Four-Year Undergraduate Programme

Bachelor of Technology

Civil Engineering

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

Faculty of Engineering & Technology
Bachelor of Technology in Civil Engineering

1. Vision of the Department

To be recognized as a leading department known for excellence in civil engineering education, research, and innovation, dedicated to shaping resilient, sustainable, and inclusive infrastructure systems for a rapidly evolving world.

2. Mission of the Department

M1: To provide quality education and technical skills in the field of Civil Engineering and allied areas.

M2: To promote innovation and research through active collaboration with industry and continuous engagement with emerging technologies for real-world problem solving.

M3: To provide students with an environment of excellence, entrepreneurship, leadership, and ethics with a focus on common societal problems for a productive career.

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the B. Tech Civil Engineering curriculum enables graduates to attain.

PEO 1	To provide a strong foundation in civil engineering and the skills required to meet the professional challenges of ever-changing technology.
PEO 2	To promote analytical and critical thinking abilities with skills to adapt to the latest technologies needed for higher studies, and whichever career they choose.
PEO 3	To inculcate an ethical and humanitarian attitude, concern for environmental and social impact and managerial abilities needed for a successful professional career and as a responsible citizen.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	**Engineering knowledge:**	Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in **WK1 to WK4 ,** respectively, to develop to the solution of **complex engineering problems**.
PLO 2	**Problem analysis**	Identify, formulate, review research literature and analyze ***complex engineering problems*** reaching substantiated conclusions with consideration for ***sustainable development***. (**WK1 to WK4**).
PLO 3	**Design/development of solutions:**	Design creative solutions for ***complex engineering problems*** and design/develop systems/ components/ processes to meet identified needs with consideration for the **public health and safety, whole-life cost, net zero**

		carbon, culture, society and environment as required. **(WK5)**.
PLO 4	**Investigation:**	Conduct investigations of ***complex engineering problems*** using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. **(WK8)**.
PLO 5	**Tool Usage:**	Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve ***complex engineering problems***. **(WK2 and WK6)**.
PLO 6	**The Engineer and the World:**	Analyze and evaluate societal and environmental aspects while solving ***complex engineering problems*** for its **impact on sustainability** with reference to economy, health, safety, legal framework, culture and environment. **(WK1, WK5, and WK7).**
PLO 7	**Ethics:**	Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. **(WK9)**.
PLO 8	**Individual and Collaborative Team work:**	Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PLO 9	**Communication:**	Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PLO 10	**Project Management and Finance:**	Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PLO 11	**Lifelong learning:**	Recognize the need for, and have the preparation and ability for i. independent and life-long learning ii. adaptability to new and emerging technologies, and iii. critical thinking in the broadest context of technological change. **(WK8)**.

5. Program Specific Learning Outcomes

PSO 1	**Software skill**	Conceptualize, analyze and design various civil engineering structures as an individual and in a team, in context of environmental, economic, and societal requirements and serve the community as responsible professionals.
PSO 2	**Codes for Designing**	Implement provisions of Indian Standard Codes / other relevant codes / specifications / guidelines and applicable laws including labour and environmental.

6. Credit Framework

Semester-wise Credit distribution of the programme	
Semester-1	20
Semester-2	23
Semester-3	22
Semester-4	21
Semester-5	24
Semester-6	20
Semester-7	24
Semester-8	14
Total Credits:	**168**

Category-wise Credit distribution of the programme	
Category	**Credit**
Basic Science	16
Engineering Science	16
Humanities and Social Sciences	9
Programme Core	72
Programme Electives	28
Open Electives	4
Project(s)	7
Internships/Seminars	16
Total Credits:	**168**

7. Program Curriculum

Semester 1						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104101	Elements of Civil Engineering	4	3	2	0
2	303104104	Civil Engineering Drawings	2	0	4	0
3	303104105	Environmental Science	Audit	1	0	0
4	303105102	Programming for Problem Solving	4	3	2	0
5	303191101	Mathematics-I	4	4	0	0
6	303192101	Engineering Physics-I	4	3	2	0
7	303193103	Communication Skills	2	0	0	2
Total			**20**	**14**	**10**	**2**
Semester 2						

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
8	303100101	Workshop	2	0	4	0
9	303104151	Computer Aided Civil Engineering Drawing	4	2	4	0
10	303104155	Mechanics of Solids	4	3	2	0
11	303104157	Disaster Preparedness and Planning	2	2	0	0
12	303104159	Surveying	5	3	4	0
13	303191151	Mathematics-II	4	4	0	0
14	303193152	Advanced Communication & Technical Writing	2	0	0	2
Total			**23**	**14**	**14**	**2**

Semester 3

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
15	303104201	Material Testing and Evaluation	2	2	0	0
16	303104202	Material Testing and Evaluation Laboratory	2	0	4	0
17	303104203	Construction Technology	3	3	0	0
18	303104205	Introduction to Fluid Mechanics	3	3	0	0
19	303104206	Introduction to Fluid Mechanics Laboratory	1	0	2	0
20	303104207	Introduction to Solid Mechanics	3	3	0	0
21	303104208	Introduction to Solid Mechanics Laboratory	1	0	2	0
22	303104210	Product Realization	1	0	2	0
23	303191205	Advance Engineering Mathematics	4	4	0	0
24	303193203	Professional Communication Skills	2	0	0	2
Total			**22**	**15**	**10**	**2**

Semester 4

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
25	303104251	Hydraulic Engineering	3	3	0	0
26	303104252	Hydraulic Engineering Laboratory	1	0	2	0
27	303104253	Mechanics of Materials	3	3	0	0
28	303104254	Mechanics of Materials Laboratory	1	0	2	0
29	303104255	Environmental Engineering	3	3	0	0
30	303104256	Environmental Engineering Laboratory	1	0	2	0
31	303104257	Geo-Technical Engineering	3	3	0	0
32	303104258	Geo-Technical Engineering Laboratory	1	0	2	0

33	303104259	Transportation Engineering	3	3	0	0
34	303104260	Transportation Engineering Laboratory	1	0	2	0
35	303193252	Professional Grooming and Personality Development	1	0	0	1
Total			**21**	**15**	**10**	**1**

Semester 5

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
36	303104301	Design of Reinforced Concrete Structures	2	2	0	0
37	303104302	Design of Reinforced Concrete Structures Laboratory	2	0	4	0
38	303104303	Engineering Hydrology	3	3	0	0
39	303104304	Engineering Hydrology Laboratory	1	0	2	0
40	303104306	Summer Internship-1	2	0	0	0
41	303193304	Professionalism & Corporate Ethics	1	0	0	1
42		Open Elective 01 (Compulsory Subjects:1)	2	2	0	0
43		PEC 01-LAB (Compulsory Subjects:1)	1	0	2	0
44		PEC 01 (Compulsory Subjects:1)	3	3	0	0
45		PEC 02 (Compulsory Subjects:1)	3	3	0	0
46		PEC 02-LAB (Compulsory Subjects:1)	1	0	2	0
47		PEC 03 (Compulsory Subjects:1)	2	2	0	0
48		PEC 03-LAB (Compulsory Subjects:1)	1	0	2	0
Total			**24**	**15**	**12**	**1**

Open Elective 01

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303105305	Internet of Things	2	2	0	0
2	303109346	Renewable Energy Sources	2	2	0	0

PEC 01

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303104311	Design of Water & Waste Water Treatment Systems	3	3	0	0
2	303104313	Cleaner Production	3	3	0	0
3	303104315	Pollution Monitoring and Legislation	3	3	0	0
4	303104317	Environmental Microbiology	3	3	0	0

PEC 01-LAB						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104312	Design of Water & Waste Water Treatment Systems Laboratory	1	0	2	0
2	303104314	Cleaner Production Laboratory	1	0	2	0
3	303104316	Pollution Monitoring and Legislation Laboratory	1	0	2	0
4	303104318	Environmental Microbiology Laboratory	1	0	2	0
PEC 02						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104321	Foundation Engineering	3	3	0	0
2	303104323	Rock Mechanics	3	3	0	0
3	303104325	Soil Mechanics	3	3	0	0
4	303104327	Environmental Geo-Technology	3	3	0	0
PEC 02-LAB						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104322	Foundation Engineering Laboratory	1	0	2	0
2	303104324	Rock Mechanics Laboratory	1	0	2	0
3	303104326	Soil Mechanics Laboratory	1	0	2	0
4	303104328	Environmental Geo-Technology Laboratory	1	0	2	0
PEC 03						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104331	Traffic Engineering	2	2	0	0
2	303104333	Railway and Metro System	2	2	0	0
3	303104335	Airport and Dock Harbour	2	2	0	0
PEC 03-LAB						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104332	Traffic Engineering Laboratory	1	0	2	0
2	303104334	Railway and Metro Systems Laboratory	1	0	2	0
3	303104336	Airport and Dock Harbour Laboratory	1	0	2	0
Semester 6						

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
49	303104351	Design of Steel Structures	2	2	0	0
50	303104352	Design of Steel Structures Laboratory	2	0	4	0
51	303104353	Estimation, Costing and Valuation	2	2	0	0
52	303104354	Estimation, Costing and Valuation Laboratory	2	0	4	0
53	303104356	Minor Project	1	0	0	0
54	303104358	Employability Skills	1	0	0	1
55		Open Elective 02 (Compulsory Subjects:1)	2	2	0	0
56		PEC 04 (Compulsory Subjects:1)	3	3	0	0
57		PEC 04-LAB (Compulsory Subjects:1)	1	0	2	0
58		PEC 05 (Compulsory Subjects:1)	3	3	0	0
59		PEC 05-LAB (Compulsory Subjects:1)	1	0	2	0
Total			**20**	**12**	**12**	**1**

Open Elective 02

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303100351	Programme Management and Entrepreneurship	2	2	0	0
2	303100352	Life Sciences	2	2	0	0
3	303100353	Fundamentals of Management	2	2	0	0
4	303100354	Constitution of India	2	2	0	0
5	303100355	Engineering Economics	2	2	0	0
6	303105392	Cyber Law and Ethics	2	2	0	0

PEC 04

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303104361	Ground Water Hydrology	3	3	0	0
2	303104363	River and Sedimentation Engineering	3	3	0	0
3	303104365	Open Channel Flow	3	3	0	0

PEC 04-LAB

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303104362	Ground Water Hydrology Laboratory	1	0	2	0
2	303104364	River and Sedimentation Engineering Laboratory	1	0	2	0

3	303104366	Open Channel Flow Laboratory	1	0	2	0
PEC 05						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104371	EIA and Audit	3	3	0	0
2	303104373	Advanced Structural Analysis	3	3	0	0
3	303104375	Geometric Design of Highways	3	3	0	0
PEC 05-LAB						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104372	EIA and Audit Laboratory	1	0	2	0
2	303104374	Advanced Structural Analysis Laboratory	1	0	2	0
3	303104376	Geometric Design of Highways Laboratory	1	0	2	0
Semester 7						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
60	303104401	Construction Project Management and Economics	3	3	0	0
61	303104402	Construction Project Management and Economics Laboratory	1	0	2	0
62	303104403	Water Resource Engineering	3	3	-	-
63	303104404	Water Resource Engineering Laboratory	1	-	2	-
64	303104406	Major Project-1	5	-	2	-
65	303104408	Summer Internship-2	2	-	-	-
66		PEC 06	2	2	-	-
67		PEC 06-LAB	1	-	2	-
68		PEC 07	2	2	-	-
69		PEC 07-LAB	1	-	2	-
70		PEC 08	2	2	-	-
71		PEC 08-LAB	1	-	2	-
Total			**24**	**12**	**12**	**0**
PEC 06						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104411	Bridge Engineering	2.00	2	0	0
2	303104413	Soil & Ground Water Contamination	2.00	2	0	0

3	303104415	Pavement Design Evaluation	2.00	2	0	0
4	303104417	Green Sustainable Building	2.00	2	0	0
PEC 06-LAB						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104412	Bridge Engineering Lab	1.00	0	2	0
2	303104414	Soil & Ground Water Contamination Lab	1.00	0	2	0
3	303104416	Pavement Design Evaluation Lab	1.00	0	2	0
4	303104418	Green Sustainable Building Lab	1.00	0	2	0
PEC 07						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104421	Environmental Chemistry	2.00	2	0	0
2	303104423	Engineering Geology	2.00	2	0	0
3	303104425	Pre-stressed Concrete Structure	2.00	2	0	0
4	303104427	Urban Transportation Planning	2.00	2	0	0
PEC 07-LAB						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104422	Environmental Chemistry Lab	1.00	0	2	0
2	303104424	Engineering Geology Lab	1.00	0	2	0
3	303104426	Pre-stressed Concrete Structure Lab	1.00	0	2	0
4	303104428	Urban Transportation Planning Lab	1.00	0	2	0
PEC 08						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104431	Earthquake Engineering	2.00	2	0	0
2	303104433	Ground Improvement Technique	2.00	2	0	0
3	303104435	Waste-water Recycle Management	2.00	2	0	0
4	303104437	Intelligent Transportation System	2.00	2	0	0
PEC 08-LAB						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303104432	Earthquake Engineering Lab	1.00	0	2	0
2	303104434	Ground Improvement Technique Lab	1.00	0	2	0
3	303104436	Waste-water Recycle Management Lab	1.00	0	2	0
4	303104438	Intelligent Transportation System Lab	1.00	0	2	0

Semester 8						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
72	303104451	Industrial Internship/Research Project	14.00	-	28	-
Total			**14**	**-**	**28**	**0**

8. Detailed Syllabus

Semester 1

(1)

a. **Course Name:** Elements of Civil Engineering
b. **Course Code:** 303104101
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level
d. **Rationale:** Basic Civil Engineering knowledge is fundamental as it provides a strong foundation for various engineering disciplines, promotes problem-solving skills, supports innovation, and opens doors to diverse career opportunities.
e. **Course Learning Objective:**

CLOBJ 1	Define and recall the branches of civil engineering, the scope of the field, and the societal role of civil engineers.
CLOBJ 2	Explain the primary divisions of surveying, articulate fundamental surveying principles, and differentiate between types of graphical scales.
CLOBJ 3	Apply methods of linear measurements, use chaining instruments, and demonstrate proficiency in chain surveying.
CLOBJ 4	Analyse errors in chaining, correct tape measurements, and assess obstacles in the chaining process.
CLOBJ 5	Synthesize levelling principles, apply methods of levelling, and compute reduced levels using both HI and rise & fall methods.
CLOBJ 6	Evaluate foundation types based on different soil conditions and make decisions on suitable foundations for various scenarios.

f. **Course Learning Outcomes:**

CLO 1	Explain the principles and techniques of linear and angular measurements, and levelling used in civil engineering surveying.
CLO 2	Interpret maps and contours topographic features and their relevance in construction planning
CLO 3	Demonstrate the importance of foundations, site selection, and building planning principles in civil engineering projects.
CLO 4	Identify key elements of superstructures and assess the causes and remedies for dampness in buildings.
CLO 5	Evaluate various building materials based on their properties and applications in construction.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION** Branches of Civil Engineering, Scope of Civil Engineering, Role of Civil Engineering Society, Impact of infrastructural development on economy of the country.	5%	2
2	**SURVEYING** Object and Uses of Surveying, Primary Divisions in Surveying, Fundamental Principles of Surveying, Classification of Surveying, Plans and Maps, Scales, Types of Graphical Scales, Units of Measurements.	5%	2
3	**LINEAR MEASUREMENTS** Methods of Linear Measurements, Instruments used in Chaining, Chain Surveying, Ranging, Obstacles in Chaining, Errors in Chaining & Corrections, Tape Corrections, Conventional Symbols.	10%	4
4	**ANGULARMEASUREMENTS** Types of Compass, Method of Using a Compass, Bearing & It's Measurements, Whole Circle Bearing and Reduced Bearing, Computation of Angles, Types of meridians and bearings, Declination and DIP, Compass traversing and correction of bearings for Local Attraction, Chain and Compass Surveying Field Work	12%	5
5	**LEVELING** Aim sand applications, Definition of various terms, Instruments for levelling, Methods of levelling, Recording observations in level-book, Computing reduced levels by HI and rise & fall method.	12%	6
6	**MAPPING AND CONTOURING** Mapping, Contours, Characteristics of contours of	6%	2

	different terrains and application of contour maps, Methods of Contouring		
7	**MINOR EQUIPMENTS AND MODERN TOOLS OF SURVEYING** Introduction to Theodolite, Electromagnetic Distance Measuring Instruments, Total Station, Global Positioning System, Remote sensing, Geographical Information System (GIS).	**5%**	**2**
8	**BUILDINGPLANNING** Elements of a Building, Basic Requirements of a Building Planning, Planning Suitable Orientation, Planning for Energy Efficiency, Planning for Suitable Utility, Planning for Meeting Other Requirements	**5%**	**2**
9	**FOUNDATIONS** Importance and necessity of Foundation, Conventional Spread Footings, R.C.C. Footings, Grillage Footing, Arch Foundation, Pile Foundations, Foundations in Black Cotton Soil	**8%**	**4**
10	**SUPERSTRUCTURES** Types of Structures Based on the Method of Load Transfer, Building components and their functions and nominal dimensions.	**7%**	**3**
11	**DAMPNESSANDITSPREVENTION** Causes of Dampness, Ill effects of Dampness, Requirements of an Ideal Material for Damp Proofing, Materials for Damp Proofing, Methods of Damp Proofing.	**5%**	**2**
12	**TRADITIONAL BUILDING MATERIALS** Introduction, Types and Properties of Stones, Bricks, Lime, Cement, Timber.	**5%**	**3**
13	**MORTARS** Introduction, Properties of Cement Mortar, Lime Mortar, Mud Mortar, Special Mortar, Tests on Mortar.	**5%**	**2**
14	**CONCRETE** Introduction, Types and Properties of Plain Concrete, Reinforced Cement Concrete (R.C.C.), Reinforced Brick Concrete (RBC), Prestressed Concrete(PSC), Pre-cast Concrete.	**5%**	**3**
15	**MISCELLANEOUS BUILDING MATERIALS** Introduction, Types and Properties of Glass, Plastics, Bitumen, Asbestos, Paints, Distempers, Varnishes, Solid and Hollow Concrete Blocks, Roofing and Flooring Tiles	**5%**	**3**

i. Text Book and Reference Book:

1. Surveying Vol. I By Dr. B. C. Punmia, Ashokkumar Jain, Arunkumar Jain | Laxmi Publication | 16th Edition.
2. Surveying and Leveling By R. Subramanian | Oxford University.
3. Elements of Civil Engineering By Dr. R.K. Jain and Dr. P.P. Lodha | McGraw Hill Education India Pvt. Ltd.
4. Building Construction and Construction Material By G.S.Birdie and T.D. Ahuja | Dhanpat Rai Publishing.
5. Basics of Civil Engineering (Textbook) By S S Bhavikatti | New Age International Publishers.

(2)

a. **Course Name:** Civil Engineering Drawings
b. **Course Code:** 303104104
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level
d. **Rationale:** As we all know Drawing is the language of a technician. Hence, to make a technician master of Civil Engineering Drawing, He should be able to prepare a detailed drawing of civil engineering structures that he will come across during service.
e. **Course Learning Objective:**

CLOBJ 1	Students will recall and articulate key engineering drawing concepts, including conventions, relationships to other types of technical drawings, and effective viewing methods.
CLOBJ 2	Demonstrate the ability to apply AutoCAD functions, such as starting and saving drawings, controlling views, setting units, and accurately entering coordinates.
CLOBJ 3	Apply principles of layout and information representation to create a title block with necessary text and projection on engineering drawing sheets.
CLOBJ 4	Apply knowledge of solid geometry to accurately draw front and top views of simple solids (cylinder, cone, prism, pyramid) and use appropriate dimensioning techniques.

f. **Course Learning Outcomes:**

CLO 1	Interpret architectural and structural drawings, symbols, and conventions used in civil engineering plans.
CLO 2	Create detailed 2D drawings of buildings, foundations, and structural components using drafting tools or CAD software.
CLO 3	Develop plan, elevation, and section views for residential and public buildings as per building bye-laws.
CLO 4	Apply scale, dimensioning, and notations accurately in engineering drawings.
CLO 5	Prepare working drawings for construction, including reinforcement detailing, plumbing, and electrical layouts.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	4	2	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE**- Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE**- End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Engineering Drawing: Introduction and its importance ● Relationship to other technical drawing types ● Conventions ● Viewing of engineering drawing sheets ● Method of Folding of printed Drawing Sheet.
2	Introduction to AutoCAD ● Start and Save Drawing ● Control the Views ● Units ● AutoCAD Coordinates Entry Methods.
3	AUTOCAD Commands
4	Drawing Of A Title Block With Necessary Text And Projection ● To draw a Title block for the given dimensions with the necessary text and projection
5	Drawing Of Front View And Top View Of Simple Solids & Dimensioning • Cylinder • Cone • Prism • Pyramid
6	Drawing Of A Simple Steel Truss
7	Drawing Of A Plan For A Residential Building

(3)

a. **Course Name:** Environmental Science
b. **Course Code:** 303104105
c. **Prerequisite:** Knowledge of Physics, Chemistry, and Mathematics up to 12th science level and Biology up to 10th science level.
d. **Rationale:** Basic knowledge of the environment is essential for all human beings for a good life and sustainability.
e. **Course Learning Objective:**

