Properties – Physical, Chemical, Mechanical, Hydraulic, Endurance and Degradation requirements, Testing & Evaluation of properties.

Design of Reinforced Earth Retaining Walls: Concept of Reinforced earth retaining wall, Internal and external stability, Selection of materials, Typical design problem; Soil Nailing Techniques: Concept, Advantages & limitations of soil nailing techniques, comparison of soil nailing with reinforced soil, methods of soil nailing, Construction sequence, Components of system, Design aspects and precautions to be taken

Unit -3

Design of Reinforced Earth Foundations: Modes of failure of foundation, Determination of force induced in reinforcement ties – Location of failure surface, tension failure and pull out resistance, length of tie and its curtailment, Bearing capacity improvement in soft soils, General guidelines.

Unit -4

Geosynthetics for Roads and Slopes: Roads - Applications to Temporary and Permanent roads, Role of Geosynthetic in enhancing properties of road, control of mud pumping, Enhancing properties of subgrade, Design requirements of slopes –Causes for slope failure, Improvement of slope stability with Geo synthetic, Drainage requirements, Construction technique. Simple Numerical Stability Checking Problems on Reinforced Slopes

Unit -5

Geosynthetics - filter, drain and landfills: Filter & Drain – Conventional granular filter design criteria, Geosynthetic filter design requirements, Drain and filter properties, Design criteria – soilretention, Geosynthetic permeability, antic logging, survivability and durability Landfills – Typical design of Landfills – Landfill liner & cover, EPA Guidelines, Barrier walls for existing landfills and abandoned dumps.

Reference:-

Sl No.	Name Of Book	Author	Publisher
01.	Design with Geosynthetics	Koerner. R.M	Prince Hall Publications
02.	Construction and Geotechnical Engineering using synthetic fabrics	Koerner. R.M. &Wesh, J.P	Wiley Inter Science, NewYork
03.	An introduction to Soil Reinforcement and Geosynthetics	Sivakumar Babu G. L.	Universities Press, Hyderabad
04.	Reinforced Soil and its Engineering Applications	Swami Saran	I. K. International Pvt. Ltd, New Delhi
05.	Engineering with Geosynthetics	Venkattappa Rao, G., & Suryanarayana Raju., G. V.S	", Tata McGraw Hill publishing Company Limited., New Delhi.
06.	Earth reinforcement and Soil structure	Jones	CJEP Butterworths, London
07.	Geotextile Hand Book	Ingold, T.S. & Millar, K.S	Thomas, Telford, London.
08.	Earth Reinforcement Practices Vol. I	Hidetoshi Octial, Shigenori Hayshi&Jen Otani	A.A. Balkema, Rotterdam
09.	Ground Engineer's reference Book	Bell F.G	Butterworths, London
10.	Reinforced Earth	Ingold, T.S	Thomas, Telford, London
11.	Geosynthetics in Civil Engineering	Sarsby R W- Editor	Woodhead Publishing Ltd & CRC Press, 2007

Course Outcome:

1. Students will be able to know about the reinforced earth and different types of reinforcements.

2. Students will be able to perform different types of experiments on reinforced earth to know different physical, chemical and mechanical properties.
3. Students will be able to analyse and design the reinforced earth retaining wall problems.
4. Students will be able to analyse and design the reinforced earth foundation problems.
5. Students will be able to know the uses of geo-synthetics in roads, slope, drainage along with the analysis and design of those structures using geo-synthetics.
6. Students will be able to know about the other miscellaneous uses of geo-synthetics

To establish the correlation between COs & POs

Table 1

No of Course Outcome (CO)	Course Outcome
UCE07E01.1	Students will be able to know about the reinforced earth and different types of reinforcements.
UCE07E01.2	Students will be able to perform different types of experiments on reinforced earth to know different physical, chemical and mechanical properties.
UCE07E01.3	Students will be able to analyse and design the reinforced earth retaining wall problems.
UCE07E01.4	Students will be able to analyse and design the reinforced earth foundation problems.
UCE07E01.5	Students will be able to know the uses of geo-synthetics in roads, slope , drainage along with the analysis and design of those structures using geo-synthetics.
UCE07E01.6	Students will be able to know about the other miscellaneous uses of geo-synthetics

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E01.1	3	2	2	1	1	1	2	1	1	1	1	2
UCE07E01.2	3	2	2	1	1	1	2	1	1	1	1	2
UCE07E01.3	3	2	2	1	1	1	2	1	1	1	1	2
UCE07E01.4	3	2	2	1	1	1	2	1	1	1	1	2
UCE07E01.5	3	2	2	1	1	1	2	1	1	1	1	2

UCE07E01.6	3	2	2	1	1	1	2	1	1	1	1	2
Total	**18**	**12**	**12**	**6**	**6**	**6**	**12**	**6**	**6**	**6**	**6**	**12**
Average	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**2**
Equivalent Avg. Attainment	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**2**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E01.1	3	4
UCE07E01.2	3	4
UCE07E01.3	3	4
UCE07E01.4	3	4
UCE07E01.5	3	4
UCE07E01.6	3	4
Total	**18**	**24**
Average	**3**	**4**

ALTERNATIVE BUILDING MATERIALS

(UCE07E02)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To give a clear idea on the energy consumed in building construction along with environmental issues the present world is facing.
2. To provide proper knowledge regarding building blocks alternate to burnt bricks that are used for construction.
3. To describe various wall construction techniques used around the world to develop a sustainable and eco-friendly constructions.
4. To give an insight into different type of alternate roofing systems available.

Course Content:

Unit-1

Introduction: Energy in building materials, Environmental issues concerned to building materials, Embodied energy and life-cycle energy, Global warming and construction industry, Green concepts in buildings, Green building ratings –IGBC and LEED manuals – mandatory requirements, Rainwater harvesting & solar passive architecture. Environmental friendly and cost effective building technologies, Requirements for buildings of different climatic regions.

Unit -2

Elements of Structural Masonry: Elements of Structural Masonry, Masonry materials, requirements of masonry units' characteristics of bricks, stones, clay blocks, concrete blocks, stone boulders, laterite Blocks, Fal- G blocks and Stabilized mud block. Manufacture of stabilized blocks. Structural Masonry Mortars: Mortars, cementations materials, sand, natural & manufactured, types of mortars, classification of mortars as per BIS, characteristics and requirements of mortar, selection of mortar. Uses of masonry, masonry bonding, Compressive strength of masonry elements, Factors affecting compressive strength, Strength of Prisms/wallets and walls, Effect of brick bond on strength, Bond strength of masonry: Flexure and shear, Elastic properties of masonry materials and masonry, Design of masonry compression elements subjected to axial load.

Unit -3

Alternative Building Materials: Lime, Pozzolana cements, Raw materials, Manufacturing process, Properties and uses. Fibers- metal and synthetic, Properties and applications. Fiber reinforced plastics, Matrix materials, Fibers organic and synthetic, Properties and applications. Building materials from agro and industrial wastes, Types of agro wastes, Types of industrial and mine wastes, Properties and applications. Masonry blocks using industrial wastes. Construction and demolition wastes.

Unit -4

Alternative Building Technologies: Use of arches in foundation, alternatives for wall constructions, composite masonry, confined masonry, cavity walls, rammed earth, Ferro cement and ferroconcrete building components, Materials and specifications, Properties, Construction methods, Applications. Top down construction, Mivan Construction Technique. Alternative Roofing Systems: Concepts, Filler slabs, Composite beam panel roofs, Masonry vaults and domes.

Unit -5

Equipment for Production of Alternative Materials: Machines for manufacture of concrete, Equipments for production of stabilized blocks, Moulds and methods of production of precast elements, Cost concepts in buildings, Cost saving techniques in planning, design and construction, Cost analysis: Case studies using alternatives.

References:-

Sl No.	Name Of Book	Author	Publisher
01.	Alternative Building Materials and Technologies	KS Jagadish, BV Venkatarama Reddy and KS Nanjunda Rao	New Age International pub.
02.	Structural Masonry	Arnold W Hendry	Macmillan Publishers
03.	Building Materials in Developing Countries	RJS Spence and DJ Cook	Wiley pub.
04.	LEED India, Green Building Rating System	----------	IGBC pub.
05.	IGBC Green Homes Rating System	----------	CII pub.
06.	Relevant IS Codes.	----------	----------

Course Outcome:

1. Students will learn the various types of building materials.
2. Students will be able to decide on the energy consumption using different construction technique and materials.
3. Students will be well verse in methods of making building materials like SMB and different types of wall construction.
4. Students will learn about ferro-cement and its design.
5. Students will learn about the possible alternative materials for sand, bricks burning etc.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E02.1	Students will learn the various types of building materials.
UCE07E02.2	Students will be able to decide on the energy consumption using different construction technique and materials.
UCE07E02.3	Students will be well verse in methods of making building materials like SMB and different types of wall construction.
UCE07E02.4	Students will learn about ferro-cement and its design.
UCE07E02.5	Students will learn about the possible alternative materials for sand, bricks burning etc.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: '-'

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E02.1	3	1	2	1	3	2	3		3			3
UCE07E02.2	3	3	3	3	1	2	3		3			3
UCE07E02.3	3	1	3	3	3	2	3		3			3
UCE07E02.4	3	3	2	1	2	2	2		2			3
UCE07E02.5	3	1	2	2	2	2	3		3			3
Total	15	9	12	10	11	10	14		14			15
Average	3	1.8	2.4	2	2.2	2	2.8		2.8			3
Equivalent Avg. Attainment	3	2	2	2	2	2	3		3			3

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E02.1	3	2
UCE07E02.2	3	3
UCE07E02.3	3	4
UCE07E02.4	2	4
UCE07E02.5	2	4
Total	**13**	**17**
Average	2.6	3.4
Equivalent Avg. Attainment	3	3

PRE-STRESSED CONCRETE DESIGN

(UCE07E03)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To obtain fundamental understanding of the concepts of prestress concrete.
2. To understand the loss of prestress during construction and service state of the structure.
3. To understand the serviceability behavior of prestress concrete structure.
4. To acquire knowledge regarding failure modes and design of prestress concrete members.
5. To acquire knowledge on design of anchorage and composite structure.

Course Content:

Unit-1

Introduction and Analysis of Members: Concept of Prestressing - Types of Prestressing - Advantages - Limitations –Prestressing systems - Anchoring devices - Materials - Mechanical Properties of high strength concrete - high strength steel - Stress-Strain curve for High strength concrete. Analysis of members at transfer - Stress concept - Comparison of behavior of reinforced concrete and prestressed concrete - Force concept - Load balancing concept - Kern point - Pressure line.

Unit -2

Losses in Prestress, Loss of Prestress due to Elastic shortening, Friction, Anchorage slip, Creep of concrete, Shrinkage of concrete and Relaxation of steel - Total Loss. Deflection and Crack Width Calculations of Deflection due to gravity loads - Deflection due to prestressing force -Total deflection - Limits of deflection - Limits of span-to-effective depth ratio -Calculation of Crack Width - Limits of crack width.

Unit -3

Design of Sections for Flexure: Analysis of members at ultimate strength - Preliminary Design - Final Design for Type 1members.

Unit -4

Design for Shear: Analysis for shear - Components of shear resistance – Modesof Failure - Limit State of collapse for shear - Design of transverse reinforcement.

Unit -5

Anchorage zone stresses and design of anchorages. Composite Sections: Types of composite construction - Analysis of composite sections - Deflection –Flexural and shear strength of composite sections.

References:-

Sl No.	Name Of Book	Author	Publisher
01.	Prestressed Concrete	Krishna Raju, N.	Tata McGraw Hill Publishing Company, New Delhi 2006
02.	Pre-stressed Concrete - Problems and Solutions	Krishna Raju. N	CBS Publishers and Distributors, Pvt.Ltd., New Delhi.

03.	Pre - stressed Concrete	Rajagopalan N	Narosa Publishing House, New Delhi
04.	Advanced Concrete Design	Praveen Nagarajan	Person
05.	Prestressed Concrete Structures	P. Dayaratnam	Oxford & IBH-Pubs Company, Delhi, 5th Edition
06.	Design of Pre - stressed Concrete Structures	Lin T Y and Burns N H	John Wiley and Sons, New York
07.	Pre - stressed Concrete	Pundit G S and Gupta S P	C B S Publishers, New Delhi
08.	IS: 1343: Indian Standard code of practice for Prestressed concrete, BIS, New Delhi.	----------	----------
09.	IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, BIS, New Delhi	----------	----------

Course Outcome:

1. Students will be able to find the stresses at various sections of prestressing members.
2. Students will be able to find out amount of losses in prestress during its construction stage as well as during service state.
3. Students will be able to determine the serviceability parameter such as, deflection and crackwidth.
4. Students will be able to design the prestress concrete members including its anchorage.
5. Students will be able to design composite section.

To establish the correlation between COs & POs
Table-1

No of course outcome (CO)	Course Outcome
UCE07E03.1	Students will be able to find the stresses at various sections of prestressing members.
UCE07E03.2	Students will be able to find out amount of losses in prestress during its construction stage as well as during service state.
UCE07E03.3	Students will be able to determine the serviceability parameter such as, deflection and crackwidth.
UCE07E03.4	Students will be able to design the prestress concrete members including its anchorage.
UCE07E03.5	Students will be able to design composite section.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: '-'

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E03.1	3	3	2	1	1	-	-	-	-	-	-	1
UCE07E03.2	3	3	2	1	1	-	-	-	-	-	-	1
UCE07E03.3	3	3	2	1	1	-	-	-	-	-	-	1
UCE07E03.4	3	3	2	1	1	1	-	-	-	-	-	1
UCE07E03.5	3	3	2	1	1	-	-	-	-	-	-	1
Total	**15**	**15**	**10**	**5**	**5**	**1**	**-**	**-**	**-**	**-**	**-**	**5**
Average	**3**	**3**	**2**	**1**	**1**	**0.20**	**-**	**-**	**-**	**-**	**-**	**1**
Equivalent Avg. Attainment	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE07E03.1	3	2
UCE07E03.2	3	3
UCE07E03.3	3	3
UCE07E03.4	3	2
UCE07E03.5	3	3
Total	**15**	**13**
Average	**3**	**2.60**
Equivalent Avg. Attainment	**3**	**3**

ADVANCED RCC DESIGN

(UCE07E04)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objectives:

1. To obtain an understanding on methods used for design of slabs and apply for slab designing.
2. To obtain concept for design of grid floors.
3. To obtain an understanding for design of continuous beams.
4. To obtain concept for Design of Chimneys, silos and bunkers.
5. To obtain concepts of detailing of earthquake resistant structures.

Course Content:

Unit-1

Yield line method of design of slabs. Design of flat slabs,

Unit -2

Design of grid floors.

Unit -3

Design of continuous beams with redistribution of moments.

Unit -4

Design of Chimneys, Design of silos and bunkers.

Unit -5

Art of detailing earthquake resistant structures. Expansion and contraction joints.

References:-

Sl No.	Name Of Book	Author	Publisher
01.	Reinforced Reinforced and Prestressed Concrete	A Park and Paulay	----------
02.	Reinforced Concrete Design	Lin TY and Burns N H	----------
03.	Design of Prestressed Concrete Structures	Kong KF and Evans T H	----------
04.	Advanced Reinforced Concrete Design	P.C.Varghese	Prentice-Hall of India, New Delhi, 2005.
05.	Comprehensive RCC Design	Dr.B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain	----------

Course Outcome:

1. Students will be able to apply different methods for designing slab.
2. Students will be able to design grid floors
3. Know the design process of continuous beams.
4. Students will be able to design Chimneys, silos and bunkers.
5. Student will know how to detail earthquake resistant structures.

To establish the correlation between COs & POs
Table- 1

No of Course Outcome (CO)	Course Outcome
UCE07E04.1	Students will be able to apply different methods for designing slab.
UCE07E04.2	Students will be able to design grid floors.
UCE07E04.3	Know the design process of continuous beams.
UCE07E04.4	Students will be able to design Chimneys, silos and bunkers.
UCE07E04.5	Student will know how to detail earthquake resistant structures.

Table-2
CORRELATION LEVELS:

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: '-'

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E04.1	3	3	2	2	2							1
UCE07E04.2	3	3	2	2	2							1
UCE07E04.3	3	3	2	2	2							1
UCE07E04.4	3	3	2	2	2							1
UCE07E04.5	3	3	2	2	3							1
Total	15	15	10	10	11							5
Average	3	3	2	2	2.2							1
Equivalent Avg. Attainment	3	3	2	2	2							1

To establish the correlation between Cos & PSOs
Table-3

CO	PSO1	PSO2
UCE07E04.1	3	2
UCE07E04.2	3	2
UCE07E04.3	3	2
UCE07E04.4	3	2
UCE07E04.5	3	2
Total	15	10
Average	3	2
Equivalent Avg. Attainment	3	2

GROUND IMPROVEMENT TECHNIQUES

(UCE07E05)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To understand about the necessity of ground improvement.
2. To explain the various methods of ground improvement technique.
3. To explain the Field compaction and its control.
4. To explain about the use of geo-synthetic.
5. To explain about the soil stabilization.

Course Content:

Unit-1

Ground improvement principles and techniques. Heavy damping, compaction of piles. Preloading with sand drains/sand wicks. Field control. Principles of stone column. Grouting, Inserting reinforcing elements.

Unit -2

Dewatering, field pumping test, common dewatering methods. Effects of dewatering. Soil stabilization, Different types of soil stabilization.

Unit -3

Various types of Geosynthetics, Major Uses of Geosynthetics; Emerging and Future Developments of Geosynthetics. Functions, Properties& designing with geosynthetics.

Unit -4

Reinforced earth, Foundation and retaining wall using reinforced earth.

Unit -5

Identification of expansive soil, problems associated with expansive soil; design consideration of foundation on expansive soil.

References:-

Sl No.	Name Of Book	Author	Publisher
1.	Guidelines on ground improvement for structure and facilities	U. S. Army Corps of Engineers (Paperback - Feb 28, 2005)	U. S. Army Corps of Engineers, Washington DC
2.	Ground Control and Improvement	Petros P. Xanthakos, Lee W. Abramson, and Donald A. Bruce	John Wiley, New York

Course Outcome:

1. Students will be able to analyze and find various engineering properties of soil.
2. Students will be able to analyze and design of dewatering systems.
3. Students will be able to analyze and design with geo-synthetic.
4. Students will be able to analyze and design the Reinforced earth.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E05.1	Students will be able to analyze and find various engineering properties of soil.
UCE07E05.2	Students will be able to analyze and design of dewatering systems.
UCE07E05.3	Students will be able to analyze and design with geo-synthetic.
UCE07E05.4	Students will be able to analyze and design the Reinforced earth.

Table-2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and '-' for NO CORELATION

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E05.1	2	3	3	3	3	2	1	-	-	-	-	2
UCE07E05.2	2	3	3	3	3	1	1	-	-	-	-	2
UCE07E05.3	2	3	3	3	3	2	1	-	-	-	-	2
UCE07E05.4	2	3	3	3	3	2	1	-	-	-	-	2

Total	8	12	12	12	12	7	4	-	-	-	-	8
Average	2	3	3	3	3	1.75	2	-	-	-	-	2
Eq. Av Attainment	2	3	3	3	3	2	2	-	-	-	-	2

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E05.1	2	2
UCE07E05.2	3	3
UCE07E05.3	3	3
UCE07E05.4	3	3
Total	**11**	**11**
Average	**2.75**	**2.75**
Equivalent Avg. Attainment	**3**	**3**

ENVIRONMENTAL GEOTECHNIQUE (UCE07E06)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To understand the concept of soil-environment interaction and its impact in design.
2. To understand the soil mineralogical chemistry with water.
3. To understand the characterization of wastes and contaminants through soil medium.
4. To study the unsaturated soil mechanics.

Course Content:

Unit-1

Soil as a multi-phase system; Soil-environment interaction; Properties of water in relation to the porous media; Water cycle with special reference to soil medium.

Unit -2

Soil mineralogy; significance of mineralogy in determining soil behaviour; Mineralogical characterization. Mechanisms of soil-water interaction: Diffuse double layer models; Force of attraction and repulsion. Soil-water-contaminant interaction; Theories of ion exchange; Influence of organic and inorganic chemical interaction. Introduction to unsaturated soil mechanics; water retention property and soil-water characteristic curve; flow of water in unsaturated soil.

Unit -3

Concepts of waste containment facilities; desirable properties of soil; contaminant transport and retention; contaminated site remediation. Introduction to advanced soil characterization techniques; volumetric water content; gas permeation in soil; electrical and thermal properties; pore-size distribution; contaminant analysis, landfills liner systems.

Soil as a multi- phase system; Soil-environment interaction; Properties of water in relation to the porous media; Water cycle with special reference to soil medium.

Unit -4

Soil mineralogy; significance of mineralogy in determining soil behaviour; Mineralogical characterization. Mechanisms of soil-water interaction: Diffuse double layer models; Force of attraction and repulsion; Soil-water-contaminant interaction; Theories of ion exchange; Influence of organic and inorganic chemical interaction. Introduction to unsaturated soil mechanics; water retention property and soil-water characteristic curve; flow of water in unsaturated soil.

Unit -5

Concepts of waste containment facilities; desirable properties of soil; contaminant transport and retention; contaminated site remediation. Introduction to advanced soil characterization techniques; volumetric water content; gas permeation in soil; electrical and thermal properties; pore-size distribution; contaminant analysis, landfills liner systems.

References:-

Sl No.	Name Of Book	Author	Publisher
01.	Fundamentals of Soil Behavior	Mitchell, J.K and Soga, K	JohnWileyandSonsInc.,2005.
02.	Introduction to Environmental Geotechnology	Fang, H-Y	CRC Press,1997.
03.	Geotechnical Practice for Waste Disposal	Daniel, D. E	Chapman and Hall, 1993.
04.	Clay Barrier Systems for Waste Disposal Facilities	Rowe,R.K.,Quigley,R.M.andBooker	J. R., E & FN Spon, 1995.
05.	Geotechnical and Geoenvironmental Engineering Handbook	Rowe, R. K	Kluwer Academic Publishers, 2001.
06.	Reddi, L. N. and Inyang, H.F,	Geoenvironmental Engineering-Principles and Applications	Marcel Dekker Inc, 2000.
07.	Waste Containment Systems,Waste Stabilization and Landfills: Design and Evaluation,	Sharma, H.D and Lewis, S.P,	John Wiley & Sons Inc., 1994.

Course Outcome:

1. Students will be able to understand the concept of geo-environmental issues in the design.
2. Students will be able to understand the concept of unsaturated soil mechanics.
3. Students will be able to learn soil mineralogical behavior and soil-water ionic relationship.
4. Students will be able to given exposure on flow of contaminant through soil medium.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E06.1	Students will be able to understand the concept of geo-environmental issues in the design.
UCE07E06.2	Students will be able to understand the concept of unsaturated soil mechanics.
UCE07E06.3	Students will be able to learn soil mineralogical behavior and soil-water ionic relationship.
UCE07E06.4	Students will be able to given exposure on flow of contaminant through soil medium.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E06.1	3	2	2	3	3	2	3	2	1	-	-	1
UCE07E06.2	3	3	2	3	2	2	3	2	-	-	-	1
UCE07E06.3	3	3	2	3	2	2	3	2	-	-	-	1
UCE07E06.4	3	3	2	3	2	2	3	2	-	-	-	1
Total	**15**	**13**	**10**	**15**	**11**	**10**	**15**	**10**	**1**	**-**	**-**	**5**
Average	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**1**	**-**	**-**	**1**
Equivalent Avg. Attainment	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**1**	**-**	**-**	**1**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E06.1	3	2
UCE07E06.2	3	3
UCE07E06.3	3	3
UCE07E06.4	3	2
Total	**15**	**13**
Average	**3**	**2.67**

Equivalent Avg. Attainment	**3**	**3**

GEOTECHNICAL INVESTIGATION AND PRACTICES

(UCE07E07)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To learn about objects and stages of site investigation: types of samples and samplers.
2. To know about the different boring methods.
3. To impart knowledge about standard penetration test, static and dynamic cone penetration tests, in-situ vane shear tests, geophysical exploration methods.
4. To learn about location of ground water table, preparation of site investigation report.
5. To access the general suitability of the site.
6. To locate the ground water level and possible corrosive effect of soil and water on foundation material.
7. To know the nature of each of the soil and rock, this may affect the design and mode of construction of proposed structure and foundation.

Course Content:

Unit-1

Soil Exploration: Purpose; Method of soil exploration; Boring, sampling; Standard penetration test; Static and dynamic cone test; Correlation between penetration resistance and strength parameters; Plate load test, Stabilization of boreholes.

Unit -2

Planning of Sub soil Investigation; Number of bore holes and depth of exploration; Types of tests to suit soil conditions. In-situ method of determination of different soil properties like shear strength, permeability etc. soundings, pressure-meter. Determination of water table, under water subsoil exploration.

Unit -3

Methods of Geophysical Exploration- Seismic reflection, refraction and electrical resistivity methods.

Unit -4

Exploration methods in Rocks-investigation, sequence, drilling, sampling and bore hole inspection.Laboratorymethodofdeterminingthevariouspropertiesandbehaviorofsoils.

Unit -5

Dynamic testing of soils. Method of Geotechnical study for various civil engineering design and construction. Preparation of necessary report. Instrumentation.

References:-

Sl No.	Name Of Book	Author	Publisher
01.	Site Investigation Science	C.R.I. Clayton, M.C. Matthews	Blackwell and N.E. Simons, (2005).Oxford
02.	Geotechnical Engineering Soil &Foundation Principles& Practice	Richard L. Handy Merlin G.	Spangler Publ.Jan. 4, 2007.
03.	A Short course in Geotechnical	N. E. Simons, Bruce Keith Menzie	

Course Outcome:

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

1. Learn the site-specific field investigations including collection of soil samples for testing and observation of soil behavior.
2. Learn the different methods of boring, types of samples and sampling, field tests.
3. Learn the detail topics on in-situ soil testing.
4. Learn the dynamic testing of soils.
5. Learn the different geophysical methods for indirect assessment subsurface profile.
6. Learn the various method of Geotechnical study for various civil engineering design and construction and preparation of investigation report.

To establish the correlation between COs &POs
Table-1

No. of Curse Outcome(CO)	Course Outcome
UCE07E07.1	Learn the specific field investigations including collection of soil samples for testing and observation of soil behavior.
UCE07E07.2	To make students understand concepts of methods of boring, types of samples and sampling, field tests.
UCE07E07.3	Learn the detail topics on in-situ soil testing.
UCE07E07.4	Learn the dynamic testing of soils.
UCE07E07.5	Learn the different geophysical methods for indirect assessment of subsurface profile.
UCE07E07.6	Learn the various method of Geotechnical study for various civil engineering design and construction and preparation of investigation report.

Table-2

Slight (Low): 1 **Moderate: 2** **Substantial (High):3** **No Correlation: "-"**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E07.1	2	2	2	2	2	1	1	1	1	1	2	2
UCE07E07.2	2	2	2	2	2	1	1	1	2	1	2	2
UCE07E07.3	1	2	2	2	2	1	1	2	1	2	2	3
UCE07E07.4	2	2	2	1	2	2	1	2	2	2	2	3
UCE07E07.5	2	2	3	2	2	2	1	1	2	2	2	3
UCE07E07.6	2	2	2	2	2	2	2	1	2	2	2	2
Total	11	12	13	11	12	9	7	8	10	10	12	15
Average	1.83	2	2.16	1.83	2	1.5	1.16	1.33	1.66	1.66	2	2.5
Eq. Av Attainment	2	2	2	2	2	2	1	1	2	2	2	3

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE07E07.1	2	3
UCE07E07.2	2	3
UCE07E07.3	3	3
UCE07E07.4	2	3
UCE07E07.5	2	3
UCE07E07.6	3	3
Total	14	18
Average	2.33	3
Equivalent Avg. Attainment	2	3

SUSTAINABILITY CONCEPT IN GEOTECHNICAL ENGINEERING (UCE07E08)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To aware and understand the concept of sustainability in geotechnical structure design.
2. To realize the challenges of application of sustainability concept.
3. To learn the computation technique of resiliency assessment tools.

4. To study the environmental impact assessment along with energy efficient design concept.
5. To introduce the concept of climate change effect on developing sustainable design guideline for geo-systems considering multiple hazards.

Course Content:

Unit-1

Sustainable Development: the concept and the practical challenge. Different layers of sustainability, new sustainability rating system, Resilience, Reliability and Adaptability.

Unit-2

Geo-sustainability, Geosystems, Sustainability and Resilience Assessment Tools, Environmental impact assessment, Multi-criteria analysis, SPeAR template.

Unit-3

Energy Geotechniques, Material reuse and recycle, Foundation rehabilitation and reuse, Use of underground space, Sustainable ground improvement, Sustainability in coastal geotechniques.

Unit-4

Effects of climate change on Geotechnical systems, Geo-environmental engineering.

Unit-5

Geo hazards monitoring and mitigation, Sustainable geotechnical design against multiple hazards.

References:-

Sl No.	Name Of Book	Author	Publisher
01.	Fundamentals of Sustainability in Civil Engineering.	Andrew Braham	CRC Press.
02.	The Theory and Practice of Sustainable Engineering1st Edition.	Braden R. Allenby	Pearson Education Ltd.
03.	Energy, Environment and Sustainable Development.	Dincer, I. and Rosen, M. (2007)	Elsevie
04.	Environmental Life Cycle Assessment.	Curran, M.A. (1996)	McGraw Hill, United States.
05.	Embodied Energy and Economic Valuation.	Constanza, R. (1980).	Science, New Series, 210(4475) 1219-1224.
06.	Environmental Accounting.	Odum H.T. (1996).	Wiley Publishing Company

Course Outcome:

1. Students will be able to understand the importance of concept of sustainability in designing different geotechnical structures.
2. Students will be able to calculate resiliency parameter to satisfy sustainable design.