CLOBJ 1	Apply systems thinking to analyze the city as a system, demonstrating application
CLOBJ 2	Evaluate the role of smart citizens and approaches for citizen engagement
CLOBJ 3	Identify sources and stressors of water resources, demonstrating understanding
CLOBJ 4	Analyze the causes, effects, and control measures of population explosion

f. **Course Learning Outcomes:**

CLO 1	Explain the relationship between environmental health, ecology, and quality of life with reference to sustainable development.
CLO 2	Evaluate methods for pollution prevention and control considering various sources of pollution.
CLO 3	Assess the impacts of population growth on natural resources and environmental sustainability.
CLO 4	Examine recent technological and policy developments addressing various global environmental challenges.
CLO 5	Discuss the concept of smart cities and use of sustainable engineering solutions for urban development.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**0**	**0**	**Audit**	**-**	**50**	**-**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	**ENVIRONMENTAL HEALTH, ECOLOGY AND QUALITY OF LIFE** Environmental education: Objective and scope, Impact of technology on the environment, Environmental disasters: Case studies, Global environmental awareness to mitigate stress on the environment, Structure and function of an ecosystem, Ecological pyramids, Pyramid of number, Pyramid of energy and pyramid of biomass.	**25%**	**7**
2	**POLLUTION PREVENTION** Air & Noise pollution - Sources & their Effects, Case studies of Major Catastrophes, Structure and composition of the atmosphere, Water, Soil, Marine, Thermal & Marine Pollution: The story of fluoride contamination, Eutrophication of lakes, control measures, Measuring water quality: Water quality index, Waste water treatment (general) primary, secondary and tertiary stages, Municipal Solid waste management: Sources and effects of municipal waste, Biomedical waste, Hazardous waste.	**20%**	**6**
3	**POPULATION GROWTH, GLOBAL ENVIRONMENTAL CHALLENGES & LATEST DEVELOPMENTS** Population Explosion - Causes, Effects and Control, an International initiative in population-related issues, Urbanization, Growth of the world's large cities, Water resources: Sources of water, Stress on water resources, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Variation in concentrations of GHG gases in ambient air during last millennium, Role of Environmental Information System(ENVIS) in India and similar programs run by EPA(USA), Role of soft tools like Quantum GIS, Autodesk Building Information Modeling (BIM) and City Finance Approach to Climate- Stabilizing Targets (C- FACT), Life Cycle Assessment, Bioinformatics and Optimization tools for sustainable development.	**25%**	**7**
4	**SMART CITIES** Introduction to smart cities - about smart cities, what is a smart city, world urbanization, case studies of Songdo, Rio De Janeiro, what makes cities smart. City as a system of systems ′Introduction, systems thinking, Milton Keynes Future Challenges, Rich picture as city challenges, Wicked problems, Development of smart city approach ′core	**30%**	**10**

	elements, open data, sustainability, privacy and ethics, development processes. Smart Citizens ′their role, engaging citizens, IES Cities, Energy systems, Approaches for Citizen Engagement, cocreating smart cities, cities unlocked, living labs, city problems, crowdsourcing ideas, redesigning cities for citizens, all age-friendly cities, mobility on demand, motion maps, Infrastructure, Technology and Data ′urban infrastructure and its technology, future of lighting, IoT, connected objects, sensing the city, NOx eating paints and air quality sensors, safest, smart citizen kit, sensing your city, Sensored City, Cyber security for data power, open, shared and closed data, satellite data, open data revolution, Smart City Project Data Innovation ′smart innovations, smart city ecosystem, data-driven innovations for smart cities Standards and Capacity Building ′the role of Standard, BSI smart city Standards, HyperCat, ITU Smart Sustainable cities, Smart City Readiness, Lessons Learnt from Amsterdam Smart Measurements - metrics and indicators, city indicators, WCCD data portal, value proposition, integrated reporting, smart city learning and education, urban data school.		

i. Text Book and Reference Book:

1. Textbook of Environmental Studies for Undergraduate Courses (TextBook) By Dr Erach Bharucha | Orient BlackSwan | Second Edition, Pub. Year 2013
2. Basics of Environmental Studies By U K Khare | Tata McGraw Hill.
3. Environmental Studies By Anindita Basak | Drling Kindersley (India)Pvt. Ltd Pearson
4. Environmental Sciences By Daniel B Botkin & Edward A Keller | John Wiley & Sons
5. Air Pollution By M N Rao, H .V N Rao | McGraw Hill Publishing Company Limited, New Delhi.

(4)

a. **Course Name:** Programming for Problem Solving
b. **Course Code:** 303105102
c. **Prerequisite:** Requires Basic Knowledge of Computer.
d. **Rationale:** This course is design to provide basic ideas of computer programming. This course also makes help to understand programming language. It will help to develop their logical abilities.
e. **Course Learning Objective:**

CLOBJ 1	Recognize and recall fundamental principles and organizations of computers, demonstrating a foundational understanding of computer architecture and design.
CLOBJ 2	Comprehend the concepts of computer programming languages, illustrating a grasp of syntax, semantics, and the essential components of programming languages.
CLOBJ 3	Develop algorithms for solving basic engineering problems, demonstrating the ability to apply theoretical knowledge to practical problem-solving scenarios.
CLOBJ 4	Demonstrate proficiency in the practical application of C programming by writing, compiling, and debugging programs, showcasing the ability to implement and troubleshoot code effectively.
CLOBJ 5	Evaluate and analyse complex computational programs written in C, demonstrating the capacity to assess and understand intricate solutions to computational challenges.
CLOBJ 6	Develop simple projects using the C programming language, showcasing creativity and application of learned principles to produce functional and practical software solutions.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate basic knowledge of computer hardware and software.
CLO 2	Describe problem-solving and logical skills in programming with C and other languages.
CLO 3	Describe decision-making and looping constructs to solve real-time problems.
CLO 4	Discuss the concept of functions for adaptive programming.
CLO 5	Use the comparisons and limitations of the various programming constructs and choose the right one for the task.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Number System:** Introduction and type of Number system, Conversion between number system, Arithmetic operations on number system, Signed and unsigned number system Software, Computer Languages and Computer Program	2%	3
2	**Introduction to 'C' Programming:** Features of C language, structure of C Program, Flow Charts and Algorithms Types of errors, debugging, tracing/stepwise execution of program, watching variables values in memory.	3%	3
3	**Constants, Variables and data Types:** Character Set, C tokens, Keywords and Identifiers, Constants, Variables, Data types, Declaration of Variables, Assigning values to variables, type def, and Defining symbolic constants.	5%	2
4	**Operators and Expression:** Introduction to Operators and its types, Evaluation of expressions, Precedence of arithmetic operators, Type conversions in expressions, Operator precedence and associatively.	10%	3
5	**Management Input and Output Operators:** Introduction, reading a character, writing a character, formatted input, formatted output.	5%	2
6	**Control structure in C:** Decision Making & branching: Decision making with If & If. Else statements, If. Else statements (Nested …. Ladder), The Switch & go to statements, The turnery Operator	15%	4

	Looping: The while statement, The break statement & The Do. While loop, The FOR loop, Jump within loops – Programs		
7	**Array:** Introduction, One-dimensional arrays, Two-dimensional arrays, arrays, Concept of Multidimensional arrays.	**10%**	**4**
8	**String:** string, string storage , Built-in-string functions	**10%**	**3**
9	**User-Defined Functions:** Concepts of user defined functions, prototypes, definition of function, parameters, parameter passing, calling a function, recursive function, Macros, Pre-processing.	**10%**	**5**
10	**Structure and Unions:** Introduction, Structure definition, declaring and initializing Structure variables, Accessing Structure members, Copying & Comparison of structures, Arrays of structures, Arrays within structures, Structures within Structures, Structures and functions, Unions	**10%**	**5**
11	**Pointers:** Basics of pointers, pointer to pointer, pointer and array, Pointer to array, array of pointers, functions returning a pointer	**10%**	**5**
12	**Dynamic memory allocation:** Introduction to Dynamic memory allocation, malloc(), calloc(), free(), realloc()	**5%**	**2**
13	**File Management in C:** Introduction to file management and its functions	**5%**	**1**

i. Text Book and Reference Book:

1. Programming in ANSI C (TextBook) By E. Balaguruswamy | Tata McGraw-Hill.
2. C Programming: Test Your Skills By Ashok Kamthane.
3. Computer Fundamentals By P.K. Sinha and Priti Sinha | BPB Publications | 4th Edition.
4. Star C Programming STAR Certification | C Certification Exam.
5. Programming with C By Byron Gottfried | Tata McGraw Hill Education.
6. C The Complete Reference By Herbert Schildt
7. Let Us C By Yeshavant Kanetkar | BPB Publications.

(5)

a. **Course Name:** Mathematics-I
b. **Course Code:** 303191101
c. **Prerequisite:** Knowledge of Mathematics up to 12th science level.
d. **Rationale:** The Mathematics I syllabus integrates fundamental calculus concepts, advanced mathematical techniques, and matrix algebra, preparing students for engineering challenges with optimized problem-solving skills.
e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of definite and improper integrals, including the application of integration techniques to find areas and volumes in both Cartesian and Polar coordinates.
CLOBJ 2	Utilize differential equations to model and solve practical scenarios, demonstrating proficiency in various solution techniques.
CLOBJ 3	Analyse the convergence and divergence of sequences and series, employing tests such as the Alternating Series Test and Ratio Test
CLOBJ 4	Analyse matrix operations and determinants, exploring their properties and applications in solving systems of linear equations.
CLOBJ 5	Apply Fourier series for representing periodic functions, verifying Dirichlet's conditions.
CLOBJ 6	Solve optimization problems using multivariable calculus concepts, such as Lagrange's multiplier.

f. **Course Learning Outcomes:**

CLO 1	Solve system of linear equations using Row-Echelon and Reduced Row Echelon form of a matrix.
CLO 2	Analyze various properties and forms of a matrix using its Eigen values and Eigen vectors.
CLO 3	Interpret the convergence of infinite sequence and series using various results and tests.
CLO 4	discuss various properties such as limit, continuity, partial differentiability and applications of multivariate functions
CLO 5	Formulate mathematical model based on first order differential equations.
CLO 6	Evaluate area and volume using definite integrals and improper integrals

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**UNIT 1 Improper Integral & Application of Definite Integral:** Evaluation of definite and improper integrals, Beta and Gamma functions and their properties Area bounded by curves in Cartesian and Polar form, Area of a region bounded by function, Area of a region bounded by curves in Parametric form, Volume by slicing, Volume of solid by revolution.	8%	5
2	**UNIT 2 First order Ordinary Differential equation:** Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type, Applications	15%	9
3	**UNIT 3 Matrices:** Matrices & Determinants with Properties, Linear Independence, Rank of Matrix, System of Linear Equations, Consistency of System, Solution of system of Linear Equations by Gauss Jordan and Gauss-Elimination Method, Eigen values, Eigenvectors, Symmetric, Skew-symmetric, and orthogonal Matrices, Eigen bases, Diagonalization, Cayley Hamilton Theorem and its Applications, Diagonalization, Orthogonal Transformation, Quadratic form.	25%	15
4	**UNIT 4 Sequences and Series:** Basic of Sequences, Bounded and Monotonic Sequences, Series, Convergence of sequence and series, Geometric series, P- series, Cauchy's Integral Test, Comparison Test, Alternating Series, Absolute and Conditional convergence, Ratio test, Cauchy's Root Test, Power series, Taylor's and	17%	10

	Maclaurin's series.		
5	**UNIT 5 Fourier Series:** Fourier Series of 2 periodic functions, Dirichlet's conditions for representation by a Fourier series, Fourier Series of a function of period 2 , Fourier Series of even and odd functions, Half range series.	**10%**	**6**
6	**UNIT 6 Multivariable Calculus (Differentiation):** Functions of Several Variables, Limit, Continuity, Partial Derivatives, Homogeneous function, Euler's Theorem for homogeneous function, Modified Euler's Theorem, Chain Rule, Implicit function, Jacobian, Tangent plane and Normal line, Maximum and Minimum Values, Lagrange 's Multiplier, Taylor's and Maclaurin's Series for functions of two variables.	**25%**	**15**

i. Text Book and Reference Book:

1. Calculus and Analytic Geometry (Text Book) By G.B.Thomas and R.L.Finney | Addison Wesley.
2. Calculus with early transcendental functions By James Stewart| Cengage Learning.
3. Higher Engineering Mathematics By B.S.Grewal | Khanna Publications.
4. Elementary Linear Algebra (Text Book) By Howard Anton, Chris Rorres|Willy India Edition|9th Edition.
5. Advanced Engineering Mathematics (TextBook) By Erwin Kreyszig | Willey India Education.

(6)

a. **Course Name:** Engineering Physics-I
b. **Course Code:** 303192101
c. **Prerequisite:** Knowledge of Physics and some basic concepts in Mathematics like differentiation, integration, limit, differential equation, vector calculus up to 12thscience level.
d. **Rationale:** Knowledge of physics is essential for all Engineering branch because physics is the foundation subject of all the branches of engineering and it develops scientific temperament and analytical capability of engineering students. Comprehension of basic physics concepts enables the students to solve engineering problem logically and develop scientific approach.
e. **Course Learning Objective:**

CLOBJ 1	Understand and explain the elastic properties of materials. Analyze the tensile stress-strain curve and its implications for material behavior. Evaluate shear strength in both perfect and real crystals.
CLOBJ 2	Investigate thermoelectric effects and their applications. Examine the Wiedemann-Franz law and its significance. Explore phonons and their role in heat transfer. Analyze different modes of heat transfer and specific heat of solids. Compare and contrast the Einstein and Debye models for solids.
CLOBJ 3	Gain a qualitative understanding of statistical mechanics. Differentiate between Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics.
CLOBJ 4	Analyze transverse waves on a string and harmonic waves. Investigate reflection, transmission, standing waves, and eigenfrequencies.
CLOBJ 5	Explore Einstein's theory of matter-radiation interaction. Understand absorption, spontaneous, and stimulated emission of radiation. Identify characteristics and components of lasers. Classify types of lasers, including Nd: YAG Laser, CO2 Laser, and Semiconductor Diode Laser.
CLOBJ 6	Examine applications of lasers in various fields.

f. **Course Learning Outcomes:**

CLO 1	Explain the band structure and origin of band gap in semiconductors.
CLO 2	Formulate various theoretical aspects and the physical phenomena at atomic level
CLO 3	Identify the materials useful for optoelectronic devices based on their optical transition processes.
CLO 4	Apply appropriate techniques to measure bandgap, resistivity, and other relevant parameters of semiconductors.
CLO 5	Explain the applications of low-dimensional semiconductor devices in modern electronics.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**UNIT- I** Properties of Material Mechanical Properties: Elastic properties, Model of elastic behavior, tensile stress- strain curve, shear strength of perfect and real crystals. Thermal Properties: Thermo-electric effects, Wiedemann-Franz law, Phonons, Modes of heat transfer, Specific heat of solids, Einstein and Debye Model, Qualitative idea about Maxwell-Boltazmann, Bose, Einstein, Fermi-Dirac statistics.	20%	9
2	**UNIT- II** Motion in a Plane Transformation of coordinates, Newton's laws and its completeness in describing particle motion, Problems including constraints and friction, Motion of a rigid body in the plane; Rotation in the plane; Angular momentum about a point of a rigid body in planar motion.	20%	9
3	**UNIT-III** Classical Mechanics Degrees of freedom, Constraints and constraint forces, Lagrange's equations of motion, Conservation law, Euler's laws of motion, Non inertial frames of reference; Centripetal and Coriolis accelerations; Fluid Mechanics: - Flow of fluids, Viscosity, Continuity equation, Euler and Bernoulli's equations	20%	9
4	**UNIT–IV** Waves & Vibration Transverse wave on a string, Wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, Standing waves and	20%	9

	their Eigen frequencies, longitudinal waves and the wave equation, Acoustics waves and speed of sound, Phase velocity and group velocity.		
5	**UNIT–V** Lasers Einstein's theory of matter-radiation interaction, Absorption, Spontaneous and Stimulated Emission of Radiation, Characteristics of Laser, Components of Laser, Types of Laser: Nd:YAG Laser, CO2 Laser, Semiconductor Diode Laser, Applications of Lasers.	**20%**	**9**

i. Text Book and Reference Book:

1. Engineering Mechanics (Text Book) By MK Harbola.
2. Engineering Mechanics - Dynamics (Text Book) By JL Meriam.
3. Mechanical Vibrations (Text Book) By JP Den Hartog.
4. University Physics (Text Book) By Sears And Zemansky | Pearson Publication.

(7)

a. **Course Name:** Communication Skills
b. **Course Code:** 303193103
c. **Prerequisite:** Knowledge of English Language studied till 12th standard.
d. **Rationale:** Basic Communication Skills are essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Develop effective technical communication skills, including writing, speaking, and presenting technical information to diverse audiences within the engineering field.
CLOBJ 2	Learn to create clear, concise, and well-structured technical documents such as reports, memos, and manuals relevant to engineering disciplines, adhering to industry standards.
CLOBJ 3	Enhance teamwork and collaboration skills by effectively communicating and contributing ideas within engineering teams, fostering a productive and cohesive working environment.
CLOBJ 4	Acquire proficiency in delivering clear and engaging presentations, incorporating visual aids and effective speaking techniques to convey technical information confidently.
CLOBJ 5	Develop interpersonal skills necessary for effective networking, relationship-building, and conveying complex engineering concepts to non-technical stakeholders in a clear and understandable manner.
CLOBJ 6	Gain awareness of cross-cultural communication nuances and adapt communication strategies when interacting with diverse teams and stakeholders, considering cultural differences and perspectives.

f. **Course Learning Outcomes:**

CLO 1	Apply creative and critical thinking in academic and professional communication tasks.
CLO 2	Apply vocabulary with accurate pronunciation in academic and professional communication.
CLO 3	Use fundamental English grammar accurately in academic communication
CLO 4	Produce effective reading and writing responses for academic, professional, and social contexts.
CLO 5	Speak content clearly and appropriately in academic and professional settings, demonstrating growing confidence in their communication skills.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	2	-	2	-	100	-	-	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Crazy Scientist** The students will be taught the importance of invention and innovation using some examples that changed the world the way it worked.	5%	2
2	**Phonetics** IPA Introduction (listening tracks) Phonic Sounds Pronunciation Practice including transcription	10%	4
3	**Vocabulary Building & Word Formation Process** Compounding, clipping, blending, derivation, creative respelling, coining and borrowing Prefixes & suffixes, synonyms & antonyms, standard abbreviations (related activities will be provided)	10%	2
4	**Speaking Activity: Role play on Critical Thinking (Lifeboat)** This activity topic gears towards making students do role play based on various scenarios. It involves giving them a scenario and asking them to further develop the idea in a very interesting manner, then going on to enact it. It aims to improve students' convincing skills.	10%	4
5	**Picture Description & Picture Connector** Enable students to use vocabulary and useful expression to describe the picture.	15%	2

	In this class the students will be trained to form logical connections between a set of pictures which will be shared with them. This geared towards building creativity and presentation skills.		
6	**Mine Activity: Usage of Preposition** Students will learn to use proper propositions by active participation in the activity.	**8%**	**2**
7	**Worksheets on Identifying Common Errors in Writing** Sentence structure Punctuations Subject-Verb Agreement Noun-Pronoun Agreement	**12%**	**2**
8	**Reading Skills** The art of effective reading and its various strategies to be taught to the learners and practice exercises be given on reading comprehension	**10%**	**2**
9	**Speech and spoken Exchanges; Extempore** Students will learn the correct usage of spoken language as different from the written form. It will help the students. in extempore speech. This will be done by making the students give variety of impromptu speeches in front of the class: 1-minute talk on simple topics. To change the average speakers in the class to some of the best Orator	**10%**	**4**
10	**Book Review** The learners will identify the central idea of the book, author's style and approach towards the book This will enable the learners to express their point of view and hone their creativity and writing skills	**10%**	**4**
11	**Activity Session** This will enhance the creative thinking among students. To develop their interpersonal communication skills	**0%**	**2**

i. Text Book and Reference Book:

1. Understanding and Using English Grammar By Betty Azar & Stacy Hagen | Pearson Education.
2. Business Correspondence and Report Writing By SHARMA, R. AND MOHAN, K.
3. Communication Skills By Kumar S and Lata P | New Delhi Oxford University Press.
4. Technical Communication: Principles And Practice By Sangeetha Sharma, Meenakshi Raman | Oxford University Press.
5. Practical English Usage By MICHAEL SWAN
6. A Remedial English Grammar for Foreign Student By F.T. WOOD.

Semester 2

(1)

a. **Course Name:** Workshop
b. **Course Code:** 303100101
c. **Prerequisite:** Zeal to learn the subject.
d. **Rationale:** The workshop practice is the backbone of the real industrial trades which helps to develop and enhance relevant technical hands-on experience of using various tools and instruments related to various trades. The use of workshop practices in day to day industrial as well domestic life helps to solve the problems. Further, it also deals with basic introduction of system components of electrical and electronic systems, and provides hands on practice in assembling, interconnecting, testing, and repairing such system by making use of various tools used in electrical and electronic workshop. Electronic systems are built on printed circuit board (PCB) and breadboard. One need to use source instruments (power sources and signal sources), and appropriate measuring instruments to study behaviour of a system.
e. **Course Learning Objective:**

CLOBJ 1	Provide an overview of the principles, scope, and importance of mechanical engineering, including its various sub-disciplines and applications.
CLOBJ 2	Emphasize and enforce safety protocols, practices, and procedures to ensure a safe working environment within a mechanical workshop.
CLOBJ 3	Measurement Techniques and Instruments: Familiarize students with various measurement techniques and instruments used in mechanical engineering, emphasizing precision and accuracy in measurements.
CLOBJ 4	Introduce students to basic manufacturing processes such as machining, casting, forming, and welding, providing insights into how different materials are shaped and manipulated.
CLOBJ 5	Hands-on Experience with Tools and Equipment: Familiarize students with basic tools, machines, and equipment commonly used in mechanical engineering through hands-on activities and demonstrations in a workshop setting.

f. **Course Learning Outcomes:**

CLO 1	Explain the safety measures required while working in a workshop.
CLO 2	Select the appropriate tools required for specific operation.
CLO 3	Describe the different manufacturing techniques for producing components from given raw materials.
CLO 4	Explain the applications of machine tools, hand tools, and power tools.
CLO 5	Identify measure and test different passive & active electronics components.

CLO 6	Explain the working principles of various electrical and electronic measurement equipments.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	4	2	-	-	40	-	60	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Study of Digital Multi meter and Measurement of voltage, current, frequency, phase difference, power, power factor for single phase supply using Digital Millimeter.
2	To study about safety, Electric shock, First aid for electric shock and other Hazards of electrical Laboratories and Safety rules.
3	Identification and symbolic representation of basic passive components
4	Understanding of working and specifications of CRO and Function generator
5	Identification, symbolic representation and testing of various electronics components (including SMD).
6	To understand working and specifications of DC regulated Power supply.
7	Understanding soldering techniques and practicing proper soldering and de-soldering.
8	Overview of PCB layout designing and fabrication.
9	Study of different types of cables, wires, probes, connectors
10	To understand series & parallel type of connections and to perform Bulb wiring, Fan wiring, Tube-light wiring
11	To perform staircase wiring, double stair case wiring, and Go-down wiring.

12	Demonstration of Fuse, MCB along its operation and study of ELCB.
13	Prepare installation diagram for a newly built room, Simple room wiring with one fan, one tube-light and one bulb with switch board
14	Introduction to Workshop Layout and Its Importance
15	Introduction to Industrial Safety
16	Introduction to Measuring Instruments
17	Fitting and Drilling Practice
18	Carpentry Practice
19	Sheet Metal Practice
20	Smithy Practice
21	Metal Joining Processes: Welding and Soldering Practice
22	Plumbing Practice
23	Metal Cutting on Lathe machine.

i. Text Book and Reference Book:

1. Electronic Principles by Albert Paul Malvino | TMH
2. Electronic Devices by Thomas L. Floyd | Pearson, Prentice Hall "Linear Systems and Signals" by B.P. Lathi.
3. Electronic Devices and Circuits by David A. Bell | Oxford Publication
4. Electronic Devices and Circuits by Jacob Millman and Halkias | Tata McGraw Hill Publication New Delhi.
5. Shop Theory by Anderson James & Earl E. Tatro | Macmillan/McGraw-Hill School.
6. Workshop Technology by Bava H. S. | Tata McGraw Hill Publishing Co. Ltd.
7. Elements of Workshop Technology Vol. I By Hajra Chaudhary S.K. | Asia Publishing House.
8. Workshop Technology by Chapman, W.A.J. ELBS Low Price Text | Edward Donald Pub. Ltd.
9. Basic Machine Shop Practice Vol. I & II By Tejwani, V.K. | Tata McGraw Hill Pub. Co.
10. Workshop Technology Vol. I & II By Arora, B.D. | Satya Prakashan, New Delhi" Signals and Systems" by Simon Haykin and Barry Van Veen.

(2)

a. **Course Name:** Computer Aided Civil Engineering Drawing
b. **Course Code:** 303104151
c. **Prerequisite:** Elements of drawing, Components of building and their types, primary knowledge of surveying and leveling.
d. **Rationale:** A Civil Engineer has to be conversant with building and town planning and their development controls, skill of preparing drawings of various types like, orthographic, perspective, working drawings etc.
e. **Course Learning Objective:**

CLOBJ 1	To develop graphical skills for communicating concepts, ideas and designs of engineering products graphically/visually as well as understand another person's designs,
CLOBJ 2	To get exposure to national standards relating to technical drawings using Computer Aided Design and Drafting practice
CLOBJ 3	Understand and apply building bye-laws for the planning of residential and public buildings
CLOBJ 4	Planning of residential buildings and various public buildings like schools, hospitals, libraries etc
CLOBJ 5	Understand, interpret and prepare civil engineering drawings with help of CAD
CLOBJ 6	Develop drawings for conventional structures using practical norms
CLOBJ 7	Understand and prepare perspective drawing

f. **Course Learning Outcomes:**

CLO 1	Define signs and symbols for communicating concepts and designs of civil engineering structures
CLO 2	Apply national standards of technical drawings using Computer-Aided Design (CAD) and drafting practices in civil engineering projects.
CLO 3	Interpret detailed architectural drawings for residential buildings, as well as public infrastructure like schools, hospitals, and libraries.
CLO 4	Classify CAD tools to understand, interpret, and prepare civil engineering drawings for conventional structures.
CLO 5	Develop technical drawings adhering to practical standards and norms in the construction industry.

g. **Teaching & Examination Scheme:**

Teaching Scheme	Evaluation Scheme

L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	4	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION** introduction to the concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer-aided drawing, coordinate systems, reference planes. Introduction to AutoCAD	5%	1
2	**Planning approach and Building regulations** Basic areas in residential buildings - Process of planning - Family requirements and analysis - Conceptual plan outlines. Objectives and importance of bye-laws, F.S.I., Principles underlying building bye-laws, rules governing light, parking, fire, water supply etc, as per city urban development authority norms or as per NBC standards. FSI for Redevelopment as per new Byelaws	15%	4
3	**Planning for residential building:** Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floorplan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Standard furniture, fittings and fixture, finish. Use of Notes to improve clarity	25%	8
4	**Planning for public building** Key Plan, Site plan, plan, section and elevation for public buildings like post office, library, hospital, primary and secondary school, industrial building, bus or rail terminal, secretariat etc	25%	8
5	**Town Planning** Necessity of Civic surveys for Planning purpose, types, data and its presentation and analysis, Fundamental principles of Town Planning, Land use Planning,	20%	6

	Components of town such as Zones, Road Network, CBD, neighborhood planning, remedial measures for avoiding slum foundation, Introduction to smart city, its Characteristics as per present scenario, Master Plan		
6	**PICTORIAL VIEW** Principles of isometrics and perspective drawing. Perspective view of building Fundamentals of Building Information Modelling (BIM)	**10%**	**3**

i. Text Book and Reference Book:

1. Civil Engineering Drawing By Malik R.S., Meo, G.S.
2. A Course in Civil Engineering Drawing By Sikka, V.B.
3. Building Drawing By M.G.Shah, C.M.Kale and S.Y.Patki |Tata McGrawHill, NewDelhi.
4. Civil Engineering Drawing By Subhash C Sharma & Gurucharan Singh.
5. Building Planning, Designing and scheduling By Gurucharan Singh|Standard Book House, NewDelhi.
6. Planning, designing building By Y.S.Sane|Allies Book Stall

(3)

a. **Course Name:** Surveying
b. **Course Code:** 303104159
c. **Prerequisite:** Knowledge of basic concepts of Civil Engineering.
d. **Rationale:** Basic surveying knowledge is essential for Civil Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Gain familiarity with types of survey, surveying instruments, area and levels measurements, can measure reduce levels.
CLOBJ 2	Solve problems related to compass traverse, theodolite traverse, dumpy levelling, and contouring survey, execute levelling of field.
CLOBJ 3	Acquire knowledge of the road, canal, channels curvature, establishment of center line for execute the survey by curves and elevation different methods.
CLOBJ 4	Understand different field areas and volume of field, regular irregular shape area can be measure by different methods and with planimeter like instrument.
CLOBJ 5	Demonstrate a clear understanding of the basic concepts, working principles and applications of remote sensing, GPS, GIS software and field applications.

f. **Course Learning Outcomes:**

CLO 1	Apply the principles and procedures of theodolite and control surveys for precise measurement and mapping.
CLO 2	Determine elevations for topographic analysis and construction planning using contour maps
CLO 3	Compute areas and volumes of landforms using surveying data for civil engineering applications.
CLO 4	Apply techniques for setting out horizontal curves in fieldwork.
CLO 5	Utilize GPS and remote sensing technologies in modern surveying practices and infrastructure planning.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**4**	**5**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Theodolite Survey** Introduction, Types of theodolites, Temporary adjustment of theodolite, field operations with a theodolite, Measurement of Horizontal and Vertical Angles, Method of Repetition, Method of Reiteration, Sources of errors in theodolite survey. Introduction and working of Digital Theodolite	**25%**	**7**
2	**Control Survey** Traverse computations ´(Recalling study related to Magnetic bearings, True bearings, whole circle bearing, quadrant bearings, forward and back bearing, conversion of angles to bearings), rectangular coordinates for traverse survey and closing error in close traverse, Theodolite Traverse Surveying, Calculation of Omitted measurements, Calculation of coordinates from a theodolite traverse, Galės Traverse Table, Location of specific items by their latitude and departure in relating to the National Grid System	**21%**	**10**
3	**Contouring** Definitions, Use of contour maps, Characteristics of contours, Typical land features and their contour forms and Methods of locating contours Interpolation of contours Uses of contour maps	**10%**	**6**
4	**Determination of elevation** Trigonometrical levelling (Indirect levelling, levelling on steep ground- methods.), Measuring heights and distances by keeping instrument axes at the same level and instrument axes at a different level, Tachometric surveying ´Introduction, Use, Principle and Methods, Calculation of distance and elevation for staff vertical	**18%**	**9**
5	**Computation of Areas and Volumes** Methods to compute the area of the traverse, Determining areas from Plans, Trapezoidal rule, Simpsoṅs rule, Computation of Volumes, Volume from cross sections, Trapezoidal and Prismoidal formulae, Prismoidal correction, Curvature correction, Determination of capacity of reservoir and volume from borrow pits, Computation of volume from spot levels and from contours.	**13%**	**6**

6	**Curve Surveying** Introduction, classification of curves, Methods of Setting out of the simple circular curves, elements of the compound and reverse curves, transition curves, types of transition curves, combined curves, and types of vertical curves.	**13%**	**6**
7	**Application of GPS and Remote sensing in surveying** Introduction, GPS and GIS system, Working, Satellite used in Remote sensing, Arc GIS software Introduction.	**10%**	**5**

i. Text Book and Reference Book:

1. Surveying Vol.I (Text Book). By Dr. B.C. Punmia, Ashokkumar Jain, Arunkumar Jain| Laxmi Publication| 16thEdition
2. Surveying and Leveling (Text Book). By R. Subramanian | Oxford University
3. Surveying Vol.I. By S.K. Duggal | Tata McGrawHill Publication NewDelhi
4. Surveying and Levelling Vol.I. By Arora K.R| Standard Publications, Delhi

(4)

a. **Course Name:** Mechanics of Solids
b. **Course Code:** 303104155
c. **Prerequisite:** System of units, Laws of motion, Basic idea of force, Concept of centroid Fundamentals of stress, strain and their relationships.
d. **Rationale:** Mechanics of Solids is conceptual applications of principles of mechanics in Engineering.
e. **Course Learning Objective:**

CLOBJ 1	Comprehend the concepts of stress, strain, and deformation in solid materials under various loading conditions, and apply this understanding to analyze structural behavior.
CLOBJ 2	Gain insight into the mechanical properties of materials such as elasticity, plasticity, and failure mechanisms, and their implications in designing resilient and safe structures.
CLOBJ 3	Analyze structural components, including beams, columns, and trusses, under different loading scenarios using principles of mechanics of solids, determining stresses, and deformations.
CLOBJ 4	Develop proficiency in constructing shear force and bending moment diagrams to understand internal forces and moments in structural elements, crucial for design and analysis.
CLOBJ 5	Calculate deflections and assess stability criteria for structural elements, recognizing critical conditions that impact structural integrity and safety.
CLOBJ 6	Apply principles of mechanics of solids to design structural elements, ensuring they meet safety standards, considering factors such as material selection, loading conditions, and design codes.

f. **Course Learning Outcomes:**

CLO 1	Explain the fundamental concepts of mechanics including force systems, equilibrium, and free-body diagrams
CLO 2	Apply the principles of centroid and moment of inertia for various geometrical sections in structural analysis.
CLO 3	Analyze shear force and bending moment in beams subjected to various loading conditions.
CLO 4	Apply the principles of friction to solve engineering problems involving ladders, wedges, and belts.
CLO 5	Calculate stresses and strains in axially loaded members using the concepts of elasticity and deformation.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION:** Forces/Equilibrium of Rigid body, Scalar and vectors, system of forces, resultant force, Statics of particles. Free-body diagrams. Equilibrium of particle in two dimensions, Resultants of three or more concurrent forces, Resolution of a force into components. Rectangular components of a force. Resultants by rectangular components, Concurrent force system in space: Resolution of a force into rectangular components in space, Coplanar Non-Concurrent Force Systems, Moments about Points and Axes, Equilibrium, Non-coplanar Non-concurrent Forces.	15%	5
2	**CENTROID MOMENT OF INERTIA:** Distributed forces: Centroid and center of gravity. Determination of centroid of lines and areas using integral technique, Determination of centroid of composite wires and areas, Centroid of volumes. Theorems of Pappus-Guldinus and its applications, Second moment of areas, Definition of moment of inertia. Determination of moment of areas by integration, Parallel axis theorem for Moment of Inertia. MI of composite areas, Concept of Mass moment of inertia of bodies.	15%	5
3	**BEAMS:** Definitions, types of beams, types of loading, types of supports. Determination of reactions for simply, Supported and over hanging beams. Relation between distributed load, Shear force and Bending Moment, Shear force and Bending moment in beams with diagrams	20%	6

4	**FRICTION:** The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Analysis of systems involving dry frictions such as ladders spheres etc., Belt Friction, Analysis of flat and v-belt.	**25%**	**8**
5	**SIMPLE STRESSES & STRAINS:** Basics of stress and strain: 3-D state of stress (Concept only), Normal/axial stresses: Tensile & compressive Stresses: Shear and complementary shear Strains, Linear, shear, lateral, thermal and volumetric. Hooke's law, Elastic Constants: Modulus of elasticity, Poisson's ratio.	**25%**	**8**

i. Text Book and Reference Book:

1. Statics and Dynamics Beer, F.P. and Johnston, E.R. Vector mechanics for engineers; Tata McGraw-Hill.
2. Engineering Mechanics: Statics and Dynamics J.A Desai and B.B Mistry; Popular Prakashan.
3. Engineering Mechanics: Statics and Dynamics R.C Hibbeler; Prentice Hall of India.
4. Engineering Mechanics: Statics and Dynamics S Rajsekaran; Vikas Publication.
5. Engineering Mechanics S.S. Bhavikatti and K. G. Rajashekarappa; Wiley 'Eastern Ltd.
6. Engineering Mechanics J.L. Meriam, and L.G.Kraige; John Wiley and sons, New York

(5)

a. **Course Name:** Disaster Preparedness and Planning
b. **Course Code:** 303104157
c. **Prerequisite:** Environmental Studies.
d. **Rationale:** This subject is conceptual applications of principles of management to mitigate various disasters.
e. **Course Learning Objective:**

CLOBJ 1	Acquire a comprehensive grasp of disaster-related concepts, definitions, and fundamental principles, covering hazards, vulnerabilities, risks, severity, frequency, capacity, impact, prevention, and mitigation.
CLOBJ 2	Analyze and categorize disasters into natural and manmade types, investigating India's hazard and vulnerability profile, including geographical features and ecological fragility.
CLOBJ 3	Explore the diverse impacts of disasters on the environment, society, economy, politics, health, psycho-social aspects, and demographic considerations, along with trends and climate change implications.
CLOBJ 4	Grasp the entire disaster management cycle, including prevention, mitigation, preparedness, relief, and recovery phases. Evaluate structural and non-structural measures, risk analysis, early warning systems, and post-disaster environmental response.
CLOBJ 5	Investigate factors influencing vulnerability, such as developmental projects, environmental modifications, and sustainable recovery methods, aligning with the subject's broader perspective.
CLOBJ 6	Understand the intersection of disasters, environment, and development, focusing on integrating disaster preparedness with sustainable development goals. Explore strategies to align developmental projects with environmental considerations for long-term resilience.

f. **Course Learning Outcomes:**

CLO 1	Identify key concepts, terms, and types of disasters, including natural, technological, and human-made events.
CLO 2	Explain the importance of disaster preparedness and planning in minimizing risks and enhancing community resilience.
CLO 3	Develop a basic disaster preparedness plan for a specific community or organization, incorporating strategies for prevention, response, and recovery.
CLO 4	Assess existing disaster preparedness plans and frameworks, identifying strengths and areas for improvement based on best practices.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction** Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks- severity, frequency and details,capacity, impact, prevention, mitigation)	10%	3
2	**Disasters** Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.	25%	7
3	**Disaster Impacts** Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.	25%	8
4	**Disaster Management Cycle and Framework** Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, reliefand recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, and Post-disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the	25%	8

	activities of National Disaster Management Authority.		
5	**Disasters, Environment and Development** Factors affecting vulnerability such as the impact of developmental projects and environmental modifications(including dams, land-use changes, urbanization etc.), sustainable and environmentally friendly recovery; reconstruction and development methods.	**15%**	**4**

i. Text Book and Reference Book:

1. Disaster Risk Reduction in South Asia Pradeep Sahni.
2. Disaster Management Ghosh G.K.
3. Disaster Medical Systems Guidelines (Text Book) Emergency Medical Services Authority, State of California, Pub. Year 2003.
4. Inter-Agency Standing Committee (IASC) (Text Book) IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

(6)

a. **Course Name:** Mathematics-II
b. **Course Code:** 303191151
c. **Prerequisite:** Knowledge of Mathematics up to 12th science level.
d. **Rationale:** The Mathematics I syllabus integrates fundamental calculus concepts, advanced mathematical techniques, and vector calculus, preparing students for engineering challenges with optimized problem-solving skills.
e. **Course Learning Objective:**

CLOBJ 1	Define and identify ordinary differential equations of higher order. Classify ODEs based on homogeneity and linearity. Solve homogeneous linear ODEs of higher order with constant coefficients, variable coefficients.
CLOBJ 2	Solve homogeneous linear ODEs of higher order with constant coefficients, variable coefficients
CLOBJ 3	Apply the Method of Undetermined Coefficients to solve nonhomogeneous ODEs. Utilize the Solution by Variation of Parameters for solving nonhomogeneous ODEs. Explore applications of ODEs in real-world scenarios.
CLOBJ 4	Understand power series solutions for ordinary points and regular
CLOBJ 5	singular points. Explore properties and applications of Legendre polynomials and Bessel functions.
CLOBJ 6	Define Laplace transform and its inverse. Understand the linearity property of Laplace transforms. Solve ordinary differential equations using Laplace transforms.

f. **Course Learning Outcomes:**

CLO 1	Solve higher-order ordinary differential equations with constant coefficients and Euler's ODE with variable coefficient
CLO 2	Use series solution methods and special functions like Bessel's' functions to solve the differential equations and analyze complex physical phenomena
CLO 3	Use the Laplace transform as tool to solve differential equations and Fourier integral representation
CLO 4	Apply Fourier integral to analyse the representation of functions in terms of frequency component.
CLO 5	Apply mathematical tools needed in evaluating vector calculus and their usage like Work, Circulation and Flux.
CLO 6	Use Multiple Integration technique to solve physical phenomena such as Area, Volume etc.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**UNIT 1 Higher order ordinary differential equations:** Ordinary differential equations of higher orders, Homogeneous Linear ODEs of Higher Order, Homogeneous Linear ODEs with Constant Coefficients, Euler–Cauchy equations, Nonhomogeneous ODEs, Method of Undetermined Coefficients, Solution by Variation of Parameters, Applications	8%	5
2	**UNIT 2 Power Series:** Power series solutions at ordinary point and regular singular point; Legendre polynomials, Bessel functions of the first kind and their property	15%	9
3	**UNIT 3 Laplace Transform:** Laplace Transform and inverse Laplace transform, Linearity, First Shifting Theorem (s-Shifting), Transforms of Derivatives and Integrals, ODEs, UNIT Step Function (Heaviside Function), Second Shifting Theorem (t-Shifting), Laplace transform of periodic functions, Short Impulses, Dirac's Delta Function, Convolution, Integral Equations, Differentiation and Integration of Transforms, Solution of ordinary differential equation by Laplace transform	25%	15
4	**UNIT 4 Fourier Integral:** Fourier Integral, Fourier Cosine Integral and Fourier Sine Integral	17%	10

5	**UNIT 5 Vector Calculus:** Gradient of scalar field, Directional Derivative, Divergence and curl of Vector field, Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.	**10%**	**6**
6	**UNIT 6 Multivariable Calculus (Integration):** Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Triple integrals (Cartesian)	**25%**	**15**

i. Text Book and Reference Book:

1. Calculus and Analytic Geometry (Textbook) By G.B. Thomasand R.L. Finney |Addison Wesley.
2. Calculus with early transcendental functions By James Stewart | Cengage Learning.
3. Higher Engineering Mathematics By B.S. Grewal | Khanna Publications.
4. Elementary Linear Algebra (Textbook) By Howard Anton, Chris Rorres| Willy India Edition|9th Edition.
5. Advanced Engineering Mathematics (Textbook) By Erwin Kreyszig | Willey India Education
6. A text book of Engineering Mathematics By N.P. Bali and Manish Goyal | Laxmi Publications

(7)

a. **Course Name:** Advanced Communication & Technical Writing
b. **Course Code:** 303193152
c. **Prerequisite:** Knowledge of English language studied till 12th standard.
d. **Rationale:** Communication confidence laced with knowledge of English grammar is essential for all engineers.
e. **Course Learning Objective:**

CLOBJ 1	Develop students' ability to actively listen and comprehend spoken content.
CLOBJ 2	Enable students to identify and correct errors in language usage, specifically focusing on tenses, voices, and reported speech.
CLOBJ 3	Equip students with the knowledge and skills to structure various types of speeches, including welcome/introductory, vote of thanks, and farewell speeches.
CLOBJ 4	Instil confidence in students to overcome stage fright, prepare compelling

f. **Course Learning Outcomes:**

CLO 1	Employ the four basic language skills listening, speaking, reading, and writing in structured academic and real-world communication contexts
CLO 2	Construct grammatically correct and error-free sentences for effective written and spoken communication.
CLO 3	Develop and deliver professional presentations effectively while building confidence to engage audiences.
CLO 4	Apply critical thinking skills to analyze and solve problems
CLO 5	Compose various types of written communication such as emails, reports, proposals, and technical documents for academic and professional purposes.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
0	**2**	**0**	**2**	**-**	**100**	**-**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	**Developing Effective Listening Skills**: To help students understand the meaning and importance of good listening skills, learning the traits of being a good listener through activity and listening audio tracks.	**10%**	**2**
2	**Error analysis**: To provide insights into the complicated processes of language development as well as a systematic way for identifying, describing and explaining errors. (Tenses, Voices, Reported speech)	**10%**	**4**
3	**Delivering different types of speeches:**: Students will understand and use the different patterns for structuring speeches • Welcome / Introductory speech • Vote of Thanks speechesFarwell speeches	**10%**	**2**
4	**Professional Pesentations**: • Combating stage fright • Preparing power point presentation • Delivering PPT	**10%**	**5**
5	**Essay writing**: Students will overcome the common pitfalls in the task of essay writing by understanding • Basics of Paragraph development and paragraph jumble • Types of essays • Characteristic features of essays • Guiding Principles	**10%**	**4**
6	**Reading Comprehension**: • Employing Different Reading Skills • Activity • Practice	**10%**	**2**
7	**Project Proposal**: To equip students with the various elements required to prepare a winning proposal.	**5%**	**2**
8	**Misplaced Modifiers**: Students will understand how to place the improperly separated word, phrase or clause from the word it describes.	**5%**	**1**
9	**Movie Review**: • A movie show followed by writing a review.	**10%**	**2**