3. Students will be able to learn ensuring geo-environmental issues.
4. Students will be able to given exposure on recycle, reuse of materials and rehabilitation concept in design.
5. Students will be able to understand the implication of climate change on different geo-hazards.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E08.1	Students will be able to understand the importance of concept of sustainability in designing different geotechnical structures.
UCE07E08.2	Students will be able to calculate resiliency parameter to satisfy sustainable design.
UCE07E08.3	Students will be able to learn ensuring geo-environmental issues.
UCE07E08.4	Students will be able to given exposure on recycle, reuse of materials and rehabilitation concept in design.
UCE07E08.5	Students will be able to understand the implication of climate change on different geo-hazards.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E08.1	3	2	2	3	3	2	3	2	1	-	-	1
UCE07E08.2	3	3	2	3	2	2	3	2	-	-	-	1
UCE07E08.3	3	3	2	3	2	2	3	2	-	-	-	1
UCE07E08.4	3	3	2	3	2	2	3	2	-	-	-	1
UCE07E08.5	3	2	2	3	2	2	3	2	-	-	-	1
Total	**15**	**13**	**10**	**15**	**11**	**10**	**15**	**10**	**1**	**-**	**-**	**5**
Average	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**1**	**-**	**-**	**1**
Equivalent Avg.	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**1**	**-**	**-**	**1**

Attainment												

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E08.1	3	2
UCE07E08.2	3	3
UCE07E08.3	3	3
UCE07E08.4	3	2
UCE07E08.5	3	3
Total	**15**	**13**
Average	**3**	**2.67**
Equivalent Avg. Attainment	**3**	**3**

DEPARTMENTAL ELECTIVE- II

WATER RESOURCES PLANNING AND MANAGEMENT (UCE07E09)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. The objective of this course is to impart the knowledge of planning, developing and managing water resources to ensure adequate, inexpensive and sustainable supplies and qualities of water.
2. To impart the knowledge of various techniques, Cost-benefit analysis, optimization techniques and system approach and how to manage the water resources, to protect against flooding, or to make passage along or across rivers easier,
3. Integrated and multiple utilization of water development projects.

Course Content:

Unit-1

Introduction: Role of water in national development, assessment of water resources of the country, scope of water resources development vis-a-vis environment.

Unit -2

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

Unit -3

Cost-benefit analysis Introduction to optimization techniques and system approach.

Unit - 4

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

Unit- 5

Water quantity and quality modeling, evaluation of impacts of water resources projects on river regimes and environment, reservoir sedimentations and watershed management.

Reference:-

	Name of Books	Authors	Publishers
01.	Principle of water Resources Planning	Good man, A.S	Prentice Hall,Inc.,Engle wood Cliffs,N.J.1984
02	Water Resources Engineering, 3rd edition	Linsley, R.K/and Frazini,J.B.,	Mc.Graw hill,

Course Outcome:

1. Identify available water resources and how these vary in time.
2. Build simple optimization models using linear programming.
3. Simulate changes in water quality and relate these to regulations.
4. Plan future demand scenarios based on climate change.
5. Evaluate system management options to optimize water availability.
6. Develop an archive that will be accessible for future research

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E09.1	Identify available water resources and how these vary in time.
UCE07E09.2	Build simple optimization models using linear programming
UCE07E09.3	Simulate changes in water quality and relate these to regulations.
UCE07E09.4	Plan future demand scenarios based on climate change..
UCE07E09.5	Evaluate system management options to optimize water availability.
UCE07E09.6	Develop an archive that will be accessible for future research

Table-2

1: Slight (LOW) 2: Moderate (MEDIUM)3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
UCE07E09.1	2	2	1	3	2	2	2	3	3	2	2	1
UCE07E09.2	3	3	3	2	2	1	1	2	2	2	2	2
UCE07E09.3	3	1	2	1	3	1	2	1	2	2	2	2
UCE07E09.4	2	2	1	2	1	2	2	1	2	2	1	2
UCE07E09.5	3	2	2	2	1	2	2	1	2	2	2	1
UCE07E09.6	2	1	3	2	2	1	3	2	1	1	2	2
Total	**15**	**11**	**12**	**12**	**11**	**10**	**12**	**10**	**12**	**11**	**11**	**10**
Average	**2.5**	**1.83**	**2.0**	**2.0**	**1.83**	**1.66**	**2.0**	**1.66**	**2.0**	**1.83**	**1.83**	**1.66**
Eq. Av Attainment	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE07E09.1	4	3
UCE07E09.2	4	3
UCE07E09.3	3	3
UCE07E09.4	3	3
UCE07E09.5	3	3
UCE07E09.6	4	3
Total	**21**	**18**
Average	**3.5**	**3**
Equivalent Avg. Attainment	**4**	**3**

RIVER ENGINEERING AND FLOOD CONTROL (UCE07E10)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. The objective of this course is to impart the knowledge of hydrology and fluvial process that deals with the occurrence, distribution, movement and properties of water on the earth.
2. To impart the knowledge of various techniques, and how to manage the water resources, to protect against flooding, or to make passage along or across rivers easier,
3. To learn about the sediment problems associated with natural stream and reservoir.

Course Content:

Unit-1

River Engineering: Generalized characteristics of river channels. Stability of the channel and rate of the channel process.

Unit -2

Hydraulics of alluvial rivers: Variation of bed material, slope along river; dominant discharge; river plan-forms, straight, meandering, braided; cross-sectional shape, Secondary circulation and

flow in bends of Alluvial streams: prediction of river plan forms, local scour at hydraulic structures.

Unit -3

Aggradations and degradation of streams; occurrence and estimation. Hydraulic and mathematical models for alluvial streams. River training: guide banks, spurs and groynes.

Unit -4

Flood Control: Flood forecasting. Flood damage mitigation, structural and nonstructural methods.

Unit -5

Flood routing through reservoirs and channels, principle, hydraulic methods; principles of hydrologic routing, probabilistic method; Flood damages and benefit studies.

References:-

Sl No.	Name of Books	Authors	Publishers
01.	River Behaviour Management and Training (Vol. I & II)	----------	CBI & P, New Delhi.
02.	Irrigation & Water Power Engineering	B. C. Punmia and Pande B. B. Lal.	
03.	Irrigation Engineering	I. E. Hook	John Wiley and Sons, New York.
04.	Hand book of Applied Hydrology	V. T. Chow	McGraw-Hill Publishing Company, New York.

Course Outcome:

1. Demonstrate an advanced understanding of hydrological and river engineering processes.
2. Identify methods of flood control and describe their appropriate application and use it to hold water
3. Recognize the movement of sediments and its impact on river flow
4. Apply knowledge of mathematics, science, and technology in the field of river engineering.
5. An ability to communicate effectively
6. Develop an archive that will be accessible for future research.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E10.1	Demonstrate an advanced understanding of hydrological and river engineering processes
UCE07E10.2	Identify methods of flood control and describe their appropriate application and use it to hold water
UCE07E10.3	Recognize the movement of sediments and its impact on river flow.
UCE07E10.4	Apply knowledge of mathematics, science, and technology in the field of river engineering.
UCE07E10.5	Students will be able to communicate effectively
UCE07E10.6	Develop an archive that will be accessible for future research

Table-2

1: Slight (LOW) 2: Moderate (MEDIUM)3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
UCE07E10.1	3	2	2	2	1	2	1	2	1	2	2	1
UCE07E10.2	2	2	3	2	2	2	1	1	2	2	2	2
UCE07E10.3	3	1	2	1	3	1	2	1	2	2	2	2
UCE07E10.4	2	2	1	2	1	2	2	1	2	2	1	2
UCE07E10.5	3	2	2	2	2	2	2	1	2	2	2	1
UCE07E10.6	2	1	3	2	2	1	3	2	1	1	2	2
Total	**15**	**10**	**13**	**11**	**11**	**10**	**11**	**8**	**10**	**11**	**11**	**10**
Average	**2.5**	**1.66**	**2.16**	**1.83**	**1.83**	**1.66**	**1.83**	**1.33**	**1.66**	**1.83**	**1.83**	**1.66**
Eq. Av Attainment	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**2**

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE07E10.1	4	3
UCE07E10.2	4	3
UCE07E10.3	4	3
UCE07E10.4	4	3
UCE07E10.5	4	3
UCE07E10.6	4	3
Total	**24**	**18**
Average	**4**	**3**
Equivalent Avg. Attainment	**4**	**3**

DESIGN OF HYDRAULIC STRUCTURES (UCE07E11)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To obtain fundamental understanding of the design of various hydraulic structures and River Training works.
2. To obtain fundamental understanding of River Engineering.
3. To obtain the knowledge to design of bridge and culvert.

Course Content:

Unit -1

Dams: Investigation Survey, Selection of dam Site, Selection of type of dam, Classification and field exploration.

Unit -2

Earth and Rock fill Dam: Causes of failures and remedial measure, selection of earth dam, Design considerations, phreatic lines, Seepage loss through earth dams, Stability analysis, Control of seepage through earth dams, Rock fill dams.

Gravity Dams: Forces acting on gravity dam; modes of failures; load combination for design, elementary profile, stability analysis; control of cracking; Galleries.

Unit -3

Spillway: Spillway and energy dissipation below spillway.

Diversion Head works: Selection of site and lay-out; Components of diversion head works; Design of barrage and weirs.

Cross Drainage Structures: Types of cross drainage structures, design of cross drainage structures, Water way and headway of the stream, Head loss through cross drainage structures, Design of transitions for canal waterway, uplift pressure on trough, Uplift pressure on culvert floor.

Unit -4

Hydraulics of Small bridges and culverts: Essential design data: empirical and rational formulae for peak run-off from catchment; estimation of flood discharge; Design discharge; Alluvial streams and lecey's equations; Linear Water way; calculation of scour depth; Elements of hydraulics of flow through small bridges and culverts; Hydraulic details of Pipe culverts, R.C. box culverts and slab culverts.

Unit -5

River Training Works: Types of river training works, Methods, Bank protection works,Spurs, Guide Banks, Artificial cutoff.

References:-

Sl No.	Name of Books	Authors	Publishers
01.	Irrigation and water Resources and Water Power Engineering	Modi	Standard Book House
02.	Irrigation Engineering and Hydraulic Structures	S.K.Garg	Khanna Publishers
03.	Irrigation Engineering and Hydraulic Structures	R.K.Sharma	Oxford & IBH Publication

Course Outcome:

1. Students will be able to classify the types of dam, design of dam and the stability against overturning and sliding.
2. Students will be able to know the river engineering and design of different river protection works.
3. Students will be able to design earthen dam based on seepage analysis.
4. Students will be able to design spillway in a concrete gravity dam.
5. Students will be able to know different types of cross drainage structure and design of it.

6. Students will be able to design bridge and culvert.

To establish the correlation between COs & POs

Table-1

UCE07E11.1	Students will be able to classify the types of dam ,design of dam and the stability against overturning and sliding
UCE07E11.2	Students will be able to know the river engineering and design of different river protection works
UCE07E11.3	Students will be able to know the different river training works
UCE07E11.4	Students will be able to design spillway in a concrete gravity dam
UCE07E11.5	Students will be able to know different types of cross drainage structure and design of it
UCE07E11.6	Students will be able to design bridge and culvert

Table-2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION-"-"

CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
UCE07E11.1	3	3	3	3	1	3	3	3	3	3	3	3
UCE07E11.2	3	2	3	3	1	3	3	3	3	3	2	2
UCE07E11.3	3	3	2	3	1	3	3	3	3	3	2	2
UCE07E11.4	3	1	2	3	1	1	3	3	2	2	3	2
UCE07E11.5	3	3	3	3	1	3	3	3	3	3	3	2
UCE07E11.6	3	3	3	3	1	3	3	3	3	3	3	2
Total	**18**	**15**	**16**	**18**	**6**	**15**	**18**	**18**	**17**	**17**	**16**	**13**
Average	**3.0**	**2.5**	**2.7**	**3.0**	**1.0**	**2.5**	**3.0**	**3.0**	**2.8**	**2.8**	**2.7**	**2.2**
Eq. Av Attainment	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**2**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE07E11.1	4	4
UCE07E11.2	3	3
UCE07E11.3	3	4
UCE07E11.4	4	4
UCE07E11.5	4	4
UCE07E11.6	3	4
Total	**21**	**23**
Average	**3.5**	**3.83**
Equivalent Avg. Attainment	**4**	**4**

HYDRO POWER ENGINEERING
(UCE07E12)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To impart an understanding of power sources and estimation of generation of Hydro power.
2. To have the knowledge of various elements of Hydro Power Engineering.
3. To understand the fundamental concept of Intake structure.
4. To carry out the concept and design of various Conveyance System, Turbine and Power house.

Course Content:

Unit-1

Introduction:

Sources of power, estimation of water power, necessity and importance of harnessing small hydro power, flow duration and power duration curves, load curve, load factors, capacity factors, utilization factors, firm and secondary power.

Unit -2

Types of Hydro Power Plants:

Elements of Hydro power, classification of hydro-power plants, run-of-river plants, storage plants diversion canal development, pumped storage plants, tidal power plants, base load and peak load plants in a power grid.

Unit -3

Intakes:

Intake structures, functions and their types, components of intakes-forebay, trash racks, gates and valves, force required to operate gates.

Unit -4

Conveyance System:

Penstocks, design criterion, economical diameter anchor blocks, cradles and footings, water hammer, instantaneous closure of power canal, surge tank, surges in canals.

Unit -5

Turbines:

Types of turbines, specific speed and classification of turbines, synchronous speed, scrollcasing, flumes and draft tubes, dimensions of scroll casing and draft tubes, setting of turbines.

Power House:

General layout and arrangements of hydro-power units, number and size of units, substructure, spacing of units, super-structure, underground power stations, tidal power.

Reference:-

Sl No.	Name of Books	Author	Publisher
01.	Water Power Engineering	Dandekar, M.M., Sharma,K.N.	----------
02.	Hydro-Electric Engineering Practice Vol.I ,II & III	Brown J.G.	----------
03.	Water Power Engineering	Borrows, H.K	----------
04.	Water Power Development, Vol.I& II	Mosonyi,E.	----------
05.	Water Power Engineering	M.M.Deshmukh.	----------

Course Outcome:

1. Students will be able to understand the various sources of water power and estimation of Hydro power.

2. Students will be able to gain the knowledge about the various elements of Hydro Power Engineering.
3. Students will be able to understand the fundamental concept of Intake structure.
4. Students will be able to carry out the concept and design of a Conveyance System.
5. Students will be able to understand the various types of turbine used in Hydro Power Engineering.
6. Students will be able to carry out the concept and design of Power House.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E12.1	Students will be able to understand the various sources of water power and estimation of Hydro power.
UCE07E12.2	Students will be able to gain the knowledge about the various elements of Hydro Power Engineering.
UCE07E12.3	Students will be able to understand the fundamental concept of Intake structure.
UCE07E12.4	Students will be able to carry out the concept and design of a Conveyance System.
UCE07E12.5	Students will be able to understand the various types of turbine used in Hydro Power Engineering.
UCE07E12.6	Students will be able to carry out the concept and design of Power House.

Table-2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and '-' for NO CORELATION

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E12.1	3	2	-	-	2	3	2	-	-	-	-	2
UCE07E12.2	3	2	-	-	2	3	2	-	-	-	-	2
UCE07E12.3	3	2	-	1	2	3	2	-	-	-	-	2
UCE07E12.4	3	2	3	1	3	3	2	-	-	-	-	3
UCE07E12.5	3	2	3	2	3	3	2	-	-	-	-	3
UCE07E12.6	3	2	3	2	3	3	2	-	-	-	-	3

Total	18	12	9	6	15	18	12	-	-	-	-	12
Average	3	2	1.5	1	2.5	3	2	-	-	-	-	2
Eq. Av Attainment	3	2	2	1	3	3	2	-	-	-	-	2

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E12.1	2	2
UCE07E12.2	2	2
UCE07E12.3	3	3
UCE07E12.4	4	4
UCE07E12.5	3	3
UCE07E12.6	3	4
Total	**17**	**18**
Average	**2.8**	**3**
Equivalent Avg. Attainment	**3**	**3**

INDUSTRIAL POLLUTION AND CONTROL (UCE07E13)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To understand the characteristics of industrial wastewater.
2. To understand the effects of discharge of industrial effluent on stream, land and environment.
3. To make the students conversant about water pollution caused by industrial effluent.
4. To make the students conversant with various industrial wastewater treatment method.
5. To study the combine treatment method of municipal wastewater along with industrial wastewater.
6. To study the effect of air pollution and its control measures.

Course Content:

Unit-1

Water Pollution: -

General Effects of discharge of industrial wastewater on streams, land and environment Importance and scope. Problems involved in treatment. Variation in quality and quantity of industrial wastewater.

Unit -2

Standards & Criteria: Indian standards for discharge of treated wastewaters on land, into municipal sewer and natural water courses. Sampling of Wastewaters, Representative sample. Grab and composite samples.

Unit -3

Effluent Quality and Quantity

Approaches to minimization-good housekeeping, equalization and neutralization byMixing of different effluent streams; recycling of wastewater streams. Process Modifications in terms of raw materials and chemicals used. Treatment of industrial Wastes, Removal of dissolved and suspended solids, organic waste treatment process, Sludge treatment and handling. General Approaches to planning of Industrial Wastewater Treatment and Disposal Equalization & proportioning, Neutralization. Treating different effluent streams separately. Including/Excluding domestic wastewater along with the industrial waste. Treating different streams jointly after mixing them partly or fully treating industrial wastewaters along with town waste.

Unit -4

General Approaches for Handling and Treatment of Specific Characteristics of Industrial Wastewaters.

Stream water quality, DO sag curve. Approaches for treating wastes having shock Loads, colors, toxic metal-ions, refractory substances e.g. ABS and other detergents, Growth inhibiting substances such as insecticides, high concentration of nutrients (N, P,K etc), oil and grease, suspended solids, BOD. Hot wastes, wastes with acidity, alkalinity,etc.

Process Flow Diagrams, Characteristics and Treatment of Various Industrial Wastes.

Industrial wastes of pulp and paper, textile, tannery, food, canning, sugar mill, distillery, dairy, pharmaceutical, electroplating etc.

Unit-5

Air Pollution:

Meteorology & atmospheric dispersion. Air pollution due to industrial activities. Control

at stationery & mobile sources.

References:-

Sl No.	Name of Books	Author	Publisher
01.	The Treatment of Industrial Wastes	Besselieure, E.B and Schwartz, M	McGraw Hill Kogakusha Ltd., New Delhi, 19
02.	Industrial Water Pollution	Ann Arbour Nemerow, N.L.	
03.	Air Pollution	Henry C	McGraw Hill KogaKusha Ltd., Tokyo, Japan
04.	Air Pollution	Stern, Arthur C.	Academic Press, New York USA,1977,
05	Wastewater Engineering	Metcalf & Eddy, Inc	Tata McGraw Hill Edition.

Course Outcome:

1. Students will be able to analyze characteristics of industrial wastewater.
2. Students will be able to understand the effects of discharge of industrial effluent on environment.
3. To make the students conversant about water pollution caused by industrial effluent.
4. Students will be able to design various wastewater treatment units.
5. Students will be able to analyze characteristics of air.
6. Students will be able to design air pollution controlling devices.

To establish the correlation between COs &POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E13.1	Students will be able to analyze characteristics of water.
UCE07E13.2	Students will be able to forecast the population and estimate water demand.
UCE07E13.3	Students will be able to design various water treatment units.
UCE07E13.4	Students will be able to design the distribution network.
UCE07E13.5	Students will be able to analyze characteristics of air.
UCE07E13.6	Students will be able to design air pollution controlling devices.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
UCE07E13.1	3	2	1	1	-	1	2	-	2	-	-	2
UCE07E13.2	3	2	1	1	-	1	2	-	2	-	-	2
UCE07E13.3	3	2	3	3	-	1	2	-	2	-	-	2

UCE07E13.4	3	2	3	3	-	2	2	-	2	-	-	2
UCE07E13.5	3	2	1	1	-	2	2	-	2	-	-	2
UCE07E13.6	3	2	3	3	-	2	2	-	2	-	-	2
Total	**18**	**12**	**12**	**12**	**-**	**9**	**12**	**-**	**12**	**-**	**-**	**12**
Average	**3**	**2**	**2**	**2**	**-**	**1.5**	**2**	**-**	**2**	**-**	**-**	**2**
Equivalent Avg. Attainment	**3**	**2**	**2**	**2**	**-**	**2**	**2**	**-**	**2**	**-**	**-**	**2**

To establish the correlation between COs &PSOs

Table 3

CO	PSO1	PSO2
UCE07E13.1	**3**	**3**
UCE07E13.2	**3**	**3**
UCE07E13.3	**3**	**3**
UCE07E13.4	**3**	**2**
UCE07E13.5	**3**	**3**
UCE07E13.6	**3**	**3**
Total	**18**	**17**
Average	**3**	**2.83**
Equivalent Avg. Attainment	**3**	**3**

ENVIRONMENTAL IMPACT ASSESSMENT AND AUDITING (UCE07E14)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To understand the Role of EIA in Planning and Decision-Making Process.
2. To grasp the significance Socioeconomic Impact Assessment.
3. To understand - meaning and objective of EIA.
4. To understand Emerging Global Environmental Issues. Environmental Legislation.
5. To understand ISO 14000 Series—Environmental monitoring and mitigation measures.
6. To understand the Environmental Auditing.

Course Content:

Unit-1

Environmental Impact:

Environmental inventories, environmental assessment, evaluation.

Unit -2

Socioeconomic Impact Assessment:

Financing of capital expenditure, increase in user charges, sociological impacts.

Unit -3

Role of EIA in Planning and Decision-Making Process, Rapid EIA.

Introduction of EIA—Environmental impact statement (EIS) and Environmental impact

Unit -4

Analysis (EIA) - meaning and objective of EIA; Environmental Impact prediction –planning and management of Impact studies—ISO 14000 Series—Environmental monitoring and mitigation measures.

Unit -5

Environmental Impact Statement, Environmental Auditing, Post audit reviews of EIA, Concept of ISO and ISO 14000, Government standards for Environmental protection. Emerging Global Environmental Issues. Environmental Legislation. Case-studies

References:-

Sl No.	Name of Books	Author	Publisher
01.	Environmental Impact Assessment	Canter , R.L	McGraw Hill Inc.
02.	Environmental Impact Analysis Handbook	John G.Rau and David C.Wooten (Ed)	McGraw Hill Book
03.	Environmental Impact Assessment, Theory and practice	Peter Wathern(Ed).,	Unwin Hyman Ltd., London, 1988
04.	Environmental Impact Assessment, Principles and procedures	Munn,R.E.(Ed)	Scope, Unwin brothers Ltd., Surrey, London, 1979
05.	Environmental Impact Analysis	Jain, R.K., Urban, L.V. and Stacay, G.S.	Van Nostrand Reinhold Company,1977

Course Outcome:

1. Students will be able to understand the Role of EIA in Planning and Decision Making Process.
2. Students will be able to understand the significance of Socioeconomic Impact Assessment.
3. Students will be able to understand - meaning and objective of EIA.
4. Students will be able to understand Emerging Global Environmental Issues.

5. Students will be able to understand various Environmental Legislation.
6. Students will be able to understand the importance of Environmental Auditing.

To establish the correlation between COs &POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E14.1	Students will be able to analyze characteristics of water.
UCE07E14.2	Students will be able to forecast the population and estimate water demand.
UCE07E14.3	Students will be able to design various water treatment units.
UCE07E14.4	Students will be able to design the distribution network.
UCE07E14.5	Students will be able to analyze characteristics of air.
UCE07E14.6	Students will be able to design air pollution controlling devices.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
UCE07E14.1	2	2	1	1	-	2	2	-	2	-	2	3
UCE07E14.2	2	2	1	1	-	2	2	-	2	-	2	3
UCE07E14.3	2	2	2	3	-	2	2	-	2	-	2	3
UCE07E14.4	2	2	2	3	-	2	2	-	2	-	2	3
UCE07E14.5	2	2	1	1	-	2	2	-	2	-	2	3
UCE07E14.6	2	2	2	3	-	2	2	-	2	-	2	3
Total	**12**	**12**	**9**	**12**	**-**	**6**	**12**	**-**	**12**	**-**	2	**18**
Average	**2**	**2**	**1.5**	**2**	**-**	**1**	**2**	**-**	**2**	**-**	12	**3**
Equivalent Avg. Attainment	**2**	**2**	**2**	**2**	**-**	**1**	**2**	**-**	**2**	**-**	**2**	**3**

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE07E14.1	**3**	**3**
UCE07E14.2	**3**	**3**
UCE07E14.3	**3**	**3**
UCE07E14.4	**4**	**2**
UCE07E14.5	**2**	**3**
UCE07E14.6	**3**	**3**
Total	**18**	**17**
Average	**3**	**2.83**
Equivalent Avg. Attainment	**3**	**3**

WATER AND WASTEWATER TREATMENT PROCESS-I
(UCE07E15)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To understand the basic water quality parameters and standards for various water uses
2. Develop treatment plant layouts of intake structures and settling tanks
3. Illustrate the fundamentals of coagulation, flocculation and filtration unit
4. To understand the basics of various treatment processes
5. To understand the fundamental water chemistry
6. To understand the rural water supply systems

Course Content:

Unit-1

Introduction – Sources of water, necessity of treatment, Critical Water quality parameters, water quality guidelines and standards for various water uses.
Unit operations – principles and design of aeration systems – two film theory, water in air system, air in water system.

Unit -2

Intake structures – Different types, design criteria.
Principles of sedimentation – types of settling and settling equations, design criteria and design of settling tanks.

Unit -3

Principle of Coagulation and Flocculation – types of coagulants, coagulant aids, coagulation theory, and optimum dose of coagulant, design criteria and numerical examples.
Filtration – theory, types, hydraulics of filter bed, design criteria and design of filters, filter backwash, operational problems and trouble shooting.

Unit -4

Adsorption Process – types, factors affecting adsorption, kinetics and equilibrium – different isotherm equations and their applications.
Unit processes - disinfection – different types, disinfectants, factors affecting disinfection, methods of disinfection, chemistry of chlorination.
Water Softening – Ions causing hardness, Langelier index, various methods.
Fluoridation and defluoridation– Principles and design.

Unit -5

Trace organic contaminants in water supplies and their removal. Bench Scale and Pilot Plant studies in water treatment. Rural Water Supply Systems.

References:-

	Name of Books	Authors	Publishers
01.	Water and Waste water Engineering" Vol II	Fair, G.M., Geyer J.C and Okun, (1969)	John Wiley Publications.
02.	Physico - Chemical Processes for Water Quality Control	Weber W.J., (1975)	----------
03.	Water Quality and Treatment	AWWA, (1971)	McGraw Hill.
04.	Water Supply and Treatment		CPHEEO Manual, (1991) GOI Publications.
05.	Environmental Engineering	Peavy, H.S., Rowe and Tchobonoglous,G., (1985)	McGraw Hill
06.	Water Supply and Wastewater Engineering	Raju, B.S.N., (1995)	Tata McGraw Hill Pvt.Co. Ltd., New Delhi.
07.	Guidelines for Drinking Water Quality, Third Edition,Volumes 1-3.	----------	World Health Organization, Geneva, (2004)
08.	Water and wastewater treatment processes	Metcalf & Eddy	----------

Course Outcome:

1. Students will be able to understand the basic water quality parameters and standards
2. Students will be able to develop treatment plant layouts
3. Students will be able to design coagulation, flocculation and filtration unit
4. Students will be able to design various treatment processes
5. Students will be able to explain the fundamental water chemistry
6. Students will be able to design the rural water supply systems

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E15.1	Students will be able to understand the basic water quality parameters and standards.
UCE07E15.2	Students will be able to develop treatment plant layouts.
UCE07E15.3	Students will be able to design coagulation, flocculation and filtration unit.

UCE07E15.4	Students will be able to design various treatment processes.
UCE07E15.5	Students will be able to explain the fundamental water chemistry.
UCE07E15.6	Students will be able to design the rural water supply systems.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12
UCE07E15.1	3	3	3	3	3	-	3	-	2	-	-	3
UCE07E15.2	3	3	3	3	3	-	3	-	2	-	-	2
UCE07E15.3	3	3	3	3	3	-	3	-	2	-	-	2
UCE07E15.4	3	3	3	3	3	-	-	-	3	-	-	3
UCE07E15.5	3	3	3	3	3	-	-	-	-	-	-	3
UCE07E15.6	3	3	3	3	3	-	-	-	2	-	-	2
Total	**18**	**18**	**18**	**18**	**18**		**9**		**11**			**15**
Average	**3**	**3**	**3**	**3**	**3**	**-**	**1.5**	**-**	**1.83**	**-**	**-**	**2.5**
Equivalent Avg. Attainment	**3**	**3**	**3**	**3**	**3**	**-**	**2**	**-**	**2**	**-**	**-**	**3**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE07E15.1	4	4
UCE07E15.2	4	4
UCE07E15.3	4	4
UCE07E15.4	4	4
UCE07E15.5	4	4
UCE07E15.6	4	4
Total	**24**	**24**
Average	**4**	**4**
Equivalent Avg. Attainment	**4**	**4**

ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY
(UCE07E16)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To understand the importance and effects of environmental chemistry on surroundings.
2. To study the fundamentals of physical chemistry and the analysis of basic parameters.
3. To study the fundamental basic of colourimetry and the application of analytical chemistry.
4. To understand the importance of microbiology and its effects.
5. To study the morphological characteristics and measurement techniques of bacteria.
6. To study the fundamental principle and classification of enzyme.

Course Content:

Unit-1

Importance of Environmental Chemistry, types of reactions, redox reactions, reaction kinetics. Electrochemistry and its applications.

Unit-2

Physical and equilibrium chemistry – fundamentals and applications. Trace Contaminants and their analysis.

pH – Principle, Measurement, Buffers and Buffer index.

Colloidal Chemistry – Properties of colloids, colloidal dispersions, stability of colloids and applications.

Unit-3

Colourimetry – Principles and applications.

Applications of Analytical Chemistry – emission and absorption techniques.

Unit-4

Microbiology - Microorganisms importance in air, water and soil environment Principles and applications of microscopy, microscopic flora and fauna of importance.

Metabolism and metabolic pathways, Bio concentration, Bio magnification and Bioaccumulation.

Unit-5

Bacteria – Morphology, typical growth curve and generation time, Measurement Techniques – APC, MPN (Probability and Thomas methods), Enzymes classification, and kinetics - Michaelis-Menten equation, factors influencing enzyme reaction.