	• To provide an exposure to students how to express their opinions about some film or documentary with unbiased and objective approach.		
10	**Narrative Writing**: • Narrative writing helps them explore different characters and settings. • To help students clarify their thinking, and teach them to express that in writing in an organized way.	**5%**	**2**
11	**Writing Reports**: • Process of writing • Order of writing • Final draft & checklist for reports • Sample reports: **1.** Memorandum **2.** Letter report	**10%**	**2**
12	**Critical Thinking**: • Need, relevance and Significance of Critical Thinking • Logic in problem solving and decision making(activities) • Moral Reasoning (Case Studies)	**5%**	**1**
13	**Activity Session (Presentation)** • An activity where the scene of a press conference is created in the class. • Students are encouraged to ask sharp questions and in turn are invited to assume roles of famous personalities, thus answering the questions posed.	**0%**	**1**

i. Text Book and Reference Book:

1. Business Correspondence and Report Writing By SHARMA, R. AND MOHAN, K.
2. Communication Skills By Kumar S and Lata P | New Delhi Oxford University Press.
3. Practical English Usage By MICHAEL SWAN.
4. A Remedial English Grammar for Foreign Student By F.T. WOOD.
5. On Writing Well By William Zinsser | Harper Paperbacks,2006 | 30th anniversary edition
6. Oxford Practice Grammar By John Eastwood | Oxford University Press
7. Technical Communication: Principles And Practice By Sangeetha Sharma, Meenakshi Raman | Oxford University Press

Semester 3

(1)

a. **Course Name:** Material Testing and Evaluation
b. **Course Code:** 303104201
c. **Prerequisite:** Basic Civil engineering knowledge.
d. **Rationale:** This subject deals with judicious selection of materials, mixed proportioning & proper workmanship so as to result in durable concrete.
e. **Course Learning Objective:**

CLOBJ 1	Develop students' ability to actively listen and comprehend spoken content.
CLOBJ 2	Enable students to identify and correct errors in language usage, specifically focusing on tenses, voices, and reported speech.
CLOBJ 3	Equip students with the knowledge and skills to structure various types of speeches, including welcome/introductory, vote of thanks, and farewell speeches.
CLOBJ 4	Instil confidence in students to overcome stage fright, prepare compelling

f. **Course Learning Outcomes:**

CLO 1	Classify various engineering materials used in construction.
CLO 2	Explain the composition and functions of cement and concrete ingredients used in construction practices.
CLO 3	Describe the behavior of concrete at early stages and in its hardened state, and factors affecting its performance.
CLO 4	Apply principles of mix design and proportioning to achieve desired concrete properties in structural applications.
CLO 5	Explain basic material testing techniques for evaluating concrete and construction materials.
CLO 6	Evaluate the role of non-destructive testing (NDT) methods in assessing the condition of existing concrete structures.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
2	**0**	**0**	**2**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION TO ENGINEERING MATERIALS** Overview of materials, Selection of material, importance and Classification of materials in civil engineering construction. Engineering Materials such as Cements, Sand, Concrete (plain, reinforced and steel fiber / glass fiber reinforced, light weight concrete, high Performance Concrete, Polymer Concrete) Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics, Structural Steel and other Metals, Paints and Varnishes, Acoustical Material and geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties and uses.	**20%**	**8**
2	**BASICS of CONCRETE** Types of Concrete, Statistics of recent cement industry, Major companies involved in GDP, Units of measurement. Cement Ingredients: Chemical Composition Manufacturing Process - Dry Process, Wet Process and Semi-Dry Process, Properties of cement, Hydration of cement, Tests on cement Aggregates Characteristics and their Significance, Admixtures Nomenclature, Specifications and Classifications, Water General requirements & limiting values of impurities. Concrete at Early Stage: Batching of ingredients; mixing, transport, and placement. Consolidation, finishing, and curing of concrete; initial and final set - significance and measurement. Workability of concrete and its measurement. Hardened Concrete: Strengths of hardened concrete, standard test methods as per IS and ASTM	**30%**	**16**
3	**MECHANICAL TESTING AND TESTING PROCEDURES** Classification of material testing, Purpose of testing, Development of testing, testing organizations and its committee, Testing standards, Result Analysis, and Advantages of testing. Mechanical testing of various metals; naming systems for various irons, steels and nonferrous metals; elastic deformation; plastic deformation. Impact test and transition temperatures;	**30%**	**16**

	fracture mechanics background; fracture toughness-different materials; Fatigue of material; Creep. Tests & testing of bricks, Tests & testing of sand, Tests & testing of concrete, Tests & testing of soils, Tests & testing of bitumen & bituminous mixes.		
4	**NON-DESTRUCTIVE TESTING** Destructive, semi-destructive & Non-destructive testing methodology. Problems faced during Non-destructive evaluation Rebound Hammer test, Ultra-sonic pulse velocity, Penetration tests, Pull out tests, Electrochemical Methods, Tomography of Reinforced Concrete Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.	**20%**	**8**

i. Text Book and Reference Book:

1. National Building Code of India' Government of India
2. Concrete microstructure, Properties and materials By P Kumar Mehta and Paulo J.M.Monterio
3. Building construction Handbook By Roy Chudley and Roger Greeno
4. Concrete Technology (TextBook) By M.L.Gambhir | Tata McGraw Hill Ltd.
5. Concrete Technology (TextBook) By M.S. Shetty
6. Building Services Handbook' (TextBook) By Roger Greeno and Fred Hall | Routledge

(2)

a. **Course Name:** Material Testing and Evaluation Laboratory
b. **Course Code:** 303104202
c. **Prerequisite:** Basic Civil engineering knowledge.
d. **Rationale:** This subject deals with judicious selection of materials, mixed proportioning & proper workmanship so as to result in durable concrete.
e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of the significance of tests such as fineness, consistency, and soundness in assessing the quality of cement, crucial for ensuring the durability and strength of concrete structures.
CLOBJ 2	Gain hands-on experience in conducting various tests, including compressive strength, sieve analysis, and workability measurements, fostering practical skills in laboratory procedures and equipment handling.
CLOBJ 3	Learn to analyze and interpret test results accurately, connecting laboratory findings to the performance characteristics of cement and concrete, and making informed decisions based on these assessments.
CLOBJ 4	Acquire knowledge and skills related to quality assurance and control practices in the construction industry, with a focus on using test results to ensure that construction materials meet industry standards and specifications.
CLOBJ 5	Explore the application of test results in real-world scenarios, including the selection of appropriate cement types for specific construction projects, troubleshooting issues related to concrete quality, and making recommendations for improvements based on test outcomes.

f. **Course Learning Outcomes:**

CLO 1	Identify various engineering materials used in construction through physical inspection and classification in a laboratory setting.
CLO 2	Analyze the composition and functions of cement and concrete ingredients using practical lab-based evaluations.
CLO 3	Analyze the behavior of concrete at early and hardened stages based on observations from laboratory experiments.
CLO 4	Design concrete mixes and proportions to achieve specific properties using standard mix design procedures in lab settings.
CLO 5	Demonstrate basic material testing techniques for evaluating the quality and performance of concrete and construction materials.
CLO 6	Assess the condition of existing concrete structures using non-destructive testing (NDT) methods in practical applications.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	4	2	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Determination of the Fineness of cement
2	Determination of Standard Consistency of Cement Paste
3	Determination of Initial and Final Setting Time of Ordinary Portland Cement
4	Determination of Soundness of Cement with the Le-Chatelier Apparatus
5	Determination of Compressive Strength of Cement
6	Sieve Analysis of Course and Fine Aggregates
7	Aggregate Crushing Value
8	Flakiness Index and Elongation Index of Course Aggregate
9	To Measure the Workability of the Concrete by Slump Method
10	To Measure the Workability of the Mix by Using Compaction Factor Apparatus

i. Text Book and Reference Book:

1. National Building Code of India' Government of India
2. Concrete microstructure, Properties and materials By P Kumar Mehta and Paulo J.M.Monterio
3. Building construction Handbook By Roy Chudley and Roger Greeno
4. Concrete Technology (TextBook) By M.L.Gambhir | Tata McGraw Hill Ltd.
5. Concrete Technology (TextBook) By M.S. Shetty
6. Building Services Handbook' (TextBook) By Roger Greeno and Fred Hall |

Routledge

(3)

a. **Course Name:** Construction Technology
b. **Course Code:** 303104203
c. **Prerequisite:** Knowledge of Basic Civil Engineering.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all engineers.
e. **Course Learning Objective:**

CLOBJ 1	Gain a solid understanding of the fundamental principles of construction practices, including safety, quality, and efficiency.
CLOBJ 2	Gain a comprehensive understanding of different types of foundations, with a specific focus on deep and heavy foundations.
CLOBJ 3	Understand the classification of construction materials based on their properties, composition, and application.
CLOBJ 4	Understand the basic principles underlying groundwater movement, including concepts such as permeability, porosity, and hydraulic conductivity.
CLOBJ 5	Develop a comprehensive understanding of various structural elements in construction, including walls, slabs, beams, columns, and arches.
CLOBJ 6	Familiarize participants with a broad range of construction equipment commonly used in the industry.

f. **Course Learning Outcomes:**

CLO 1	Explain the methods of excavation and foundation construction used in various soil conditions and project types.
CLO 2	Describe the types, techniques, and standards of masonry construction with respect to material selection and structural performance.
CLO 3	Analyze the functions and construction techniques of caissons and cofferdams in underwater and foundation works.
CLO 4	Select the appropriate formwork based on design and safety considerations.
CLO 5	Evaluate the use of construction equipment and diaphragm wall construction in large-scale infrastructure projects.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION** Overview of construction practices, theory and methods. Overview of construction practices, theory and methods.	10%	2
2	**EXCAVATION & FOUNDATION** Excavation methods − Manual & Mechanized, shoring and strutting for lateral retainment of soil. Building foundations − Objectives and Types (Deep and Shallow foundations).	15%	4
3	**MASONRY CONSTRUCTION** Types of masonry constructions, materials for masonry construction, bonds in masonry constructions, construction of masonry walls, lintels (chajja), arches & roofs.	10%	3
4	**CAISSONS & COFFER DAMS** **CAISSONS:** Definition, uses, construction material, types of caissons, loads on caisson, design features of caissons, floating of caissons, cutting edges, sinking of caisson, tilting of caisson, shifting of caisson, caisson diseases. **COFFER DAMS:** Definition, uses, selection of coffer dams, types of coffer dams, design features of coffer dams, leakage prevention, economic height	15%	6
5	**CONTROL OF GROUND WATER IN EXCAVATIONS** Methods-pumping, well points, bore wells, electro-osmosis, injections with cement, clays and chemical, freezing process, vibro- flotation	15%	3
6	**FORM WORK** Form works for R.C.C. Wall, slab, beam and column, centering for arches of large spans and dams, design features for temporary works, slip formwork, False work for Bridges	15%	4
7	**CONSTRUCTION EQUIPMENT** **Introduction to Construction Equipment**: Their contribution and importance in the construction Industry. Classification of Equipment, Depreciation, Cost of owning and operating construction equipment, Basics of equipment replacement policy, performance of IC engines, rimpull, drawbar pull, Coefficient of traction,	22%	8

	Gradability. **Equipment:** Tractors and related equipment: Bulldozers, Rippers, Scrapers. Excavating Equipment: Power Shovels, Draglines, Hoes, Clam Shells and trenching machines, their basic Parts, Operation, Factors influencing output and methods to enhance it. Belt conveyor system: Terminology, Classification, Components, Power requirement estimation and design. Hauling equipment: Trucks and wagons, operation and guideline for selection and deployment.		

i. Text Book and Reference Book:

1. Construction Technology, By Chudley and Greeno
2. Advanced Construction Technology, By Roger Greeno, R. Chudley, Mike Hurst, Simon Topliss
3. Construction Planning, Equipments and Methods, By R.L. Peurifoy and W.B. Ledbetter | McGraw-Hill Publishers
4. Fluid mechanics & hydraulic Machines, By R.K.Bansal | Lakhsmi publication
5. Introduction to Fluid Mechanics, By Fox, Pritchard and McDonald | John Wiley & Sons
6. Engineering Fluid Mechanics, By D. S. Kumar | S K KATARIA & SONS-NEW DELHI
7. Hydraulics and fluid mechanics including Hydraulic machines, By Modi P.N. and Seth S.M.
8. Fluid mechanics & hydraulic machines, By S.C. Gupta | PERSON Education
9. Fluid Mechanics and Hydraulic Machines, By Dr. R K. Bansal | Laxmi Publications
10. Building Construction, By S.P.Arora, S.P Bindra | Dhanpat Rai Publications

(4)

a. **Course Name:** Introduction to Solid Mechanics
b. **Course Code:** 303104207
c. **Prerequisite:** Knowledge of the Mechanics of Solids.
d. **Rationale:** This subject deals with conceptual applications of principles of mechanics of rigid and deformable bodies.
e. **Course Learning Objective:**

CLOBJ 1	Describe the mechanical behaviour of engineering materials subjected to various types of stresses and compute the resulting strain and strain energy.
CLOBJ 2	Analyse the bending of various types of beams under static loading conditions and compute the shear stress distribution for different cross sections of beams.
CLOBJ 3	Understand that how knowledge of principal planes, stresses and strains and analyse the elastic deformation of members and apply different theories of elastic failures.
CLOBJ 4	Compute the torsion for the circular shaft and analyse the crippling load and equivalent length for various types of columns of different end conditions.
CLOBJ 5	Demonstrate and Compute the deflection of beams and shafts under static loading and stresses in thin walled cylindrical and spherical vessels.

f. **Course Learning Outcomes:**

CLO 1	Determine Principal Stresses and Strains to locate Principal Planes.
CLO 2	Determine displacements of statically determinate structures.
CLO 3	Calculate stresses due to axial & eccentric loading.
CLO 4	Describe buckling load for columns & struts with different end conditions.
CLO 5	Demonstrate principles of statics to determine reactions & internal forces in statically determinate structures.
CLO 6	Examine Bending Stresses on Extreme fibers of the Beam

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Principal Stress and Strain Principal planes**: Principal stresses and principal strains, Analytical and graphical method (Mohr's circle) for finding normal and shear stress on an oblique section of a body subjected to direct and shear stresses, Determination of principal stresses and location of principal planes, maximum shear stress and location of plane of maximum shear. **Shear Stresses in beam:** Introduction and derivations of shear stress, shearing stress at any layer in a loaded beam, shear stress distribution of a rectangular section, circular section, I-section, T-section and triangular section.	**5%**	**2**
2	**Bending Stresses in Beam Introduction**, Assumptions and derivations of theory of simple bending, position of neutral axis, moment of resistance, distribution of bending moment across the section modulus of section, bending stress in symmetric sections, unsymmetrical sections **Direct and bending stress**: Introduction, eccentric loading, column with eccentric loading, symmetrical column with eccentric loading about one axis and two axes, limit of eccentricity, kernel of a section, structures subjected to lateral pressure.	**5%**	**2**
3	**Truss** Classification of truss, Perfect and Imperfect truss, analysis of pin- jointed perfect truss using method of joints and method of sections.	**10%**	**4**
4	**Deformation of Beams** Introduction to type of structures: static and kinematic indeterminacy, Elastic curve, relationship of slope deflection with radius of curvature, bending moment, shear force and load intensity, methods of finding slope and deflection at any section of beam by Macaulay's method, Moment area method, Conjugate beam method	**12%**	**5**
5	**Fundamentals of Statically Determinate Structures** Types of statically determinate & indeterminate structures, static and kinematic indeterminacy, stability of structures, principle of superposition, Maxwell's	**12%**	**6**

	reciprocal theorems. Computation of internal forces in statically determinate structures such as plane truss, plane frame, grids.		
6	**Columns and Struts** Buckling of columns, different end conditions, effective length, least radius of gyration, Euler's and Rankine's formulae, columns with initial curvature, eccentrically loaded columns, columns with lateral loading.	**6%**	**2**
7	**Strain Energy** Resilience, strain energy due to axial loads & flexure, proof resilience, modulus of resilience, impact loads, and sudden loads	**5%**	**2**

i. Text Book and Reference Book:

1. Structural Analysis, By Hibbler R C | Pearson Education
2. Intermediate Structural Analysis, By Wang C. K.
3. Engineering Mechanics of Solids, By Popov E.P
4. 'Strength of Materials' , By R.S Khurmi | S. Chand
5. Strength of Materials, By Ryder G.H
6. Mechanics of Structures Vol-I, By Junarkar S.B. and Shah H.J.

(5)

a. **Course Name:** Introduction to Solid Mechanics Laboratory
b. **Course Code:** 303104208
c. **Prerequisite:** Basic Civil engineering knowledge.
d. **Rationale:** This subject deals with judicious selection of materials, mixed proportioning & proper workmanship so as to result in durable concrete.
e. **Course Learning Objective:**

CLOBJ 1	Develop a strong foundation in the principles and methods used to determine displacements in statically determinate structures, enabling students to analyze and predict how structures deform under different loading conditions.
CLOBJ 2	Acquire the skills to calculate and interpret stresses in structural elements subjected to axial and eccentric loading, understanding the impact of loading eccentricity on the behavior of materials and structures.
CLOBJ 3	Understand the concept of buckling and its significance in the stability of columns and struts with various end conditions, enabling students to calculate critical buckling loads and make informed decisions about structural design.
CLOBJ 4	Develop the ability to determine principal stresses and strains in materials under different loading conditions, and learn how to locate principal planes, providing insights into the material's behavior and aiding in the design process.
CLOBJ 5	Gain proficiency in calculating and analyzing bending stresses on extreme fibers of beams, considering different loading configurations and support conditions, and understanding the factors that influence the structural integrity of beams.

f. **Course Learning Outcomes:**

CLO 1	Analyze principal stresses and strains to locate principal planes through practical experimentation and data interpretation.
CLO 2	Measure displacements of statically determinate structures using appropriate laboratory equipment and techniques.
CLO 3	Compute stresses due to axial and eccentric loading through hands-on experiments and calculations.
CLO 4	Evaluate buckling loads for columns and struts with different end conditions using lab-based tests and observations.
CLO 5	Apply principles of statics to determine reactions and internal forces in statically determinate structures using physical models or simulations.
CLO 6	Investigate bending stresses on extreme fibers of a beam through experimental setups and data analysis.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Determine displacements of statically determinate structures
2	Determine stresses due to axial & eccentric loading
3	Determine buckling load for columns & struts with different end conditions
4	Determine Principal Stresses and Strains also to locate Principal Planes
5	Determine Bending Stresses on Extreme fibers of the Beam
6	Analysis of Truss

i. Text Book and Reference Book:

1. Structural Analysis, By Hibbler R C | Pearson Education
2. Intermediate Structural Analysis, By Wang C. K.
3. Engineering Mechanics of Solids, By Popov E.P
4. 'Strength of Materials' , By R.S Khurmi | S. Chand
5. Strength of Materials, By Ryder G.H
6. Mechanics of Structures Vol-I, By Junarkar S.B. and Shah H.J.

(6)

a. **Course Name:** Introduction to Fluid Mechanics
b. **Course Code:** 303104205
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all engineers.
e. **Course Learning Objective:**

CLOBJ 1	Identify and recall fundamental fluid properties like viscosity, density, and pressure.
CLOBJ 2	Interpret pressure distribution in various fluid systems and its implications on flow.
CLOBJ 3	Apply fluid mechanics principles to solve problems involving fluid flow in pipes
CLOBJ 4	Analyze and compare different flow scenarios, evaluating the impact of changes in fluid properties or system geometry on flow behavior.
CLOBJ 5	Assess the validity of experimental results obtained from flow measurements and compare them with theoretical predictions.
CLOBJ 6	Critique and propose improvements to existing engineering designs or systems based on fluid mechanics principles.

f. **Course Learning Outcomes:**

CLO 1	Classify fluids and understand their behavior in solving practical fluid flow problems.
CLO 2	Analyze fluid pressure and hydrostatic forces on immersed surfaces using manometers and pressure equations to ensure structural safety and design accuracy.
CLO 3	Differentiate various types of fluid flow and flow lines using continuity equation and flow nets to visualize and solve real-life fluid flow scenarios.
CLO 4	Interpret laminar flow behavior in pipelines and closed conduits by applying Bernoulli's and Euler's equations to predict energy loss and flow efficiency.
CLO 5	Select flow measuring devices to measure discharge and velocity in civil and hydraulic systems.
CLO 6	Evaluate the force exerted by fluid jets on vanes using momentum principles to design hydraulic machines and energy transfer devices.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Fundamental Concepts of Fluid Flow Hydraulics, Fluid Mechanics; Importance of fluid mechanics; Classification of fluids: Ideal and rear fluid; Fluid properties: Density, Specific gravity, Viscosity, Thermodynamic properties, Surface tension and capillarity, Compressibility and bulk modulus, Vapour pressure	15%	6
2	Fluid Pressure & hydrostatic forces on surface Pressure of a fluid; Pressure head of a liquid; Pascal's law; Hydrostatic pressure and distribution; Absolute and Gauge pressure; Measurement of pressure: Manometers, Simple manometer, Differential manometer, Merits and Demerits of manometers, Total pressure and center of pressure; Horizontally immersed surface; Vertically immersed surface; Inclined immersed surface; Curved immersed surface.	15%	8
3	Fluid Kinematics Fluid motion : Langrangian method , Eularian method ; Types of fluid flow : Steady and unsteady flows , Uniform and non-uniform flows , One – two and three dimensional flows , Rotational and irrotational flows , Laminar and turbulent flows , Compressible and incompressible flows ; Types of flow lines : Path line , Stream line , Stream tube , Streak line ; Rate of flow of discharge ; Continuity equation : in Cartesian coordinates , in Polar coordinates ; Velocity potential and stream function; Flow nets : Method of drawing the flow nets , Uses and limitations of flow nets.	15%	8
4	Fluid Dynamics & Laminar Flow Different types of energies of a liquid in motion; Bernoulli's equation;	20%	12

	Bernoulli's equation for real fluid; Euler's equation for motion, Reynold's experiment; Navier Stokes equation of motion; Relationship between shear stress and pressure gradient; Hagen Poiseuille law.		
5	Introduction to Flow Measurement of Discharge -venturi meter, Orifice meter, Nozzle meter, Rotameter. Measurement velocity-pitot tube. Orifice Classification. Flow through reservoir opening i.e., orifice, trajectory of free jet, hydraulic coefficients, small and large orifice, Time of emptying a tank with orifice. Mouthpiece classification, External cylindrical mouthpiece, convergent-divergent mouthpiece, Borda's Mouthpiece. Nothces and weirs discharge over the rectangular notch and triangular notch. Velocity of approach, End contraction. Cipolletti notch. Time Emptying a Tank with notch or weir, ventilation of weir, sutro weir.	**15%**	**7**
6	Impact of free Jets Impact of a jet on a flat or a curved vane, moving and stationary vane	**10%**	**3**

i. Text Book and Reference Book:

1. A Text Book of Hydraulics, Fluid Mechanics and Hydraulic Machines (TextBook) By Khurmi R .S. | S. Chand & Company Limited, New Delhi, Pub. Year 1970
2. Introduction to Fluid Mechanics By R.W. Fox A.T Mac Donald and P.J. Pritchard | Wiley
3. Engineering Fluid Mechanics By D. S. Kumar | S K KATARIA & SONS-NEW DELHI
4. Hydraulics and Fluid Mechanics Modi P.N, Seth S.M.; Standard Book House
5. Fluid Mechanics By Fox, McDonald, Pritchard | Wiley
6. Hydraulics and fluid mechanics including Hydraulic machines By Modi P.N. and Seth S.M..

(7)

a. **Course Name:** Introduction to Fluid Mechanics Laboratory
b. **Course Code:** 303104206
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Acquire hands-on experience in conducting experiments to measure velocity, discharge, meta-centre, meta-centric height, and hydraulic coefficients, developing proficiency in using equipment such as orifice meters, Venturi meters, and notches.
CLOBJ 2	Learn to analyze and interpret experimental results related to fluid forces and moments, with a focus on the practical implications of meta-centre determination, center of pressure, and hydraulic coefficients for engineering applications.
CLOBJ 3	Explore the practical applications and limitations of Bernoulli's theorem by conducting experiments to verify its principles, emphasizing its importance in understanding fluid behavior in pipes, nozzles, and other fluid flow systems.
CLOBJ 4	Gain proficiency in calibrating flow measuring devices such as Venturi meters, orifice meters, and notches, and understand the importance of accurate calibration for precise measurement and control of fluid flow in engineering projects.

f. **Course Learning Outcomes:**

CLO 1	Measure and calibrate discharge and velocity using flow measuring devices such as venturimeter, orifice meter, and notches to ensure accurate flow measurements in water management systems.
CLO 2	Identify flow types through experiments such as Reynolds apparatus and fluid property observation to understand flow regimes for practical hydraulic applications.
CLO 3	Evaluate the stability of floating bodies by measuring meta-centric height to ensure safe and effective design of waterborne structures.
CLO 4	Verify Bernoulli's theorem using Bernoulli apparatus to demonstrate energy conservation in steady fluid flow systems.
CLO 5	Analyze hydrostatic pressure forces using center of pressure apparatus to support the design of submerged surfaces in hydraulic structures.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Determination of Velocity & Discharge
2	Study Characteristics of Laminar and Turbulent flows (Reynold's experiment)
3	Determination of Meta-centre and Meta-centric Height
4	Verification of Bernoulli Theorem
5	Determination of the centre of pressure
6	Determine Hydraulic coefficients of a small circular orific
7	Calibration of flow measuring devices (Venturi meter, Orifice meter)
8	Calibration of Rectangular and V notch

i. Text Book and Reference Book:

1. Fluid Mechanics & Hydraulics Machines By R. K. Bansal | Laxmi Publications
2. Fluid Mechanics By Fox, McDonald, Pritchard | Wiley
3. Engineering Fluid mechanics By D. S. Kumar | S K KATARIA & SONS-NEW DELHI
4. Engineering Fluid mechanics By K. L. Kumar | S. Chand Limited
5. Introduction to Fluid Mechanics By S. K. Som and G. Biswas | Tata McGraw Hill

(8)

a. **Course Name:** Advanced Engineering Mathematics
b. **Course Code:** 303191201
c. **Prerequisite:** Knowledge of Mathematics up to 12th science level.
d. **Rationale:** This course helps to enhance students' understanding of advanced mathematical concepts, such as differential equations and vector calculus, for career paths in engineering.
e. **Course Learning Objective:**

CLOBJ 1	Develop a solid understanding of mathematical foundations, including probability spaces, random variables, and key probability distributions such as Binomial, Poisson, and Normal distributions.
CLOBJ 2	Master the solution techniques for first-order partial differential equations using Charpit's method. Skillfully solve second and higher-order linear and non-linear PDEs, including applications to real-world problems.
CLOBJ 3	Analyze correlation and regression to model relationships between variables. Apply the method of least squares for effective curve fitting of linear, quadratic, and more general curves.
CLOBJ 4	Implement numerical methods such as Gauss-Jacobi and Gauss Seidel for solving systems of linear equations. Solve algebraic and transcendental equations using Bisection, Newton-Raphson, and Regula-Falsi methods. Explore finite differences, interpolation, and numerical integration techniques.
CLOBJ 5	Apply numerical methods, including Taylor's series, Euler's method, Modified Euler's method, and the Runge-Kutta method, for solving ordinary differential equations. Develop proficiency in modeling and solving dynamic systems.
CLOBJ 6	Formulate and model practical problems using mathematical techniques, emphasizing the application of PDEs to describe physical phenomena. Demonstrate the ability to translate real-world problems into mathematical equations and solve them effectively.

f. **Course Learning Outcomes:**

CLO 1	Formulate partial differential equations to model given physical problems.
CLO 2	Solve differential equations by applying the definition and properties of Z–Transform and inverse Z – Transform.
CLO 3	Solve System of Linear Equations, Roots of Algebraic and Transcendental Equations by applying a suitable numerical method.
CLO 4	Estimate value of dependent variable for given value of dependent variable based on given set of values using interpolation.
CLO 5	Evaluate definite integrals and boundary/initial value problem using a suitable numerical method.

CLO 6	Analyse correlation and regression between two variables and fit a curve to the given set of values.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
4	0	0	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Probability and Probability Distributions:** Probability Spaces, Conditional Probability, Bayes' Rule, Discrete and Continuous Random Variables, Independent Random Variables, Expectation and Variance of Discrete and Continuous Random Variables, Distribution and Their Properties: Binomial Distribution, Poisson Distribution, Normal Distribution	23%	13
2	**Partial Differential Equations:** First order partial differential equations, solutions of first order linear and nonlinear PDEs, Charpit's Method Solution to homogeneous and nonhomogeneous linear partial differential equations second and higher order by complementary function and particular integral method. Separation of variables method to simple problems in Cartesian coordinates, second-order linear equations and their classification, Initial and boundary conditions, Modeling and solution of the Heat, Wave and Laplace equations.	29%	17
3	**Correlation, Regression and Curve Fitting:** Correlation and Regression – Rank correlation Curve Fitting by The Method of Least Squares- Fitting of Straight Lines, Second Degree Parabolas and More General Curves	15%	9
4	**Solution of a System of Linear Equations, Roots of Algebraic and Transcendental Equations:**	11%	7

	Gauss-Jacobi and Gauss Seidel Methods, Solution of Polynomial and Transcendental Equations – Bisection Method, Newton-Raphson Method and Regula-Falsi Method		
5	**Finite Differences and Interpolation:** Finite Differences, Relation between Operators, Interpolation using Newton's Forward and Backward Difference Formulae. Newton's Divided and Lagrange's Formulae for Unequal Intervals.	**11%**	**7**
6	**Numerical Integration:** Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ Rules **Numerical solution of Ordinary Differential Equations:** Taylor's Series, Euler and Modified Euler's Methods. Runge-Kutta Method of Fourth Order for Solving First Order Equations.	**11%**	**7**

i. Text Book and Reference Book:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Willey India Edition.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2010.
3. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003 (Reprint).
4. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall, 1998.
5. Manish Goyal and N.P. Bali, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.

(9)

a. **Course Name:** Product Realisation
b. **Course Code:** 303104210
c. **Prerequisite:** Knowledge of Fundamental of Civil Engineering.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all engineers.
e. **Course Learning Objective:**

CLOBJ 1	Explain the phases of product development, from ideation to design, construction, and maintenance, emphasizing their significance in civil engineering projects.
CLOBJ 2	Apply fundamental design principles and methodologies to create innovative and sustainable solutions for civil engineering products, considering structural integrity, environmental impact, and societal needs.
CLOBJ 3	Evaluate materials and their properties to make informed decisions in selecting suitable materials for specific civil engineering applications, considering durability, cost-effectiveness, and environmental impact.
CLOBJ 4	Demonstrate proficiency in project management techniques, including scheduling, budgeting, risk assessment, and quality control, to efficiently oversee product realization processes in civil engineering.
CLOBJ 5	Utilize prototyping tools and testing methodologies to assess the viability and performance of prototypes in civil engineering projects, enabling iterative improvements before full-scale implementation.
CLOBJ 6	Engage in collaborative teamwork, integrating diverse perspectives from various disciplines to address complex challenges encountered during the realization of civil engineering products, fostering effective communication and problem-solving skills.

f. **Course Learning Outcomes:**

CLO 1	Develop group working, including task sub-division and integration of individual contributions from the team.
CLO 2	Explain the importance of Design Thinking in fostering innovation, entrepreneurship, and societal solutions using various learning tools.
CLO 3	Perform various tasks like market survey, industrial visits, use creative and innovative techniques, etc to identify project
CLO 4	Develop sense of Environmental responsibility.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Design Conceptualization and Philosophy, Original, Adaptive, Variant and Re-Design, Evolution of Concept, Need for Systematic design Past methods of and design.
2	Product life cycle, Innovation, Types of innovation
3	Needs and opportunities, Vision and Mission of a concept, Type of needs, Technology S - curve, Need analysis, market analysis and competitive analysis, Kano Diagrams, SWOT analysis
4	Conceptualization techniques Idea generation ideation, brainstorming, Trigger session
5	Brainwriting, Mind maps, SCAMPER, Shape mimicry, Familiarity Matrix
6	Concepts screening, Concept testing - exploratory tests, Assessment tests, Validation tests Comparison tests - Case studies
7	Organization of design concept and design methods, Engineering Design - Descriptive and prescriptive model, Design decisions, and development of the design.
8	Group work and case studies

(10)

a. **Course Name:** Professional Communication Skills
b. **Course Code:** 303193203
c. **Prerequisite:** Knowledge of English language in practical life.
d. **Rationale:** Knowledge and application of English, Aptitude and Management Skills are crucial for better employability as well as professionalism.
e. **Course Learning Objective:**

CLOBJ 1	Demonstrate the ability to communicate clearly and persuasively in oral presentations.
CLOBJ 2	Practice active listening techniques to enhance understanding in professional interactions.
CLOBJ 3	Write professional emails, memos, and reports with clarity and conciseness.
CLOBJ 4	Understand and practice professional etiquette in various business settings.
CLOBJ 5	Demonstrate skills in resolving conflicts and negotiating effectively.
CLOBJ 6	Use digital communication tools and platforms effectively.

f. **Course Learning Outcomes:**

CLO 1	demonstrate advanced communication skills by expressing ideas clearly, adapting language to diverse audiences, and participating effectively in collaborative discussions and presentations.
CLO 2	produce formal written texts such as reports, emails, and proposals, using appropriate tone, structure, and language conventions.
CLO 3	apply interpersonal communication skills to collaborate effectively and enhance productivity in workplace settings.
CLO 4	achieve personal and academic goals by applying effective time management strategies.
CLO 5	use appropriate vocabulary to communicate ideas clearly and appropriately in diverse situations.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
0	**2**	**0**	**2**	**-**	**100**	**-**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Technical Writing: Email etiquette & Email writing Letter Writing (Types of Letters & Layout)**: • Trains students on detailed email and letter writing etiquette. • Students will be able to write formal letters following certain stipulated formats. • They will learn different types of letters for different official purposes.	**10%**	**4**
2	**Interpersonal Communication at Workplace: Dynamics of communication**: • To develop the confidence to handle a wide range of demanding situation more effectively at the workplace • To enable the students to analyse their own interpersonal communication style.	**10%**	**2**
3	**Debate: The three minute debate planner**: • To enable the students to generate effective critical thinking into primary issues in the given topic. • Students will be able to resolve controversies and recognize strengths and weaknesses of arguments.	**10%**	**4**
4	**Goal setting & Tracking**: ● To enable the students to define strategies or implementation steps to attain the identified goals and make progress every day.	**10%**	**2**
5	**Time Management & Task Planning (Case –study)**: • To enable the students to identify their own time wasters and adopt strategies to reduce them. • To enable students to clarify and priorities their objective and goals by creating more planning time	**5%**	**2**
6	**Reading Comprehension: Intermediate level**: • To enable the students develop the knowledge, skills, and strategies they must possess to become proficient and independent readers	**5%**	**2**
7	**Information design and writing for print and online media: Blog Writing**:	**5%**	**2**

	• To enable students to design information that is targeted to specific audiences in specific situation to meet defined objectives. • To create blogs and share their own knowledge and experience to the world.		
8	**Advanced vocabulary Building:** • The students will expand their vocabulary so as to enhance their proficiency in reading and listening to academic texts, writing, and speaking. • The students will attain vocabulary to comprehend academic and social reading and listening texts. • The students will develop adequate speaking skills to communicate effectively.	**10%**	**2**
9	**Picture Perception**: ● To prepare the students for a test for basic intelligence and IQ, generally done on the first day of SSB (Sashastra Seema Bal is one of India's Central Armed Police Forces)	**5%**	**1**
10	**Appreciation, Apology and Acknowledgement letters**: • To enable the students to maintain productive business relationship through different types of letters. • To enable the students to express their feelings without speaking out loud.	**10%**	**2**
11	**The Art of Negotiation**: • To enable the students to reach an agreement for mutual benefits through negotiation. • To enable the students to learn a process by which compromise or agreement is reached while avoiding argument and dispute.	**5%**	**2**
12	**Activity Session (Game of Truth)**: • To make the students think of significance of certain things in their life. • To make them share their thoughts and perception of matters in life, with others.	**0%**	**1**

i. Text Book and Reference Book:

1. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
2. Communication Skills Kumar S And Lata P; New Delhi Oxford University Press
3. Practical English Usage MICHAEL SWAN
4. A Remedial English Grammar for Foreign Student F.T. WOOD
5. On Writing Well William Zinsser; Harper Paperbacks,2006; 30th anniversary edition
6. Oxford Practice Grammar, John Eastwood; Oxford University Press
7. Quantitative Aptitude for Competitive Examinations Dr. R.S. Aggarwal.

Semester 4

(1)

a. **Course Name:** Hydraulic Engineering
b. **Course Code:** 303104251
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all engineers.
e. **Course Learning Objective:**

CLOBJ 1	Understanding the fundamental principles and equations governing open channel flow
CLOBJ 2	Understanding the concepts of water flow, forces leading to water flux and jumps and solving related problems rate, velocity and depth of open flow channels.
CLOBJ 3	Applying various methods and techniques to calculate the hydraulic parameters of open channel flow, such as Manning's equation and the Chezy equation and dimensional analysis.
CLOBJ 4	Evaluating the effects of different factors, such as channel slope, roughness, and cross-sectional shape, on the behavior of turbulent flow.
CLOBJ 5	Understanding the importance of environmental considerations and sustainability in managing open channel flow systems.

f. **Course Learning Outcomes:**

CLO 1	Apply flow formulas to analyze open channel behavior for efficient water conveyance design.
CLO 2	Evaluate non-uniform flow and hydraulic jumps to assess energy loss in flood and spillway systems.
CLO 3	Explain boundary layer properties to study flow separation for drag reduction in structures.
CLO 4	Analyze ideal fluid flow over bodies to determine lift and drag for hydraulic and aerodynamic design.
CLO 5	Use model laws and similitude to perform dimensional analysis for prototype prediction
CLO 6	Assess turbulent flow characteristics to compute velocity and resistance for pipe flow design.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Flow in Open Channel** Open channel and pipe flows; Chezy's formula for uniform flow; Velocity of flow in open channel; Most economical sections of channel, Open channel section for the constant velocity at all depths of flow, Specific energy and specific energy curve; Subcritical flow, critical flow, and supercritical flow	**15%**	**6**
2	**Non-uniform Flow through Open Channel** Gradually varied flow: Equation of gradually varied flow, Back water curve and afflux, Rapidly Varied Flow: Hydraulic jump, Height of hydraulic jump, Length of hydraulic jump; Loss of energy due to hydraulic jump	**20%**	**9**
3	**Boundary Layer Theory** Boundary layer characteristics: Boundary layer thickness, displacement thickness, Momentum thickness, Energy thickness; Momentum equation for boundary layer; Concept of Laminar and turbulent boundary layer, Boundary layer separation and its control.	**15%**	**6**
4	**Ideal Fluid Flow** Source & Sink, Force exerted by a flowing fluid on a body; Expressions for drag and lift; applications of Stoke's law; Drag on a cylinder; Circulation and lift on a circular cylinder: Concept of Flow patterns, development of lift, Position of stagnation points. Pressure at any point on the cylindrical surface, Expression for a lift on the cylinder; Expression for lift coefficient for rotating cylinder; Magnus effect; Lift on an aerofoil	**15%**	**6**
5	**Dimensional and Model Analysis** Dimensions; Dimensional homogeneity; Methods of dimensional analysis: Rayleigh's method, Buckingham's method, Limitations of dimensional analysis Model	**20%**	**9**

	analysis; Similitude; Forces influencing hydraulic phenomena; Dimensional numbers and their significance: Reynolds number, Froude number, Euler number, Weber number, Mach number; Model (similarity) laws: Reynolds law, Froude law, Euler law, Weber law, Mach law; Types of models: Undistorted model, Distorted model, Composite model, Sectional model; Scale effects in models; Limitations of hydraulic similitude		
6	**Turbulent Flows** Darcy Weisbach equation: Shear stresses in turbulent flow: Boussinesq's theory, Reynolds theory, Prandtl's mixing length theory; Universal velocity distribution equation Hydrodynamically smooth and rough boundaries: Velocity distribution for turbulent flow in smooth pipes, Velocity distribution for turbulent flow in rough pipes; Velocity distribution for both smooth and rough pipes; Resistance to fluid flow in smooth and rough pipes	**15%**	**6**

i. Text Book and Reference Book:

1. Fluid Mechanics & Hydraulics Machines By R. K. Bansal | Laxmi Publications.
2. Fluid Mechanics By Fox, McDonald, Pritchard | Wiley.
3. Engineering Fluid Mechanics By D. S. Kumar | S K KATARIA & SONS-NEW DELHI.
4. Engineering Fluid Mechanics By K. L. Kumar | S. Chand Limited.
5. Introduction to Fluid Mechanics and Fluid Machines By S. K. Som and G. Biswas | Tata McGraw Hill.

(2)

a. **Course Name:** Hydraulic Engineering Laboratory
b. **Course Code:** 303104252
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Understanding the fundamental principles and equations governing open channel flow
CLOBJ 2	Understanding the concepts of water flow, forces leading to water flux and jumps and solving related problems rate, velocity and depth of open flow channels.
CLOBJ 3	Applying various methods and techniques to calculate the hydraulic parameters of open channel flow, such as Manning's equation and the Chezy equation and dimensional analysis.
CLOBJ 4	Evaluating the effects of different factors, such as channel slope, roughness, and cross-sectional shape, on the behavior of turbulent flow.
CLOBJ 5	Understanding the importance of environmental considerations and sustainability in managing open channel flow systems.

f. **Course Learning Outcomes:**

CLO 1	Measure discharge and velocity in open channels using flow measurement techniques to analyze flow conditions for efficient water conveyance systems.
CLO 2	Analyze flow transitions and energy dissipation through hydraulic jump experiments to support the design of energy dissipating structures.
CLO 3	Identify physical variables and their dimensions using dimensional analysis methods to simplify and structure fluid mechanics problems.
CLO 4	Apply the Buckingham π theorem to form relevant dimensionless parameters for scalable hydraulic modeling.
CLO 5	Demonstrate the application of dynamic similitude laws like Reynolds, Froude, Mach, Euler, and Weber laws to model real fluid flow behavior.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	

0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Measurement of flow in open channel
2	Velocity measurement using Current meter & Pitot tube
3	Experiment on Hydraulic jump
4	Introduction to dimensional analysis
5	Buckingham pi Theorem –Theory and Application
6	Introduction to Modal analysis
7	Reynolds's Modal Law
8	Froude's Model Law
9	Mach's Model Law
10	Euler's Model Law
11	Weber's Model Law

i. Text Book and Reference Book:

1. Fluid Mechanics & Hydraulics Machines By R. K. Bansal | Laxmi Publications
2. Fluid Mechanics By Fox, McDonald, Pritchard | Wiley
3. Engineering Fluid mechanics By D. S. Kumar | S K KATARIA & SONS-NEW DELHI
4. Engineering Fluid mechanics By K. L. Kumar | S. Chand Limited
5. Introduction to Fluid Mechanics By S. K. Som and G. Biswas | Tata McGraw Hill

(3)

a. **Course Name:** Mechanics of Materials
b. **Course Code:** 303104253
c. **Prerequisite:** Mechanics of Solids, Introduction to Solid Mechanics.
d. **Rationale:** This subject deals with conceptual applications of principles of mechanics of rigid and deformable bodies in Engineering. Analysis of Determinate and Indeterminate Structures.
e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of the fundamental principles and theories related to the analysis of fixed and continuous beams, employing both analytical and computational methods.
CLOBJ 2	Acquire proficiency in applying the Consistent Deformation Method, Slope Deflection Method, and Moment Distribution techniques to solve complex structural analysis problems, demonstrating an ability to analyze and assess structural behaviour.
CLOBJ 3	Develop critical thinking skills to evaluate and compare different structural analysis methods, enabling the selection of appropriate techniques based on the characteristics of the given structure and loading conditions.
CLOBJ 4	Apply energy principles to analyze and predict the behaviour of structural elements under various loading conditions, demonstrating an understanding of the relationship between internal forces and deformations.
CLOBJ 5	Gain proficiency in constructing and interpreting Influence Line Diagrams for determinate and indeterminate structures, and demonstrate the ability to use these diagrams for assessing critical loading scenarios.
CLOBJ 6	Develop effective communication skills for presenting structural analysis results through written reports, diagrams, and verbal explanations, facilitating clear and concise dissemination of engineering concepts.

f. **Course Learning Outcomes:**

CLO 1	Illustrate moment distribution and slope deflection methods for analysis of indeterminate structures.
CLO 2	Explain the principles of energy methods for the analysis of various structural systems.
CLO 3	Describe the fundamentals of the matrix method of structural analysis.
CLO 4	Construct influence line diagrams for various structural elements and use them to analyze internal forces under moving loads.
CLO 5	Calculate slope and deflection for determinate structures using appropriate analytical methods such as double integration, moment area, and conjugate beam methods.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Fixed and Continuous Beams** Computation of fixed-end actions for various types of loads and secondary effects, beams of varying moment of inertia, analysis of propped cantilever beams. Theorem of Three-Moments.	15%	7
2	**Consistent Deformation Method** Analysis of propped cantilever beams, rigid & elastic support, beams of varying moment of inertia. Flexibility Method Introduction.	15%	7
3	**Energy Principles** Castigliano's theorems, computation of displacements of statically determinate beams, trusses and frames by unit load method, analysis of indeterminate structures – beams, trusses, frames & two hinge arches.	15%	7
4	**Slope Deflection Method** Analysis of continuous beams for various loading including Settlement/rotation of support, analysis of simple portal frame with sway.	20%	10
5	**Moment Distribution** Analysis of continuous beams & frames including sway, use of symmetry of structure up to two storied/two bay frames.	20%	10
6	**Influence Line Diagrams** ILD for statically determinate beams- I.L.D of support reaction, shear force and moment bending moment for beams subjected to u.d.l and several point loads, criteria	15%	6

	for maximum effects, ILD for statically determinate trusses, forces in members for u.d.l and point loads.		

i. Text Book and Reference Book:

1. Structural Analysis By Hibbler R C | Pearson Education
2. Intermediate Structural Analysis By Wang C. K.
3. Engineering Mechanics of Solids By Popov E.P
4. Strength of Materials By R.S Khurmi | S. Chand
5. Strength of Materials By Ryder G.H.
6. Matrix Analysis of Framed Structures By Weaver and Gere
7. Strength of Material & Mechanics of Structures By Dr. B C Punamia
8. Mechanics of Structures Vol I & II By S B Junarkar and H J Shah.