References:-

	Name of Books	Authors	Publishers
01.	Microbiology for Sanitary Engineers	McKinney R.E.(1962)	Newyork McGraw Hill.
02.	Chemistry for Environmental Engineering and Science",5th Edition	Sawyer C.N. and McCarty, P.L	Tata McGraw Hill Publishing Co. Ltd., New Delhi.
03.	Textbook of Microbiology" 5th edition	Pelczar M.J ,Chan ECS, Krieg, NR(1998)	Tata McGrawHill Publishing Co. Ltd., New Delhi
04.	Microbiology for Environmental Scientists and Engineers	Gaudy and Gaudy (1980)	McGraw Hill.
05.	Standard Methods for Examination of Water and Wastewater"; 21st Edition.	----------	APHA, (2002)
06.	Aquatic Chemistry	Stumn and Morgan(1970)	John Willey & Sons Newyork

Course Outcome:

1. To understand the importance and effects of environmental chemistry on surroundings.
2. To study the fundamentals of physical chemistry and the analysis of basic parameters.
3. To study the fundamental basic of colourimetry and the application of analytical chemistry.
4. To understand the importance of microbiology and its effects.
5. To study the morphological characteristics and measurement techniques of bacteria.
6. To study the fundamental principle and classification of enzyme.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E16.1	Students will be able to understand the importance and effects of environmental chemistry on surroundings.
UCE07E16.2	Students will be able to get idea regarding fundamentals of physical chemistry and the analysis of basic parameters.
UCE07E16.3	Students will be able to collect the basic of colourimetry and the application of analytical chemistry.
UCE07E16.4	Students will be able to understand the importance of microbiology and its effects.
UCE07E16.5	Students will be able to study the morphological characteristics and measurement techniques of bacteria.

UCE07E16.6	Students will be able to study the fundamental principle and classification of enzyme.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E16.1	-	3	-	3	-	2	3	-	-	-	-	3
UCE07E16.2	3	-	-	2	2	-	-	-	-	-	-	-
UCE07E16.3	3	3	2	2	-	2	2	-	-	-	-	-
UCE07E16.4	2	3	3	-	-	3	3	-	-	-	-	3
UCE07E16.5	3	2	2	-	3	2	2	-	-	-	-	-
UCE07E16.6	3	3	-	2	3	2	2	-	-	-	-	-
Total	14	14	8	9	8	11	12	-	-	-	-	6
Average	**2.33**	**2.33**	**1.33**	**1.5**	**1.33**	**1.83**	**2**	**-**	**-**	**-**	**-**	**1**
Eq. Av Attainment	**2**	**2**	**1**	**2**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**1**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE07E16.1	4	2
UCE07E16.2	4	3
UCE07E16.3	4	4
UCE07E16.4	4	4
UCE07E16.5	4	3
UCE07E16.6	4	2
Total	**24**	**18**
Average	**4**	**3**
Equivalent Avg. Attainment	**4**	**3**

DEPARTMENTAL ELECTIVE- III

ADVANCED RAILWAY ENGINEERING
(UCE07E17)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. Students will be able to identify the basic components of railway permanent way and evaluate track stresses developed by locomotives.
2. Students will be able to design the geometric shape of railway track.
3. Students will be able to understand maintenance of track and control of train movement.
4. Students will be able to understand signal and interlock functioning.

Course Content:

Unit-1

Railway permanent way - components and important features.

Unit -2

Track and track stresses; Train resistances and hauling power of locomotives.

Unit -3

Railway geometric design-- curves, cant Gradients and grade compensation, track diversion; turn out -- points and crossing and their design approaches.

Unit -4

Construction and maintenance of railway track, Control of train movements.

Unit -5

Signals and interlocking; Modernization of railways and future trends; Track standards and track rehabilitation; Rail transportation system planning; Urban rail transit system.

References:-

	Name of Books	Authors	Publishers
01.	Railway Track Engineering	J.S. Mundrey	Tata McGraw Hill Co. Ltd
02.	Railway Track Engineering	M.M. Agarwal	Standard Publishers
03.	Railway Engineering	S. Chandra and Aqarwal	Oxford University Press
04.	Fundamentals of Railway Track Engineering	A.D. Kerr	Simmons Boardman Pub Co

Course Outcome:

1. Students will be able to identify the basic components of railway permanent way.
2. Students will be able to evaluate track stresses developed by locomotives.
3. Students will be able to design the geometric shape of railway track.
4. Students will be able to understand maintenance of track and control of train movement.
5. Students will be able to understand signal and interlock functioning.

To establish the correlation between Cos & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE07E17.1	Students will be able to identify the basic components of railway permanent way.
UCE07E17.2	Students will be able to evaluate track stresses developed by locomotives.
UCE07E17.3	Students will be able to design the geometric shape of railway track.
UCE07E17.4	Students will be able to understand maintenance of track and control of train movement.
UCE07E17.5	Students will be able to understand signal and interlock functioning.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E17.1	3	3	2	1	1	-	-	-	-	-	-	-
UCE07E17.2	3	3	2	1	1	-	-	-	-	-	-	-
UCE07E17.3	3	3	2	1	1	-	-	-	-	-	-	-
UCE07E17.4	3	3	2	1	1	-	-	-	-	-	-	-
UCE07E17.5	3	3	2	1	1	-	-	-	-	-	-	-
Total	**15**	**15**	**10**	**5**	**5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Average	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Equivalent Avg. Attainment	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E17.1	3	3
UCE07E17.2	3	3
UCE07E17.3	3	3
UCE07E17.4	3	2
UCE07E17.5	3	3
Total	**15**	**14**
Average	**3**	**2.8**
Equivalent Avg. Attainment	**3**	**3**

ADVANCED TRANSPORTATION ENGINEERING (UCE07E18)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. Students will be able to learn the basic concepts and design of pavements.
2. Students will be able to understand the quality maintenance during pavement construction.
3. Students will be able to understand the highway traffic characteristics, operate traffic volume and its management.
4. Students will be able to learn about intersection types and its importance.

Course Content:

Unit-1

Pavement Design:

Layered system analysis, Load and temperature stress, Analysis and design of flexible & rigid pavement. Design of joints and load transfer devices.

Unit -2

Quality control of Highway construction.

Unit -3

Highway traffic Characteristics, Traffic parameters and interrelationship, traffic volume, speed, density, capacity, Traffic studies- Volume speed, Origin& Destination studies.

Unit -4

Traffic operation and management, Traffic congestion, control devices, various traffic operation improvement measures,

Unit -5

Intersection- At grade and Grade separated, Road safety.

References:-

	Name of Books	Authors	Publishers
01.	Pavement Analysis and Design	Yang H. Hung	Prentice-Hall
02.	Design and Performance of Road Pavements	David Croney	McGraw Hill
03.	Guide for Design of Pavement Structures- I & II		AASHTO
04.	Introduction To traffic Engg A manual for data collection & analysis	Thomas R. Currin	Brooks
05.	Traffic Engineering and Transport Planning	Kadyali, L.R	Khanna Publisher
06.	Traffic Engineering	Roger P Roess, Elena S Prassas,Mike Slinn, Poter Guest,	Prentice Hall,Elsevier,
07.	Traffic Engineering Design principle & Practice	Paul Matthews	

Course Outcome:

1. Students will be able to learn the basic concepts and design of pavements.
2. Students will be able to understand the quality maintenance during pavement construction.
3. Students will be able to understand the highway traffic characteristics.
4. Students will be able to operate traffic volume and its management.
5. Students will be able to learn about intersection types and its importance.

To establish the correlation between Cos & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE07E18.1	Students will be able to learn the basic concepts and design of pavements.
UCE07E18.2	Students will be able to understand the quality maintenance during pavement construction.
UCE07E18.3	Students will be able to understand the highway traffic characteristics.
UCE07E18.4	Students will be able to operate traffic volume and its management.
UCE07E18.5	Students will be able to learn about intersection types and its importance.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E18.1	3	3	2	2	1	-	-	-	-	-	-	-
UCE07E18.2	3	3	2	2	1	-	-	-	-	-	-	-
UCE07E18.3	3	3	2	2	1	-	-	-	-	-	-	-
UCE07E18.4	3	3	2	2	1	-	-	-	-	-	-	-
UCE07E18.5	3	3	2	2	1	-	-	-	-	-	-	-
Total	**15**	**15**	**10**	**10**	**5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Average	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Equivalent Avg. Attainment	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E18.1	3	2
UCE07E18.2	3	3
UCE07E18.3	3	3
UCE07E18.4	3	2
UCE07E18.5	3	2
Total	**15**	**12**
Average	**3**	**2.4**
Equivalent Avg. Attainment	**3**	**2**

HILL ROADS
(UCE07E19)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To obtain knowledge about hill roads and construction related problems.
2. To understand the concept of geometric design and construction methods of hill roads.
3. To obtain knowledge about maintenance aspect of hill roads.
4. To obtain idea about curve layout and related features in hill road.

Course Content:

Unit-1

Importance of hill roads, problems specific to hill road construction; alignment survey,

Unit-2

Geometric design of hill roads;

Unit-3

Construction of hill roads: formation cutting, protective structures, cross drainage works;

Unit-4

Maintenance: drainage, landslides, snow clearance,

Unit-5

Curve layout in hill Road.

References:-

Sl No.	Name of Books	Authors	Publishers
01.	Hill Road MannualIRC-SP:48-1998	--------	Indian Road Congress

Course Outcome:

1. Students will be able to know the importance of hill roads, problems related to hill road construction and alignment survey.
2. Students will be able to learn the geometric design of hill roads.
3. Students will be able to understand the construction procedures of hill roads.
4. Students will be able to know protective structures and cross drainage structures of hill roads.
5. Students will be able to understand the maintenance work associated with hill roads.
6. Students will be able to learn the curve layout of hill road.

To establish the correlation between COs & POs

Table-1

UCE07E19.1	Students will be able to know the importance of hill roads, problems related to hill road construction and alignment survey.
UCE07E19.2	Students will be able to learn the geometric design of hill roads.
UCE07E19.3	Students will be able to understand the construction procedures of hill roads.
UCE07E19.4	Students will be able to know protective structures and cross drainage structures of hill roads.
UCE07E19.5	Students will be able to understand the maintenance work associated with hill roads.
UCE07E19.6	Students will be able to learn the curve layout of hill road.

To establish the correlation between COs & POs

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E19.1	3	3	2	2	1	2	2	1	2	1	1	2
UCE07E19.2	3	3	3	2	2	1	2	2	2	2	2	2
UCE07E19.3	3	3	2	1	3	1	2	2	3	2	3	2
UCE07E19.4	3	3	2	1	2	1	3	1	2	2	2	2
UCE07E19.5	3	3	3	2	3	2	3	1	3	2	2	2
UCE07E19.6	3	3	2	2	1	1	2	2	2	1	1	2

Total	**18**	**18**	**14**	**10**	**12**	**9**	**14**	**10**	**14**	**10**	**11**	**12**
Average	**3**	**3**	**2.33**	**1.67**	**2**	**1.5**	**2.33**	**1.67**	**2.33**	**1.67**	**1.83**	**2**
Equivalent Avg. Attainment	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E19.1	3	2
UCE07E19.2	3	2
UCE07E19.3	3	3
UCE07E19.4	3	2
UCE07E19.5	3	2
UCE07E19.6	3	3
Total	**18**	**14**
Average	**3**	**2.33**
Equivalent Avg. Attainment	**3**	**2**

URBAN TRANSPORT PLANNING
(UCE07E20)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To obtain understanding of the concepts of urban planning
2. To understand the concepts of travel demand forecasting, trip generation and trip distribution
3. To understand the behavior of individuals and households related to travel behavior.
4. To obtain an understanding on urban freight transportation and mass transportation systems
5. To study the concepts of travel management measures.

Course Content:

Unit-1

Urban Transportation Planning Process, Urban Travel and Transportation Systems Characteristics, Function and form of urban structures.

Unit -2

Travel Demands Forecasting- trip generation, trip distribution, modal split and trip assignment, urban transport problems.

Unit -3

Transport Behavior of Individuals and Households, Land use/ Transportation systems.

Unit -4

Introduction to Urban Freight Transportation and Urban Mass Transportation Systems.

Unit -5

Characteristics of buses, bicycle, para transit, rapid transit, Travel demand management measures; Case studies.

References:-

Sl No.	Name of Books	Authors	Publishers
01.	Traffic Engg.and Transport	Kadiyali, L.R	Khanna Publishers
02	Transportation Engineering and Planning	C.S. Papacostas and P.D. Prevedouros	Pearson Education India

Course Outcome:

1. Students will be able to understand the concepts of urban planning process.
2. Students will be able to understand the concepts of travel demand forecasting, trip generation and trip distribution.
3. Students will be able to study the transport behavior of individuals and households.
4. Students will be able to understand the urban freight transportation.
5. Students will be able to study the concepts of mass transportation systems.
6. Students will be able to understand the concepts of travel management measures.

To establish the correlation between Cos & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE07E20.1	Students will be able to understand the concepts of urban planning process
UCE07E20.2	Students will be able to understand the concepts of travel demand forecasting, trip generation and trip distribution.
UCE07E20.3	Students will be able to study the transport behavior of individuals and households
UCE07E20.4	Students will be able to understand urban freight transportation
UCE07E20.5	Students will be able to study the concepts of mass transportation systems

UCE07E20.6	Students will be able to understand the concepts of travel management measures

Table-2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: -**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E20.1	3	3	3	3	1	2	-	-	-	-	-	1
UCE07E20.2	3	3	3	3	2	2	-	-	-	-	-	1
UCE07E20.3	3	3	3	3	2	2	-	-	-	-	-	1
UCE07E20.4	3	3	3	3	1	2	-	-	-	-	-	1
UCE07E20.5	3	3	3	3	1	2	-	-	-	-	-	1
UCE07E20.6	3	3	3	3	2	2	-	-	-	-	-	1
Total	**18**	**18**	**18**	**18**	**9**	**12**	**-**	**-**	**-**	**-**	**-**	**6**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E20.1	3	3
UCE07E20.2	3	2
UCE07E20.3	3	3
UCE07E20.4	3	2
UCE07E20.5	3	3
UCE07E20.6	3	3
Total	18	16
Average	3	2.67
Equivalent Avg. Attainment	3	3

ADVANCED STRUCTURAL ANALYSIS

(UCE07E21)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objectives:

1. To obtain understanding of different type of structural systems, various principles of the structural systems and their characteristics based on which their analysis procedures are determined.
2. To understand analysis procedures of flexibility method and its application on beams and trusses.
3. To understand analysis procedures of Stiffness method and its application on beams grids and trusses.

4. To obtain a fundamental understanding on structural dynamics and on free vibration systems.
5. To obtain an understanding on Forced Vibrations of Single Degree of Freedom systems.

Course Content:

Unit-1

Introduction: Structural systems, geometric and material non-linearity, principle of superposition, equilibrium and compatibility conditions, static and kinematic indeterminacy, principle of minimum potential energy and minimum complementary energy, concepts of stiffness and flexibility, flexibility and stiffness matrices of beam and truss elements.

Unit -2

Element Flexibility Method: Force transformation matrix, global flexibility matrix, analysis of continuous beams, and trusses.

Unit -3

Direct Stiffness Method: Displacement transformation matrix, global stiffness matrix, analysis of continuous beams, and trusses, Plane grids.

Unit -4

Introduction to structural dynamics: Introduction to structural dynamics, brief history of vibration, Basic definitions, vibration of SDOF (Single Degree of Freedom) systems, un damped, Damped, Free vibrations, equivalent viscous damping, Logarithmic decrement.

Unit -5

Forced Vibrations: Forced vibrations of SDOF system, Response of un-damped and damped system subjected to harmonic loading, response to SDOF subject to harmonic base excitation and support motion. Duhamel's integral, Introduction to response spectrum.

References:-

Sl No.	Name of Books	Authors	Publishers
01.	Matrix Analysis of Framed Structures	Weaver W and Gere J H	CBS publications, New Delhi.
02.	Computational Structural Mechanics	Rajasekaran S	PHI, New Delhi.
03.	Matrix and Finite Element Analysis of Structures	Madhujit Mukhopadhay and Abdul Hamid Sheikh	AneBooks Pvt. Ltd.

04.	Structural Dynamics	Anil K Chopra	PHI Publications
05.	Vibrations, Structural Dynamics	Mukobadhyay	Oxford IBH Publications
06.	Earth Quake resistant design of building structures	Vinod Husur	WILE EASTERN India Publications
07.	Matrix Method of Structural Analysis	Godbole P N et.al	PHI ltd, New Delhi.
8.	Theory of Structures Vol II	Pundit and Gupta	TMH publications, New Delhi
9.	Advanced Structural Analysis	A K Jain	Nemchand Publications, Roorkee.
10.	Elements of Matrix Analysis and Stability of Structures	Manikaselvam	Khan na Publishers, New Delhi.
11.	Introduction to Matrix Methods in Structural Analysis	H C Martin	International textbook company, McGraw Hill
12.	Elementary structural dynamics	V K Mac Subramanian	Danpatra Publications
13.	Structural Dynamics	Mario Poz	CBS publications.
14.	Structural Dynamics	Manik A Selvam	Danpatra publications

Course Outcome:

1. Students will be able to classify different type of structures and various principles.
2. Students will be able to analyze a beam or truss using flexibility method.
3. Students will be able to analyze a beam, grid or truss using Stiffness method.
4. Students will be able to analyze a Single Degree of Freedom vibrating systems using concepts of structural dynamics.
5. Students will be able to analyze a forced vibrating system.

To establish the correlation between COs & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE07E21.1	Students will be able to classify different type of structures and various principles.
UCE07E21.2	Students will be able to analyze a beam or truss using flexibility method.
UCE07E21.3	Students will be able to analyze a beam, grid or truss using Stiffness method.
UCE07E21.4	Students will be able to analyze a Single Degree of Freedom vibrating systems using concepts of structural dynamics.
UCE07E21.5	Students will be able to analyze a forced vibrating system.

Table-2

CORRELATION LEVELS:

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E21.1	3	3	3	1	1	1						1
UCE07E21.2	3	3	2	1	1	1						1
UCE07E21.3	3	3	2	1	1	1						1
UCE07E21.4	3	3	2	1	2	1						1
UCE07E21.5	3	3	2	1	2	1						1
Total	15	15	11	5	7	5						5
Average	3	3	2.2	1	1.4	1						1
Equivalent Avg. Attainment	3	3	2	1	1	1						1

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E21.1	3	2
UCE07E21.2	3	2
UCE07E21.3	3	3
UCE07E21.4	3	2
UCE07E21.5	3	2
Total	15	11
Average	3	2.2
Equivalent Avg. Attainment	3	2

NUMERICAL METHODS AND APPLICATIONS IN CIVIL ENGINEERING

(UCE07E22)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objectives:

1. To obtain an understanding on the different methods of Solution of Equations and Eigen value Problems
2. To obtain concept of different Interpolation and Approximation methods.
3. To obtain an understanding on the different methods of numerical differentiation and integration.
4. To obtain an understanding on Initial Value Problems for Ordinary Differential Equations.

5. To obtain basic understanding of Boundary Value Problems in Ordinary and Partial Differential Equations.

Course Content:

Unit-1

Solution of Equations and Eigen value Problems: Solution of algebraic and transcendental equations, Fixed point iteration method, Newton Raphson method, Solution of linear system of equations, Gauss elimination method, Pivoting, Gauss Jordan method Iterative methods of Gauss Jacobi and Gauss Seidel - Matrix Inversion by Gauss Jordan method.

Unit -2

Interpolation and Approximation: Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae.

Unit -3

Numerical Differentiation and Integration: Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

Unit -4

Initial Value Problems for Ordinary Differential Equations : Single Step methods - Taylor's series method - Euler's method - Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations - Multi step methods - Milne's and Adams-Bash forth predictor corrector methods for solving first order equations.

Unit -5

Boundary Value Problems in Ordinary and Partial Differential Equations: Finite difference methods for solving two-point linear boundary value problems - Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

References:-

Sl No.	Name of Books	Authors	Publishers
1.	Numerical methods in Engineering and Science	Grewal. B.S., and Grewal. J.S	Khanna Publishers, 9th Edition, New Delhi
2.	Applied Numerical Analysis	Gerald. C. F., and	Pearson Education, Asia, 6th

		Wheatley. P. O.	Edition,New Delhi
3.	Numerical Methods for Engineers	Chapra. S.C., and Canale.R.P	Tata McGraw Hill, New Delhi
4.	A friendly introduction to Numerical analysis	Brian Bradie	Pearson Education, Asia, New Delhi
5.	Numerical methods for Scientists and Engineers	Sankara Rao. K.	Prentice Hall of India Private, New Delhi

Course Outcome:

1. Students will be able to apply different methods of Solution of Equations wherever necessary in Civil Engineering problems.
2. Students will be able to use different Interpolation and Approximation methods in Civil Engineering problems.
3. Students will be able to use different methods of numerical differentiation and integration.
4. Students will be able to use Initial Value Problems for Ordinary Differential Equations.
5. Students will be able to use Boundary Value Problems in Ordinary and Partial Differential Equations.

To establish the correlation between COs & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE07E22.1	Students will be able to apply different methods of Solution of Equations wherever necessary in Civil Engineering problems.
UCE07E22.2	Students will be able to use different Interpolation and Approximation methods in Civil Engineering problems.
UCE07E22.3	Students will be able to use different methods of numerical differentiation and integration.
UCE07E22.4	Students will be able to use Initial Value Problems for Ordinary Differential Equations.
UCE07E22.5	Students will be able to use Boundary Value Problems in Ordinary and Partial Differential Equations

Table-2

CORRELATION LEVELS:

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E22.1	3	3	3	2	3							1
UCE07E22.2	3	3	2	2	3							1

UCE07E22.3	3	3	2	2	3							1
UCE07E22.4	3	3	2	2	3							1
UCE07E22.5	3	3	2	2	3							1
Total	15	15	11	10	15							5
Average	3	3	2.2	2	3							1
Equivalent Avg. Attainment	3	3	2	2	3							1

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E22.1	3	2
UCE07E22.2	3	2
UCE07E22.3	3	2
UCE07E22.4	3	2
UCE07E22.5	3	2
Total	15	10
Average	3	2
Equivalent Avg. Attainment	3	2

RETROFITTING AND REHABILITATION OF STRUCTURES

(UCE07E23)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objectives:

1. Study the structural health monitoring using Jacketing technique, externally bonding (ERB) technique, near surface mounted (NSM) technique.
2. To know the physical and chemical Causes of deterioration of concrete structures,
3. To learn about the different strategies adopted for repair and rehabilitation of structures at site.
4. To study about the durability and serviceability of concrete.

Course Content:

Unit-1

General: Introduction and Definition for Repair, Retrofitting, Strengthening and rehabilitation. Physical and Chemical Causes of deterioration of concrete structures, Evaluation of structural damages to the concrete structural elements due to earthquake.

Unit -2

Damage Assessment: Purpose of assessment, Rapid assessment, Investigation of damage, Evaluation of surface and structural cracks, Damage assessment procedure, destructive, non-destructive and semi destructive testing systems.

Unit -3

Influence on Serviceability and Durability: Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, and cathodic protection.

Unit -4

Maintenance and Retrofitting Techniques: Definitions: Maintenance, Facts of Maintenance and importance of Maintenance Need for retrofitting, retrofitting of structural members i.e., column and beams by Jacketing technique, Externally bonding(ERB) technique, near surface mounted (NSM) technique, External post-tensioning, Section enlargement and guidelines for seismic rehabilitation of existing building

Unit -5

Materials for Repair and Retrofitting: Artificial fibre reinforced polymer like CFRP, GFRP, AFRP and natural fiber like Sisal and Jute. Adhesive like, Epoxy Resin, Special concretes and mortars, concrete chemicals, special elements for accelerated strength gain, Techniques for Repair: Rust eliminators and polymer coating for rebar during repair of foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shot Crete Epoxy injection, Mortar repair for cracks, shoring and underpinning

References:-

Sl No.	Name of Books	Authors	Publishers
01.	Deterioration, Maintenance and Repair of Structures	Sidney, M. Johnson	----------
02.	Concrete Structures – Materials, Maintenance and Repair"- Longman Scientific and Technical.	Denison Campbell, Allen & Harold Roper	----------
03.	Repair of Concrete Structures	R.T.Allen and S.C. Edwards	Blakie and Sons
04.	Learning for failure from Deficiencies in Design, Construction and Service	Raiker R.N	R&DCenter (SDCPL).

Course Outcomes:

1. The students will able to decide the appropriate maintenance and repair strategies of buildings, strengthening, rehabilitation and retrofitting technique required for a case study building.
2. The students will able to learn the nondestructive tests and other repair strategy.
3. The students will know the durability and serviceability of concrete and demolition and dismantling of structures at site.
4. The students will able to know the Section enlargement and guidelines for seismic rehabilitation of existing building.
5. The students will able to apply the concept of an appropriate health monitoring technique and demolition technique.

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E23.1	The students will able to decide the appropriate maintenance and repair strategies of buildings, strengthening, rehabilitation and retrofitting technique required for a case study building.
UCE07E23.2	The students will able to learn the nondestructive tests and other repair strategy.
UCE07E23.3	The students will know the durability and serviceability of concrete and demolition and dismantling of structures at site.
UCE07E23.4	The students will able to know the Section enlargement and guidelines for seismic rehabilitation of existing building.
UCE07E23.5	The students will able to apply the concept of an appropriate health monitoring technique and demolition technique.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: - "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
UCE07E23.1	3	3	1	1	2	1	1	1	2	1	1	2
UCE07E23.2	3	2	2	1	3	1	1	1	2	1	1	3
UCE07E23.3	3	2	2	2	3	2	1	1	2	1	1	3
UCE07E23.4	3	2	3	1	2	1	1	1	2	1	1	2
UCE07E23.5	3	3	2	2	3	1	1	1	1	1	1	2
Total	**15**	**12**	**10**	**7**	**13**	**6**	**5**	**5**	**9**	**5**	**5**	**12**
Average	**3**	**2.4**	**2**	**1.4**	**2.6**	**1.2**	**1**	**1**	**1.8**	**1**	**1**	**2.4**
Equivalent Average Attainment	**3**	**2**	**2**	**1**	**3**	**1**	**1**	**1**	**2**	**1**	**1**	**2**

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE07E23.1	3	4
UCE07E23.2	3	3
UCE07E23.3	4	3
UCE07E23.4	3	3
UCE07E23.5	3	4
Total	**16**	**14**
Average	**3.2**	**2.8**
Equivalent Avg. Attainment	**3**	**3**

MASONRY STRUCTURES

(UCE07E24)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To understand the fundamental properties of various types masonry unit and masonry prism along with the defects and error in masonry construction.
2. To obtain an understanding on the methodology of analyzing and designing of masonry wall.
3. To apply the knowledge from statics, mechanics of solid, and structural analysis to gain further understanding in the relationship between analysis and design of masonry structures.
4. To understand the stress concentration on different types of masonry wall.
5. To learn the design of different types of masonry wall under axial, lateral and combined loads.

Course Content:

Unit -1

Masonry Units, Materials, types and masonry construction: Bricks, Stone and Block masonry units- strength, modulus of elasticity and water absorption of masonry materials – classification and properties of mortars. Defects and Errors in masonry construction – cracks in masonry, types, reason for cracking, methods of avoiding cracks. Strength and Stability: Strength and stability of axially loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship. Compressive strength formulae based on elastic theory and empirical formulae.

Unit -2

Permissible stresses: Types of walls, permissible compressive stress, stress reduction and shape modification factors, increase in permissible stresses for eccentric vertical and lateral load, permissible tensile stress and shear stresses.

Unit -3

Design Considerations: Effective height of walls and columns, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. Problems on design considerations for solid walls, cavity walls, wall with pillars.

Unit -4

Load considerations and design of Masonry subjected to axial loads: Design criteria, design examples of walls under UDL, solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers.

Unit -5

Design of walls subjected to concentrated axial loads: Solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers, design of wall with openings.

Design of walls subjected to eccentric loads: Design criteria – stress distribution under eccentric loads – problems on eccentrically loaded solid walls, cavity walls, walls with piers.

Design of Laterally and transversely loaded walls: Design criteria, design of solid wall under wind loading, design of shear wall – design of compound walls. Introduction to reinforced brick masonry, lintels and slabs.

In-filled frames: Types – modes of failures – design criteria of masonry retaining walls.

Use of IS 1905–1987 "Code of practice for structural use of un-reinforced masonry" may be permitted.

References:-

Sl No.	Name of Books	Authors	Publishers
01.	Structural Masonry	Henry, A.W.	Macmillan Education Ltd., 1990.
02.	Brick and Reinforced Brick Structures	Dayaratnam P	Oxford & IBH, 1987
03.	Building and Construction Materials	M. L. Gambhir	Mc Graw Hill education Pvt. Ltd.
04.	IS 1905–1987 "Code of practice for	----------	----------

	structural use o f un-reinforced masonry-(3rd revision) BIS, New Delhi.		
05.	SP 20 (S&T) – 1991, "Hand book on masonry design an d construction (1st revision) BIS, New Delhi	----------	----------

Course Outcome:

1. Students completing this course understand the fundamental properties of masonry unit and masonry prism.
2. Students understand the fundamental principles of analysis and design methodologies of masonry structural elements.
3. They develop professional competencies in the analysis and design of masonry elements as well as masonry buildings.
4. Students are able to solve technical problems on various defects and errors in masonry construction through critical thinking and discussions.
5. Students also learn to communicate their outcomes of design in writing in a discipline-appropriate format.

To establish the correlation between Cos & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE07E24.1	Students completing this course understand the fundamental properties of masonry unit and masonry prism
UCE07E24.2	Students understand the fundamental principles of analysis and design methodologies of masonry structural elements.
UCE07E24.3	They develop professional competencies in the analysis and design of masonry elements as well as masonry buildings.
UCE07E24.4	Students are able to solve technical problems on various defects and errors in masonry construction through critical thinking and discussions
UCE07E24.5	Students also learn to communicate their outcomes of design in writing in a discipline-appropriate format.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E24.1	3	3	-	2	-	-	-	-	-	-	-	-
UCE07E24.2	3	3	-	2	-	-	-	-	-	-	-	1
UCE07E24.3	3	3	2	3	1	1	2	3	2	-	-	2

UCE07E24.4	3	3	2	-	1	-	2	3	2	3	-	2
UCE07E24.5	3	3	-	1	-	-	-	-	2	3	-	1
Total	**15**	**15**	**4**	**8**	**2**	**1**	**4**	**6**	**6**	**6**	**-**	**6**
Average	**3**	**3**	**0.8**	**1.6**	**0.4**	**0.2**	**0.8**	**1.2**	**1.2**	**1.2**	**-**	**1.2**
Equivalent Avg. Attainment	**3**	**3**	**2**	**2**	**-**	**-**	**1**	**1**	**1**	**1**	**-**	**1**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E24.1	3	3
UCE07E24.2	3	3
UCE07E24.3	3	3
UCE07E24.4	3	3
UCE07E24.5	3	3
Total	**15**	**15**
Average	**3**	**3**
Equivalent Avg. Attainment	**3**	**3**

OPEN ELECTIVE

DISASTER MANAGEMENT AND MITIGATION
(UCE07E25)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To learn the basic concepts in disaster management.
2. To learn definitions and terminologies used in Disaster Management.
3. To learn different types and categories of Disasters.
4. To learn impacts of disasters.
5. To learn the awareness of Disaster Risk Management institutional processes in India.
6. To learn the policy and programmers for Disaster in India.
7. To ensure skills and abilities to analyze potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects.