(4)

a. **Course Name:** Mechanics of Materials Laboratory
b. **Course Code:** 303104254
c. **Prerequisite:** Mechanics of Solids, Introduction to Solid Mechanics.
d. **Rationale:** This subject deals with conceptual applications of principles of mechanics of rigid and deformable bodies in Engineering, Analysis of Determinate and Indeterminate Structures.
e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of the fundamental principles and theories related to the analysis of fixed and continuous beams, employing both analytical and computational methods.
CLOBJ 2	Acquire proficiency in applying the Consistent Deformation Method, Slope Deflection Method, and Moment Distribution techniques to solve complex structural analysis problems, demonstrating an ability to analyze and assess structural behaviour.
CLOBJ 3	Develop critical thinking skills to evaluate and compare different structural analysis methods, enabling the selection of appropriate techniques based on the characteristics of the given structure and loading conditions.
CLOBJ 4	Apply energy principles to analyze and predict the behaviour of structural elements under various loading conditions, demonstrating an understanding of the relationship between internal forces and deformations.
CLOBJ 5	Gain proficiency in constructing and interpreting Influence Line Diagrams for determinate and indeterminate structures, and demonstrate the ability to use these diagrams for assessing critical loading scenarios.
CLOBJ 6	Develop effective communication skills for presenting structural analysis results through written reports, diagrams, and verbal explanations, facilitating clear and concise dissemination of engineering concepts.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate moment distribution and slope deflection methods for the analysis of indeterminate structures using practical exercises.
CLO 2	Apply energy methods to analyze various structural systems in laboratory problems.
CLO 3	Perform matrix-based structural analysis using appropriate matrix techniques and tools.
CLO 4	Construct influence line diagrams for structural elements and internal forces under moving loads.
CLO 5	Calculate slope and deflection for determinate structures using analytical methods such as double integration, moment area, and conjugate beam techniques.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Solve Problems of Fixed and Continous Beam
2	Solve Problems Using Consistent Deformation Method
3	Solve Problems using diffrent Energy Principles
4	Solve Problems Using Slope deflection Method
5	Solve Problems using Moment distribution & Kani's Method
6	Determine ILD for statically determinate beams

i. Text Book and Reference Book:

1. Structural Analysis By Hibbler R C | Pearson Education
2. Intermediate Structural Analysis By Wang C. K.
3. Engineering Mechanics of Solids By Popov E.P
4. Strength of Materials By R.S Khurmi | S. Chand
5. Strength of Materials By Ryder G.H.
6. Matrix Analysis of Framed Structures By Weaver and Gere
7. Strength of Material & Mechanics of Structures By Dr. B C Punamia
8. Mechanics of Structures Vol I & II By S B Junarkar and H J Shah.

(5)

a. **Course Name:** Environmental Engineering
b. **Course Code:** 303104255
c. **Prerequisite:** Knowledge of Physics, Chemistry and Mathematics up to 12th science level and of Biology up to 10th science level. Environmental Studies.
d. **Rationale:** Basic knowledge of environmental engineering is essential for all engineers to ensure a sustainable supply of basic civilian needs i.e. pure air, water and food.
e. **Course Learning Objective:**

CLOBJ 1	Interpret the impact of water and wastewater characteristics on human health and the environment, demonstrating a comprehensive understanding of how water quality parameters influence public well-being and ecological sustainability.
CLOBJ 2	Determine the quantity and quality of water needed for public water supply systems, employing comprehensive assessments and analytical techniques. They will develop the skills to evaluate the demands of a community, assess water sources, and implement quality control measures, ensuring the sustainable and efficient provision of safe drinking water to the public
CLOBJ 3	Develop proficiency in designing processes such as coagulation, sedimentation, filtration, and disinfection for water treatment, as well as biological treatment, sludge management, and odor control for sewage treatment.
CLOBJ 4	Develop the skills to analyze and interpret the components of a solid waste management system, gaining a comprehensive understanding of the various strategies and methods employed in the effective handling and disposal of solid waste.
CLOBJ 5	Analyzing the multifaceted impacts of air and noise pollution on both human health and the environment. They will gain a comprehensive understanding of the intricate interplay between pollutants and their adverse effects on respiratory and cardiovascular systems, as well as the broader ecological consequences.

f. **Course Learning Outcomes:**

CLO 1	Explain the physical, chemical, and biological characteristics of water and wastewater and their significance in treatment processes.
CLO 2	Analyze the collection, conveyance, and treatment of sewage in urban and rural environments.
CLO 3	Evaluate the sources, effects, and control measures of air pollution on health and the environment.
CLO 4	Apply scientific principles for the management of solid waste, including collection, disposal, and recycling methods.

CLO 5	Design and assess plumbing systems for buildings with respect to water supply, drainage, and sanitary fittings.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**CHARATERISTICS OF WATER AND WASTEWATER** Physical, chemical and biological characteristics of domestic wastewater.	15%	7
2	**WATER** Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design. Water Treatment: aeration, sedimentation, coagulation-flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes.	25%	11
3	**SEWAGE** Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, growth systems, recycling of sewage – quality requirements for various purposes.	25%	11

	Layout plan and section of municipal wastewater treatment plant, Pre-and Primary Treatment: screens, grit chamber and Primary Settling tank Secondary Treatment: Biological unit processes- Aerobic attached growth and aerobic suspended growth treatment processes, Sludge Handling and Disposal.		
4	**AIR POLLUTION** Sources, classification, characteristics, effects on humans, vegetation & properties, plume behaviour, Maximum Mixing Depth, Stack height, standards for air pollution. Air pollution control: Classification of pollutant, Particulate emission control- Gravitational settling chamber, bag house filter, Cyclone separator, Fabric filter, Electrostatic precipitator, Wet scrubbers.	**20%**	**10**
5	**SOLID WASTE MANAGEMENT** Introduction: Sources, classification, composition and characteristics of solid wastes. Elements of solid waste management as collection, transportation, processing for recovery and final disposal. E-waste management and recycle. Basics of SWM: Typical generation rate for solid wastes, factors affecting the generation rate. Estimation of quantity of solid waste, Onsite handling, storage and processing, collection services, types of collection systems, Dewatering of solid waste Advanced SWM: Determination of vehicle and labor requirements, collection routes, and transfer stations, location of transfer stations, transfer means and methods, solid waste processing techniques, Mechanical volume reduction, Mechanical size reduction, Thermal volume reduction, manual component separation. Ultimate disposal, land filling with solid waste, Sanitary land filling and composting, reduction at source, recovery and recycle, Visit of Landfill site.	**20%**	**9**

i. Text Book and Reference Book:

1. Environmental Engineering By Howard S. Peavy, Donald R. Rowe, George Tchobanoglous; McGraw-Hill
2. Solid Waste Treatment and Disposal By G. Tchabanoglous; McGraw Hill Pub.
3. Water Supply and Sanitary Engineering By G.S. Birdie and J.S. Birdie; Dhanpat Rai,Publishing Co
4. Environmental Engineering, Vols. I and II By Garg S.K.; Khanna Publishers
5. Manual on water supply and Treatment By CPHEEO; Government of India.
6. Water Supply Engineering By B. C. Punamia, Ashok Jain, Arun Jain
7. Elements of Water Supply and Waste water Disposal By Davis and Cornwell; John Wiley & Sons, New York., 1998

8. Theory and Practice of Water and Wastewater Treatment By Ronald L. Droste; John Wiley & Sons, New York, 1997.

(6)

a. **Course Name:** Environmental Engineering Laboratory
b. **Course Code:** 303104258
c. **Prerequisite:** Knowledge of Physics, Chemistry and Mathematics up to the 12th science level and of Biology up to the 10th science level. Environmental Studies.
d. **Rationale:** Basic knowledge of environmental engineering is essential for all engineers to ensure a sustainable supply of basic civilian needs i.e. pure air, water and food.
e. **Course Learning Objective:**

CLOBJ 1	Interpret the impact of water and wastewater characteristics on human health and the environment, demonstrating a comprehensive understanding of how water quality parameters influence public well-being and ecological sustainability.
CLOBJ 2	Determine the quantity and quality of water needed for public water supply systems, employing comprehensive assessments and analytical techniques. They will develop the skills to evaluate the demands of a community, assess water sources, and implement quality control measures, ensuring the sustainable and efficient provision of safe drinking water to the public
CLOBJ 3	Develop proficiency in designing processes such as coagulation, sedimentation, filtration, and disinfection for water treatment, as well as biological treatment, sludge management, and odor control for sewage treatment.
CLOBJ 4	Develop the skills to analyze and interpret the components of a solid waste management system, gaining a comprehensive understanding of the various strategies and methods employed in the effective handling and disposal of solid waste.
CLOBJ 5	Analyzing the multifaceted impacts of air and noise pollution on both human health and the environment. They will gain a comprehensive understanding of the intricate interplay between pollutants and their adverse effects on respiratory and cardiovascular systems, as well as the broader ecological consequences.

f. **Course Learning Outcomes:**

CLO 1	Explain the principles and methods of sampling for water, wastewater, and air.
CLO 2	Perform sampling procedures for water, wastewater, and air following standard protocols.
CLO 3	Analyze the basic characteristics of water samples.
CLO 4	Evaluate the basic characteristics of wastewater samples.
CLO 5	Determine and evaluate the concentration of particulate matter in ambient air using standard analytical techniques.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Introduction of laboratory and IS standards
2	Determination of Turbidity, electrical conductivity and pH of water
3	Analysis of solids content of water: Dissolved, Settleable, suspended, total
4	Determination of alkalinity
5	Determination of acidity
6	Determination of hardness
7	Determination of residual chlorine
8	Determination of MPN
9	Determination of Break Point chlorine dose
10	Determination of optimum coagulant dose
11	Determination of DO
12	Determination of BOD
13	Determination of COD
14	Determination of Chlorides
15	Monitoring of RSPM (PM100)

16	Monitoring of PM10
17	Ambient noise level monitoring
18	Layout diagram for water treatment plant
19	Layout diagram for wastewater treatment plant
20	Report on visit to water or wastewater treatment plant

i. Text Book and Reference Book:

1. Environmental Engineering By Howard S. Peavy, Donald R. Rowe, George Tchobanoglous; McGraw-Hill
2. Solid Waste Treatment and Disposal By G. Tchabanoglous; McGraw Hill Pub.
3. Water Supply and Sanitary Engineering By G.S. Birdie and J.S. Birdie; Dhanpat Rai, Publishing Co..
4. Environmental Engineering, Vols. I and II By Garg S.K.; Khanna Publishers
5. Manual on water supply and Treatment By CPHEEO; Government of India.
6. Water Supply Engineering By B. C. Punamia, Ashok Jain, Arun Jain
7. Elements of Water Supply and Wastewater Disposal By Davis and Cornwell; John Wiley & Sons, New York., 1998
8. Theory and Practice of Water and Wastewater Treatment By Ronald L. Droste; John Wiley & Sons, New York, 1997.
9. Solid Waste Treatment and Disposal by G. Tchabanoglous; McGraw Hill Pub.

(7)

a. **Course Name:** Geo-Technical Engineering
b. **Course Code:** 303104257
c. **Prerequisite:** Geotechnical Engineering fundamentals and practical knowledge.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Gain familiarity with types of rock identification, foundation soil types, various difficulties in geotechnical engineering terms and problems etc.
CLOBJ 2	Solve problems related to Atterberg limit, particle size analysis, soil formation, various soil and rock types, index properties and engineering properties of soil etc.
CLOBJ 3	Acquire knowledge of the soil testing instruments relationship of soil structure interaction.
CLOBJ 4	Understand different soil and rock types and properties, can be able to check soil on field as per basic index and engineering properties of soil.
CLOBJ 5	Demonstrate a clear understanding of the basic concepts, working principles and applications of sieve shaker, direct box shear, triaxial, permeability test, compaction and consolidation test, swelling property of soil.
CLOBJ 6	Study the use of standard proctor test, consolidometer, direct box shear test for identified soil engineering characteristics.

f. **Course Learning Outcomes:**

CLO 1	Classify different types of soils based on index properties and their engineering significance using three-phase relationships
CLO 2	Describe soil structure, soil-water relationships, and their influence on engineering behavior of soils.
CLO 3	Analyze permeability and seepage through soils using flow nets and Darcy's law for practical applications.
CLO 4	Explain application of compaction principles for improving soil strength and stability in field conditions.
CLO 5	Explain the process of soil consolidation and its effects on settlement of structures.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION** Definition of soil and soil mechanics, Formation of soil, types of soil, three phase system of soil and their relationships, Definition of index properties of soil, their determination and relationship among them.	10%	5
2	**CLASSIFICATION OF SOIL** Classification of soil, Grain size analysis, Stoke's law and hydrometer analysis, Consistency of soils, Atterberg's limits and their determination - consistency index, shrinkage ratio, flow index and toughness index, Classification of coarse-grained and fine-grained soil as per IS, Textural Classification.	20%	8
3	**SOIL STRUCTURE AND SOILWATER** The shape of particles, Texture and structure of the soil, Types of the structure, properties, conditions for the formation of different structures, types of soil water, Vertical stress distribution, Total vertical stress, pore water pressure, Effective stress.	20%	8
4	**PERMEABILITY AND SEEPAGE** Definition of Permeability and seepage, Assumption - one-dimensional flow through soil, Darcy's law, Discharge velocity and seepage velocity, factors affecting the permeability, permeability determination, lab methods, permeability in stratified soil deposits, Introduction of flow net and its properties - application of flow net.	15%	6
5	**COMPACTION AND CONSOLIDATION** Compaction, field and lab methods, Proctor's test – factors affecting the compaction, Field density - sand replacement and core cutter method. Effect of compaction on soil properties, ConsolidationTerzaghi's theory of one-dimensional consolidation, partial differential equation	15%	6

	(no analytical solution), Lab method, coefficient of consolidation and its Determination - Nt and log t method.		
6	**PHYSICAL GEOLOGY** Branches and scope of Geology; Surface processes and landforms: Weathering and Erosion; Introduction to geological agents (river, wind, oceans, glaciers, groundwater) and their actions (erosion, transport and deposition). Interior of the Earth: internal structure of earth, study of core, mental and crust of the Earth	**10%**	**5**
7	**GEOLOGICAL TIME-SCALE AND LAWS OF STRATIGRAPHY** Introduction to geological time scale and stratigraphy, laws of stratigraphy, Structural geology: Introduction to primary and secondary geological structures. Study of geological faults, folds, joints and active faulting. Their origin, types and engineering consideration.	**10%**	**5**

i. Text Book and Reference Book:

1. Mechanics of Soils By Raju. K.V.B .and Ravichandran .P.T; Ayyappaa Publications
2. Basic and applied soil mechanics By Gopal Ranjan, Rao A.S.R.; New age int. (p) ltd.
3. Soil Mechanics and Foundation Engineering By Arora. K.R; Standard Publication Distributors
4. Soil Mechanics in Engineering Practice By Terzaghi. K and Peck .R.B; John Wiley
5. Soil Mechanics By Lambe. T.W, Whitman; John Wiley Ltd.
6. A text book of Soil Mechanics and Foundation Engineering By Murthy, V.N.S.

(8)

a. **Course Name:** Geo-Technical Engineering Laboratory
b. **Course Code:** 303104258
c. **Prerequisite:** Practical knowledge of Geotechnical Engineering.
d. **Rationale:** Geotechnical Engineering is required to equip the students to understand the properties and behavior of soil and Laboratory practical.

e. **Course Learning Objective:**

CLOBJ 1	Gain familiarity with types of rock identification, foundation soil types, various difficulties in geotechnical engineering terms and problems etc.
CLOBJ 2	Solve problems related to Atterberg limit, particle size analysis, soil formation, various soil and rock types, index properties and engineering properties of soil etc.
CLOBJ 3	Acquire knowledge of the soil testing instruments relationship of soil structure interaction.
CLOBJ 4	Understand different soil and rock types and properties, can be able to check soil on field as per basic index and engineering properties of soil.
CLOBJ 5	Demonstrate a clear understanding of the basic concepts, working principles and applications of sieve shaker, direct box shear, triaxial, permeability test, compaction and consolidation test, swelling property of soil.

f. **Course Learning Outcomes:**

CLO 1	Classify different types of soils based on index properties and engineering significance using three-phase relationships through laboratory testing and data interpretation.
CLO 2	Interpret soil structure and soil-water relationships to assess their influence on engineering behavior using experimental observations.
CLO 3	Analyze permeability and seepage through soils using flow nets and Darcy's law in practical laboratory and field scenarios.
CLO 4	Apply compaction principles to enhance soil strength and stability through hands-on testing and field procedures.
CLO 5	Evaluate the effects of soil consolidation on structural settlement using experimental data and case studies.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	

0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Auger Boring
2	Determination of Water Content by Oven Drying Method
3	Determination of Liquid Limit
4	Determination of Plastic Limit
5	Determination of Specific Gravity by Density Bottle
6	Determination of Specific Gravity by Pycnometer
7	Determination of Field Density by Core Cutter Method
8	Determination of Field Density by Sand Replacement Method
9	Soil Classification by Grain Size Analysis
10	Soil Classification by Hydrometer Analysis
11	Determination of Shrinkage Limit

i. Text Book and Reference Book:

1. Mechanics of Soils By Raju. K.V.B .and Ravichandran .P.T; Ayyappaa Publications
2. Basic and applied soil mechanics By Gopal Ranjan, Rao A.S.R.; New age int. (p) ltd.
3. Soil Mechanics and Foundation Engineering By Arora. K.R; Standard Publication Distributors
4. Soil Mechanics in Engineering Practice By Terzaghi. K and Peck .R.B; John Wiley
5. Soil Mechanics By Lambe. T.W, Whitman; John Wiley Ltd.
6. A text book of Soil Mechanics and Foundation Engineering By Murthy, V.N.S.

(9)

a. **Course Name:** Transportation Engineering
b. **Course Code:** 303104259
c. **Prerequisite:** Knowledge of Basic of Civil Engineering.
d. **Rationale:** The rationale for studying transportation engineering lies in its pivotal role in fostering economic development, ensuring safety, and promoting efficient, sustainable movement of people and goods within a society.
e. **Course Learning Objective:**

CLOBJ 1	Understand the principles and components of transportation systems, including modes of transportation, traffic flow theory, and infrastructure design.
CLOBJ 2	Analyze traffic characteristics, including volume, speed, density, and their impact on transportation systems, applying traffic management strategies and control measures.
CLOBJ 3	Gain proficiency in designing and planning highway systems, considering geometric design elements, pavement design, safety measures, and environmental considerations.
CLOBJ 4	Explore the principles and challenges of public transportation systems, including transit planning, multimodal transportation, and sustainable urban mobility solutions.
CLOBJ 5	Understand the policies governing transportation infrastructure development and their environmental implications, including sustainability, emissions, and land use planning.

f. **Course Learning Outcomes:**

CLO 1	Describe the history of road development and the principles of road classification and survey planning.
CLO 2	Conduct engineering surveys to support highway route selection.
CLO 3	Design the various highway geometrics using geometric standards and traffic considerations.
CLO 4	Evaluate properties of road construction materials through laboratory testing and selection criteria.
CLO 5	Apply IRC methods for designing flexible and rigid pavements.
CLO 6	Identify the pavements distress, its maintenance, importance of drainage

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Road Development and Planning** Brief history of road development, Necessity of highway planning, Jayakar committee, CRF, IRC, CRRI, HRB, NTPC, classification of roads, road patterns, planning surveys, saturation system/maximum utility system, highway planning in India, Nagpur, Bombay, Lucknow road development plans.	10%	4
2	**Highway Location and Alignment** Basic requirements of an ideal alignment and controlling factors, engineering survey for highway location, drawing and reports, highway projects.	10%	4
3	**Highway Geometric Design** Cross-sectional elements; design speed, sight distances; PIEV theory, requirements and design principles of horizontal alignment including radius of curvature, super elevation, extra-widening, design of transition curves, curve resistance, Set-back distance, grade compensation and vertical alignment, summit curve and valley curve.	20%	12
4	**Highway Construction Materials** Types, properties and tests of Aggregates, Bituminous materials, and cement.	20%	9
5	**Pavement Design** Introduction, pavement design variables, Methods of flexible pavement design: GI, IRC, IRC guidelines, Stresses in the rigid pavement, design of slab thickness, dowel bar and tie bar, joints in cement concrete pavements	23%	12
6	**Construction of Roads**	10%	4

	Construction of water-bound macadam roads, WMM, bituminous pavements, Rigid Pavement, drainage of roads: surface and subsurface drainage		
7	**Highway Marking, Lighting and Road Side Arboriculture**	**2%**	**1**
8	**Highway Maintenance** Pavement distress, repair and maintenance of flexible and rigid pavement	**5%**	**2**

i. Text Book and Reference Book:

1. Highway Engineering S. K. Khanna, C.E.G. Justo
2. Traffic Engineering and Transport Planning Dr. L.R. Kadiyali; Khanna Publishers, New Delhi.
3. Highway Engineering Dr. L.R. Kadiyali; Khanna Publishers, New Delhi
4. Principles, Practice and Design of Highway Engineering Dr. S.K. Sharma; S. Chand & Co., New Delhi

(10)

a. **Course Name:** Transportation Engineering Laboratory
b. **Course Code:** 303104260
c. **Prerequisite:** Basic of Civil Engineering.
d. **Rationale:** Road transportation plays an important role for the development of any country. The study of this subject imparts the knowledge to the students of properties and tests of road construction materials and design process of flexible and rigid pavements.
e. **Course Learning Objective:**

CLOBJ 1	Understand the principles and components of transportation systems, including modes of transportation, traffic flow theory, and infrastructure design.
CLOBJ 2	Analyze traffic characteristics, including volume, speed, density, and their impact on transportation systems, applying traffic management strategies and control measures.
CLOBJ 3	Gain proficiency in designing and planning highway systems, considering geometric design elements, pavement design, safety measures, and environmental considerations.
CLOBJ 4	Explore the principles and challenges of public transportation systems, including transit planning, multimodal transportation, and sustainable urban mobility solutions.
CLOBJ 5	Understand the policies governing transportation infrastructure development and their environmental implications, including sustainability, emissions, and land use planning.

f. **Course Learning Outcomes:**

CLO 1	Carry out laboratory tests on aggregates and bituminous materials to assess their suitability for pavement construction.
CLO 2	Analyze the model traffic flow byvarious theories and methodologies.
CLO 3	Calculate design speed, maximum speed & minimum speed limits of a location through spot speed
CLO 4	Design the layers of flexible and rigid pavements by considering factors such as traffic load, subgrade strength, environmental conditions, and material properties.
CLO 5	Discuss the importance of drainage in pavement performance.

g. **Teaching & Examination Scheme:**

Teaching Scheme	Evaluation Scheme

L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	To determine the impact value of aggregates
2	To determine the crushing value of aggregates
3	To determine the flakiness and elongation index of aggregates
4	To determine Los- Angeles test on aggregates
5	To determine the specific gravity and water absorption of aggregates
6	To determine bulk density and % voids
7	To determine penetration value of the bitumen
8	To determine the softening point of bitumen
9	To determine the ductility value of bitumen
10	To determine the viscosity of bitumen
11	Examples based on geometric design of Highway
12	Examples based on flexible and rigid pavement design
13	Classified volume count at an Intersection

i. Text Book and Reference Book:

1. Highway Engineering S. K. Khanna, C.E.G. Justo
2. Traffic Engineering and Transport Planning Dr. L.R. Kadiyali; Khanna Publishers, New Delhi.
3. Highway Engineering Dr. L.R. Kadiyali; Khanna Publishers, New Delhi
4. Principles, Practice and Design of Highway Engineering Dr. S.K. Sharma; S. Chand & Co., New Delhi

(11)

a. **Course Name:** Professional Grooming & Personality Development
b. **Course Code:** 303193252
c. **Prerequisite:** Knowledge of English language in practical life.
d. **Rationale:** Knowledge and application of English, Aptitude and Management Skills are crucial for better employability as well as professionalism.
e. **Course Learning Objective:**

CLOBJ 1	Gain familiarity with electrical current, potential difference, power and energy, sources of electrical energy and elements of electrical circuit.
CLOBJ 2	Solve problems related to Alternating current, alternating voltage, etc, Demonstrate a clear understanding of Pure R, L C circuit and combination of RLC, Series and Parallel combination of R, L and C, etc
CLOBJ 3	Acquire knowledge of the resistor, capacitor, and inductor and their performance characteristics for series and parallel connections.
CLOBJ 4	Understand different single phase and three phase circuits.
CLOBJ 5	Demonstrate a clear understanding of the basic concepts, working principles and applications of transformer, DC machines and AC machines.
CLOBJ 6	Study the use of LT SwitchGear, Fuse, MCB, ELCB etc

f. **Course Learning Outcomes:**

CLO 1	Apply essential soft skills for personal effectiveness and professional growth.
CLO 2	demonstrate professional etiquette and appropriate workplace behaviour in team-based and organizational settings.
CLO 3	participate effectively in oral organizational communication through clear speaking, active listening, and appropriate interaction in group settings.
CLO 4	apply reading comprehension strategies to understand, interpret, and evaluate a variety of texts.
CLO 5	demonstrate assertive communication skills to express ideas and handle situations with confidence and professionalism.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**1**	**0**	**1**	**-**	**100**	**-**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Self-Development and Assessment**: Various self-assessments for personal and professional development skills that are relevant to career development: • Change, Grow, Persist, Prioritize, Read, Learn, Listen, Record, Remember, Guess, Think, Communicate, Relate, and Dream	25%	5
2	**Corporate Etiquette**: Tips and guide to develop personality and gain various etiquettes manners, case studies and activities. • Telephone etiquette • Etiquette for foreign business trips • Etiquette for small talks • Respecting privacy • Learning to say'No'	25%	5
3	**Public Speaking**: It's process of communicating information to an audience and is helpful in career advancement. Effective Public speaking skills includes: • Choosing appropriate pattern • Selecting appropriate method • Art of persuasion • Making speeches effective • Delivering different types of speeches	20%	4
4	**Reading Skills Activity & Reading Comprehension**: Aims to improve students' Comprehensive Skills in English Language by getting them involved in reading activity and providing practice for reading comprehension.	15%	2
5	**Listening Skills- Inquiry-Based Listening Questions**: Aims to improve students' listening skills in English Language providing them practice of various types of inquiry based listening tracks. • Students will listen and will be able to find out details from the conversations.	15%	2

i. Text Book and Reference Book:

1. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.

2. Communication Skills Kumar S And Lata P; New Delhi Oxford University Press
3. Practical English Usage MICHAEL SWAN
4. A Remedial English Grammar for Foreign Student F.T. WOOD
5. On Writing Well William Zinsser; Harper Paperbacks,2006; 30th anniversary edition
6. Oxford Practice Grammar, John Eastwood; Oxford University Press
7. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
8. Communication Skills Kumar S and Lata P; New Delhi Oxford University Press
9. Practical English Usage MICHAEL SWAN
10. A Remedial English Grammar for Foreign Student F.T. WOOD
11. On Writing Well William Zinsser; Harper Paperbacks,2006; 30th anniversary edition
12. Quantitative Aptitude for Competitive Examinations Dr. R.S. Aggarwal.

Semester 5

(1)

a. **Course Name:** Design of Reinforced Concrete Structure
b. **Course Code:** 303104301
c. **Prerequisite:** Mechanics of solids, Introduction to solid mechanics, Mechanics of materials.
d. **Rationale:** This subject is applications of structural engineering principles to design basic structural elements using of reinforced concrete and steel concrete as materials. This subject is specifically design to develop understanding of various design philosophy, Indian codal provisions, design basis used in design of basic elements of basic elements of any structures.
e. **Course Learning Objective:**

CLOBJ 1	Students will be able to understand and apply the fundamental principles of reinforced concrete design, including material properties, load types, and structural behavior under various conditions
CLOBJ 2	Students will be proficient in interpreting and applying relevant design codes and standards (such as ACI, Eurocode, or IS codes) to the design of reinforced concrete structures
CLOBJ 3	Students will be able to design key structural elements such as beams, columns, slabs, and footings, ensuring adequate strength, serviceability, and durability
CLOBJ 4	Students will develop the ability to analyze and evaluate different reinforced concrete structural systems, considering factors like load distribution, deflection, and stability.
CLOBJ 5	Students will gain practical skills in using industry-standard software tools for the analysis and design of reinforced concrete structures, enhancing their ability to solve complex design problems efficiently

f. **Course Learning Outcomes:**

CLO 1	Describe limit state method of design and differentiate it with the previous methods like WSM and ULM
CLO 2	Illustrate different codal provisions for designing the RC structures
CLO 3	Analyze the behavior of flexural members with reference to codal limitations.
CLO 4	Design reinforced concrete structural members like slabs, columns, straircases, footings.

g. **Teaching & Examination Scheme:**

Teaching Scheme	Evaluation Scheme

L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction** The objective of structural design-Steps in RCC Structural Design Process- Type of Loads on Structures and Load combinations- Code of practices and Specifications – Concept of Working Stress Method, Ultimate Load Design and Limit State Design Methods for RCC –Properties of Concrete and Reinforcing Steel – Analysis and Design of Singly reinforced Rectangular beams by working stress method – Limit State philosophy as detailed in IS code – Advantages of Limit State Method over other methods – Analysis and design of singly and doubly reinforced rectangular beams by Limit State Method.	15%	3
2	**DESIGN OF BEAMS** Analysis and design of Flanged beams for – Use of design aids for Flexure – Behaviour of RC members in Shear, Bond and Anchorage – Design requirements as per current code – Behaviour of rectangular RC beams in shear and torsion – Design of RC members for combined Bending, Shear and Torsion.	20%	15
3	**DESIGN OF SLABS AND STAIRCASE** Analysis and design of cantilever, one way simply supported and continuous slabs and supporting beams- Two way slab- Design of simply supported and continuous slabs using IS code coefficients- Types of Staircases – Design of dog-legged Staircase.	20%	10
4	**DESIGN OF COLUMNS** Types of columns –Axially Loaded columns – Design of short Rectangular Square and circular columns –Design of Slender columns- Design for Uniaxial and Biaxial bending using Column Curves.	25%	15
5	**DESIGN OF FOOTINGS** Concepts of Proportioning footings and foundations based on soil properties-Design of wall footing – Design of axially	10%	8

	and eccentrically loaded square, rectangular pad and sloped footings – Design of Combined Rectangular footing for two columns only.		

i. Text Book and Reference Book:

1. Reinforced Concrete Vol 1, By H J Shah | Charotar Publishers
2. Reinforced concrete design, By N. Krishna Raju and R.N. Prenesh | New age International Publishers
3. Reinforced Concrete Design, By Pillai S. U. and Menon D.
4. Code of practice for General Construction in steel, By IS: 800 – 2007
5. IS Code – 456 -2000, Code Of Practice For Plain & Reinforce Concrete', By BIS | New Delhi

(2)

a. **Course Name:** Design of Reinforced Concrete Structures Laboratory
b. **Course Code:** 303104302
c. **Prerequisite:** Mechanics of solids, Introduction to solid mechanics, Mechanics of materials.
d. **Rationale:** This subject is applications of structural engineering principles to design basic structural elements using of reinforced concrete and steel concrete as materials. This subject is specifically design to develop understanding of various design philosophy, Indian codal provisions, design basis used in design of basic elements of basic elements of any structure.
e. **Course Learning Objective:**

CLOBJ 1	Students will be able to understand and apply the fundamental principles of reinforced concrete design, including material properties, load types, and structural behavior under various conditions
CLOBJ 2	Students will be proficient in interpreting and applying relevant design codes and standards (such as ACI, Eurocode, or IS codes) to the design of reinforced concrete structures
CLOBJ 3	Students will be able to design key structural elements such as beams, columns, slabs, and footings, ensuring adequate strength, serviceability, and durability
CLOBJ 4	Students will develop the ability to analyze and evaluate different reinforced concrete structural systems, considering factors like load distribution, deflection, and stability
CLOBJ 5	Students will gain practical skills in using industry-standard software tools for the analysis and design of reinforced concrete structures, enhancing their ability to solve complex design problems efficiently

f. **Course Learning Outcomes:**

CLO 1	Differentiate the limit state method of design from previous methods like WSM and ULM through practical design problems.
CLO 2	Interpret codal provisions for the design of reinforced concrete structures using IS codes during laboratory work.
CLO 3	Evaluate codal limitations based on design outcomes of flexural members.
CLO 4	Design reinforced concrete structural members such as slabs, columns, staircases, and footings as per codal guidelines in laboratory sessions.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	4	2	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Analysis and design of singly and doubly reinforced rectangular beams
2	Analysis and Design of Singly reinforced Rectangular beams
3	Analysis and design of Flanged beams
4	Design of RC members for combined Bending, Shear and Torsion
5	Analysis and design of cantilever, one way simply supported and continuous slabs
6	Design of simply supported and continuous slabs using IS code
7	Design of dog-legged Staircase
8	Design of short Rectangular Square and circular columns
9	Design of Slender columns
10	Design of axially and eccentrically loaded square, rectangular pad and sloped footings

i. Text Book and Reference Book:

1. Reinforced Concrete Vol 1, By H J Shah | Charotar Publishers
2. Reinforced concrete design, By N. Krishna Raju and R.N. Prenesh | New age International Publishers
3. Reinforced Concrete Design, By Pillai S. U. and Menon D.
4. Code of practice for General Construction in steel, By IS: 800 – 2007
5. IS Code – 456 -2000, Code Of Practice For Plain & Reinforce Concrete', By BIS | New Delhi

(3)

a. **Course Name:** Engineering Hydrology
b. **Course Code:** 303104303
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level, Fluid Mechanics.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of the key hydrological processes, including precipitation, evaporation, infiltration, and runoff, and their roles in the water cycle
CLOBJ 2	Students will be able to apply various hydrological modeling techniques to predict and analyze water flow, flood risks, and water availability in different catchment areas
CLOBJ 3	Students will develop the ability to design and implement effective water management systems, including reservoirs, drainage networks, and flood control measures, to manage water resources sustainably
CLOBJ 4	Students will learn to collect, analyze, and interpret hydrological data using modern tools and techniques, enabling them to make informed decisions in water resource management and planning

f. **Course Learning Outcomes:**

CLO 1	Describe rainfall measurement and data correction to estimate catchment precipitation for hydrologic analysis.
CLO 2	Calculate evapotranspiration and infiltration using field methods for water balance assessment.
CLO 3	Estimate runoff and peak discharge from rainfall data for flood and drainage design.
CLO 4	Develop hydrographs from rainfall-runoff data to model watershed response.
CLO 5	Analyze aquifer and well data to compute safe yield for groundwater management.
CLO 6	Assess reservoir and dam site data to estimate storage and safety for water supply planning.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	

3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction and Hydrometeorology**: Role of hydrology in water resources projects; Hydrological cycle and its components. Measurement of precipitation: Non-recording type rain gauge, Self-recording type rain gauge, Rain gauge network, Optimum rain gauge network design, Estimation of missing rainfall data, Double mass curve technique - Test for consistency of rainfall data, Mean minimum and maximum annual rainfall, Average depth of rainfall over an area: Arithmetic mean method, Thiessen polygon method, Isohyetal method; Hyetograph .	**14%**	**6**
2	**Evaporation, transpiration and evapotranspiration**: Evaporation: Definition, Energy balance approach in evaporation studies, Evaporation measurement: Standard USBR class A pan evaporimeter, Sunken screen pan evaporimeter; Transpiration; Evapotranspiration: Definition, Meteorological factors influencing evapotranspiration Estimating evapotranspiration: Penman-Monteith equation; Infiltration: Definition , Factors affecting infiltration rate, Infiltration indices, Infiltration capacity curve, Double Ring infiltrometer, Measurement of infiltration.	**20%**	**10**
3	**Runoff**: Factors affecting runoff; Methods of determining runoff; Estimation of maximum flood discharge	**6%**	**2**
4	**Hydrograph**: Hydrograph, Base flow separation, Unit hydrograph; S-hydrograph; Change in duration of unit hydrograph	**18%**	**8**
5	**Groundwater hydrology and well hydraulics**: Divisions of subsurface water ; Types of water bearing formations : Unconfined aquifer , Confined aquifer ; Semi confined aquifer ; Perched water table ; Aquifer characteristics : Hydraulic conductivity , Transmissibilty, Coefficient of storage , Specific yield , Hydraulic resistance. Determination of safe withdrawal of ground water ; Steady radial flow into a well; Unsteady radial flow into a well ; Well losses ; Well efficiency .	**20%**	**9**

6	**Reservoir and Introduction to Dams**: Types, Investigations, Site selection, Zones of storage, Safe yield, Reservoir capacity, Reservoir sedimentation and control. Introduction and types of dams, spillways, and ancillary works, Site assessment and selection of the type of dam	**22%**	**10**

i. Text Book and Reference Book:

1. Engineering Hydrology (TextBook), K. Subramanya; Tata McGraw Hill Pub. Co. New Delhi
2. Hydrology and Water Resources Engineering, S. K Garg; Khanna Publishers
3. Elementary Hydrology, V.P. Singh; Prentice Hall, Englewood Cliffs, New Jersey
4. Hydrology and Water Resources Engineering K C Patra; Narosa

(4)

a. **Course Name:** Engineering Hydrology Laboratory
b. **Course Code:** 303104304
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level, Fluid Mechanics I.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of the key hydrological processes, including precipitation, evaporation, infiltration, and runoff, and their roles in the water cycle
CLOBJ 2	Students will be able to apply various hydrological modeling techniques to predict and analyze water flow, flood risks, and water availability in different catchment areas
CLOBJ 3	Students will develop the ability to design and implement effective water management systems, including reservoirs, drainage networks, and flood control measures, to manage water resources sustainably
CLOBJ 4	Students will learn to collect, analyze, and interpret hydrological data using modern tools and techniques, enabling them to make informed decisions in water resource management and planning

f. **Course Learning Outcomes:**

CLO 1	Estimate infiltration indices from rainfall-runoff data to evaluate water losses in catchments.
CLO 2	Measure infiltration rate using field infiltrometers to assess soil permeability for recharge planning.
CLO 3	Develop flow duration curve using streamflow data to determine reservoir capacity.
CLO 4	Design unit hydrograph from rainfall-runoff data to model catchment response.
CLO 5	Calculate well efficiency from drawdown and discharge data to improve groundwater use.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Estimation of φ- index and W-index
2	To find infiltration rate using Single Ring Infiltrometer
3	To find infiltration rate using Double Ring Infiltrometer
4	Development of flow duration curve to determine reservoir capacity
5	Design of Instantaneous Unit Hydrograph
6	Determination of Well Efficiency

i. Text Book and Reference Book:

1. Engineering Hydrology (TextBook), K. Subramanya; Tata McGraw Hill Pub. Co. New Delhi
2. Hydrology and Water Resources Engineering, S. K Garg; Khanna Publishers
3. Elementary Hydrology, V.P. Singh; Prentice Hall, Englewood Cliffs, New Jersey
4. Hydrology and Water Resources Engineering K C Patra; Narosa

(5)

a. **Course Name:** Design of Water & Waste Water Treatment Systems
b. **Course Code:** 303104311
c. **Prerequisite:** Knowledge of Physics, Chemistry and Mathematics up to 12th science level and of Biology up to 10th science level. Environmental Studies.
d. **Rationale:** Basic knowledge of environmental engineering is essential for all engineers to ensure sustainable supply of basic civilian needs i.e. pure air, water and food.
e. **Course Learning Objective:**

CLOBJ 1	Students will develop a thorough understanding of the fundamental physical, chemical, and biological processes involved in water and wastewater treatment, including coagulation, sedimentation, filtration, and biological treatment
CLOBJ 2	Students will gain the skills to design key components of water and wastewater treatment facilities, such as sedimentation tanks, filtration systems, aeration basins, and sludge handling units, ensuring compliance with regulatory standards
CLOBJ 3	Students will be able to interpret and apply relevant environmental regulations and standards in the design and operation of water and wastewater treatment systems, ensuring public health and environmental protection
CLOBJ 4	Students will learn to integrate modern technologies and advanced treatment methods, such as membrane filtration, disinfection, and nutrient removal, into the design of efficient and sustainable water and wastewater treatment systems.

f. **Course Learning Outcomes:**

CLO 1	Describe working of water and wastewater treatment plant by operational procedures of treatment systems.
CLO 2	Identify the most appropriate technique for the treatment of water and wastewater by selecting appropriate methods
CLO 3	Design various units in a water treatment plant by using design criteria and standard formulas and assumptions.
CLO 4	Design different units of the wastewater treatment plant by applying design criteria for sizing units
CLO 5	Develop sewer and water distribution networks using design principles and software tools.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Collection and conveyance of raw water from source** Intakes, types of intakes, conveyance of water, design of pumps and gravity and rising mains	**10%**	**5**
2	**Water treatment processes and treatment units** Plain sedimentation, aeration, sedimentation tank & its design, sedimentation with coagulation, types of coagulants, optimum dose of coagulants, mixing devices, design of flocculation unit. theory of filtration, types of filters and their comparison, design of rapid sand filter, washing of filter, methods of disinfection, methods of removing hardness, Computation of dose of chemicals for removal of hardness	**30%**	**13**
3	**Distribution system** Layouts of water distribution networks, Components of distribution system, Newton's and Hardy cross methods for network analysis, storage capacity of ESR and underground reservoir, determination of location and height of ESR	**15%**	**7**
4	**Collection of sewage & estimation of its discharge** Different types of sewers, sewerage systems, variation in sewage flow, sewer appurtenance, estimation of wastewater discharge in a sewer in sewerage system, estimation of storm water discharge in urban area, separate and combined sewerage systems, laying and testing of sewers, Introduction to soft tools for design of water distribution network, storm water pipes and sewers	**15%**	**7**
5	**Design of wastewater treatment units** Design of racks, screens, grit chamber, aeration units, primary & secondary clarifiers, activated sludge plant and Sequencing batch reactors, rotating biological contactors, sludge dewatering units, sludge digesters and drying beds, design of septic tanks, soak pit, Introduction to bio-toilet	**30%**	**13**

i. Text Book and Reference Book:

1. Environmental engineering, By H.S. Peavy, D.R.Row & G.Tchobanoglous | Mc Graw Hill Intranational Edition
2. Solid Waste Treatment and Disposal (TextBook), By G. Tchabanoglous | McGraw Hill Pub.
3. Environmental Engineering, Vols. I and II, By Garg S.K. | Khanna Publishers | 12th
4. Water Supply and Sanitary Engineering, By G.S. Birdie and J.S. Birdie | Dhanpat Rai,Publishing Co.
5. Water Supply Engineering (TextBook), By B. C. Punamia, Ashok Jain, Arun Jain
6. Manual on Sewerage and Sewage Treatment, By CPHEEO | Government of India
7. Elements of Water Supply and Waste water Disposal, By Davis and Cornwell | John Wiley & Sons, New York., Pub. Year 1998
8. Theory and Practice of Water and Wastewater Treatment, By Ronald L. Droste | John Wiley & Sons, New York, Pub. Year 1997
9. Manual on Water Supply & Treatment, Central Public Health & Environmental. Engg. Organization, Ministry of Urban Development, Govt.