Course Content:

Unit-1

Elements of Engineering Seismology.

Unit -2

Earthquake Phenomenon.

Unit -3

Landslides, Flood, Cyclone, Fire.

Unit -4

Environmental Geomorphology and Hazards

Unit -5

Landform Evolution and Environment.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Disaster Management	Dr. Mrinalini Pandey	Wiley India Pvt. Ltd.
02.	Disaster Science and Management	Tushar Bhattacharya	McGraw Hill Education (India) Pvt. Ltd.

Course Outcome:

1. Learn the causes for earthquakes occurrence.
2. Learn the earthquake intensity and earthquake magnitude.
3. Learn the basic characteristics of landslides.
4. Learn the several ways that engineers reduce the danger and destruction of landslides.
5. Learn the reasons for Fire.
6. Learn the different Fire extinguisher apparatus.

To establish the correlation between COs &POs
Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E25.1	Learn the causes for earthquakes occurrence
UCE07E25.2	Learn the earthquake intensity and earthquake magnitude
UCE07E25.3	Learn the basic characteristics of landslides, Flood and cyclones.
UCE07E25.4	Learn the several ways that engineers reduce the danger and destruction of landslides, Flood and cyclones.
UCE07E25.5	Learn the reasons for Fire.
UCE07E25.6	Learn the different Fire extinguisher apparatus.

Table-2

Slight (Low): 1 **Moderate: 2** **Substantial (High):3** **No Correlation: "-"**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E25.1	2	2	2	1	1	2	2	1	2	2	3	3
UCE07E52.2	2	2	1	1	2	2	2	1	2	2	3	3
UCE07E25.3	2	2	2	2	1	1	2	2	2	2	3	2
UCE07E25.4	3	2	3	2	2	1	2	1	2	2	2	3
UCE07E25.5	3	2	3	2	2	1	2	1	2	2	2	3
UCE07E25.6	1	1	1	1	3	1	1	1	1	1	1	1
Total	13	11	12	9	11	8	11	7	11	11	14	15
Average	2.16	1.83	2	1.5	1.83	1.33	1.83	1.16	1.83	1.83	2.33	3
Eq. Av Attainment	2	2	2	2	2	1	2	1	2	2	2	3

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE07E25.1	2	3
UCE07E25.2	2	3
UCE07E25.3	3	3
UCE07E25.4	4	3
UCE07E25.5	3	3
UCE07E25.6	3	3
Total	17	18
Average	2.83	3
Equivalent Avg. Attainment	3	3

SUSTAINABLE ENGINEERING

(UCE07E26)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To aware and understand the concept of sustainability in civil engineering design.
2. To realize the challenges of application of sustainability concept.
3. To learn the computation technique of carbon foot print and other parameters of sustainability.
4. To study the different environmental management standards with social implication.
5. To introduce concept of green engineering, sustainable energy etc. in civil engineering practice.

Course Content:

Unit-1

Introduction: Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act.

Unit-2

Global Environmental Issue: Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print Carbon sequestration – Carbon capture and storage (CCS). Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking.

Unit-3

Sustainable Design: Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification- GRIHA & IGBC Certification for buildings, Energy efficient building design- Passive solar design technique, Thermal storage, Cooling strategies, high performance insulation. Sustainable cities, Sustainable transport.

Unit-4

Clean Technology and Energy: Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy. Rainwater harvesting.

Unit-5

Green Engineering: Green Engineering concepts, Sustainable Urbanization, industrialization and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Sustainability Engineering: ConceptsDesign and Case Studies	Allen, D. T. and Shonnard, D. R	Prentice Hall.
02.	Engineering applications in sustainable design and development	Bradley. A.S; Adebayo,A.O., Maria, P	Cengage
03.	Basic Concepts in Environmental Management	Mackenthun, K.M.	Lewis Publication
04.	ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System,TERI Publications - GRIHA Rating System	----------	----------
05.	Systems Analysis for Sustainable Engineering: Theory and Applications	Ni bin Chang	McGraw-Hill Professional

06.	Renewable Energy Resources	Twidell, J. W. and Weir, A. D.	English Language Book Society (ELBS).
07.	Climate Change and Sustainable Development: Law	. Malcolm Dowden	Policy and Practice
08.	Sustainable Design: The Science of Sustainability and Green Engineering	Daniel A. Vallero and Chris Brasier	Wiley-Blackwell
09.	Sustainable Engineering Practice: An Introduction, Committee on Sustainability	----------	American Society of Civil Engineers.

Course Outcome:

1. Students will be able to understand the importance of concept of sustainable design.
2. Students will be able to calculate different parameters related to sustainable design.
3. Students will be able to analyze environmental management crediting technique.
4. Students will be able to design green and energy efficient infrastructure and perform life cycle analysis.
5. Students will be able to understand the implication of sustainability engineering in managing social problems.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E26.1	Students will be able to understand the importance of concept of sustainable design
UCE07E26.2	Students will be able to calculate different parameters related to sustainable design.
UCE07E26.3	Students will be able to analyze environmental management crediting technique.
UCE07E26.4	Students will be able to design green and energy efficient infrastructure and perform life cycle analysis.
UCE07E26.5	Students will be able to understand the implication of sustainability engineering in managing social problems.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E26.1	3	2	2	3	3	2	3	2	1	-	-	1
UCE07E26.2	3	3	2	3	2	2	3	2	-	-	-	1
UCE07E26.3	3	3	2	3	2	2	3	2	-	-	-	1
UCE07E26.4	3	3	2	3	2	2	3	2	-	-	-	1
UCE07E26.5	3	2	2	3	2	2	3	2	-	-	-	1
Total	**15**	**13**	**10**	**15**	**11**	**10**	**15**	**10**	**1**	**-**	**-**	**5**
Average	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**1**	**-**	**-**	**1**
Equivalent Avg. Attainment	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**1**	**-**	**-**	**1**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E26.1	3	2
UCE07E26.2	3	3
UCE07E26.3	3	3
UCE07E26.4	3	2
UCE07E26.5	3	3
Total	**15**	**13**
Average	**3**	**2.67**
Equivalent Avg. Attainment	**3**	**3**

AIR POLLUTION AND NOISE POLLUTION

(UCE07E27)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To understand the type of air pollutants.
2. To understand the sources of air pollutants.
3. To understand the air pollution due to industries & automobile exhausts.
4. To study the effects of air pollution.
5. To study the air quality and emission standards.
6. To understand the global effects of air pollution.

Course Content:

Unit-1

General: An Environmental problem, Definitions.

Type of Air Pollutants &Sources: Particulates, CO, SO_2,NO_X, Hydrocarbons etc. Natural & Man made sources, Emission Factors.

Unit-2

Air Pollution due to Industries & Automobile Exhausts

Meteorology: Wind profiles, turbulent diffusion, wind roses, Topographical effects, Inversions, Plume behavior, plume rise, stable and unstable conditions.

Plume Dispersion: Gaussian model, Diffusion coefficients, Inversion effects, Limits to the models.

Particulates: Terminology, Size distribution, Removal mechanisms, particulate collection devices, choice of equipment's, standards.

Sulphur Oxides: SO_X sources, ambient concentrations, Test methods, Control techniques, Standards, Costs, Ambient downwind concentrations.

Nitrogen Oxides: Sources, Ambient concentrations, Test methods, Thermo dynamics & kinetics of nitrogen oxides, Control techniques, Standards of performance, costs.

Unit-3

Effects of Air Pollution: Plant damage, corrosion, Art treasures, human health-respiratory system, special diseases.

Unit-4

Air Quality & Emission Standards: Criteria & Standards, U.S ad Indian Standards, Pollution control laws.

Unit-5

Global Effects of Air-Pollution: Greenhouse effect, Acid rain, Ozone layer disruption etc.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Air Pollution	Henry C	McGraw Hill KogakushaLtd.Tokyo,
02.	Air Pollution	Stern, Arthur C.	Academic Press, New York, USA,1977
03.	Water supply and sanitary Engineering	G.S.Birdie & J.S.Birdie.	Dhanpat Rai publishing Company, New Delhi
04.	Sewage Treatment & Disposal and Wastewater Engineering.	Dr. P.N.Modi	Standard Book House.

05.	Water supply, Waste Disposal and Environmental Pollution Engineering i/c Air pollution and control	A.K. Chatterjee.	Khanna Publishers.

Course Outcome:

1. Students will be able to understand the type of air pollutants.
2. Students will be able to understand the sources of air pollutants.
3. Students will be given a broad idea regarding the air pollution due to industries & automobile exhausts.
4. Students will be able to understand the effects of air pollution.
5. Students will be able to understand the air quality and emission standards.
6. Students will be given a broad idea regarding the global effects of air pollution.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E27.1	Students will be able to understand the type of air pollutants.
UCE07E27.2	Students will be able to understand the sources of air pollutants.
UCE07E27.3	Students will be given a broad idea regarding the air pollution due to industries & automobile exhausts.
UCE07E27.4	Students will be able to understand the effects of air pollution.
UCE07E27.5	Students will be able to understand the air quality and emission standards.
UCE07E27.6	Students will be given a broad idea regarding the global effects of air pollution.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E27.1	3	3	3	3	3	3	3	-	-	2	2	3
UCE07E27.2	3	3	3	3	3	3	3	-	-	2	2	3
UCE07E27.3	3	3	3	3	3	3	3	-	-	2	2	3
UCE07E27.4	3	3	3	3	3	3	3	-	-	2	2	3
UCE07E27.5	3	3	3	3	3	3	3	3	-	3	2	3
UCE07E27.6	3	3	3	3	3	3	3	3	-	2	2	3
Total	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**6**	**-**	**13**	**12**	**18**
Average	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**-**	**2.17**	**2**	**3**
Eq. Av Attainment	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**-**	**2**	**2**	**3**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE07E27.1	4	3
UCE07E27.2	4	3
UCE07E27.3	4	3
UCE07E27.4	4	3
UCE07E27.5	4	3
UCE07E27.6	4	3
Total	**24**	**18**
Average	**4**	**3**
Equivalent Avg. Attainment	**4**	**3**

MUNICIPAL SOLID WASTE MANAGEMENT
(UCE07E28)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To understand the land pollution and general control measures.
2. To understand the sources of solid waste.
3. To understand the transport system of solid waste.
4. To study the treatment and disposal methods of solid waste.
5. To study the recent developments in solid wastes reuse and disposal.
6. To study the biomedical waste management.

Course Content:

Unit-1

Land pollution and control – Land Pollution sources and their impacts, general control measures.

Solid waste – Sources and engineering classification, characterization, generation and quantification.

Unit -2

Transport – Collection systems, collection equipment, transfer stations, collection route optimization.

Treatment methods – Various methods of refuse processing, recovery, recycle and reuse, composting – aerobic and anaerobic, incineration, pyrolysis and energy recovery.

Disposal methods –Impacts of open dumping, site selection, sanitary land filling – design, engineered landfill system, leachate and gas collection systems, leachate treatment.

Unit -3

Recent Developments in Solid Wastes Reuse and Disposal – Power Generation, Blending with construction materials and Best Management Practices (BMP).

Unit -4

Role of various organizations in Solid Waste Management – Governmental, Non-Governmental, Citizen Forums.

Unit -5

Biomedical Waste management – Sources, treatment and disposal

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Solid Waste Engineering – Principles And Management Issues	Tchobanoglous G., Theissen H., and EIiassen R.(1991)	McGraw Hill, New York.
02.	Handbook of Solid Waste Disposal	PavoniJ.L(1973).	
03.	Environmental Engineering	. Peavy, Rowe and Tchobanoglous (1985)	McGraw Hill Co. 4thEdition
04.	Solid Waste Management	Mantell C.L., (1975)	John Wiley
05.	CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.	----------	----------
06.	WHO Manual on Solid Waste Management.		

07.	Solid Waste Engineering	Vesiland A.(2002)	Thompson Books.
08.	Hazardous waste (management and handling) rules, 2001	----------	----------
09.	Biomedical (Handling and Management) Rules 2008	----------	----------

Course Outcome:

1. Students will be able to understand the land pollution and general control measures.
2. Students will be able to understand the sources of solid waste.
3. Students will be able to understand the transport system of solid waste.
4. Students will be given a broad idea regarding the treatment and disposal methods of solid waste.
5. Students will be able to understand the recent developments in solid wastes reuse and disposal.
6. Students will be given a broad idea regarding the biomedical waste management.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E28.1	Students will be able to understand the land pollution and general control measures.
UCE07E28.2	Students will be able to understand the sources of solid waste.
UCE07E28.3	Students will be able to understand the transport system of solid waste.
UCE07E28.4	Students will be given a broad idea regarding the treatment and disposal methods of solid waste.
UCE07E28.5	Students will be able to understand the recent developments in solid wastes reuse and disposal.
UCE07E28.6	Students will be given a broad idea regarding the biomedical waste management.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E28.1	3	3	3	3	2	3	3	-	-	2	2	3
UCE07E28.2	3	3	3	3	2	3	3	-	-	2	2	3
UCE07E28.3	3	3	3	3	2	3	3	-	-	2	2	3
UCE07E28.4	3	3	3	3	3	3	3	-	-	2	2	3
UCE07E28.5	3	3	3	3	3	3	3	-	-	2	2	3
UCE07E28.6	3	3	3	3	3	3	3	-	-	2	2	3
Total	**18**	**18**	**18**	**18**	**15**	**18**	**18**	**-**	**-**	**12**	**12**	**18**
Average	**3**	**3**	**3**	**3**	**2.5**	**3**	**3**	**-**	**-**	**2**	**2**	**3**
Eq. Av Attainment	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**2**	**2**	**3**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE07E28.1	4	3
UCE07E28.2	4	3
UCE07E28.3	4	3
UCE07E28.4	4	3
UCE07E28.5	4	3
UCE07E28.6	4	3
Total	**24**	**18**
Average	**4**	**3**
Equivalent Avg. Attainment	**4**	**3**

RURAL INFRASTRUCTURE DEVELOPMENT

(UCE07E29)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To give a clear idea about the earthquake resistant rural housing.
2. To provide proper knowledge regarding Rural Water Supply and Sanitation.
3. To describe about the various rural energy sources.
4. To developed the rural roads and overview of various schemes.

Course Content:
Unit-1

Earthquake Resistant Rural Housing: Historical construction practices in India; Review of current rural construction practices; Performance of such construction in past; Need for the scientific development of low-cost building typologies using locally available materials and skills. Review of low-cost housing construction practices; Engineered vs. Non-engineered construction; Socio-economic considerations in seismic safety of buildings; Earthen buildings: adobe buildings, earthen construction with wood and bamboo; Earthquake design concept; Selection of construction materials; Physical and mechanical properties of construction materials; Foundations; Walling and roofing. Construction and design aspects; Horizontal reinforcement in walls; Horizontal bands or ring beams; Dowels at corners or junctions; Vertical reinforcement in walls; Framing of thin load bearing walls; Reinforcement in hollow block masonry; Confined masonry buildings; Tie columns; Tie Beams; Horizontal wall reinforcement; Vertical wall reinforcement; Openings in walls; Repair, restoration, and strengthening concepts; Repair materials; Techniques to restore original strength. Various types of rural housing scheme adopted by the Government of India.

Unit -2

Rural Water Supply and Sanitation: Review of current status; National and State level programmers of RWS; Basic principles of rural water supply and sanitation; Traditional/low cost methods and practices: water sources, surface and ground water treatment, Latest developments in rural water supply and sanitation practices; Safe disposal and reuse systems in rural settings: low cost Biological/ Chemical treatment; Relevant governmental schemes/initiatives/policies: NBA, SBA etc.

Unit -3

Rural Energy : An overview of different energy sources: biogas, wind, solar and hydel; Biomass based energy systems, Pyrolysis : Concept, Types, Technology and Waste Management, Biogas production using various substrates including MSW and industrial wastes, Types of digesters and feed materials, Bio diesel: potential and scope in India, Bio-diesel production technology: Uses and Advantages, Cook Stoves, Multi-fuel and biomass cook stoves, improved chulhas, Micro Hydel : Site characterization, Hydro potential estimation, Animal power: Application and power generation, Solar Energy Technologies: Solar Pond and Solar Photovoltaic.

Unit -4

Rural Roads: Overview of Development of Rural Roads, Historical Development, Socio-Economic Development by Rural Roads, Impact on Rural Economy, Recommendations of National Rural Road Development Committee. Pradhan Mantri Gram Sadak Yojana and Bharat Nirman, Strategy and Objectives, Initiatives for Structured Development, Recommendations. Planning and Design of Rural Roads: Network Planning for Rural Roads, District Rural Road Plan (DRRP) and Core Network (CN) In PMGSY, Intra-village Roads,

Unit -5

Design of Rural Roads, Feasibility and Detailed Project Reports, Pavement Design, Options for Paved and Unpaved All-weather Roads, Cross Drainage Structures, Recommendations, Materials and Construction Technology: Pavement Materials, Construction Methods and Technology, Design Modifications, Employment Potentials in Rural Road Sector, Maintenance Management of Rural Roads: Maintenance Needs and Criteria, Community Participation in Maintenance.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Environmental Engineering	H. S. Peavy, D. R. Rowe and G. Tchobanoglous	McGraw-Hill International Ed., 2013.
02.	Rural Water Supply and Sanitation	S. Gupta	Vayu Education of India, New Delhi, 2013.
03.	Central Public Health and Environmental Engineering Organization, Manual on Water Supply and Treatment, 2nd Ed, Ministry of Urban Development, New Delhi December 1991.	----------	----------
04.	Solar Energy: Fundamentals, Design, Modeling and Applications	G. N. Tiwari	Narosa, 2002.
05.	Non-Conventional Sources of Energy	U. C. Sharma	Studium Press LLC, USA, 2014.
06.	Solar Energy: Fundamental and Application	H. P. Garg and S. Prakash	Tata McGraw Hill, 1997.
07.	Third Generation Photovoltaics: Advance Solar Energy	M. Green	Springer, 2005.
08.	Design for earthquakes	James Ambrose and DimitryVergun	John Wiley & Sons Inc., New York, 1999.
09.	UNDP, Repair and strengthening of reinforced concrete, stone and brick-masonry buildings -vol 5, UNDP/UNIDO Project RER/79/015, UNIDO, UNDP, 1983.	----------	----------
10.	UBC EERI, “Evaluation of Confined	----------	----------

	Masonry Guidelines for Earthquake-Resistant Housing", UBC EERI, Mexico City, 2007.		
11.	BIS, Handbook on Masonry Design and Construction (SP 20):1991, Bureau of Indian Standards, New Delhi, 1991.	----------	----------
12.	Highway Engineering	Khanna, S.K. and Justo CEG	Nem Chand & Bros
13.	IRC-SP:48, Hill Road Mannual, Indian Road Congress, 1998	----------	----------

Course Outcome:

1. Students will learn about various rural housing techniques, historical background, Government schemes and ways to strengthened existing non-engineered buildings.
2. Students will learn about the basic principles of rural water supply and sanitation and its application using environmental friendly methods.
3. Students will be aware of different energy sources that can be generated for the benefit of rural population.
4. Students will have knowledge about the various initiatives taken by the government to connect rural areas with other major's areas to uplift their socio-economic conditions.
5. Students will be able to design all weather rural roads, maintenances by involving community participation and prepare detailed project reports.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E29.1	Students will learn about various rural housing techniques, historical background, Government schemes and ways to strengthened existing non-engineered buildings.
UCE07E29.2	Students will learn about the basic principles of rural water supply and sanitation and its application using environmental friendly methods.
UCE07E29.3	Students will be aware of different energy sources that can be generated for the benefit of rural population.
UCE07E29.4	Students will have knowledge about the various initiatives taken by the government to connect rural areas with other major's areas to uplift their socio-economic conditions.
UCE07E29.5	Students will be able to design all weather rural roads, maintenances by involving community participation and prepare detailed project reports.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E29.1	3	3	2	3	3	3	3					3
UCE07E29.2	3	2	3	2	2	3	3					3
UCE07E29.3	3	3	3	2	2	3	3					3
UCE07E29.4	3	2	2	3	2	3	2					3
UCE07E29.5	3	3	3	3	3	3	3					3
Total	15	13	13	13	12	15	14					15
Average	3	2.6	2.6	2.6	2.4	3	2.8					3
Equivalent Avg. Attainment	3	3	3	3	2	3	3					3

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E29.1	3	2
UCE07E29.2	3	3
UCE07E29.3	3	4
UCE07E29.4	3	4
UCE07E29.5	3	4
Total	**15**	**17**
Average	3	3.4
Equivalent Avg. Attainment	3	3

SATELLITE DIGITAL IMAGE ANALYSIS
(UCE07E30)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. Classify the types and formats of digital satellite data
2. Process digital satellite images for retrieving features.
3. Classify the processed remote sensing data.
4. Evaluate the accuracy of image classification.
5. Quality assessment of freely available DEMS, GIS analysis-1, GIS analysis-2
6. Applications of Image Analysis, Limitations and future of Digital Image Processing Technique.

Course Content:

Unit-1

Geographic Information Systems, Different components of GIS, Different types of vector data Raster data models and their types, TIN data model

Advantages and disadvantages associated with vector, raster and TIN, Non-spatial data (attributes) and their type, Raster data compression techniques, Different raster data file formats Spatial database systems and their types

Unit -2

Pre-processing of spatial datasets, Different map projections, spatial interpolation techniques, Different types of resolutions, Digital Elevation Model (DEM)

Quality assessment of freely available DEMS, GIS analysis-1, GIS analysis-2 and applications Errors in GIS, Key elements of maps

Unit -3

Remote sensing image and its represented, Different techniques of Image acquisition

Important of digital image processing, Image characteristics and different resolutions in Remote SensingEM spectrum, solar reflection and thermal emission remote sensing

Colour representations and transforms, Image Histograms and statistics, Geometric transformations /Georeferencing Technique, Image enhancement techniques –I, Image enhancement techniques -II

Unit -4

Multispectral transforms: scatter plot, principal component analysis and decorrelation stretch

Spatial filtering techniques, Frequency domain - Fourier transformation, Basic Image Compression techniques and different image file formats, Image classification techniques

Unit -5

Principles of image interpretation, SAR Interferometry (InSAR) Technique, Image merging and mosaic king techniques, Applications of Image Analysis, Limitations and future of Digital Image Processing Technique

References:-

SlNo.	Name of Books	Authors	Publishers
01	Digital Image Processing (3rd Edition)	Gonzalez, Rafael C. and Richard E. Woods	Pearson Education, London.
02.	Remote Sensing and Image Interpretation	Lillesand, T.M., Kiefer, R.W. and Chapman, J.W	John Wiley & Sons, 2007.
03.	Remote Sensing and Digital Image Processing	Jarocińska, Anna, van der Meer, Freek D.	Springer, 2016.
04.	Image Interpretation in Geology	Drury, S. A.	Allen & Unwin, 1993.

Course Outcome:

1. Students will be able to classify the types and formats of digital satellite data.

2. Students will be able to Process digital satellite images for retrieving features.

3. Students will be able to classify the processed remote sensing data.

4. Students will be able to evaluate the accuracy of image classification.

5. Students will be able to Quality assessment of freely available DEMS, GIS analysis-1, GIS analysis-2

6. Students will be able to study the applications of Image Analysis, Limitations and future of Digital Image Processing Technique.

To establish the correlation between Cos & POs

Table 1

No of course outcome (CO)	Course Outcome
UCE07E30.1	Students will be able to classify the types and formats of digital satellite data.
UCE07E30.2	Students will be able to process digital satellite images for retrieving features.
UCE07E30.3	Students will be able to classify the processed remote sensing data.
UCE07E30.4	Students will be able to evaluate the accuracy of image classification.
UCE07E30.5	Students will be able to quality assessment of freely available DEMS, GIS analysis-1, GIS analysis-2
UCE07E30.6	Students will be able to study the applications of Image Analysis, Limitations and future of Digital Image Processing Technique.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E30.1	3	3	2	1	1	-	-	-	-	-	-	1
UCE07E30.2	3	3	2	1	1	-	-	-	-	-	-	1
UCE07E30.3	3	3	2	1	1	-	-	-	-	-	-	1
UCE07E30.4	3	3	2	1	1	1	-	-	-	-	-	1
UCE07E30.5	3	3	2	1	1	-	-	-	-	-	-	1
UCE07E30.6	3	3	2	1	1	1	-	-	-	-	-	1
Total	**18**	**18**	**12**	**6**	**6**	**1**	**-**	**-**	**-**	**-**	**-**	**6**
Average	**3**	**3**	**2**	**1**	**1**	**0.17**	**-**	**-**	**-**	**-**	**-**	**1**
Equivalent Avg. Attainment	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E30.1	3	2
UCE07E30.2	3	3
UCE07E30.3	3	3
UCE07E30.4	3	2
UCE07E30.5	3	3
UCE07E30.6	3	3
Total	**18**	**16**
Average	**3**	**2.67**
Equivalent Avg. Attainment	**3**	**3**

CIVIL ENGINEERING MATERIALS
(UCE07E31)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To obtain fundamental idea about traditional and advanced Civil engineering materials for building.
2. To understand the building by-laws and serviceability requirement of building.
3. To understand the physics of the building materials such as energy efficiency, thermal, acoustic and electrical properties.
4. To acquire knowledge regarding functional requirement of the building and selection of suitable materials for the interior of the building
5. To acquire knowledge on landscaping and road materials.

Course Content:

Unit-1

Materials for construction: Cement concrete, grade of concrete, types of steel, uses of steel, market forms of steel used in construction, Doors and windows, Stairs with different materials.
Building planning and maintenance: Classification of buildings, building bylaws, orientation of buildings, ventilation, acoustic requirements, Building maintenance, anti-termite treatment in building.

Unit -2

Other materials: Energy efficient building, material properties such as specific heat, thermal conductivity and electrical resistivity are and how they can be used to calculate the performance of construction materials.

Unit -3

Interior design: Functional requirement of interior designer, basic elements of interior design, design problems :Interior design for spacious rooms, comfortable rooms, theme rooms, living area, cooking area, drinking area dining area, home offices, sleeping area, bathrooms, public/private buildings.

Unit -4

Landscaping: Elements of Landscape architecture, specialization in landscape, landscape products, landscape materials, and water efficient landscaping, design guidelines for interior landscape.

Unit -5

Road walkway materials: Properties of road and walkway materials, Design of garden walkways, Road decoration

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Civil Engineering Materials	Peter Claisse	Elsevier
02.	Basic Civil Engineering	M.S. Palanichamy	Tata McGraw Hill

Course Outcome:

1. Students will garner knowledge regarding various types of traditional and advanced materials used for various components of a building.
2. Students will be able to understand the building physics, which enable them to choose energy efficient and sustainable building materials.
3. Students will be able to understand interior design according to the functional requirement.
4. Students will be able to design the landscape with the appropriate landscaping materials.
5. Students will be able to select suitable materials for roads and walkway according to various geographic, traffic and weather conditions.

To establish the correlation between COs & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE07E31.1	Students will garner knowledge regarding various types of traditional and advanced materials used for various components of a building.
UCE07E31.2	Students will be able to understand the building physics, which enable them to choose energy efficient and sustainable building materials.
UCE07E31.3	Students will be able to understand interior design according to the functional requirement.
UCE07E31.4	Students will be able to design the landscape with the appropriate landscaping materials.
UCE07E31.5	Students will be able to select suitable materials for roads and walkway according to various geographic, traffic and weather conditions.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: '-'

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E31.1	3	3	2	1	1	-	-	-	-	-	-	1
UCE07E31.2	3	3	2	1	1	-	-	-	-	-	-	1
UCE07E31.3	3	3	2	1	1	-	-	-	-	-	-	1
UCE07E31.4	3	3	2	1	1	1	-	-	-	-	-	1
UCE07E31.5	3	3	2	1	1	-	-	-	-	-	-	1
Total	**15**	**15**	**10**	**5**	**5**	**1**	**-**	**-**	**-**	**-**	**-**	**5**
Average	**3**	**3**	**2**	**1**	**1**	**0.20**	**-**	**-**	**-**	**-**	**-**	**1**
Equivalent Avg. Attainment	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE07E31.1	3	2
UCE07E31.2	3	3
UCE07E31.3	3	3
UCE07E31.4	3	2
UCE07E31.5	3	3
Total	**15**	**13**
Average	**3**	**2.60**
Equivalent Avg. Attainment	**3**	**3**

DATA STRUCTURES & PROGRAMMING METHODOLOGY (UCE07E32)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques.
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To demonstrate advantages and disadvantages of specific algorithms and data structures.
5. To formulate new solutions for programming problems or improve existing code using learned algorithms and data-structures.
6. To evaluate algorithms and data structures in terms of time and memory complexity of basic operations.

Course Content:

Unit-1

INTRODUCTION:

Basic concepts and notations: data structures and data structure operation, Interrelationship of Data structure and algorithms. Asymptotic complexity analysis, Abstract Data Types, Recursive programming and recurrence relations.

ARRAYS:

Different representation of Array, Sparse matrix - its implementation and usage, Array representation of polynomials, Circular arrays.

Unit-2

STACKS and QUEUES:

Fundamental of stacks, Operations on stacks, Evaluation of postfix and prefix expressions, conversion from infix to postfix representation, implementing recursive functions, Application

of Stack. Fundamental of Queues, Representation with arrays, Operation on Queues, Circular queue, multiple queues dynamics, Dequeues.

Unit-3

LINK LISTS:
Singly linked list and their manipulation, Doubly linked list, Circular linked list, Circular doubly linked list, Dynamic storage management, Garbage collection, Generalized list, Linked stacks and queues.

TREES:
Binary trees and its representation arrays, Tree traversals (Preorder, Inorder and Postorder), Threaded binary tree, Binary tree representation of tree, Binary search trees, Balanced binary search trees, heaps, Height balanced binary tree ,AVL tree, B- Trees.

Unit-4

SORTING AND SEARCHING:
Searching –linear search, binary search, Different algorithms for sorting – Bubble sort, Selection sort, Insertion sort, Merge sort, Quick sort, Heap sort, Radix sort.

Unit-5

GRAPH REPRESENTATION:
Graph definitions and concepts. Graph Traversal Techniques: Breadth First Search (BFS) and Depth First Search (DFS), Applications of BFS and DFS, Minimum Spanning Trees (MST), Prim's and Kruskal's algorithms for MST.

HASHING AND HEAPS:
Comparing direct address tables with hash tables, hash functions, concept of collision and its resolution using open addressing and separate chaining, double hashing, rehashing. Representing a heap in memory, operations on heaps, application of heap in implementing priority queue.

Reference:-

Sl. No.	Name of Books	Authors	Publishers
1	Data Structure	S. Lipschutz	Schaum's Outline Series, TataMcGraw-Hill
2	Data Structures using C	M. Tenenbaum and Augestien	Pearson Education 2007.
3	Classic Data Structures	D. Samanta	PHI

4	An Introduction to Data Structures With Applications	J.P. Tremblay and P.J. Sorenson	Tata Mcgraw Hill
5	Fundamentals of Data Structures	S. Horowitz and S. Sahani	Computer Science Press
6	Data Structures and Algorithm Analysis in C++	Mark Allen Weiss	Pearson, II Ed, 2004

Course Outcome:

1. Students will be able to describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented and used by algorithms.
2. Students will be able to describe common applications for arrays, records, linked structures, stacks, queues, trees, and graphs.
3. Students will be able to write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs.
4. Students will be able to demonstrate different methods for traversing trees.
5. Students will be able to describe the concept of recursion, give examples of its use, describe how it can be implemented using a stack.
6. Students will be able to design and implement an appropriate hashing function for an application.

To establish the correlation between COs & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE07E32.1	Students will be able to describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented and used by algorithms.
UCE07E32.2	Students will be able to describe common applications for arrays, records, linked structures, stacks, queues, trees, and graphs.
UCE07E32.3	Students will be able to write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs.
UCE07E32.4	Students will be able to demonstrate different methods for traversing
UCE07E32.5	Students will be able to describe the concept of recursion, give examples of its use, describe how it can be implemented using a stack.
UCE07E32.6	Students will be able to design and implement an appropriate hashing function for an application.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E32.1	3	3	2	2	1	-	-	-	-	-	-	1
UCE07E32.2	3	3	2	1	2	-	-	-	-	-	-	1
UCE07E32.3	3	2	2	1	1	-	-	-	-	-	-	1

UCE07E32.4	3	2	2	1	2	1	-	-	-	-	-	1
UCE07E32.5	3	2	2	1	1	-	-	-	-	-	-	1
UCE07E32.6	3	3	2	2	1	1	-	-	-	-	-	1
Total	**18**	**15**	**12**	**8**	**8**	**2**	**-**	**-**	**-**	**-**	**-**	**6**
Average	**3**	**2.5**	**2**	**1.33**	**1.33**	**0.33**	**-**	**-**	**-**	**-**	**-**	**1**
Equivalent Avg. Attainment	**3**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E32.1	3	2
UCE07E32.2	3	2
UCE07E32.3	2	2
UCE07E32.4	2	2
UCE07E32.5	2	2
UCE07E32.6	2	2
Total	**14**	**12**
Average	2.33	**2**
Equivalent Avg. Attainment	**2**	**2**

APPLICATION OF MACHINE LEARNING IN TIME-SERIES ANALYSIS

(UCE07E33)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objectives:

1. To understand the principles of time series analysis, including model structure determination, parameter estimation, and model validation.
2. To infer the characteristics of the stochastic process from a data sample by time series analysis.
3. To know the coefficients estimation in autoregressive models, coefficient estimation in ARMA (p) processes, quality of adjustment of time series models.
4. To know Box - Jenkins Analysis that refers to a systematic method of identifying, fitting, checking, and using integrated autoregressive.

Course Content:

Unit– 1

Stochastic process and its main characteristics

Stochastic process. Time series as a discrete stochastic process. Stationarity. Main characteristics of stochastic processes (means, auto covariation and autocorrelation functions).Stationary stochastic processes. Stationarity as the main characteristic of stochastic component of time series.

Unit – 2

Autoregressive-moving average models ARMA (p,q)

Moving average models MA(q). Condition of invertability. Autoregressive models AR(p). Yull-Worker equations. Stationarity conditions. Autoregressive-moving average models ARMA (p,q).

Unit – 3

Coefficient estimation in ARMA (p,q) processes. Box-Jenkins' approach

Coefficients estimation in autoregressive models. Coefficient estimation in ARMA (p) processes. Quality of adjustment of time series models.AIC information criterion.BIC information criterion."Portmonto"-statistics. Box-Jenkins methodology to identification of stationary time series models.

Unit – 4

Forecasting in the framework of Box-Jenkins model

Forecasting, trend and seasonality in Box-Jenkins model.

Non-stationary in time series. Time series with non-stationary variance. Non-stationary mean.

Unit – 5

Hindrances in Economic Time-Series Prediction , Machine Learning Approach to Time-Series Prediction, Scope of Machine Learning in Time-Series Prediction, Sources of

Uncertainty in a Time-Series, Scope of Uncertainty Management by Fuzzy Sets, Fuzzy Time-Series, Partitioning of Fuzzy Time-Series, Fuzzification of a Time-Series, Time-Series Prediction Using Fuzzy Reasoning, Single and Multi-Factored Time-Series Prediction.

Mini Project for prediction of Economic Time series using machine learning.

Reference:-

Sl. No.	Name of books	Authors	Publisher
1	Time Series Analysis And Forecasting by Example	SorenBisgaard and Murat Kulachi	Wiley Publication.

2	Mathematic for Economic Analysis	Knut Sydsaeter and Peter J. Hammond	Pearson Publication
3	Computational Intelligence Principal Techniques and Application	Amit Konar	Springer Publication.
4	Time Series Prediction and Applications	Amit Konar and Diptendu Bhattacharya	Springer Publication.

Course Outcomes:

1. The students will able to know the concept of time series analysis using transfer functions, state-space models, and spectral decomposition. By using time series analysis student will able to develop stochastic, or probabilistic, models. By the end of the chapter, the reader should have a thorough understanding of the principles of time series analysis.
2. The students will able to estimate the parameters for Box–Jenkins models involves numerically approximating the solutions of nonlinear equations.
3. The students will able to drawn attention and have established themselves as serious contenders to classical statistical models in the forecasting community Machine learning models.
4. The students will able to deal with forecasting under the fuzzy environment that contains uncertainty, vagueness and imprecision by using fuzzy time series.

To establish the correlation between COs & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE07E33.1	The students will able to know the concept of time series analysis using transfer functions, state-space models, and spectral decomposition. By using time series analysis student will able to develop stochastic, or probabilistic, models. By the end of the chapter, the reader should have a thorough understanding of the principles of time series analysis.
UCE07E33.2	The students will able to estimate the parameters for Box–Jenkins models involves numerically approximating the solutions of nonlinear equations.
UCE07E33.3	The students will able to drawn attention and have established themselves as serious contenders to classical statistical models in the forecasting community Machine learning models.
UCE07E33.4	The students will able to deal with forecasting under the fuzzy environment that contains uncertainty, vagueness and imprecision by using fuzzy time series.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E33.1	1	2	2	1	3	1	1	1	1	1	1	2
UCE07E33.2	3	2	3	2	3	2	2	2	1	1	1	1
UCE07E33.3	3	2	2	2	3	3	1	1	1	1	1	2
UCE07E33.4	2	3	1	3	2	2	1	1	2	2	1	1
Total	**9**	**9**	**8**	**8**	**11**	**8**	**5**	**5**	**5**	**5**	**4**	**6**
Average	**2.25**	**2.25**	**2**	**2**	**2.75**	**2**	**1.25**	**1.25**	**1.25**	**1.25**	**1**	**1.5**
Equivalent	**2**	**2**	**2**	**2**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E33.1	4	3
UCE07E33.2	2	4
UCE07E33.3	4	3
UCE07E33.4	3	2
Total	**13**	**12**
Average	**3.25**	**3**
Equivalent Avg. Attainment	**3**	**3**

SOFT COMPUTING

(UCE07E34)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To understand the ideas of soft computational techniques based on human experience.
2. To conceptualize fuzzy logic and its implementation for various real world applications.
3. To understand the fundamental concept, models and various classification of Neural Networks.
4. To carry out the optimization using Genetic Algorithms, Particle Swarm, Differential Evolution and Bacterial Foraging optimization.
5. To apply the process of approximate reasoning uses Neuro-Fuzzy, Neuro-GA, Neuro-Swarm, Neuro-evolution Modeling.

6. To generate an ability to design, analyze and perform experiments on real life problems using various Neural Learning Algorithms, Pattern Recognition, Robotics, and Image Processing.

Course Content:

Unit– 1

Introduction to Fuzzy sets, Fuzzy t- and s- norms, projection, cylindrical extension, Fuzzy relations, Implication relations, Fuzzy relational equations, Possibilistic reasoning, Fuzzy pattern recognition, Introduction to Fuzzy control and Fuzzy databases.

Unit – 2

Biological vs. artificial neurons, McCulloch and Pitts Model, Perceptron as linear classifier, Supervised learning: Perceptron learning algorithm, Steepest descent learning and back propagation algorithm, Radial basis function neural net. Unsupervised learning: Hopfield neural net, Self-organizing feature map neural net, Competitive neural learning, Reinforcement learning: Q-learning and temporal difference Q-learning, Support vector machine (SVM), Kernelized SVM, Learning vector quantization.

Unit – 3

Genetic Algorithm: Binary and real codes, Genetic programming, Particle swarm optimization, Differential Evolution, Bacterial Foraging

Unit – 4

Hybridization of neuro-fuzzy, neuro-GA, neuro-swarm, neuro-evolution algorithms. Applications in Pattern Recognition, Robotics, and Image Processing.

Reference:-

Sl. No.	Name of books	Authors	Publisher
1	Computational Intelligence: Principles, Techniques, and Applications	A. Konar	Springer 2005
2	Computational Intelligence	A. P. Engelbrecht	

Course Outcome:

1. Students will be able to understand the ideas of soft computational techniques based on human experience.
2. Students will be able to understand the concept of fuzzy logic and its implementation for various real world applications.

3. Students will be able to understand the concept, models and various classifications of Neural Networks.
4. Students will be able to carry out optimization using Genetic Algorithms, Particle Swarm Optimization, Differential Evolution and Bacterial Foraging optimization.
5. Students will be able to apply the process of approximate reasoning uses Neuro-Fuzzy, Neuro-GA, Neuro-Swarm, Neuro-evolution Modeling.
6. Student will be able to use human like thought process on deterministic machines and apply it to different real world problems.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07E34.1	Students will be able to understand the ideas of soft computational techniques based on human experience.
UCE07E34.2	Students will be able to understand the concept of fuzzy logic and its implementation for various real world applications.
UCE07E34.3	Students will be able to understand the concept, models and various classifications of Neural Networks.
UCE07E34.4	Students will be able to carry out optimization using Genetic Algorithms, Particle Swarm Optimization, Differential Evolution and Bacterial Foraging optimization.
UCE07E34.5	Students will be able to apply the process of approximate reasoning uses Neuro-Fuzzy, Neuro-GA, Neuro-Swarm, Neuro-evolution Modeling.
UCE07E34.6	Student will be able to use human like thought process on deterministic machines and apply it to different real world problems.

Table-2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and '-' for NO CORELATION

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07E34.1	2	3	3	3	3	2	1	-	-	-	-	2
UCE07E34.2	2	3	3	3	3	1	1	-	-	-	-	2
UCE07E34.3	2	3	3	3	3	2	1	-	-	-	-	2
UCE07E34.4	2	3	3	3	3	2	1	-	-	-	-	2
UCE07E34.5	2	3	3	3	3	2	1	-	-	-	-	2
UCE07E34.6	3	3	3	3	3	2	1	-	-	-	-	2
Total	13	18	18	18	18	11	6	-	-	-	-	12
Average	2.1	3	3	3	3	1.8	1	-	-	-	-	2
Eq. Av Attainment	2	3	3	3	3	2	1	-	-	-	-	2

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE07E34.1	2	2
UCE07E34.2	3	3
UCE07E34.3	3	3
UCE07E34.4	3	3
UCE07E34.5	3	3
UCE07E34.6	3	3
Total	**17**	**17**
Average	**2.8**	**2.8**
Equivalent Avg. Attainment	**3**	**3**

CONSTRUCTION PLANNING AND MANAGEMENT
(UCE07B01)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To obtain the concept of PERT and CPM.
2. To understand the network rules.
3. To understand labour laws, arbitration.
4. To understand the tendering, contract.

Course Content:

Unit-1

Project: Project management, Project planning

Chart: Details of bar chart and mile stone chart.

Network: Elements of network, various types of activities and events

Unit -2

Time Estimation: Various types of time, Mean variance and standard deviation, selection of critical path, determination of slack.

Unit -3

Concept of CPM, PERT, Network Analysis.

Unit -4

Tendering: Pre-qualification criteria, Tender documents, Tender evaluation, Tender negotiation, Tender pricing strategies. Construction Finance, Financial planning, Costing, Time and cost over runs, Claims & Settlement. Insurance, E tendering concept

Unit -5

Personnel: Personnel management, Staff & Labour welfare, Public relation.

Quality control: Organizing construction, Inspection and quality control.

Safety: Site safety measures, Accident prevention, First Aid.

Laws: Labour law; Arbitration

References:-

Sl No.	Name of Books	Author	Publisher
01.	Project Planning and Control With PERT And CPM	Dr. B.C. Punmia K. K. Khandelwal	Laxmi Publications(P) Ltd. New Delhi
02.	PERT and CPM Principles and Applications Press Pvt. Ltd.	L.S. Srinath	Affiliated East -West New Delhi
03.	Project Management with PERT and CPM	Dr. D.S. Hira	S.K. Kataria & Sons New Delhi
04.	A Management Guide to PERT/ CPM With GERT/PDM/DCPM And other Network	Jerome D. Wiest Ferdinand K. Levy	Prentice Hall of**.** New Delhi India Pvt. Ltd.

Course Outcome:

1. Students will be able to identify the difference of bar chart and milestone chart.
2. Students will be able to form the network of a project.
3. Students will be able to understand different types of project phases.
4. Students will be to understand the tendering, arbitration
5. Students will be able to understand muster roll
6. Students will be able to understand the critical path

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE07B01.1	Students will be able to identify the difference of bar chart and milestone chart.
UCE07B01.2	Students will be able to form the network of a project.
UCE07B01.3	Students will be able to understand different types of project phases.
UCE07B01.4	Students will be to understand the tendering, arbitration
UCE07B01.5	Students will be to understand the muster roll
UCE07B01.6	Students will be to understand the critical path

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -"-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07B01.1	3	3	3	-	-	-	-	-	-	-	-	3
UCE07B01.2	3	-	3	-	-	-	-	-	-	-	-	3
UCE07B01.3	3	-	-	-	-	-	-	-	-	-	-	3
UCE07B01.4	3	-	-	-	-	-	-	-	-	-	-	3
UCE07B01.5	3	3	-	-	-	-	-	-	-	-	-	3
UCE07B01.6	3	-	-	-	-	3	-	-	-	-	-	3
Total	**18**	**6**	**6**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**18**
Average	**3**	**1**	**1**	**0.5**	**-**	**0.5**	**-**	**-**	**-**	**-**	**-**	**3**
Eq. Av Attainment	**3**	**1**	**1**	**0**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**3**

To establish the correlation between COs and PSOs

Table-3

CO	PSO1	PSO2
UCE07B01.1	4	2
UCE07B01.2	3	3
UCE07B01.3	3	4
UCE07B01.4	4	4
UCE07B01.5	3	4
UCE07B01.6	3	3
Total	**20**	**20**
Average	**3.3**	**3.3**
Equivalent Avg. Attainment	**3**	**3**

STRUCTURAL DESIGN AND DRAWING

(UCE07P01)

Total Credit: 1.5 **Contact Periods: 03 (0L+0T+3P)**

Courses Objective:

1. To have an overview of design methods of various RCC structures.
2. To know the various codal provisions in respect to RCC and steel structure design.
3. To carry out hands-on practice on the method of preparation of drawing from actual design output.
4. To gather knowledge regarding use of software for preparation of drawing.

Course Content:

Design and Detailing of RCC Structures

1. Beams – Simply supported, Cantilever and Continuous.
2. Slab – One way, Two way and One-way continuous.
3. Staircase – Doglegged.
4. Cantilever Retaining wall
5. Circular Water Tank, Rectangular Water Tank.

Detailing of Steel Structures

1. Connections – Beam to beam, Beam to Column by Bolted and Welded Connections.
2. Built-up Columns with lacings and battens.
3. Column bases and Gusseted bases with bolted and welded connections.
4. Roof Truss – Welded and Bolted.
5. Beams with Bolted and Welded Connections subjected to eccentric loadings.
6. Plate Girder and Gantry Girder.

Course Outcome:

1. Students will learn to prepare layout plan of the building as a whole and its components.
2. Students will be able to design RCC structures, e.g. building, retaining wall and water tank.
3. Students will be able to understand codal provisions of steel structures, e.g. roof truss, water tank and various structural components including their connections.
4. Students will be able to learn the method of preparation of structural drawing for both RCC and steel structures.
5. Students will be well conversant about the various codal provisions of RCC structures.

To establish the correlation between COs & POs
Table-1

No. of Course Outcome (CO)	Course outcome
UCE07P01.1	Students will learn to prepare layout plan of the building as a whole and its components.
UCE07P01.2	Students will be able to design RCC structures, e.g. building, retaining wall and water tank.
UCE07P01.3	Students will be able to understand codal provisions of steel structures, e.g. roof truss, water tank and various structural components including their connections.
UCE07P01.4	Students will be able to learn the method of preparation of structural drawing for both RCC and steel structures.
UCE07P01.5	Students will be well conversant about the various codal provisions of RCC structures.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE07P01.1	3	3	3	3	3	1	1	1	3	3	1	3
UCE07P01.2	3	3	3	3	3	1	1	1	3	3	1	3
UCE07P01.3	3	3	3	3	3	1	1	1	3	3	1	3
UCE07P01.4	3	3	3	3	3	1	1	1	3	3	1	3
UCE07P01.5	3	3	3	3	3	1	1	1	3	3	1	3
Total	**15**	**15**	**15**	**15**	**15**	**5**	**5**	**5**	**15**	**15**	**5**	**15**
Average	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**3**	**3**	**1**	**3**
Eq. Av Attainment	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**3**	**3**	**1**	**3**

To establish the correlation between COs &PSOs
Table-3

CO	PSO1	PSO2
UCE07P01.1	4	3
UCE07P01.2	4	3
UCE07P01.3	4	3
UCE07P01.4	4	3
UCE07P01.5	4	3
Total	**20**	**15**
Average	**4**	**3**
Equivalent Avg. Attainment	**4**	**3**

PROJECT-I
(UCE07P02)

Total Credit: 02 **Contact Periods: 04 (0L+0T+4P)**

The Project-I / Thesis work will involve in-depth study / review / evaluation / assessment/ analysis / design / experimental investigation/software development related to civil engineering problem of interest.

The findings and results are to be presented appropriately in the form ofreports/photographic records / drawings / computer printout, presentation in seminar willbe encouraged.

COMPREHENSIVE VIVA -VOCE
(UCE07P03)

Total Credit: 01 **Contact Periods: 0 (0L+0T+0P)**

It is for assessing the candidates overall performances in subject matters related to civil engineering and their ability to communicate effectively.

SEMINAR
(UCE07P04)

Total Credit: 02 **Contact Periods: 02 (0L+0T+2P)**

Each student will perform presentation in seminar on a topic related to the field of Civil Engineering.

DETAILCOURSE CURRICULUM

FOR

UNDERGRADUATE PROGRAMME
B.TECH

IN

CIVIL ENGINEERING
(8th SEMESTER)

NATIONAL INSTITUTE OF TECHNOLOGY AGARTALA
TRIPURA (WEST)

DEPARTMENTAL ELECTIVE- IV

ROCK MECHANICS & TUNNELLING

(UCE08E01)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To understand the composition of different types of Rock.
2. To obtain the idea about different tests on rocks.
3. To obtain the concept of structural features of rocks and its measurement of stresses.
4. To obtain the idea about the design and construction of rock structures.

Course Content:

Unit-1

Composition of Rocks, Geological classification of rocks, rock structures, Pore space in rock. Rock coring, various method of obtaining Rock cores, engineering classification of Rock masses.

Unit -2

Strength and failure of Rocks. Uniaxial strength of Rock Samples, Evaluation of Triaxial strength of Rocks, other shear test on rock sample. Effect of water on rock strength, Effect of water on rock deformation, flow of water through Rocks.

Unit -3

Structural features of massive rocks, effect of cracks, faults and folds on engineering behavior of rock masses. Measurement of stresses in rock masses, various types of stress measuring devices.

Unit -4

Evaluation of properties of rocks in the field, hydraulic fracturing, uses of flat jacks.

Unit -5

Design of structures in rocks, basic design principles of tunnels in rock, design of pressure tunnel in rock, principle of design of rock slopes.

References:-

Sl No.	Name of Books	Authors	Publishers
01.	Fundamental of Rock Mechanics.	John Jaeger, N. G. Cook, and Robert Zimmerman.	----------
02.	Introduction to Rock Mechanics.	Richard E. Goodman	PierreHabib and Bronwen A. Rees.
03.	Rock Mechanics and the Design of Structures in Rock	L. Obert and W.I. Duvall	
04.	Experimental Rock Mechanics	Kiyoo Mogi.	Geomechanics Reasearch

Course Outcome:

1. Study the various method of rock obtaining.
2. Study the strength and failure of rock.
3. Study the deformation, effect of crack, failure.
4. Study the properties of rock.
5. Study of the stress.
6. Study on effect of water on rock.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE08E01.1	Students will be able to understand the various method of rock obtaining.
UCE08E01.2	Students will be able to understand the strength and failure of rock
UCE08E01.3	Students will be able to understand deformation of rock
UCE08E01.4	Students will be able to how to fix alignment of any rock
UCE08E01.5	Students will be able to understand the stress in rock
UCE08E01.6	Students will be able to understand effect of water on rock

Table 2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and '-' for NO CORELATION

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E01.1	2	2	1	1	-	-	-	-	2	-	-	1
UCE08E01.2	2	2	1	1	-	-	-	-	2	-	-	1
UCE08E01.3	2	2	1	1	-	-	-	-	2	-	-	1
UCE08E01.4	2	2	1	1	-	-	-	-	2	-	-	2
UCE08E01.5	2	1	1	1	-	-	-	-	2	-	-	1
UCE08E01.6	2	1	1	1								
Total	**12**	**10**	**6**	**6**	**-**	**-**	**-**	**-**	**10**	**-**	**-**	**6**
Average	**2**	**1.7**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**1.2**
Eq. Av Attainment	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**1**

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE08E01.1	3	2
UCE08E01.2	3	3

UCE08E01.3	3	4
UCE08E01.4	2	4
UCE08E01.5	2	4
UCE08E01.6	2	4
Average	**2.5**	**3.5**
Equivalent Avg. Attainment	**3**	**4**

SEISMOLOGY AND SEISMIC DESIGN OF FOUNDATION

(UCE08E02)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objectives

1. To learn the basic fundamentals regarding earthquake seismology, liquefaction etc.
2. To gather knowledge about site assessment along with site geotechnical models and also of different types of Foundation Selection.

Course Content:

Unit-1

Earthquake Seismology: Causes of earthquake, Plate tectonics, Earthquake fault sources, Seismic waves, Elastic rebound theory, Quantification of earthquake, Intensity and magnitudes, Earthquake source models. Liquefaction and lateral spreading - Liquefaction related phenomena, Liquefaction susceptibility: Historical, Geological, Compositional and State criteria. Evaluation of liquefaction by cyclic stress and cyclic strain approaches, Lateral deformation and spreading, Criteria for mapping liquefaction hazard zones.

Unit -2

Introduction, Site Geotechnical Model: Selection of representative design parameters

Foundation Performance Objectives for Earthquake Loading: Introduction, Regulatory environment, Serviceability limit state (SLS), Ultimate limit state (ULS), Intermediate limit states, LRFD design procedure, LRFD design with earthquake loading, Soil structure interaction, Performance based design

Unit -3

Site Assessment and Foundation Selection: Introduction, Soil liquefaction, Lateral spreading, Other site stability issues, Natural raft, Ground improvement, Sand-like soils with FL >1, Clay-

like soils, Settlement, Free field settlement, Building induced settlements, Other settlement sources, Shallow foundation requirements, Deep foundation requirements

Unit -4

Shallow Foundation Design: Introduction, Types of shallow foundations, Pad footings and strip footings, Gravity design procedure, Seismic design procedure, Foundation beams, Design of mats and rafts.

Unit -5

Deep Foundation Design: Types of deep foundations, Driven piles, Bored piles, Belled piles, CFA piles, Screw piles, Gravity design procedures, Seismic design procedures, Axial load capacity and settlement, Lateral load resistance and kinematic effects

References:-

Sl No.	Name of Books	Authors	Publishers
01.	Geotechnical Earthquake Engineering	Kramer S. L	Prentice Hall, 1996.
02.	Geotechnical Earthquake Engineering Handbook	R. W. Day	McGraw-Hill, 2002.
03.	Analysis and Design of Foundations	Bowles, J. W.	McGraw-Hill, 4th Ed., 1988
04.	Pile foundation Analysis and Design	Poulose H.G. and Davis E.H.	John-Wiley & Sons, NY, 1980.

Course Outcome:

1. Students will be able to understand about Earthquake Seismology, Earthquake source models, Liquefaction related phenomena etc.
2. Students will be able to gather knowledge about Introduction of Site Geotechnical Models.
3. Students will be able to understand about Site Assessment and Foundation Selection.
4. Students will be able to analyze Shallow Foundation Design.
5. Students will be able to understand Deep Foundation Design.

To establish the correlation between Cos & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE08E02.1	Students will be able to understand about Earthquake Seismology, Earthquake source models, Liquefaction related phenomena etc.
UCE08E02.2	Students will be able to gather knowledge about Introduction of Site Geotechnical Models.

UCE08E02.3	Students will be able to understand about Site Assessment and Foundation Selection.
UCE08E02.4	Students will be able to analyze Shallow Foundation Design.
UCE08E02.5	Students will be able to understand Deep Foundation Design.

Table 2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E02.1	3	3	2	1	1	-	-	-	-	-	-	1
UCE08E02.2	3	3	2	1	1	-	-	-	-	-	-	1
UCE08E02.3	3	3	2	1	1	-	-	-	-	-	-	1
UCE08E02.4	3	3	2	1	1	1	-	-	-	-	-	1
UCE08E02.5	3	3	2	1	1	-	-	-	-	-	-	1
Total	**15**	**15**	**10**	**5**	**5**	**1**	**-**	**-**	**-**	**-**	**-**	**5**
Average	**3**	**3**	**2**	**1**	**1**	**0.17**	**-**	**-**	**-**	**-**	**-**	**1**
Equivalent Avg. Attainment	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE08E02.1	3	2
UCE08E02.2	3	3
UCE08E02.3	3	3
UCE08E02.4	3	2
UCE08E02.5	3	3
Total	**15**	**13**
Average	**3**	**2.6**
Equivalent Avg. Attainment	**3**	**3**

GEOGRAPHIC INFORMATION SYSTEM AND ITS APPLICATIONS (UCE08E03)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. Explored mapped data
2. Relate GIS with remote sensing technologies
3. Analyze spatial data, using GIS analysis tools

4. Develop and manage geo database

Course Content:

Unit-1

Introduction: Information systems, spatial andnon- spatial information, Geographical concepts and terminology, Advantages of GIS. Basic components of GIS, Commercially available GIS hardware & software, organization of data in GIS.

Unit -2

Data Management: Input data- Field data, Statistical data, Maps, Aerial photographs, Satellite data, Points, lines and areas features, Vector and Raster data, Advantages and Disadvantages, Data entry through keyboard, digitizers and scanners, Digital data. Preprocessing of data - Rectification and registration, Interpolation techniques.

Unit -3

Application of GIS: Data Management, Data Base Management System (DBMS),various data models, Run- length encoding, Quad trees.

Unit -4

Data Analysis- Data layers, analysis of spatial and non-spatial data, Data overlay and modeling. Data Presentation- Hardcopy devices, softcopy devices.

Unit -5

Applications of GIS in Map Revision, Land use, Agriculture, Forestry, Archaeology, Municipal, Geology Water Resources, Soil Erosion, Land suitability analysis, Change detection

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Principles of Geographic Information System for Land Resources Assessment,	Burrough, P.A	Claredon Press Oxford, 1988,
02.	Introduction to Remote Sensing	Campbell, J .B.,	The Guilford Press
03.	Remote Sensing in Hydrology	Engaman, E.T.	London, 1986. Chapman and
04.	Remote Sensing & Geographic Information Systems	and Gurney, R.J Legg, C.A.,	Hall, London 1991, Ellis Horwood, London. 1992.

Course Outcome:

1. Comprehend fundamental concepts and practices of geographic information system and advances in geospatial information science and technology

2. Apply basic graphic and data visualization concepts such as color theory, symbolization, and use of white space

3. Demonstrate organizational skills in file and database management.

4. It give examples of interdisciplinary applications of geospatial science and technology.

5. Apply GIS analysis to address geospatial problems and /or research questions.

6. Demonstrate proficiency in the use of GIS tools to create maps that are fit for purpose and effectively convey the information they are intended to.

To establish the correlation between COs &POs

Table-1

No. of Course Outcome(CO)	Course Outcome
UCE08E03.1	Student will be able to comprehend fundamental concepts and practices of geographic information system and advances in geospatial information science and technology.
UCE08E03.2	Student will be able to apply basic graphic and data visualization concepts such as color theory, symbolization, and use of white space
UCE08E03.3	Student will be able to demonstrate organizational skills in file and database management.
UCE08E03.4	Student will be able to give examples of interdisciplinary applications of geospatial science and technology.
UCE08E03.5	Student will be able to apply GIS analysis to address geospatial problems and /or research questions.
UCE08E03.6	Student will be able to demonstrate proficiency in the use of GIS tools to create maps that are fit for purpose and effectively convey the information they are intended to.

Table-2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: "-"**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E03.1	3	2	1	2	1	2	1	1	2	1	2	3
UCE08E03.2	3	2	1	2	1	2	1	1	2	1	2	3
UCE08E03.3	3	2	1	2	1	2	1	1	2	1	2	3

UCE08E03.3	3	2	1	2	1	2	1	1	2	1	2	3
UCE08E03.5	3	2	1	2	2	2	2	2	1	1	2	3
UCE08E03.6	3	2	2	2	2	2	2	2	2	1	2	3
Total	18	12	6	12	8	12	8	8	11	6	10	18
Average	3	2	1	2	1.33	2	1.33	1.33	1.83	1	1.67	3
Equivalent Avg. attainment	3	2	1	2	1	2	1	1	2	1	2	3

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE08E03.1	3	2
UCE08E03.2	3	3
UCE08E03.3	3	4
UCE08E03.4	2	4
UCE08E03.5	2	4
UCE08E03.6	2	4
Average	**2.5**	**3.5**
Equivalent Avg. Attainment	**3**	**4**

FOUNDATION DESIGN AND DETAILING
(UCE08E04)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To obtain fundamental understanding of the concepts of foundation design.
2. To understand the details about different types of shallow and deep foundations.
3. To give a clear idea regarding different analysis and design procedure on different types of foundations.
4. To understand clearly about the proportioning of footing, bearing capacity failure, behaviour of expansive soil, machine foundations and settlement analysis in details.

Course Content:

Unit-1

Shallow foundations: Selection of type and depth of foundations, isolated footings, combined footings, mat foundations including floating raft, settlement calculations.

Unit -2

Deep foundations: Well foundations, coffer dams, pier foundations.

Unit -3

Earth pressure computations on retaining walls and their design, and Pile Foundation.

Unit -4

Pile Foundation: Introduction, estimation of pile capacity by static and dynamic formulae, wave equation method of analysis of pile resistance-load-transfer method of estimating pile capacity, settlement of single pile, elastic methods. Laterally loaded pile-modulus of sub grade reaction method, ultimate lateral resistance of piles.

Unit -5

Pile Groups: Consideration regarding spacing, efficiency of pile groups, stresses on underlyingsoilstrata,approximateanalysisofpilegroups,settlementofpilegroups,pile caps, pile load tests, negative skin friction.

References:-

Sl No.	Name of Books	Authors	Publishers
01.	Soil Mechanics	Lambe andWhitman	Wiley Eastern.,1976.
02.	Advanced Soil Mechanics	Das B.M	Mc. Graw-Hill, NY, 1985.
03.	Foundation Engineering Hand Book	Winterkorn H.F. and FangH.Y.Ed	Van-Nostrand Reinhold, 1975.
04.	Foundation Analysis and Design (4th Ed.)	Bowles J.E	Mc.Graw –Hill,NY, 1996.
05.	Pile foundation Analysis and Design	Poulose H.G. and Davis E.H	John-Wiley & Sons, NY, 1980.
06.	Foundation Engineering	Leonards G. Ed	Mc.Graw-Hill,NY, 1962.
07.	Analytical and Computer Methods in Engineering	Bowles J.E	Mc.Graw-Hill, NY.
08.	Soil Dynamics	Shamsher Prakash	McGraw Hill.
09.	Dynamics in Soil Engineering	Alexander Major	
10.	Handbook of Machine Foundations	Sreenivasalu &Varadarajan	Tata McGraw Hill.
11.	IS 2974 - Part I and II, Design Considerations for Machine Foundations.	----------	----------
12.	IS 5249: Method of Test for Determination of Dynamic Properties of Soils	----------	----------

Course Outcome:

1. Students will be able to learn in detail the advanced geotechnical engineering.
2. Students will be able to learn in details about the proportioning of footing, bearing capacity failure, behaviour of expansive soil, machine foundations and settlement analysis in details.
3. Students will be able to understand detail analysis and design procedures of different foundations.
4. In depth study on different types of foundations based on different types of soil to be learned by the students.
5. Students will be able to learn detail about the investigation report on soil also and accordingly, foundations to be chosen.
6. Students will be able to learn also the proper application of the foundation in the field of geotechnical engineering.

To establish the correlation between COs &POs

Table-1

No. of Course Outcome(CO)	Course Outcome
UCE08E04.1	1. Students will be able to learn in detail the advanced geotechnical engineering.
UCE08E04.2	2. Students will be able to learn in details about the proportioning of footing, bearing capacity failure, behaviour of expansive soil, machine foundations and settlement analysis.
UCE08E04.3	3. Students will be able to understand detail analysis and design procedures of different foundations.
UCE08E04.4	4. In depth study on different types of foundations based on different types of soil to be learned by the students.
UCE08E04.5	5. Students will be able to learn detail about the investigation report on soil also and accordingly, foundations to be chosen.
UCE08E04.6	6. Students will be able to learn also the proper application of the foundation in the field of geotechnical engineering.

Table-2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: "-"**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E04.1	3	2	1	2	1	2	1	1	2	1	2	3
UCE08E04.2	3	2	1	2	1	2	1	1	2	1	2	3
UCE08E04.3	3	2	1	2	1	2	1	1	2	1	2	3
UCE08E04.4	3	2	1	2	1	2	1	1	2	1	2	3
UCE08E04.5	3	2	1	2	2	2	2	2	1	1	2	3
UCE08E04.6	3	2	2	2	2	2	2	2	2	1	2	3
Total	18	12	6	12	8	12	8	8	11	6	10	18
Average	3	2	1	2	1.33	2	1.33	1.33	1.83	1	1.67	3
Equivalent Avg. attainment	3	2	1	2	1	2	1	1	2	1	2	3

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE08E04.1	3	2
UCE08E04.2	3	3
UCE08E04.3	3	4
UCE08E04.4	2	4
UCE08E04.5	2	4
UCE08E04.6	2	4
Average	**2.5**	**3.5**
Equivalent Avg. Attainment	**3**	**4**

STOCHASTIC HYDROLOGY
(UCE08E05)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To impart knowledge of the concepts of Probability Theory in order to measure and quantify uncertainty in Stochastic Processes.
2. To explore various approaches to develop predictive models of hydrologic stochastic processes
3. To educate students about the advanced water resources engineering applications of probability and statistical concepts
4. To train students regarding frequency analysis of extreme hydrologic events
5. To educate students regarding time series analysis and stochastic modeling techniques

6. To apply concepts of probability and statistics in water resources engineering research and practices.

Course Content:

Unit-1

Deterministic and stochastic hydrology, types of problems in hydrology, need for statistical methods in hydrology.

Unit -2

Continuous and discrete distributions applied in hydrology, moments and expectations, parameter estimation by moments, probability weighted moments.

Unit -3

Least square methods and maximum likelihood methods, probability plotting, regional flood frequency analysis, hypothesis testing, linear and nonlinear regression.

Unit -4

Hydrologic time-series analysis, modeling of hydrological time series.

Unit -5

Data generation techniques, auto regressive processes and models for operational hydrology.

References:-

Sl No.	Name of Books	Authors	Publishers
01.	Statistical Methods in Hydrology	Charles T Han, Charles T Han	East West Publishers, 1998.
02.	Stochastic Hydrology	Jayarami Reddy	Laxmi Publications, 1997.

Course Outcome:

1) Will possess a good overview of stochastic hydrology;

2) Will possess a good basis for reading and understanding literature on stochastic hydrology and stochastic modeling in the earth sciences;

3) Will be able to apply basic methods of mathematical statistics, probability theory and random function theory;

4) Will be able to incorporate stochastic methods and principles in hydrological analysis and model building

5) Will appreciate the added value of the stochastic approach, i.e. “it pays to be certain about uncertainty”.

To establish the correlation between COs &POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE08E05.1	Reading and understanding literature and current research trends on stochastic hydrology and stochastic modeling in the earth sciences
UCE08E05.2	Knowledge on the advanced water resources engineering applications of probability and statistical concepts.
UCE08E05.3	Applying basic methods of mathematical statistics, probability theory and random function theory
UCE08E05.4	Frequency Analysis of Extreme Events (Floods and Droughts), and time series analysis (Univariate and Multivariate)
UCE08E05.5	Applying different stochastic methods and principles in hydrological analysis and model building
UCE08E05.6	Synthetic Hydrology, Models of Long Term Persistence, Analysis of Spatial Hydrologic Processes

Table-2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: "-"**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E05.1	3	2	2	2	1	2	2	2	1	2	2	1
UCE08E05.2	2	2	3	2	2	1	1	1	2	2	2	2
UCE08E05.3	3	1	2	1	3	1	2	1	2	2	2	2
UCE08E05.4	3	2	1	2	1	2	2	1	2	2	1	2
UCE08E05.5	2	2	2	2	2	2	2	1	2	2	2	2
UCE08E05.6	3	3	1	1	3	2	1	2	2	1	3	2
Total	16	12	11	10	12	10	10	8	11	11	12	11
Average	2.66	2	1.83	1.66	2	1.66	1.66	1.33	1.83	1.83	2	1.83

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE08E12.1	4	3
UCE08E12.2	2	3
UCE08E12.3	4	2
UCE08E12.4	3	3
UCE08E12.5	3	4
UCE08E12.6	4	3
Total	**20**	**18**
Average	**3.3**	**3**

COMPUTATIONAL HYDRAULICS
(UCE08E06)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objectives:

1. Equations describing flow and transport processes in free surface flows
2. The methods of characteristics, finite differences, finite elements, and finite volumes
3. Application of the method of finite differences to ordinary and partial differential equations
4. The analysis of convergence, stability, and accuracy of numerical schemes
5. Code various numerical methods in a modern computer language

Course Content:

Unit-1

Differential equations: Ordinary differential equations, nature of problems, boundary and initial equations, Euler's method, modified Euler's method, Predictor-Corrector methods, Runge-Kutta methods, Boundary value problems, mixed boundary conditions, boundary conditions at infinity, nonlinear boundary value problems, linear Eigen value problems. Applications for reservoir routing, gradually varied flow problems, pipe networks.

Unit -2

Partial differential equations: Parabolic, elliptic and hyperbolic partial differential equations subject to Dirichlet, Neumann (or flux) and mixed (or Robin or radiation) boundary conditions, Navier Stoke's equation.

Unit -3

Basic concepts of finite difference method, finite difference schemes, Solution of parabolic equations, pollutant transport, Solution of elliptical equations

Unit -4

Solution of Laplace equation and Poisson equation, flow through porous media.

Unit -5

Solution of hyperbolic equation, method of characteristics, unsteady flow through open channels, propagation of waves, Concepts of finite volume method.

References:-

Sl No.	Name of Books	Authors	Publishers
01.	Computational Hydraulics	Brebbia, C.A. and Freeante , A.J.	Burrerworth& Company (Publishers) Ltd., London, 1983
02.	Numerical Methods for Engineers and Scientists	Hoffman, J.D., (2011)	CRC Press, Special Indian Edition
03.	Applied Numerical Methods for Engineering	Schilling, R.J., and S.L. Harris, (2007)	CENGAGE Learning, India Edition
04.	Computational Hydraulics	Abbot, M.A. and Vervey (1996)	Elsevier Publications
05.	Introduction to Computational Fluid Dynamics, A finite volume method	H. K. Veersteeg and W. Malalasekar	Pearson printice hall
06.	Unsteady Flow in Open Channels Mahmood	K. and Yeyjevich, V	Water Resources Publications, Fort Collins, Colorado, U.S.A,!975

Course Outcomes:

1. Solve an algebraic or transcendental equation using an appropriate numerical method
2. Use numerical methods to solve engineering problems
3. Understanding the theoretical and practical aspects of the use of numerical methods
4. Implementing numerical methods for a variety of multidisciplinary applications
5. Code a numerical method in a modern computer language
6. Apply well-known numerical techniques to solve engineering problems and evaluate the results

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE08E06.1	Solve an algebraic or transcendental equation using an appropriate numerical method
UCE08E06.2	Use numerical methods to solve engineering problems
UCE08E06.3	Understanding the theoretical and practical aspects of the use of numerical methods
UCE08E06.4	Implementing numerical methods for a variety of multidisciplinary applications
UCE08E06.5	Code a numerical method in a modern computer language
UCE08E06.6	Apply well-known numerical techniques to solve engineering problems and evaluate the results

Table-2

1: Slight (LOW) 2: Moderate (MEDIUM)3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E06.1	3	2	2	2	1	2	2	2	1	2	2	1
UCE08E06.2	2	2	3	2	2	1	1	1	2	2	2	2
UCE08E06.3	3	1	2	1	3	1	2	1	2	2	2	2
UCE08E06.4	3	2	1	2	1	2	2	1	2	2	1	2
UCE08E06.5	2	2	2	2	2	2	2	1	2	2	2	2
UCE08E06.6	3	3	1	1	3	2	1	2	2	1	3	2
Total	16	12	11	10	12	10	10	8	11	11	12	11
Average	2.66	2	1.83	1.66	2	1.66	1.66	1.33	1.83	1.83	2	1.83
Eq. Av Attainment	3	2	2	2	2	2	2	1	2	2	2	2

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE08E06.1	4	3
UCE08E06.2	2	3
UCE08E06.3	4	2
UCE08E06.4	3	3

UCE08E06.5	3	4
UCE08E06.6	4	3
Total	**20**	**18**
Average	**3.3**	**3**
Equivalent Avg. Attainment	**3**	**3**

OPEN CHANNEL FLOW AND SEDIMENT TRANSPORT

(UCE08E07)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. The objective of this course is to impart the knowledge of sediment transport mechanism and fluvial process that deals with the occurrence, distributions, and movement river bed materials.
2. To impart the knowledge of various techniques, and how to manage the water resources to protect against flooding, or to make passage along or across rivers easier,
3. To learn about the sediment problems associated with natural stream and reservoir.

Course Content:

Unit-1

Steady GVF, SVF, RVF. Unsteady flow: basic equations.

Unit -2

Velocity of flood wave discharge, flood routing.

Unit -3

Bulk properties of sediments, various related theories such as competent velocity concepts, lift concept, critical tractive force concept

Unit -4

Shield's analysis, regimes of flow, bed forms, resistance to flow, bed and suspended load transport.

Unit -5

Reservoir sedimentation, aggradations and degradation of rivers, local scour, sediment samplers.

References:-

Sl No.	Name of Books	Authors	Publishers
01.	Open channel flow	Subramanya. K	Tata McGraw Hill,3rd Edition, 2010.

02.	Hydraulics of sediment transport	Graf,W. H.	McGraw Hill, 1984.
03.	Sediment transport	Garde and Rangaraju	Wiley Eastern, 2nd Edition, 1985
04.	open channel flow	Chow, V. T	----------

Course Outcome:

1. Apply knowledge of flow properties in open channel flows which include wave propagation, surge and dam break problems.
2. Demonstrate an advanced understanding of sediment incipient motion in river engineering.
3. Recognize the movement of sediments and its impact on river flow.
4. Apply knowledge of mathematics, science, and technology in the field of river engineering.
5. An ability to communicate effectively the river bed scour problem.
6. Develop an archive that will be accessible for future research in sediment transport process.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE08E07.1	**A**pply knowledge of flow properties in open channel flows which includewave propagation, surge and dam break problems.
UCE08E07.2	Demonstrate an advanced understanding of sediment incipient motion in river engineering.
UCE08E07.3	Recognize the movement of sediments and its impact on river flow.
UCE08E07.4	Apply knowledge of mathematics, science, and technology in the field of river engineering.
UCE08E07.5	An ability to communicate effectively the river bed scour problem.
UCE08E07.6	Develop an archive that will be accessible for future research in sediment transport process.

Table-2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E07.1	3	2	1	2	1	1	2	1	1	1	2	1
UCE08E07.2	3	1	1	2	2	1	2	1	2	1	2	1
UCE08E07.3	3	2	1	2	1	1	2	1	2	1	2	1
UCE08E07.4	3	1	1	2	2	1	2	1	2	1	2	1
UCE08E07.5	3	2	1	2	2	1	2	1	2	1	2	1
UCE08E07.6	3	2	1	2	2	1	2	1	2	1	2	1
Total	18	9	6	12	9	6	12	6	12	6	12	6
Average	3.00	1.67	1.00	2.00	1.67	1.0	2.0	1.0	1.8	1.00	2.00	1.00

						0	0	0	3			
Eq. Av Attainment	3	2	1	2	2	1	2	1	2	1	2	1

To establish the correlation between COs &PSOs
Table-3

CO	PSO1	PSO2
UCE08E07.1	4	3
UCE08E07.2	4	3
UCE08E07.3	4	3
UCE08E07.4	4	3
UCE08E07.5	4	3
UCE08E07.6	4	3
Total	24	18
Average	4	3
Equivalent Avg. Attainment	4	3

GROUND WATER DEVELOPMENT AND MANAGEMENT (UCE08E08)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To understand the idea about hydrological cycle and its properties.
2. To understand the concept of ground water distribution, movement and related laws for ground water distribution.
3. To get the idea about different saturated formation and different tests for management and development of ground water.
4. To understand the ground water pollution, quality and improvement.
5. To understand the use of different softwares for the exploration of ground water sources.

Course Content:

Unit -1

Hydrological cycle, Hydrological properties of rocks.

Unit -2

Distribution of ground water, Ground water movement- Darcy's law, Flow nets. Aquifer parameters, Parameter estimation, pump test and recovery test-Thei's, Theim's, Jacob's equations.

Unit -3

Ground water exploration-Geophysical techniques RS, GIS, GPS, Construction of wells, Springs. Ground water recharge, Rain Water harvesting, Water conservation techniques.

Unit -4

Ground water quality, Ground water pollution, Environmental issues.

Unit -5

Ground water budget, Ground water management. Ground water legislation

References:-

Sl No.	Name of Books	Authors	Publishers
01.	Ground water hydrology, 3rd edition	Todd D. K	Wiely, 2008.
02.	Ground water resource evaluation.	Walton, W. C.	McGraw Hill, 1970.
03.	Ground water	Raghunath, H. M	New Age International, 3rd edition, 1998.
04.	Groundwater Assessment and Management	Karanth, K	Tata McGraw Hill, 2007.

Course Outcomes:

1. Students will be able to understand basic hydrologic concepts and its properties.
2. Students will be given idea about laws and tests related to ground water distribution and movement.
3. Students will be able to understand different techniques of ground water exploration.
4. Students will be given idea about ground water pollution and techniques to improve the quality of it.
5. Students will be able to understand ground water management and legislation.

To establish the correlation between COs & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE08E08.1	Students will be able to understand basic hydrologic concepts and its properties
UCE08E08.2	Students will be given idea about laws and tests related to ground water distribution and movement.

UCE08E08.3	Students will be able to understand different techniques of ground water exploration.
UCE08E08.4	Students will be given idea about ground water pollution and techniques to improve the quality of it.
UCE08E08.5	Students will be able to understand ground water management and legislation.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E08.1	3	3	2	2	2	1	2	1	1	1	2	2
UCE08E08.2	3	3	2	2	2	1	2	1	1	1	2	2
UCE08E08.3	3	3	2	2	2	1	2	1	1	1	2	2
UCE08E08.4	3	3	2	2	2	1	2	1	1	1	2	2
UCE08E08.5	3	3	2	2	2	1	2	1	1	1	2	2
Total	**15**	**15**	**10**	**10**	**10**	**5**	**10**	**5**	**5**	**5**	**10**	**10**
Average	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**2**	**2**
Equivalent Avg. Attainment	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**2**	**2**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE08E08.1	3	3
UCE08E08.2	3	3
UCE08E08.3	3	3
UCE08E08.4	3	3
UCE08E08.5	3	3
Total	**15**	**15**
Average	**3**	**3**

DEPARTMENTAL ELECTIVE- V

AIR & WATER QUALITY MODELLING
(UCE08E09)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To understand the importance of mathematical models for water and air quality management.
2. To understand the cause and effect of surface water quality
3. To assess required level of controls in surface water quality modeling
4. To develop a clear conceptual model to predict ground water contaminants
5. To study about computer based modeling for surface and ground water quality
6. To understand the ambient air quality standards.

Course Content:

Unit-1

Systems Approach: Water and air quality management - Role of mathematical models; systems approach -systems and models - kinds of mathematical models - model development and validation, effluent and stream standards; ambient air quality standards.

Unit -2

Surface Water Quality Modelling: Historical development of water quality models ; rivers and streams water quality modelling river hydrology and flow - low flow analysis - dispersion and mixing - flow, depth, and velocity - estuaries - estuarine transport, net estuarian flow, estuary dispersion coefficient; Lakes and impoundments - water quality response to inputs; water quality modeling process model sensitivity- assessing model performance ; Models for dissolved oxygen, pathogens; Streeter - Phelps models.

Unit -3

Air Quality Modelling: Transport and dispersion of air pollutants - wind velocity, wind speed and turbulence; estimating concentrations from point sources - the Gaussian Equation –determination of dispersion parameters, atmospheric stability; dispersion instrumentation - Atmospheric traces; concentration variation with averaging time; Air pollution modelling and prediction – Plume rise, modelling techniques, modelling for nonreactive pollutants, single source - short term impact;

multiple sources and area sources; model performance, accuracy and utilization; computer models.

Unit -4

Groundwater Quality Modelling: Mass transport of solutes, degradation of organic compounds, application of concepts to predict groundwater contaminant movement.

Unit -5

Computer Models: Exposure to computer models for surface water quality, groundwater quality and air quality.

Reference:-

Sl No.	Name of Books	Authors	Publishers
1.	Surface Water quality modeling	Steven C.Chapra	The McGraw-Hill- Companies, Inc., New York, 1997.
2.	Fundamentals of Air pollution	R.W.Boubel, D.L. Fox, D.B. Turner & A.C. Stern	Academic Press, New York, 1994.
3.	Water Management Models - A Guide to Software	Ralph A. Wurbs	Prentice Hall PTR, New Jersey, 1995.

Course Outcome:

1. Students will be able to understand importance of mathematical models for water and air quality management.
2. Students will be given a broad idea to understand the cause and effect of surface water quality
3. Students will be able to assess required level of controls in surface water quality modeling.
4. Students will be able to develop a clear conceptual model to predict ground water contaminants.
5. Students will be able to understand the ambient air quality standards.
6. Students will be able to aware of various computer based modeling for surface and ground water quality.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE08E09.1	Students will be able to understand importance of mathematical models for water and air quality management.
UCE08E09.2	Students will be given a broad idea to understand the cause and effect of surface water quality

UCE08E09.3	Students will be able to assess required level of controls in surface water quality modeling
UCE08E09.4	Students will be able to develop a clear conceptual model to predict ground water contaminants
UCE08E09.5	Students will be able to understand the ambient air quality standards.
UCE08E09.6	Students will be able to aware of various computer-based modeling for surface and ground water quality

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E09.1	3	2	3	2	3	-	-	-	1	-	1	1
UCE08E09.2	2	2	3	2	3	-	3	-	1	-	1	1
UCE08E09.3	2	2	2	1	3	-	-	-	1	-	1	1
UCE08E09.4	2	2	1	1	3	-	-	-	1	-	1	2
UCE08E09.5	2	1	3	2	3	-	3	-	1	-	1	1
UCE08E09.6	3	1	1	-	2	-	-	-	1	-	1	2
Total	**14**	**10**	**13**	**8**	**17**	**-**	**6**	**-**	**6**	**-**	**6**	**8**
Average	**2.3**	**1.7**	**2.2**	**1.3**	**2.8**	**-**	**1**	**-**	**1**	**-**	**1**	**1.3**
Eq. Av Attainment	**2**	**2**	**2**	**1**	**3**	**-**	**1**	**-**	**1**	**-**	**1**	**1**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE08E09.1	3	3
UCE08E09.2	3	3
UCE08E09.3	3	3
UCE08E09.4	3	3
UCE08E09.5	3	3
UCE08E09.6	3	3
Total	**18**	**18**
Average	**3**	**3**
Equivalent Avg. Attainment	**3**	**3**

GLOBAL WARMING AND CLIMATE CHANGE
(UCE08E10)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To develop knowledge about the Greenhouse effect and their emission sources
2. To understand the cause of climate change and their control
3. To assess required level of controls for ozone layer depletion
4. To understand the effect of climate change on our surroundings
5. To understand the different approaches related to climate change.
6. To find alternatives of carbon sequestration and their role

Course Content:

Unit-1

Energy Issues and Climate Change, Alternate Energy Sources.

Green-House Effect as a Natural Phenomenon, Green House Gases (GHGs) and their Emission Sources. Quantification of CO_2 Emission, Global Warming Potential (GWP) of GHGs,

Unit -2

Modeling Climate change, Ozone layer depletion and its control.

Unit -3

Impacts of climate change – Global and India, Temperature Rise, Sea Level rise, Coastal Erosion and landslides, Coastal Flooding, Wetlands and Estuaries loss.

Unit -4

Kyoto Protocol – Importance, Significance and its role in Climate Change.

Carbon Trading - Mechanisms, Various Models (European, Indian) Global and Indian Scenario.

Cleaner Development Mechanisms – Various Projects related to CO_2Emission Reduction.

Unit -5

Alternatives of Carbon Sequestration – Conventional and non-conventional techniques. Role of Countries and Citizens in Containing Global Warming.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Atmosphere, Weather and Climate	Barry R.G., and Chorley R.L., (1992)	4th Edition, ELBS Publication.
02.	Carbon Cycle Modelling	Bolin B., (Ed.), (1981)	John Wiley and Sons Publications.
03.	Global Environmental Change	Corell R.W., and	Springler

		Anderson P.A., (Eds.), (1991)	Verlog Publishers.
04.	Global Warming: The Science and Climate Change	Francis D., (2000)	Oxford UniversityPress.
05.	Global Climate Change: Science, Impactand Responses	Frame B., Medury Y., and Joshi Y., (Eds.), (1992)	
06.	The Winds of Change: Climate, Weather and the Destruction of Civilizations	Linden E., (2006)	Simon and Schuster Publications.
07.	Confronting Climate Change, Risks, Implications andResponses	Mintzer I.M., (Ed.), (1982)	Cambridge University Press.
08.	Global Warming	Srivatsava A.K., (2007)	APH Publications.
09.	Global Climate Change and Life on Earth	Wyman R.L., (Ed.), (1991)	Chapman and Hall Publications.
10.	Global Warming: India's Response and Strategy	Yadav, Chander and Bhan, (2005)	RPH Publications

Course Outcome:

1. Students will be able to develop knowledge about the Greenhouse effect and their emission sources
2. Students will be able to understand the cause of climate change and their control
3. Students will be able to assess required level of controls for ozone layer depletion
4. Students will be able to understand the effect of climate change on our surrounding
5. Students will be able to understand the different approaches related to climate change.
6. Students will be able to find alternatives of carbon sequestration and their role

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE08E10.1	Students will be able to develop knowledge about the Greenhouse effect and their emission sources
UCE08E10.2	Students will be to understand the cause of climate change and their control
UCE08E10.3	Students will be able to assess required level of controls for ozone layer depletion
UCE08E10.4	Students will be able to understand the effect of climate change on our surrounding
UCE08E10.5	Students will be able to understand the different approaches related to climate change
UCE08E10.6	Students will be able to find alternatives of carbon sequestration and their role

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E10.1	-	-	1	-	1	-	3	1	1	3	1	3
UCE08E10.2	-	-	1	-	1	-	3	1	1	3	1	3
UCE08E10.3	-	-	1	-	1	-	3	1	1	3	1	3
UCE08E10.4	-	-	-	-	1	-	3	1	1	2	1	3
UCE08E10.5	-	-	-	-	1	-	3	1	1	3	1	2
UCE08E10.6	-	-	-	-	1	-	3	1	1	2	1	2
Total	**-**	**-**	**3**	**-**	**6**	**-**	**18**	**6**	**6**	**16**	**6**	**16**
Average	**-**	**-**	**0.5**	**-**	**1**	**-**	**3**	**1**	**1**	**2.7**	**1**	**2.7**
Eq. Av Attainment	**-**	**-**	**1**	**-**	**1**	**-**	**3**	**1**	**1**	**3**	**1**	**3**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE08E10.1	3	3
UCE08E10.2	3	3
UCE08E10.3	3	3
UCE08E10.4	3	3
UCE08E10.5	3	3
UCE08E10.6	3	3
Total	**18**	**18**
Average	**3**	**3**
Equivalent Avg. Attainment	**3**	**3**

ENVIRONMENTAL PLANNING AND MANAGEMENT
(UCE08E11)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To understand the Basic and importance of Sustainable development in any project work.
2. To study the importance of proper planning and management
3. To study the different aspect need to follow or consider before making policy.
4. To understand value of Economics in environmental management and planning
5. To understand various concepts on Budgeting, accounting and most importantly Environmental Auditing
6. To study the various rules and regulation associated with the environmental management and protection.

Course Content:

Unit-1

Environment and Sustainable Development - carrying capacity, relationship with quality of life, carrying capacity and resource utilization.

Unit -2

Engineering Methodology in Planning and its Limitations – carrying capacity based short and long term regional planning.

Unit -3

Environmental Protection - Economic development and social welfare consideration in socioeconomic developmental policies and planning.

Total cost of development and environmental protection cost. Case studies on Regional carrying capacity.

Unit -4

Engineering Economics – Value Engineering, Time Value of Money, Cash Flows, Budgeting and Accounting.

Environmental Economics: Introduction, economic tools for evaluation, Green GDP, Cleaner development mechanisms and their applications.

Unit -5

Environmental Audit – methods, procedure, reporting and case studies.

Total Quality Management in environmental management and protection – ISO 9000, 14000 and18000 series of standards.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Environmental Quality Management	Lohani B.N (1984)	South Asian Publishers, New Delhi
02.	Environmental Protection	. Chanlett, (1973)	McGraw Hill Publication, Newyork
03.	Planning and Design of Engineering Systems	Danoy G.E., and Warner R.F., (1969)	UnwinHyman Publications.
04.	Carrying Capacity Based Developmental Planning Studies forthe National Capital Region", 1995-96.	----------	MOEF, Government of India
05.	NEERI, Nagpur, Annual Reports 1995 & 1996.	----------	
06.	Environmental Sustainable Development	----------	UNEP / UNDP

Course Outcome:

1. Students will be able to understand the basic and importance of Sustainable development
2. Students will be given a broad idea on proper planning and management
3. Students will be able to understand the different aspect need to consider for making policy
4. Students will be able to understand the Economics involve in environmental management and planning.
5. Students will be able to understand concepts associated with Budgeting, accounting and Environmental Auditing
6. Students will be able to understand rules and regulation associated with the environmental management and protection.
7.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE08E11.1	To understand the Basic and importance of Sustainable development in any project work.
UCE08E11.2	To study the importance of proper planning and management.
UCE08E11.3	To study the different aspect need to follow or consider before making policy.
UCE08E11.4	To understand value of Economics in environmental management and planning
UCE08E11.5	To understand Various aspect such as Budgeting, accounting and most importantly Environmental Auditing.
UCE08E11.6	To study the various rules and regulation associated with the environmental management and protection

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E11.1	-	1	1	-	-	2	2	-	1	2	-	2
UCE08E11.2	-	1	1	-	2	1	3	1	3	2	3	1
UCE08E11.3	1	2	2	-	-	2	2	2	3	2	2	2
UCE08E11.4	2	2	1	-	2	1	2	1	1	-	3	1
UCE08E11.5	3	-	1	-	-	-	2	-	2	-	3	1
UCE08E11.6	-	-	1	-	-	1	2	2	1	-	2	1
Total	**6**	**6**	**7**	**-**	**4**	**5**	**13**	**6**	**11**	**6**	**13**	**8**
Average	**1**	**1**	**1.16**	**-**	**0.66**	**0.83**	**2.16**	**1**	**1.83**	**1**	**2.16**	**1.33**
Eq. Av Attainment	**1**	**1**	**1**	**-**	**1**	**1**	**2**	**1**	**2**	**1**	**2**	**1**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE08E11.1	2	2
UCE08E11.2	2	2
UCE08E11.3	2	2
UCE08E11.4	2	2
UCE08E11.5	3	2
UCE08E11.6	2	2
Total	**13**	**12**
Average	**2.16**	**2**
Equivalent Avg. Attainment	**2**	**2**

WATER AND WASTEWATER TREATMENT PROCESS-II (UCE08E12)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. Understand the Basic layout of process involve in wastewater Treatment
2. Understand various types of treatment option available for wastewater treatment.
3. Understand Types of Biological treatment available for wastewater Treatment
4. To study Various Advance process involve for wastewater Treatment
5. Understand the treatment method adopted in Rural places.
6. To study various methods associated with reuse of wastewater and produce value added things from wastewater.

Course Content:

Unit-1

Objectives of wastewater treatment, characteristics, flow variations, types of reactors, CSTR and PFR reactors analysis. Wastewater Treatment Flow Diagrams and Hydraulic Profile.

Theoretical principles and design - screens, equalization basin, grit chamber, primary and secondary settling tanks.

Unit -2

Kinetics of biological treatment systems – bio kinetic constants and their determination, batch and continuous systems.

Unit -3

Theoretical principles and design – suspended growth system - conventional activated sludge process and its modifications.

Unit -4

Theoretical principles and design – attached growth system – trickling filter, bio-towers and rotating biological contactors. Principles and design of stabilization ponds

Sludge Processing – separation - sludge thickeners, volume reduction, conditioning and digestion – aerobic and anaerobic.

Unit -5

Advanced Wastewater Treatment – Need and technologies used. Nitrification and DE nitrification Processes, Phosphorous removal. Wastewater disinfection.

Rural wastewater systems – septic tanks, two-pit latrines, eco-toilet, soak pits.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Biological Process Design for Waste water Treatment	Benefield R.D., and Randal C.W., (1980)	Prentice Hall, Englewood Chiffs, New Jersey.
02.	Wastewater Engineering - Treatment and Reuse4thEdition	Metcalf and Eddy Inc., (2003)	Tata McGraw Hill Publishing Co. Ltd., New Delhi.
03.	Wastewater Treatment Concepts and Design Approach	Karia G.L., and Christian R.A., (2001)	Prentice Hall of India Pvt. Ltd., New Delhi.
04.	Theory and Practice of Water and Wastewater Treatment	Ronand L., and Droste, (1997)	John Wiley and Sons Inc.
05.	Water-wastewater Engineering	Fair G.M., Geyer J.G and Okun	
06.	Handbook of Environmental Engineering Calculations	Lee C.C., and Lin S.D., (1999)	McGraw Hill, New York.
07.	Advanced Wastewater Treatment	Gaudy,(1972)	----------
08.	Industrial Safety and Pollution Control Handbook		National Safety Council And Associate (Data) Publishers Pvt. Ltd

Course Outcome:

1. Student will be able to learn & understand the Basic layout of process involve in Wastewater Treatment
2. Student will be able to learn &Understand various types of treatment option available for wastewater treatment
3. Student will be able to learn & Understand Types of Biological treatment available for wastewater Treatment
4. Student will be able to learn & understand various Advance process involve for wastewater Treatment
5. Student will be able to learn & Understand the treatment method adopted in Rural places
6. Student will able to learn various method to get value added product from waste water treatment.

To establish the correlation between COs &POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE08E12.1	Understand the Basic layout of process involve in wastewater Treatment
UCE08E12.2	Understand various types of treatment option available for wastewater treatment.
UCE08E12.3	Understand Types of Biological treatment available for wastewater Treatment
UCE08E12.4	To study Various Advance process, involve for wastewater Treatment
UCE08E12.5	Understand the treatment method adopted in Rural places.
UCE08E12.6	To study various methods associated with reuse of wastewater and produce value added things from wastewater.

Table-2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: "-"**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E12.1	2	1	3	-	1	2	1	-	1	1	-	2
UCE08E12.2	2	1	1	1	2	3	2	-	1	2	1	2
UCE08E12.3	2	2	2	-	-	2	2	-	1	1	-	2
UCE08E12.4	2	1	2	-	3	2	2	-	1	-	1	2
UCE08E12.5	1	1	2	1	1	2	2	-	-	3	1	2
UCE08E12.6	1	-	2	-	2	2	2	1	1	2	1	2
Total	10	6	12	2	9	13	11	1	5	9	4	12
Average	1.66	1	2	0.33	1.5	2.16	1.83	0.16	0.83	1.5	0.66	2
Equivalent Avg. attainment	2	1	2	-	2	2	2	-	1	2	1	2

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE08E12.1	2	2
UCE08E12.2	2	2
UCE08E12.3	2	2
UCE08E12.4	2	2
UCE08E12.5	2	2

UCE08E12.6	2	2
TOTAL	**12**	**12**
AVERAGE	**2**	**2**
Equivalent Avg. Attainment	**2**	**2**

TRAFFIC SAFETY ENGINEERING

(UCE08E13)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To obtain fundamental concepts of traffic engineering
2. To understand the nature and behaviour of different traffic lanes
3. To obtain an understanding about the parking characteristics and traffic signalling
4. To understand concepts of accident studies

Course Content:

Unit-1

Traffic studies- Volume, Speed, OD, density, parking. Traffic operation and management-Traffic congestion, circulation, planning, control devices, management improvement measures.

Unit -2

One way lane and reversible lane, Advantages and disadvantages of oneway lane and reversible lane. Speed change lane- Different type of speed change lane, Design of speed change lane, Street lighting, Level of services.

Unit -3

Parking- On street parking, parallel parking and angle parking, Offstreet parking, Advantages and disadvantages of on street and off street parking.

Unit -4

Traffic Accident Characteristics, Safety audit, Traffic control device design

Unit -5

Traffic signal- Different type of traffic signal, Design of traffic signal.

Intersection- advantages and disadvantages of different types of intersection, Design of rotary intersection.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Introduction To traffic Engg: A manual for data collection & analysis	Thomas R. Currin	Brooks
02.	Traffic Engineering and Transport Planning	Kadyali, L.R.	Khanna Publisher
03.	Traffic Engineering	Roger P Roess,Elena S Prassas	Prentice Hall.
04.	Traffic Engineering Design principle & Practice	Mike Slinn, Poter Guest Paul Matthews	Elsevier,

Course Outcome:

1. Students will be able to identify the fundamental concepts of traffic engineering
2. Students will be able to understand the need and behaviour of different traffic lanes
3. Students will be able to study the parking characteristics
4. Students will be able to analyse the accident conditions
5. Students will be able to understand the traffic signalling characteristics
6. Students will be able study the traffic intersection design and behaviours.

To establish the correlation between Cos & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE08E13.1	Students will be able to identify the fundamental concepts of traffic engineering
UCE08E13.2	Students will be able to understand the behaviour of different traffic lanes
UCE08E13.3	Students will be able to study the parking characteristics
UCE08E13.4	Students will be able to analyse the accident conditions
UCE08E13.5	Students will be able to understand the traffic signalling characteristics
UCE08E13.6	Students will be able study the traffic intersection design and behaviours.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E13.1	3	3	3	1	1	3	-	-	-	-	-	1
UCE08E13.2	3	3	3	1	1	3	-	-	-	-	-	1
UCE08E13.3	3	3	3	1	1	3	-	-	-	-	-	1
UCE08E13.4	3	3	3	2	2	3	-	-	-	-	-	1
UCE08E13.5	3	3	3	1	1	3	-	-	-	-	-	1
UCE08E13.6	3	3	3	1	2	3	-	-	-	-	-	1
Total	**18**	**18**	**18**	**7**	**8**	**18**	**-**	**-**	**-**	**-**	**-**	**6**

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE08E13.1	3	2
UCE08E13.2	3	3
UCE08E13.3	3	3
UCE08E13.4	3	2
UCE08E13.5	3	3
UCE08E13.6	3	3
TOTAL	**18**	**16**
AVERAGE	**3**	**2.67**
Equivalent Avg. Attainment	**3**	**3**

PAVEMENT ENGINEERING
(UCE08E14)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To understand the behaviour and characteristics of pavement materials
2. To understand the pavement design procedure.
3. To obtain an understanding on the type of pavements.
4. To understand the distresses associated with pavements.

Course Content:

Unit-1

Pavement Materials: Types of Pavement Materials and their evaluation, Bitumen, Tar, Cutbacks and emulsion.

Unit -2

Structural Design of Pavement: Design Factors, Equivalent single wheel load, Repetition of loads, Pavement structure- soil interaction, strength of pavement component materials,

Unit -3

Flexible Pavements: Methods of bituminous mix design, Pavement design, Layered system analysis and design.

Unit -4

Rigid Pavement: Load and temperature stress, Analysis and design, Design of joints and load transfer devices, Joints, Fillers and sealers.

Unit -5

Pavement distress, Overlay design, Pavement performance evaluation

Reference:-

Sl No.	Name of Books	Authors	Publishers
1.	Pavement Analysis and Design	Yang H. Hung,	Prentice-Hall
2	Design and Performance of Road Pavements	David Croney	McGraw Hill
3.	Guide for Design of Pavement Structures- I & II	AASHTO	AASHTO

Course Outcome:

1. Students will be able to understand the behaviour and characteristics of pavement materials
2. Students will be able to design pavement structures.
3. Students will be able to understand the loading characteristics in pavement.
4. Students will be able to study the characteristics of flexible pavement systems.
5. Students will be able to study the characteristics of rigid pavement systems.
6. Students will be able to understand the distresses associated with pavements
7. Students will be able to perform overlay designs

To establish the correlation between Cos & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE08E14.1	Students will be able to understand the behaviour and characteristics of pavement materials
UCE08E14.2	Students will be able to design pavement structures.

UCE08E14.3	Students will be able to understand the loading characteristics in pavement.
UCE08E14.4	Students will be able to study the characteristics of flexible pavement systems.
UCE08E14.5	Students will be able to study the characteristics of rigid pavement systems.
UCE08E14.6	Students will be able to understand the distresses associated with pavements
UCE08E14.7	Students will be able to perform overlay designs

Table-2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: -**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E14.1	3	3	3	2	1	1	-	-	-	-	-	1
UCE08E14.2	3	3	3	2	1	1	-	-	-	-	-	1
UCE08E14.3	3	3	3	2	1	1	-	-	-	-	-	1
UCE08E14.4	3	3	3	2	1	1	-	-	-	-	-	1
UCE08E14.5	3	3	3	2	1	1	-	-	-	-	-	1
UCE08E14.6	3	3	3	2	1	1	-	-	-	-	-	1
UCE08E14.7	3	3	3	2	1	1	1	-	-	-	-	1
Total	**21**	**21**	**21**	**14**	**7**	**7**	**1**	**-**	**-**	**-**	**-**	**7**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE08E14.1	4	3
UCE08E14.2	4	3
UCE08E14.3	3	3
UCE08E14.4	4	3
UCE08E14.5	3	3
UCE08E14.6	4	3
UCE08E14.7	3	3
Total	**25**	**21**
Average	**3.57**	**3**
Equivalent Avg. Attainment	**4**	**3**

ADVANCED AIRPORT PLANNING AND DESIGN
(UCE08E15)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To obtain the knowledge about air traffic characteristics, control and runway.
2. To obtain the idea about geometric aspects, taxiway and terminal building functions.
3. To obtain the knowledge planning of airport and design of pavement.
4. To obtain knowledge about the operations & scheduling, ground transportation facilities and airport capacity.

Course Content:

Unit-1

Aircraft characteristics; obstruction criteria; air traffic control; runways: orientation, length,

Unit -2

Geometric standards, capacity, configuration; taxiway: geometric standards, fillets, high speedexit taxiway; apron-gate area and circulation

Unit -3

Terminal building functional areas and facilities;

Unit -4

Planning and site selection; pavement design and evaluation; visual aids; drainage; heliports, noise pollution.

Unit -5

Operations and scheduling; Ground transportation facilities; Airport capacity and delays.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Planning & Design of Airports5th Edition	Robert Horenjoff	McGraw Hill Professional
02.	Airport Planning & Design	Khanna, Arora,Jain	Nem Chand Bros
03.	Airport Engineering	Rangwala	Charotar Book Publishing
04.	Airport Engineering	J. Ashford	John – Willey

Course Outcome:

1. Students will be able to know aircraft characteristics, air traffic control and runways.
2. Students will be able to understand geometric aspects, taxiway and related details.
3. Students will be able to know terminal building functional areas and facilities.
4. Student will be able to know planning of site and design of pavement.
5. Students will be able to get idea about visual aids, drainage, heliports and noise pollution.

6. Student will be able to know operation & scheduling, ground transportation facilities and airport capacity & delays.

To establish the correlation between COs & POs

Table-1

UCE08E15.1	Students will be able to know aircraft characteristics, air traffic control and runways.
UCE08E15.2	Students will be able to understand geometric aspects, taxiway and related details.
UCE08E15.3	Students will be able to know terminal building functional areas and facilities.
UCE08E15.4	Student will be able to know planning of site and design of pavement.
UCE08E15.5	Students will be able to get idea about visual aids, drainage, heliports and noise pollution.
UCE08E15.6	Student will be able to know operation & scheduling, ground transportation facilities and airport capacity & delays

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E15.1	3	2	3	2	2	3	2	1	3	3	3	3
UCE08E15.2	3	3	3	2	2	3	2	2	3	2	3	3
UCE08E15.3	3	2	3	2	2	2	2	1	3	2	3	3
UCE08E15.4	3	3	3	3	2	3	2	2	3	3	3	3
UCE08E15.5	3	2	3	2	2	2	2	1	3	2	3	2
UCE08E15.6	2	3	2	2	2	3	2	2	2	2	3	2
Total	**17**	**15**	**17**	**13**	**12**	**16**	**12**	**09**	**17**	**14**	**18**	**16**
Average	**2.83**	**2.5**	**2.83**	**2.17**	**2**	**2.67**	**2**	**1.5**	**2.83**	**2.33**	**3**	**2.67**
Eq. Av Attainment	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**3**	**3**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE08E15.1	4	3
UCE08E15.2	4	3
UCE08E15.3	4	4
UCE08E15.4	4	4
UCE08E15.5	4	4
UCE08E15.6	4	4

Total	24	22
Average	4	3.67
Equivalent Avg. Attainment	4	4

PAVEMENT MATERIALS AND CONSTRUCTION
(UCE08E16)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To obtain knowledge about construction techniques of various types of pavement and related specifications.
2. To obtain the idea about different types of pavement surface binders and their design specifications.
3. To obtain knowledge about paving concrete and design of mixes for recycling of bituminous and concrete pavement surfaces.
4. To obtain the idea about soil stabilization techniques using conventional and alternative materials.

Course Content:

Unit-1

Construction Techniques and specifications: Quality control test for highway construction, Construction equipment's and specifications for stabilized and bituminous roads, Bituminous surface treatment, Penetration macadam, Bituminous bound macadam and bituminous concrete, Mastic asphalt, sheet asphalt, Construction equipment's and specifications for cement concrete roads.

Unit-2

Penetration grade, emulsions, cut backs and modified binders. Rheology of bituminous binders, modified binders. Bituminous mix design. Marshall method and Super pave procedure;

Unit-3

Design of emulsified mixes, Visco-elastic and fatigue properties of bituminous mixtures, resilient modulus of pavement materials.

Unit-4

Requirements of paving concrete, design of mixes for recycling of bituminous and concrete pavement surfaces.

Unit-5

Soil stabilization techniques; Use of alternative material – fly ash, rice husk, geotextiles etc

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Highway construction and Maintenance	Martin	Blackwell Science
02.	Highway Material Testing	Khanna & Justo	Nem Chand Bros
03.	Standard specification for Transportation Material & Method of sampling & Testing		AASHTO,

Course Outcome:

1. Students will be able to know construction techniques of different types of pavement and their specification.
2. Students will be able to learn about different types of pavement binders and their design specifications.
3. Students will be able to know the design of emulsifies mixes, visco-elastic and fatigue properties of bituminous mixes.
4. Students will be able to get idea about requirements of paving concrete and its design features.
5. Students will be able to know about design of mixes for recycling of bituminous and concrete pavement surfaces.
6. Students will be able to get idea about soil stabilization techniques by conventional and alternative materials.

To establish the correlation between COs & POs

Table-1

UCE08E16.1	Students will be able to know construction techniques of different types of pavement and their specification
UCE08E16.2	Students will be able to learn about different types of pavement binders and their design specifications
UCE08E16.3	Students will be able to know the design of emulsifies mixes, visco-elastic and fatigue properties of bituminous mixes
UCE08E16.4	Students will be able to get idea about requirements of paving concrete and its design features
UCE08E16.5	Students will be able to know about design of mixes for recycling of bituminous and concrete pavement surfaces
UCE08E16.6	Students will be able to get idea about soil stabilization techniques by conventional and alternative materials

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E16.1	3	2	3	2	2	3	2	1	3	3	3	3
UCE08E16.2	3	2	2	2	2	3	2	1	3	2	3	3
UCE08E16.3	3	2	2	2	2	2	2	1	3	2	3	3
UCE08E16.4	3	2	3	3	2	3	2	2	3	3	3	3

UCE08E16.5	3	2	3	2	2	2	2	1	3	2	3	2
UCE08E16.6	2	3	2	2	2	3	2	2	2	2	3	2
Total	**17**	**13**	**15**	**13**	**12**	**16**	**12**	**08**	**17**	**14**	**18**	**16**
Average	**2.83**	**2.17**	**2.5**	**2.17**	**2**	**2.67**	**2**	**1.33**	**2.83**	**2.33**	**3**	**2.67**
Eq. Av Attainment	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**1**	**3**	**2**	**3**	**3**

To establish the correlation between COs & PSOs

Table-3

CO	**PSO1**	**PSO2**
UCE08E16.1	4	3
UCE08E16.2	4	3
UCE08E16.3	4	4
UCE08E16.4	4	4
UCE08E16.5	4	4
UCE08E16.6	4	4
Total	**24**	**22**
Average	**4**	**3.67**
Equivalent Avg. Attainment	**4**	**4**

DEPARTMENTAL ELECTIVE - VI

FINITE ELEMENT METHOD OF STRUCTURAL ANALYSIS

(UCE08E17)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To learn basic principles of finite element analysis procedure.
2. To learn the theory and characteristics of finite elements that represent engineering structures.
3. To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses.
4. To understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements.

Course Content:

Unit-1

Boundary Value Problem - Approximate Solution - Variation and Weighted Residual Methods - Ritz and Galerkin Formulations -Concepts of Piecewise Approximation and Finite Elements- Displacement and Shape Functions - Weak Formulation - Minimum Potential Energy- Generation of Stiffness Matrix and Load Vector.

Unit-2

Types of elements - Principles and steps in Finite Element Analysis - Generalized and natural co-ordinates - Direct stiffness approach-Analysis of 2D Trusses, beams, and Plane frames.

Unit-3

Introduction to continuum problems - CST elements for plane stress and Plane strain problems.

Unit-4

LST Elements, quadrilateral elements, brick elements, higher order elements - Numerical Integration.

Unit-5

Introduction of Plate Bending and Shell Elements.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Introduction to Finite Elements in Engg.	T.R. Chandrupatla & Ashok D. Belegundu	Prentice Hall
02.	Finite Element Method Its Basis & Fundamentals	O.C. Zienkiewicz, R.L. Taylor and J.Z. Zhu	Elsevier.
03.	Finite Elements & Approximation	O. C. Zienkiewicz and K Morgan	John Wiley & Sons.
04.	An Introduction to the Finite Element Method	J. N. Reddy	Tata McGraw-Hill.
05.	Matrix and Finite Element Analyses of Structures	M. Mukhopadhyay and A. H Sheikh	Ane Books Pvt. Ltd.
06.	The Finite Element Method-Vol	O. C. Zienkiewicz and R. L. Taylor	McGraw-Hill
07.	Finite element Analysis- Theory and programming	Krishna Murthy, C.S.	Tata McGra-Hill.
08.	Concepts and Applications of Finite Element Analysis	Cook, R.D.	John Willey & Sons

Course Outcome:

1. Students will be able to understand the concepts behind formulation methods in FEM.
2. Students will be able to identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.
3. Students will be able to develop element characteristic equation and generation of global equation.
4. Students will be Able to apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer, fluid flow, axi symmetric and dynamic problems and solve them displacements, stress and strains induced.
5. Students will be able to compute the buckling load of short and long columns with different end conditions.

To establish the correlation between Cos & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE08E17.1	Students will be able to identify the type of force, type of supports and the reactions on beams.
UCE08E17.2	Students will be able to draw shear force and bending moment diagram of a beam.
UCE08E17.3	Students will be able to identify the stress developed in beams due to bending.

UCE08E17.4	Students will be able to analyze the deflection of beams.
UCE08E17.5	Students will be able to understand on the torsion of solid circular shaft and resulting shear stress on the cross section.
UCE08E17.6	Students will be able to compute the buckling load of short and long columns with different end conditions.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E17.1	3	3	2	1	1	1	-	-	-	1	1	1
UCE08E17.2	3	3	2	1	1	1	-	-	-	1	1	1
UCE08E17.3	3	3	2	1	1	1	-	-	-	1	1	1
UCE08E17.4	3	3	2	1	1	1	-	-	-	1	1	1
UCE08E17.5	3	3	2	1	1	1	-	-	-	1	1	1
UCE08E17.6	3	3	2	1	1	1	-	-	-	1	1	1
Total	**18**	**18**	**12**	**6**	**6**	**6**	**-**	**-**	**-**	**6**	**6**	**6**
Average	**3**	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**1**
Equivalent Avg. Attainment	**3**	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**1**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE08E17.1	2	1
UCE08E17.2	2	1
UCE08E17.3	2	1
UCE08E17.4	2	1
UCE08E17.5	2	1
UCE08E17.6	2	1
Total	**12**	**6**
Average	**2**	**1**
Equivalent Avg. Attainment	**2**	**1**

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

(UCE08E18)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objectives:

1. To learn the basic fundamentals regarding earthquake seismology, seismological designs etc.
2. To learn about the procedures of earthquake resistant designs of buildings using different codal methods.

Course Content:

Unit-1

Engineering Seismology: Terminologies (Focus, Focal depth, Epicenter, etc.); Causes of Earthquakes; Theory of plate tectonics; Types and characteristics faults; Classification of Earthquakes; Major past earthquakes and their consequences; Types and characteristics of seismic waves; Magnitude and intensity of earthquakes; local site effects; Earthquake ground motion characteristics: Amplitude, frequency and duration; Seismic zoning map of India; (Problems on computation of wave velocities. Location of epicenter, Magnitude of earthquake)

Unit -2

Response Spectrum: Basics of structural dynamics; Free and forced vibration of SDOF system; Effect of frequency of input motion and Resonance; Numerical evaluation of response of SDOF system (Linear acceleration method), Earthquake Response spectrum: Definition, construction, Characteristics and application; Elastic design spectrum.

Unit -3

Seismic Performance of Buildings and Over View of IS-1893 (Part-1): Types of damages to building observed during past earthquakes; Plan irregularities; mass irregularity; stiffness irregularity; Concept of soft and weak storey; Tensional irregularity and its consequences; configuration problems; continuous load path; Architectural aspects of earthquake resistant buildings; Lateral load resistant systems. Seismic design philosophy; Structural modeling; Code based seismic design methods.

Unit -4

Determination of Design Lateral Forces: Equivalent lateral force procedure and dynamic analysis procedure. Step by step procedures for seismic analysis of RC buildings using Equivalent static lateral force method and response spectrum methods (maximum of 4 storey's and without infill walls).

Unit -5

Earthquake Resistant Analysis and Design of RC Buildings: Typical failures of RC frame structures, Ductility in Reinforced Concrete, Design of Ductile Reinforced Concrete Beams, Seismic Design of Ductile Reinforced Concrete column, Concept of weak beam-strong column, Detailing of Beam-Column Joints to enhance ductility, Detailing as per IS-13920. Retrofitting of RC buildings. Earthquake Resistant Design of Masonry Buildings: Performance of Unreinforced, Reinforced, Infill Masonry Walls, Box Action, Lintel and sill Bands, elastic properties of structural masonry, lateral load analysis, Recommendations for Improving performance of Masonry Buildings during earthquakes; Retrofitting of Masonry buildings. Introduction of Plate Bending and Shell Elements.

Reference:-

Sl No.	Name of Books	Authors	Publishers
1	Earthquake resistant design of structures	Pankaj Agarwal and Manish Shrikande	PHI India.
2	Earthquake Resistant Design of Structures	S.K. Duggal	Oxford University Press
3	Dynamics of Structures: Theory and Applications to Earthquake Engineering	Anil K. Chopra	Pearson Education, Inc.
4	Seismic Analysis of Structures	T. K. Datta	John Wiley & Sons (Asia) Ltd.
5	Earthquake resistant design and risk reduction	David Dowrick	John Wiley and Sons Ltd.
6	Some Concepts in Earthquake	C. V. R. Murty, Rupen Goswami, A. R. Vijayanarayanan & Vipul V. Mehta	----------
7	IS-13920 – 2016, Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces, BIS, New Delhi	----------	----------
8	IS-1893 – 2016, Indian Standard Criteria for Earthquake Resistant Design of Structures, Part-1, BIS, New Delhi	----------	----------
9	IS- 4326 – 2013, Earthquake Resistant Design and Construction of Buildings, BIS, New Delhi.	----------	----------
10	IS-13828 – 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength MasonryBuildings, BIS, New Delhi.	----------	----------
11	IS-3935 – 1993, Repair and Seismic Strengthening of Buildings-Guidelines, BIS, New Delhi.	----------	----------

Course Outcome:

1. Students will be able to know about earthquake, terms related to it, significance, effects etc.
2. Students will be able to understand Response spectrum, its Definition, construction, effects, Characteristics and application.
3. Students will be able to understand Seismic Performance of Buildings and Over View of IS-1893 (Part-1).
4. Students will be able to Determine Design Lateral Forces of RC buildings using different methods.
5. Students will be able to understand Earthquake Resistant Analysis and Design of RC Buildings.

To establish the correlation between Cos & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE08E18.1	Students will be able to know about earthquake, terms related to it, significance, effects etc.
UCE08E18.2	Students will be able to understand Response spectrum, its Definition, construction, effects, Characteristics and application.
UCE08E18.3	Students will be able to understand Seismic Performance of Buildings and Over View of IS-1893 (Part-1).
UCE08E18.4	Students will be able to Determine Design Lateral Forces of RC buildings using different methods.
UCE08E18.5	Students will be able to understand Earthquake Resistant Analysis and Design of RC Buildings.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E18.1	3	3	2	1	1	-	-	-	-	-	-	1
UCE08E18.2	3	3	2	1	1	-	-	-	-	-	-	1
UCE08E18.3	3	3	2	1	1	-	-	-	-	-	-	1
UCE08E18.4	3	3	2	1	1	1	-	-	-	-	-	1
UCE08E18.5	3	3	2	1	1	-	-	-	-	-	-	1
Total	**15**	**15**	**10**	**5**	**5**	**1**	**-**	**-**	**-**	**-**	**-**	**5**
Average	**3**	**3**	**2**	**1**	**1**	**0.17**	**-**	**-**	**-**	**-**	**-**	**1**
Equivalent Avg. Attainment	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE08E18.1	3	2
UCE08E18.2	3	3
UCE08E18.3	3	3
UCE08E18.4	3	2
UCE08E18.5	3	3
Total	**15**	**13**
Average	**3**	**2.6**
Equivalent Avg. Attainment	**3**	**3**

BRIDGE ENGINEERING
(UCE08E19)

Total Credit: 03Contact Periods: 03 (2L+1T+0P)

Course Objective:

1. Students will be able to learn the basic components of bridge engineering.
2. Students will be able to understand the standard guidelines for bridges.
3. Students will be able to design various components of bridges.
4. Students will be able to learn basic concepts of plate bending and shell elements.

Course Content:

Unit-1

Introduction– classification and components of bridges–layout and planning–Structural forms of bridge decks– grillage analysis of slab decks, beam and slab decks, cellular decks.

Unit -2

Standard specifications for bridges– IRC loadings for road bridges–standards for railway bridges–design of RC slab, skew slab and box culverts. Design of T-beam bridges–balanced cantilever bridges–rigid frame bridges–Arch bridges–bow string girder bridges.

Unit -3

Designofplategirderbridges–steeltrussedbridges–Introductiontolongspanbridges:

Cable stayed bridges and suspension bridges –instability.

Unit -4

Force onpiersandabutments–Designofpiersandabutments–typesofwingwalls–types of bearings – design of bearings.

Unit -5

Introduction of Plate Bending and Shell Elements.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Bridge deck behaviour,	E.C. Hambly	Chapman and Hall, London
02.	Bridge deck analysis	E.J. O'Brien and D.L. Keogh	E& FN Spon, New York
03.	Essentials of bridge engineering	D.JohnsonVictor	Oxford & IBH publishing Co. Ltd., New Delhi.
04.	Design of bridges	N.KrishnaRaju	Oxford & IBH publishing Co.Ltd., New Delhi.
05.	Bridge Engineering.	S. Ponnuswamy.	Tata McGraw Hill
06.	Concrete Bridges: Inspection, repair, Strengthening, testing and load capacity evaluation	Raina.	Tata McGraw Hill
07.	Concrete Bridge Practice: Analysis, design and economics	Raina.	Tata McGraw Hill
08.	Essentials of bridge engineering	D.Johnson Victor	Oxford & IBH
09.	Design of bridges	N.Krishna Raju	Oxford & IBH

Course Outcome:

1. Students will be able to learn the basic components of bridge engineering.
2. Students will be able to understand the standard guidelines for bridges.
3. Students will be able to design various components of bridges.
4. Students will be able to design piers and abutments.
5. Students will be able to learn basic concepts of plate bending and shell elements.

To establish the correlation between Cos & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE08E19.1	Students will be able to learn the basic components of bridge engineering.
UCE08E19.2	Students will be able to understand the standard guidelines for bridges.
UCE08E19.3	Students will be able to design various components of bridges.
UCE08E19.4	Students will be able to design piers and abutments.
UCE08E19.5	Students will be able to learn basic concepts of plate bending and shell elements.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E19.1	3	2	3	2	1	-	-	-	-	-	-	1
UCE08E19.2	3	3	2	2	1	-	-	-	-	-	-	1
UCE08E19.3	3	3	2	2	1	-	-	-	-	-	-	1
UCE08E19.4	3	2	3	2	1	-	-	-	-	-	-	2
UCE08E19.5	3	3	2	2	1	-	-	-	-	-	-	1
Total	**15**	**13**	**12**	**10**	**5**	**-**	**-**	**-**	**-**	**-**	**-**	**6**
Average	**3**	**2.6**	**2.4**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1.2**
Equivalent Avg. Attainment	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE08E19.1	3	3
UCE08E19.2	3	3
UCE08E19.3	3	3
UCE08E19.4	2	2
UCE08E19.5	3	2
Total	**14**	**13**
Average	**2.8**	**2.6**
Equivalent Avg. Attainment	**3**	**3**

GEOMETRIC DESIGN OF TRANSPORTATION FACILITIES (UCE08E20)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Courses Objective:

1. To obtain the knowledge about highway functional aspects and different characteristics.
2. To understand the concept of different geometrical design elements and their functions along with different roads with different terrains.
3. To obtain the idea about different types of intersections, bicycle track and parking lots
4. To obtain knowledge about terminals and their different design aspects.

Course Content:

Unit-1

Highway functional classification; route layout and selection; design controls and criteria: vehicular characteristics, turning paths; driver performance;

Unit -2

Traffic characteristics; highway capacity; access control; safety.

Unit -3

Elements of design: sight distances, horizontal alignment, transition curves, superelevation and side friction; vertical alignment: grades crest and sag curves; highway cross-sectional elements and their design.

Unit -4

Hill road; Intersections -- at-grade intersections, sight distance consideration and principles of design, channelization, speed change lanes;

Unit -5

Roundabout, mini roundabouts, design of roundabout; Inter-changes, types of interchanges, entrance and exit ramps, ramp metering; Bicycle and pedestrian facility design; Parking layout and design; Terminal layout and design.

Reference:-

Sl No.	Name of Books	Authors	Publishers
1.	Highway Engineering	Khanna & Justo	Nem Chand Bros
2.	Highway Engineering, Rogers	Martin	Blackwell Publisher
3.	Principles of Transportation, and Highway Engineering	Rao, G.V	Tata McGraw Hill

Course Outcome:

1. Students will be able to know the highway functional classification and vehicular characteristics.
2. Students will be able to understand traffic characteristics, highway capacity and different controls and safety.
3. Students will learn different geometrical design elements along with different types of road with different terrain conditions.
4. Students will get idea about different types of intersection and their design principles.
5. Students will be able to know about maneuverability concept like ramp and design aspects of bicycle & pedestrian facility.
6. Students will be able to understand the layout and design aspects of parking lots and terminals.

To establish the correlation between COs & POs

Table-1

UCE08E20.1	Students will be able to know the highway functional classification and vehicular characteristics.
UCE08E20.2	Students will be able to understand traffic characteristics, highway capacity and different controls and safety.
UCE08E20.3	Students will learn different geometrical design elements along

	with different types of road with different terrain conditions.
UCE08E20.4	Students will get idea about different types of intersection and their design principles.
UCE08E20.5	Students will be able to know about maneuverability concept like ramp and design aspects of bicycle & pedestrian facility.
UCE08E20.6	Students will be able to understand the layout and design aspects of parking lots and terminals.

To establish the correlation between COs & POs

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	PO12
UCE08E20.1	3	3	2	2	1	2	2	2	2	1	1	2
UCE08E20.2	3	3	3	2	2	2	2	2	2	2	2	2
UCE08E20.3	3	3	3	2	1	2	1	1	2	2	2	2
UCE08E20.4	3	3	3	2	2	2	1	2	2	2	2	2
UCE08E20.5	3	3	2	2	2	2	1	2	2	1	2	2
UCE08E20.6	3	3	3	2	2	2	2	2	2	2	2	2
Total	**18**	**18**	**14**	**10**	**10**	**12**	**9**	**11**	**12**	**10**	**11**	**12**
Average	**3**	**3**	**2.33**	**1.67**	**1.67**	**2**	**1.5**	**1.83**	**2**	**1.67**	**1.83**	**2**
Equivalent Avg. Attainment	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE08E20.1	3	2
UCE08E20.2	3	2
UCE08E20.3	3	3
UCE08E20.4	3	2
UCE08E20.5	3	2
UCE08E20.6	3	3
Total	**18**	**14**
Average	**3**	**2.33**
Equivalent Avg. Attainment	**3**	**2**

FOUNDATION IN PROBLEMATIC SOIL, UNDERGROUND CONSTRUCTION AND RETAINING STRUCTURE

(UCE08E21)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To learn about the characteristics of expansive and collapsible soil and selection of appropriate type of foundation.
2. To acquire fundamental knowledge about analysis of well foundation for bearing capacity and lateral stability.
3. To learn about the braced excavation and analysis and design of retaining wall under seismic loading condition.

Course Content:

Unit-1

Foundations on expansive and collapsible soil; under- reamed pile, uplift resistance of piles.

Unit -2

Well foundation and its elements; size and depth; forces on well foundation; methods of sinking; scour depth; analysis of well foundation for bearing capacity and lateral stability.

Unit -3

Braced excavation: types of bracing system; stability considerations, heave and uplift computation of earth pressure and strut load. Ground movement. Construction control, Shield Tunneling.

Unit -4

Analysis and design of retaining wall under seismic loading condition.

Unit -5

Check for stability of retaining wall under seismic loading condition, Pseudo-static and pseudo-dynamic method, tsunami.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Shallow Foundations: Bearing Capacity and Settlement	Braja.M. Das	McGraw-Hill Publishing Company
02	Foundation Engineering	Peck, Hanson,. (1^{st}and2^{nd}Edition)	Thomas.H. Thornburn
03.	Foundation Analysis and Design	Bowles, J.	McGraw-Hill Publishing Company
04.	Analysis and Design of Foundations and Retaining Structures	Shamsher Prakash	Sarita Prakashan, 1979

Course Outcome:

1. Students will be able to learn about the characteristics of expansive and collapsible soil and selection of appropriate type of foundation.
2. Students will be able to determine the size and depth of well foundation and forces acting on well foundation.
3. Students will be able to check the stability of well foundation.
4. Students will be able to become skilled at braced excavation.
5. Students will be able to learn about the analysis and design of retaining wall under seismic loading condition.
6. Students will be able to check the stability of retaining structure under Pseudo-static and pseudo-dynamic and during tsunami.

To establish the correlation between COs & POs
Table-1

No. of Course Outcome (CO)	Course Outcome
UCE08E21.1	Students will be able to learn about the characteristics of expansive and collapsible soil and selection of appropriate type of foundation.
UCE08E21.2	Students will be able to determine the size and depth of well foundation and forces acting on well foundation.
UCE08E21.3	Students will be able to check the stability of well foundation.
UCE08E21.4	Students will be able to become skilled at braced excavation.
UCE08E21.5	Students will be able to learn about the analysis and design of retaining wall under seismic loading condition.
UCE08E21.6	Students will be able to check the stability of retaining structure under Pseudo-static and pseudo-dynamic and during tsunami.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E21.1	3	3	2	2	2	2	2	2	2	1	2	2
UCE08E21.2	3	2	3	2	2	2	2	2	2	2	2	2
UCE08E21.3	3	3	2	2	2	2	2	2	2	2	2	2
UCE08E21.4	2	3	2	2	2	2	2	2	2	2	2	2
UCE08E21.5	3	3	3	3	3	2	2	2	2	2	2	2
UCE08E21.6	3	3	3	3	3	2	2	2	2	2	2	2
Total	**17**	**17**	**15**	**14**	**14**	**12**	**12**	**12**	**12**	**11**	**12**	**12**
Average	**2.83**	**2.83**	**2.5**	**2.33**	**2.33**	**2**	**2**	**2**	**2**	**1.83**	**2**	**2**
Equivalent Avg. Attainment	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE08E21.1	3	2
UCE08E21.2	3	2
UCE08E21.3	3	2
UCE08E21.4	3	2
UCE08E21.5	3	2
UCE08E21.6	3	2
Total	**18**	**12**
Average	**3**	**2**
Equivalent Avg. Attainment	**3**	**2**

APPLIED GEOMECHANICS

(UCE08E22)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To understand the basic concept of stress path and its representation in various spaces, and its simulation to practical problems
2. To understand the concept of stress distribution under earth embankments and evaluation of settlement profile
3. To understand the concept of Landslides and their classification
4. To understand the concept of Stability analysis of natural slopes
5. To understand the concept of Deep excavations, dewatering operations
6. To understand the concept of Seepage control through the dam body and foundation
7. To understand the concept of Instrumentation field problems to monitor movement of slopes, foundations, etc.

Course Content:

Unit-1

Role of soil testing in Geotechnical engineering. Basic concept of stress path and its representation in various spaces, and its simulation to practical problems. Analysis of soil behaviour, Kondners hyperbolic stress-strain response and its application. Parabolic stress- strain formulation.

Unit -2

Evaluation of various elastic constants for practical use. Stability of embankments on clayey soils. Design of berms. Stage construction. Design of sand-drain system. Stress distribution under earth embankments and evaluation of settlement profile. Landslide sand their classification.

Unit -3

Stability analysis of natural slopes. Different stability analysis models. Culman, friction circle, Swedish, modified Bishop and limit state analysis of slopes. Earthquake loading considerations. Use of design charts in practice.

Unit -4

Deep excavations, dewatering operations, drainage, methods of stabilizing slopes. Erosion, design of filter, rock toe.

Unit -5

Seepage control through the dam body and foundation; Curtain walls, Relief wells and sudden draw down condition. Instrumentation field problems to monitor movement of slopes, foundations, etc.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Design of Foundation Systems – Principles and Practices	Kurian, N. P	New Delhi, Narosa publishing House, 2nd Edn., 1994.
02.	Modern Foundations – Introduction to Advanced Techniques	Kurian, N. P	New Delhi, Tata McGraw-Hill Publishing Company Limited, 1984.
03.	Earth Pressure and Earth Retaining Structures	Clayton,C.R.I.,Militit sky,J. and Woods,R.I.	Blackie Academic & Professional, 1993.
04.	Theoretical Soil Mechanics	Terzaghi, K.	Wiley, 1965.
05.	Soil Mechanics in Engineering Practice	Terzaghi, Kand Peck,R.B	AsiaPublishing House, 1960.
06.	Foundation Design, Prentice	Teng, W. C	Hall of India Pvt. Ltd., 1965.
07.	Analysis and Design of Foundations	Bowles, J. W.	McGraw-Hill, 4th Ed., 1988.
08.	Soil Engineering	Spangler, M. G and Handy, R. L	Harper & Row, 1982.

Course Outcome:

1. Students will be able to understand the basic concept of stress path and its representation in various spaces, and its simulation to practical problems
2. Students will be able to understand the concept of stress distribution under earth embankments and evaluation of settlement profile
3. Students will be able to understand the concept of Landslides and their classification
4. Students will be able to understand the concept of Stability analysis of natural slopes
5. Students will be able to understand the concept of Deep excavations, dewatering operations
6. Students will be able to understand the concept of Seepage control through the dam body and foundation

7. Students will be able to understand the concept of Instrumentation field problems to monitor movement of slopes, foundations, etc.

To establish the correlation between COs &POs
Table-1

No. of Course Outcome (CO)	Course Outcome
UCE08E22.1	Students will be able to understand the basic concept of stress path and its representation in various spaces, and its simulation to practical problems
UCE08E22.2	Students will be able to understand the concept of stress distribution under earth embankments and evaluation of settlement profile
UCE08E22.3	Students will be able to understand the concept of Landslides and their classification
UCE08E22.4	Students will be able to understand the concept of Stability analysis of natural slopes
UCE08E22.5	Students will be able to understand the concept of Deep excavations, dewatering operations
UCE08E22.6	Students will be able to understand the concept of Seepage control through the dam body and foundation
UCE08E22.7	Students will be able to understand the concept of Instrumentation field problems to monitor movement of slopes, foundations, etc.

Table-2

Slight (Low): 1 **Moderate: 2** **Substantial (High): 3** **No Correlation: 0**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E22.1	3	3	2	1	1	3	2	1	1	1	0	3
UCE08E22.2	3	3	2	1	1	3	2	1	1	1	0	3
UCE08E22.3	3	3	2	1	1	3	2	1	1	1	0	3
UCE08E22.4	3	3	2	1	1	3	2	1	1	1	0	3
UCE08E22.5	3	3	2	1	1	3	2	1	1	1	0	3
UCE08E22.6	3	3	2	1	1	3	2	1	1	1	0	3
UCE08E22.7	3	3	2	1	1	3	2	1	1	1	0	3
Total	**21**	**21**	**14**	**7**	**7**	**21**	**14**	**7**	**7**	**7**	0	**21**
Average	**3**	**3**	**2**	**1**	**1**	**3**	**2**	**1**	**1**	**1**	0	**3**
Equivalent Avg. attainment	**3**	**3**	**2**	**1**	**1**	**3**	**2**	**1**	**1**	**1**	0	**3**

To establish the correlation between COs &PSOs
Table-3

CO	PSO1	PSO2
UCE08E22.1	4	3
UCE08E22.2	3	3
UCE08E22.3	4	3
UCE08E22.4	4	3
UCE08E22.5	3	3
UCE08E22.6	4	4
UCE08E22.7		
Total	**22**	**19**
Average	**3.67**	**3.17**
Equivalent Avg. Attainment	**4**	**3**

ENVIRONMENTAL QUALITY & POLLUTION MONITORING TECHNIQUES

(UCE08E23)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To make the students conversant with ecology and environment.
2. To understand the importance of human environment relationship.
3. To understand the Environmental policies and Legislation.
4. To understand the nature Causes of Environmental Problems.
5. To understand the concept of Environmental Impact Assessment.
6. To understand the concept of Sustainable Development.

Course Content:

Unit-1

General: Introduction and scope. Ecology and Environment. Recap of Environment: Pollution and control basic principles of management. Environmental quality a Solid waste management.

Unit -2

Environmental policies and Legislation: Rule, act, code, standards, criteria, specification.

Unit -3

Causes of Environmental Problems: Nature and scope of environmental problems, population and economic growth, energy growth, human environmental disturbances.

Unit -4

Environmental Samples collection and Analysis Fate of Pollutants in the Environment and pollution control Strategies: Dispersion and diffusion of pollutants in air and water, ground water pollution, leachate and gas movement in landfills, Propagation of noise, various pollution control devices/measures.

Unit -5

Hazardous Waste and Risk Analysis. Environmental Impact Assessment. Sustainable Development.

References:-

Sl No.	Name of Books	Author	Publisher
01.	Introduction to Environmental Engineering and Scince	Masters, G.M.,Peavy, H.S.,Rowe,	Prentice Hall of India Pvt. Ltd
02.	Environmental Engineering	D.R and Tchobanoglous, G	McGraw Hill company

Course Outcome:

1. Students will be able to know about ecology and environment.
2. Students will be able to understand the importance of human environment relationship.
3. Students will be able to understand the Environmental policies and Legislation.
4. Students will be able to understand the nature Causes of Environmental Problems.
5. Students will be able to understand the concept of Environmental Impact Assessment.
6. Students will be able to understand the concept of Sustainable Development.

To establish the correlation between COs &POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE08E23.1	Students will be able to analyze characteristics of water.
UCE08E23.2	Students will be able to forecast the population and estimate water demand.
UCE08E23.3	Students will be able to design various water treatment units.

UCE08E23.4	Students will be able to design the distribution network.
UCE08E23.5	Students will be able to analyze characteristics of air.
UCE08E23.6	Students will be able to design air pollution controlling devices.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: "-"

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
UCE08E23.1	2	2	1	1	-	1	2	-	2	-	-	1
UCE08E23.2	2	2	1	1	-	1	2	-	2	-	-	1
UCE08E23.3	2	2	3	3	-	1	2	-	2	-	-	2
UCE08E23.4	2	2	3	3	-	1	2	-	2	-	-	2
UCE08E23.5	2	2	1	1	-	1	2	-	2	-	-	1
UCE08E23.6	2	2	3	3	-	1	2	-	2	-	-	2
Total	**12**	**12**	**12**	**12**	**-**	**6**	**12**	**-**	**12**	**-**	**-**	**9**
Average	**2**	**2**	**2**	**2**	**-**	**1**	**2**	**-**	**2**	**-**	**-**	**1.5**
Equivalent Avg. Attainment	**2**	**2**	**2**	**2**	**-**	**1**	**2**	**-**	**2**	**-**	**-**	**2**

To establish the correlation between COs &PSOs

Table-3

CO	PSO1	PSO2
UCE08E23.1	3	3
UCE08E23.2	3	3
UCE08E23.3	3	3
UCE08E23.4	4	2
UCE08E23.5	2	3
UCE08E23.6	3	3
Total	**18**	**17**
Average	**3**	**2.83**
Equivalent Avg. Attainment	**3**	**3**

RURAL WATER SUPPLY AND SANITATION

(UCE08E24)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objective:

1. To understand the basic and scope of environmental sanitation in rural areas with existing policy.
2. To study the sources of water supply in rural areas and significance of water quality parameters.

3. To study the parameters for designing water supply schemes according to population demand.
4. To understand the treatment units of rural water supply system.
5. To study the various methods of collection and disposal of wastes in rural sanitary system.
6. To study the fundamental principle and their use in rural areas as sustainable waste management.

Course Content:

Unit-1

General: Concept and scope of Environmental sanitation in rural areas, magnitude and problems of water supply and sanitation in rural areas in India, National Policy.

Unit-2

Water Supply: Quality aspects: specific impurities ad their significance, Design population, Demand and variations, Planning of water supply schemes in rural areas: individual village and group schemes, Sources of water supply: springs, wells, infiltration wells, radial wells, infiltration galleries and surface water intake.

Unit-3

Treatment of water for rural water supply, compact system: multi bottom settler, slow sand filter, diatomaceous earth filter, cloth filter, chlorine diffusion cartridges, pumps, pipe, materials, appurtenances and improvised device for use in rural water supply schemes, Distribution systems for rural water supply.

Unit-4

Disposal of Night soil and wastewater: Various methods of collection and disposal of night soil: Sanitary latrines, community latrines, septic tanks, soakage system, anaerobic filter, Imhoff tank, Compact and simple wastewater treatment units: Stabilization ponds, revolving biological surface.

Unit-5

Biogas Plants: Quantity of cow dung, Required capacity and design. Disposal of Solid Wastes: Composting, land filling, Incineration.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Water supply for Rural areas and small communities	Wagner, E.G and Lanoix, J.N	WHO Monograph series No. 42,1959
02.	Rural Water Supply and Sanitation	Wright, F.B.,	--
03.	Excreta Disposal for Rural Areas and Small Communities"	Wagner, E.G.,	WHO Monograph, and Lanoix, J.N W

Course Outcome:

1. To understand the basic and scope of environmental sanitation in rural areas with existing policy.
2. To study the sources of water supply in rural areas and significance of water quality parameters.
3. To study the parameters for designing water supply schemes according to population demand.
4. To understand the treatment units of rural water supply system.
5. To study the various methods of collection and disposal of wastes in rural sanitary system.
6. To study the fundamental principle and their use in rural areas as sustainable waste management.

To establish the correlation between COs & POs

Table-1

No. of Course Outcome (CO)	Course Outcome
UCE08E24.1	Students will be able to understand the basic and scope of environmental sanitation in rural areas with existing policy.
UCE08E24.2	Students will be able to know the sources of water supply in rural areas and significance of water quality parameters.
UCE08E24.3	Students will be able to know the parameters for designing water supply schemes according to population demand.
UCE08E24.4	Students will be able to understand the treatment units of rural water supply system.
UCE08E24.5	Students will be able aware about the various methods of collection and disposal of wastes in rural sanitary system.
UCE08E24.6	Students will be able to know about the fundamental principle and their use in rural areas as sustainable waste management

Table-2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and '-' for NO CORELATION

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E24.1	4	3	2	-	-	4	3	-	-	2	-	-
UCE08E24.2	2	4	-	3	-	2	3	-	-	-	-	-
UCE08E24.3	4	2	4	3	-	2	2	3	3	3	-	-
UCE08E24.4	3	3	4	4	3	-	-	-	-	2	-	-
UCE08E24.5	-	3	4	3	4	3	2	-	-	2	-	-
UCE08E24.6	3	4	4	4	4	3	4	3	3	-	-	-
Total	**16**	**19**	**18**	**16**	**11**	**14**	**14**	**6**	**6**	**9**	**-**	**-**
Average	**2.7**	**3.2**	**3**	**2.7**	**1.8**	**2.3**	**2.3**	**1**	**1**	**1.5**	**-**	**-**

Eq. Av Attainment	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**-**	**-**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE08E24.1	3	3
UCE08E24.2	4	3
UCE08E24.3	4	3
UCE08E24.4	4	3
UCE08E24.5	3	3
UCE08E24.6	4	3
Total	**22**	**18**
Average	**3.7**	**3**
Equivalent Avg. Attainment	**4**	**3**

COMPUTATIONAL METHODS IN HYDROLOGY
(UCE08E25)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objectives:

1. To learn the basic hydrological measurement techniques – measurement of rainfall and Rain fall intensities, abstraction losses like evaporation, infiltration etc.
2. Application of numerical techniques for measurements in steady and transient flow problems.

Course Contents:

Unit-1

Introduction, Hydro meteorological measurements,

Unit -2

Hydrological models, catchment simulation.

Unit -3

Continuity, momentum and energy equations, differential equations in hydrology.

Unit -4

Finite difference technique, Finite element method, Galerkin method, steady and transient problems.

Unit -5

Model application, flow routing, wave motion, unsaturated /saturated ground water flow.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Hand Book of Hydrology	Maidment, D.	McGraw Hill, 1st edition, 1993.
02.	Computational methods in subsurface flow	Huyakorn and Pinder	Academic Press, New York, 1983.
03.	Finite elements and approximation	Zienkiewiz O.C. and Morgan, K.	John Wiley,2006

Course Outcomes:

1. To learn the basic hydro-meteorological measurement techniques.
2. To understand and simulate various processes involved in rainfall runoff models.
3. To understand and apply continuity, momentum and energy equations, differential equations in hydrology.
4. Able to apply various numerical techniques like finite difference technique, finite element method in steady and transient flow problems.
5. Study of various flow routing problem and wave motion.
6. To familiarize the students about various water resources modelling software for surface and ground water flow problems.

To establish the correlation between Cos & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE08E25.1	To learn the basic hydro-meteorological measurement techniques.
UCE08E25.2	To understand and simulate various processes involved in rainfall runoff models.
UCE08E25.3	To understand and apply continuity, momentum and energy equations, differential equations in hydrology.
UCE08E25.4	Able to apply various numerical techniques like finite difference technique, finite element method in steady and transient flow problems.
UCE08E25.5	Study of various flow routing problem and wave motion.
UCE08E25.6	To familiarize the students about various water resources modelling software for surface and ground water flow problems.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E25.1	3	3	1	2	2	-	-	-	-	-	-	2

UCE08E25.2	3	3	3	3	2	-	-	-	-	-	-	2
UCE08E25.3	3	3	2	1	1	-	-	-	-	-	-	2
UCE08E25.4	2	2	3	2	1	-	-	-	-	-	-	1
UCE08E25.5	2	2	1	1	2	-	-	-	-	-	-	1
UCE08E25.6	3	2	2	2	3	1	-	-	-	-	-	2
Total	**16**	**15**	**12**	**11**	**11**	**1**	**-**	**-**	**-**	**-**	**-**	**10**
Average	**2.67**	**2.50**	**2.00**	**1.83**	**1.83**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.67**
Equivalent Avg. Attainment	**3**	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE08E25.1	2	2
UCE08E25.2	3	3
UCE08E25.3	2	2
UCE08E25.4	3	2
UCE08E25.5	2	2
UCE08E25.6	3	2
Total	**15**	**13**
Average	**2.5**	**2.17**
Equivalent Avg. Attainment	**3**	**2**

WATERSHED MANAGEMENT
(UCE08E26)

Total Credit: 03 **Contact Periods: 03 (2L+1T+0P)**

Course Objectives:

1. To learn basic concepts of conservation of water and management in watersheds.
2. To understand the analysis of hydrological time series and forecasting.
3. To know the introduction to soil and water conservation practices.
4. To have knowledge on water harvesting and conservation structures.

Course Contents:

Unit-1

Introduction: Water and life, Management and conservation of water, Climate data, Soil erosion and sedimentation, Conservation of soil, System and conceptual models of runoff hydrograph, System models. Conceptual models of unit hydrograph, Conceptual models and Dynamic models.

Unit -2

Time Series Analysis: Determination of trend and periodic components, Analysis of stochastic components Stationary and non-stationary series, Synthetic data generation and short term forecasting.

Unit -3

Soil erosion and its control: Types of soil erosion wind erosion, Water erosion. Estimation of soil erosion, Soil loss models, Sediment yield models. Sediment graph, Bed-load models, controlling soil erosion due to wind and water soil conservation practices, Vegetative and mechanical practices, Erosion control in torrents and gullies.

Unit -4

Water harvesting: Storage structures. Yield from catchment, Diversion of runoff, Ponds and reservoirs, Earth embankments.

Unit -5

Watershed: Watershed programs. Mass soil movement, Afforestation, Streams. Management of saline and alkaline soils, Grassland management, Watershed water sources, Conservation of water, Augmentation of water resource, Methods of artificial recharge.

Reference:-

Sl No.	Name of Books	Authors	Publishers
01.	Handbook of Applied Hydrology	Chow. V.T	Mc Graw-Hill New York
02	Soil Erossion in the Tropics	Rattan Lal.	Mc Graw-Hill New York.
03.	Soil Conservation and Land Management	Dutta. SK.	International Book Distributors, Dehradun. Blaisdell, F.W. and A.F. Moratz
04.	Land and Water Management Engineering	Whiny, V.V. N.	Kalyani Publishers, New Delhi.
05.	Hydrology and Soil Conservation Engineering.	Glianshyant -Das.	Prentice Hall of India. New Delhi.

Course Outcomes:

1. To learn the basic concepts of management and conservation of water, models of rainfall runoff mechanism.
2. To have knowledge of analysis of time series for hydrological forecasting.
3. To study soil erosion in watersheds and sedimentation control.
4. To have knowledge of various water harvesting and storage structures for watershed management.
5. To get understanding of saline and alkaline soils and sediment management.
6. To understand water conservation measures and methods of artificial recharge.

To establish the correlation between COs & POs

Table-1

No of course outcome (CO)	Course Outcome
UCE08E26.1	To learn the basic concepts of management and conservation of water, models of rainfall runoff mechanism.
UCE08E26.2	To have knowledge of analysis of time series for hydrological forecasting.
UCE08E26.3	To study soil erosion in watersheds and sedimentation control.
UCE08E26.4	To have knowledge of various water harvesting and storage structures for watershed management.
UCE08E26.5	To get understanding of saline and alkaline soils and sediment management.
UCE08E26.6	To understand water conservation measures and methods of artificial recharge.

Table-2

Slight (Low): 1 Moderate: 2 Substantial (High): 3 No Correlation: -

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
UCE08E26.1	2	2	2	2	2	-	-	-	-	-	-	1
UCE08E26.2	3	3	3	3	2	-	-	-	-	-	-	2
UCE08E26.3	2	2	2	1	1	-	-	-	-	-	-	2
UCE08E26.4	2	2	3	2	1	-	-	-	-	-	-	2
UCE08E26.5	2	2	1	1	2	-	-	-	-	-	-	1
UCE08E26.6	3	2	2	2	3	1	-	-	-	-	-	2
Total	**14**	**13**	**13**	**11**	**11**	**1**	**-**	**-**	**-**	**-**	**-**	**10**
Average	**2.33**	**2.17**	**2.17**	**1.83**	**1.83**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.67**
Equivalent Avg. Attainment	**2**	**2**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**

To establish the correlation between Cos & PSOs

Table-3

CO	PSO1	PSO2
UCE08E26.1	3	2
UCE08E26.2	2	3
UCE08E26.3	2	2
UCE08E26.4	3	3
UCE08E26.5	2	2
UCE08E26.6	3	2
Total	15	14
Average	2.5	2.33
Equivalent Avg. Attainment	3	2

PROJECT: II
(UCE08P01)

Total Credit: 03 **Contact Periods: 6 (0L+0T+6P)**

The Project-II/Thesis work will involve in-depth study/review/evaluation/assessment/ analysis/design/experimental investigation/software development related to civil engineering problems of interest. The findings and results are to be presented appropriately in the form of reports/photographic records/drawings/computer printout and presentation in seminar will be encouraged.

COMPREHENSIVE VIVA-VOCE
(UCE08P02)

Total Credit: 01 **Contact Periods: 0 (0L+0T+0P)**

It is for assessing the candidates overall performances in subject matters related to civil Engineering and their ability.