(6)

a. **Course Name:** Design of Water & Waste Water Treatment Systems Laboratory
b. **Course Code:** 303104312
c. **Prerequisite:** Knowledge of Physics, Chemistry and Mathematics up to 12th science level and of Biology up to 10th science level. Environmental Studies.
d. **Rationale:** Basic knowledge of environmental engineering is essential for all engineers to ensure sustainable supply of basic civilian needs i.e. pure air, water and food.
e. **Course Learning Objective:**

CLOBJ 1	Students will develop a thorough understanding of the fundamental physical, chemical, and biological processes involved in water and wastewater treatment, including coagulation, sedimentation, filtration, and biological treatment
CLOBJ 2	Students will gain the skills to design key components of water and wastewater treatment facilities, such as sedimentation tanks, filtration systems, aeration basins, and sludge handling units, ensuring compliance with regulatory standards
CLOBJ 3	Students will be able to interpret and apply relevant environmental regulations and standards in the design and operation of water and wastewater treatment systems, ensuring public health and environmental protection
CLOBJ 4	Students will learn to integrate modern technologies and advanced treatment methods, such as membrane filtration, disinfection, and nutrient removal, into the design of efficient and sustainable water and wastewater treatment systems.

f. **Course Learning Outcomes:**

CLO 1	Develop the skill of analyzing, interpreting and inferring the laboratory data.
CLO 2	Illustrate the selection of the most appropriate technique for the treatment of water, wastewater.
CLO 3	Design of various units in a water treatment plant by using design criteria and standard formulas and assumptions.
CLO 4	Apply concepts and design principles of units in a wastewater treatment plant.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Introduction to laboratory equipments
2	Sampling, Preservation and Standards
3	Determination of optimum dose of coagulant
4	Layout of water treatment plant
5	Design of flash mixer and clarrifloculator
6	Design of Rapid Sand filter
7	Layout of wastewater treatment plant
8	Design of Screen and Grit chamber
9	Design of Sedimentation tank, Activated sludge process or Trickling filter
10	Design of sludge digester and drying beds
11	Report on visit to wastewater treatment plant

i. Text Book and Reference Book:

1. Environmental engineering, By H.S. Peavy, D.R.Row & G.Tchobanoglous | Mc Graw Hill Intranational Edition
2. Solid Waste Treatment and Disposal (TextBook), By G. Tchabanoglous | McGraw Hill Pub.
3. Environmental Engineering, Vols. I and II, By Garg S.K. | Khanna Publishers | 12th
4. Water Supply and Sanitary Engineering, By G.S. Birdie and J.S. Birdie | Dhanpat Rai,Publishing Co.
5. Water Supply Engineering (TextBook), By B. C. Punamia, Ashok Jain, Arun Jain
6. Manual on Sewerage and Sewage Treatment, By CPHEEO | Government of India
7. Elements of Water Supply and Waste water Disposal, By Davis and Cornwell | John Wiley & Sons, New York., Pub. Year 1998
8. Theory and Practice of Water and Wastewater Treatment, By Ronald L. Droste | John Wiley & Sons, New York, Pub. Year 1997
9. Manual on Water Supply & Treatment, Central Public Health & Environmental. Engg. Organization, Ministry of Urban Development, Govt

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a. **Course Name:** Cleaner Production
b. **Course Code:** 303104313
c. **Prerequisite:** Fundamental understanding of basic environmental science and industrial processes.
d. **Rationale:** Cleaner production reduces environmental impact by minimizing resource use, waste generation, and emissions, promoting sustainable practices for a healthier planet and enhanced business efficiency.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a solid understanding of the principles of cleaner production, including pollution prevention, resource efficiency, and sustainable industrial practices.
CLOBJ 2	Students will develop the ability to analyze the environmental impacts of industrial processes, identifying opportunities for reducing waste, emissions, and resource consumption.
CLOBJ 3	Students will learn to design and implement sustainable solutions for reducing the environmental footprint of manufacturing and industrial operations, incorporating cleaner technologies and processes.
CLOBJ 4	Students will be able to evaluate the economic and environmental trade-offs of different cleaner production strategies, considering factors such as cost, efficiency, and long-term sustainability.
CLOBJ 5	Students will gain practical skills in applying Life Cycle Assessment (LCA) tools to assess the environmental performance of products and processes, guiding decisions toward more sustainable production practices.

f. **Course Learning Outcomes:**

CLO 1	Explain the concept and principles of cleaner production.
CLO 2	Suggest different unit operations in the industrial production process to minimize pollution.
CLO 3	Plan good housekeeping practices for Industry/other places with concern of safety, hygiene, and waste reduction.
CLO 4	Suggest basic methods and techniques of pollution prevention during production.
CLO 5	Suggest cleaner production methods for a given situation which will also lead to cost reduction in the long run.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction** Cleaner production definition: Evaluation of cleaner production, Cleaner production network, Area covered by cleaner production (what is not cleaner production?) Difference between cleaner production and other methods, End of the pipe treatment to curb pollution, prerequisites of cleaner production	15%	7
2	**Cleaner production technique** Waste reduction at source, (a) Good housekeeping, (b) Process changes: change in raw material, batter process, control, equipment modification and technology changes, Recycling: on site recovery and reuse creation of useful byproducts, Product modification.	18%	8
3	**Cleaner production methodology** Methods of environmental protection -- preventive strategy, Methods of environmental protection -- preventive strategy, making team for cleaner production, Analyzing process steps, Generating C.P opportunities Selection of C.P solution, Implementing C.P solution	18%	8
4	**Concept of cleaner production** Overview of CP Assessment Steps and skills, preparing for the site visit, Information Gathering, and process flow diagram, material balance, CP Option Generation Technical and Environmental feasibility analysis-Economic valuation of alternatives fuels, Total cost analysis-CP Financing- Establishing a program-Organizing a program preparing a program plan-Measuring progress pollution prevention and cleaner production Awareness plan -Waste audit Environmental Statement. Energy audit related to cleaner production, Energy audit's need and scope, Types of energy audit.	18%	8

	Preliminary or walk through energy audit. Detailed energy audit, Methodology of energy audit, Energy balance and identifying the energy conservation opportunities		
5	**Financial analysis of cleaner production** Gathering base line information, Determining the capital or investment cost, establishing lifetime of equipment and annual depreciation, Determine revenue implication of the project. Estimating change in operating cost, calculating incremental cash flow, Assessing project's viability.	**15%**	**7**
6	**Case studies and Cleaner Production applications** Application (Industrial application of CP, LCA, EMS and Environmental Audits. C.P in chemical process industry, Practical ways & means to save material loss in loading/unloading and unit operations equipment like distillation column, drying and other equipments like heat exchanger, vacuum unit, conveying, etc. Practical ways & means for energy saving in industries. Case Studies of cleaner production.	**16%**	**7**

i. Text Book and Reference Book:

1. Training Manual Package" by NCPC
2. Chemical Process Safety: Learning from case Histories, By Sanders R.E. | Oxford Butter Worth Publication
3. "Green Chemistry: Environmentally Benign Reactions". By Ahluvalia V. K.
4. "Engineers Guide to Cleaner Production Technologies By Randall Paul M
5. "Clean Technology for manufacture of Specialty Chemicals", Editor-W. Hoyle and M. Lancaster, Royal Society of Chemistry, U.K
6. "Cleaner Production Worldwide", By 1993, United Nations Environment Programme, Industry and Environment | Paris, France, 1993.

(8)

a. **Course Name:** Cleaner Production Laboratory
b. **Course Code:** 303104314
c. **Prerequisite:** Fundamental understanding of basic environmental science and industrial processes.
d. **Rationale:** Cleaner production reduces environmental impact by minimizing resource use, waste generation, and emissions, promoting sustainable practices for a healthier planet and enhanced business efficiency.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a solid understanding of the principles of cleaner production, including pollution prevention, resource efficiency, and sustainable industrial practices.
CLOBJ 2	Students will develop the ability to analyze the environmental impacts of industrial processes, identifying opportunities for reducing waste, emissions, and resource consumption.
CLOBJ 3	Students will learn to design and implement sustainable solutions for reducing the environmental footprint of manufacturing and industrial operations, incorporating cleaner technologies and processes.
CLOBJ 4	Students will be able to evaluate the economic and environmental trade-offs of different cleaner production strategies, considering factors such as cost, efficiency, and long-term sustainability.
CLOBJ 5	Students will gain practical skills in applying Life Cycle Assessment (LCA) tools to assess the environmental performance of products and processes, guiding decisions toward more sustainable production practices.

f. **Course Learning Outcomes:**

CLO 1	Explain the concept and principles of cleaner production.
CLO 2	Suggest different unit operations in industrial production process to minimize pollutions.
CLO 3	Plan good housekeeping practices for Industry/other places with concern of safety, hygiene and waste reduction.
CLO 4	Suggest basic methods and techniques of pollution prevention during production.
CLO 5	Suggest cleaner production methods for a given situation which will also lead to cost reduction in long run.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Introduction to Cleaner Production
2	Life Cycle Assessment (LCA)
3	Waste Minimization Techniques
4	Energy Efficiency in Manufacturing
5	Green Chemistry Principles
6	Sustainable Materials and Resources
7	Environmental Management Systems

i. Text Book and Reference Book:

1. Training Manual Package" by NCPC
2. Chemical Process Safety: Learning from case Histories, By Sanders R.E. | Oxford Butter Worth Publication
3. "Green Chemistry: Environmentally Benign Reactions". By Ahluvalia V. K.
4. "Engineers Guide to Cleaner Production Technologies By Randall Paul M
5. "Clean Technology for manufacture of Specialty Chemicals", Editor-W. Hoyle and M. Lancaster, Royal Society of Chemistry, U.K
6. "Cleaner Production Worldwide", By 1993, United Nations Environment Programme, Industry and Environment | Paris, France, 1993

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a. **Course Name:** Pollution Monitoring and Legislation
b. **Course Code:** 303104315
c. **Prerequisite:** Knowledge of various Environmental acts.
d. **Rationale:** To learn different pollution monitoring methods.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of the different types of pollution (air, water, soil, noise) and their sources, including industrial, agricultural, and urban activities.
CLOBJ 2	Students will learn to use various pollution monitoring techniques and tools to measure and analyze pollutants in the environment, ensuring accurate data collection and interpretation.
CLOBJ 3	Students will develop the ability to interpret and apply relevant environmental legislation, regulations, and standards at local, national, and international levels, ensuring compliance with legal requirements.
CLOBJ 4	Students will gain the skills to design and implement effective pollution monitoring programs, including selecting appropriate methods, managing data, and reporting findings to stakeholders.
CLOBJ 5	Students will be able to critically evaluate the effectiveness of environmental legislation and policies in controlling and reducing pollution, proposing improvements where necessary to enhance environmental protection.

f. **Course Learning Outcomes:**

CLO 1	Know the role of law, policy and institutions in the conservation and management of natural resources as well as pollution control
CLO 2	Introduce the laws and policies both at the national and international levels relating to the environment.
CLO 3	Equip with the skills needed for interpreting laws, policies and judicial decisions.
CLO 4	Understand the environmental clearance process & its acquaintance

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction to Pollution Monitoring** Environmental Audit and its function, SPCBs and CPCB and its function.	**30%**	**14**
2	**Basic Concepts in Environmental Law** National and Global Environmental Policies, Forest Policy, Water Policy, Mineral Development policy	**10%**	**5**
3	**Environmental Legislation-Acts** Rules, Regulations and Notifications. Environmental Standards, Criteria for Standard Setting	**30%**	**14**
4	**Environmental Clearance** Forest clearance; Consent to Establish & Consent to Operate; Environmental conservation plan for endangered flora and fauna. Framework for EIA, Screening, Scoping, Baseline studies, EIA Methodologies (Adhoc, Checklist, Matrix, Network, and Overlay Methods).	**30%**	**15**

i. Text Book and Reference Book:

1. 'Introduction to Environment Impact Assessment (The Natural and Built Environment Series) (TextBook) By John Glasson, Riki Therivel and Andrew Chadwick | Routledge
2. Environmental Impact Assessment Handbook: A Practical Guide for Planners, Developers and Communities' By Barbara Caroll, Trevor Turpin, Adam Boyden | ICE Publishing.

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a. **Course Name:** Pollution Monitoring and Legislation Laboratory
b. **Course Code:** 303104316
c. **Prerequisite:** Knowledge of various Environmental acts.
d. **Rationale:** To learn different pollution monitoring methods.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of the different types of pollution (air, water, soil, noise) and their sources, including industrial, agricultural, and urban activities.
CLOBJ 2	Students will learn to use various pollution monitoring techniques and tools to measure and analyze pollutants in the environment, ensuring accurate data collection and interpretation.
CLOBJ 3	Students will develop the ability to interpret and apply relevant environmental legislation, regulations, and standards at local, national, and international levels, ensuring compliance with legal requirements.
CLOBJ 4	Students will gain the skills to design and implement effective pollution monitoring programs, including selecting appropriate methods, managing data, and reporting findings to stakeholders.
CLOBJ 5	Students will be able to critically evaluate the effectiveness of environmental legislation and policies in controlling and reducing pollution, proposing improvements where necessary to enhance environmental protection.

f. **Course Learning Outcomes:**

CLO 1	Know the role of law, policy and institutions in the conservation and management of natural resources as well as pollution control
CLO 2	Introduce the laws and policies both at the national and international levels relating to the environment.
CLO 3	Equip with the skills needed for interpreting laws, policies and judicial decisions.
CLO 4	Understand the environmental clearance process & its acquaintance

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Environmental Audit Process
2	Environmental Impact Assessment.
3	Environmental Clearance Process
4	Understanding Environmental Laws

i. Text Book and Reference Book:

1. 'Introduction to Environment Impact Assessment (The Natural and Built Environment Series) (TextBook) By John Glasson, Riki Therivel and Andrew Chadwick | Routledge
2. Environmental Impact Assessment Handbook: A Practical Guide for Planners, Developers and Communities' By Barbara Caroll, Trevor Turpin, Adam Boyden | ICE Publishing.

(11)

a. **Course Name:** Environmental Microbiology
b. **Course Code:** 303104317
c. **Prerequisite:** Knowledge of the subject of Environmental Microbiology.
d. **Rationale:** Microorganisms not play a very important role in treatment and disposal of wastes but also are responsible for spreading many diseases. Hence a working knowledge of microbiology forms a base for other core subjects of environmental engineering.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a deep understanding of microbial ecology, including the roles and interactions of microorganisms in various environmental contexts such as soil, water, and air.
CLOBJ 2	Students will learn to analyze key microbial processes, such as biodegradation, nutrient cycling, and bioremediation, and their impact on environmental health and sustainability.
CLOBJ 3	Students will acquire practical skills in applying microbiological techniques, including culturing, identification, and molecular analysis of microorganisms, to study and manage environmental systems.
CLOBJ 4	Students will be able to evaluate the role of microorganisms in pollution control and waste treatment processes, designing strategies to harness microbial activity for environmental remediation and pollution mitigation.

f. **Course Learning Outcomes:**

CLO 1	demonstrate knowledge of the diverse range of microorganisms present in different environmental settings, including bacteria, fungi, viruses, and archaea
CLO 2	understanding of microbial interactions in different ecosystems, including symbiotic relationships, competition, and the role of microorganisms in nutrient cycling.
CLO 3	Understand the microbial processes involved in the degradation of pollutants and contaminants, and explore strategies for using microorganisms in environmental cleanup.
CLO 4	Acquire hands-on experience with laboratory techniques relevant to environmental microbiology, such as microbial isolation, identification, and characterization methods

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction to Microbiology** Scope of microbiology, Structure and classification of microbes, Role of microbes in human life and environment, Prokaryotic cell, Cytoplasm of Eukaryotes, structure, characteristics, nucleic acids, DNA and RNA, Viruses, their detection and quantification	8%	3
2	**Basic Methods in Microbiology** Microscopic methods, Techniques of sterilization, Media preparation, Isolation and inoculation, direct observation and staining techniques, Maintenance and preservation of cultures.	8%	5
3	**Microscope and Microscopy** Optical Microscopes and electron microscope	8%	4
4	**Microorganisms and Human Diseases** Diseases caused by bacteria, fungi and protozoa	14%	6
5	**Microorganisms in Environment, Industry and Food** Soil microorganisms, microorganisms in aquatic habitats, microorganisms and pollution, Microorganisms in sewage, Fermentation processes, products of industrial fermentation	14%	8
6	**Microbial Metabolism and Growth** Enzyme and enzyme kinetics – Metabolism – Respiration – Fermentation – Glycolysis – Kreb's cycle – Carbohydrate – Protein, lipids, significance of energetic – Chemical composition of cell and nature of organic matter used by microorganisms – Metabolic classification of microorganisms: phototrophs, chemotrophs, applications in environmental engineering	20%	9

7	**Microbiology of Water and Wastewater** Distribution of microorganisms in natural water – Indicator organisms – Coliforms – Fecal coliforms – E.coli, Streptococcus faecalis – Differentiation of coliforms – Significance – MPN – M.F. techniques – Microbiology of wastewater treatment processes such as activated sludge process – Trickling filter – Anaerobic processes. – Introduction to Microbiology of Soil and Air and Industrial Microbiology – Microbiology of bioremediation and solid waste treatment	**28%**	**10**

i. Text Book and Reference Book:

1. Microbiology (TextBook) Pelczar, Chan Kreig; Tata McGraw Hill
2. Environmental Microbiology (TextBook) Maier R.M, Pepper I.L and Gerba C.P.; Elsevier
3. Textbook of Microbiology (TextBook) Ananthanarayan; Universities Press.

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a. **Course Name:** Environmental Microbiology Laboratory
b. **Course Code:** 303104318
c. **Prerequisite:** Knowledge of the subject of Environmental Microbiology.
d. **Rationale:** Microorganisms not play a very important role in treatment and disposal of wastes but also are responsible for spreading many diseases. Hence a working knowledge of microbiology forms a base for other core subjects of environmental engineering.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a deep understanding of microbial ecology, including the roles and interactions of microorganisms in various environmental contexts such as soil, water, and air.
CLOBJ 2	Students will learn to analyze key microbial processes, such as biodegradation, nutrient cycling, and bioremediation, and their impact on environmental health and sustainability.
CLOBJ 3	Students will acquire practical skills in applying microbiological techniques, including culturing, identification, and molecular analysis of microorganisms, to study and manage environmental systems.
CLOBJ 4	Students will be able to evaluate the role of microorganisms in pollution control and waste treatment processes, designing strategies to harness microbial activity for environmental remediation and pollution mitigation.

f. **Course Learning Outcomes:**

CLO 1	demonstrate knowledge of the diverse range of microorganisms present in different environmental settings, including bacteria, fungi, viruses, and archaea
CLO 2	understanding of microbial interactions in different ecosystems, including symbiotic relationships, competition, and the role of microorganisms in nutrient cycling.
CLO 3	Understand the microbial processes involved in the degradation of pollutants and contaminants, and explore strategies for using microorganisms in environmental cleanup.
CLO 4	Acquire hands-on experience with laboratory techniques relevant to environmental microbiology, such as microbial isolation, identification, and characterization methods

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Microbial Observation: Observation of microbial specimens under a microscope.
2	Sterilization Techniques: Practice autoclaving, filtration, and other sterilization methods.
3	Media Preparation: Preparation of agar plates and broth media.
4	Isolation and Inoculation: Techniques for isolating and inoculating microbial cultures.
5	Staining Techniques: Direct observation and staining of microbial samples.
6	Determination of MPN of water/wastewater.

i. Text Book and Reference Book:

1. Microbiology (TextBook) Pelczar, Chan Kreig; Tata McGraw Hill
2. Environmental Microbiology (TextBook) Maier R.M, Pepper I.L and Gerba C.P.; Elsevier
3. Textbook of Microbiology (TextBook) Ananthanarayan; Universities Press.

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a. **Course Name:** Foundation Engineering
b. **Course Code:** 303104321
c. **Prerequisite:** Basic Soil Mechanics.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will develop a comprehensive understanding of the properties and behavior of soils, including concepts such as soil classification, shear strength, compressibility, and bearing capacity, as they relate to foundation design.
CLOBJ 2	Students will acquire the skills to design different types of foundation systems, such as shallow foundations (footings, mats) and deep foundations (piles, caissons), ensuring stability and safety under various loading conditions.
CLOBJ 3	Students will learn to analyze the interaction between soil and structural elements, considering factors like settlement, lateral earth pressures, and load distribution, to optimize foundation performance.
CLOBJ 4	Students will be able to apply geotechnical investigation techniques, including site exploration, soil testing, and field assessments, to gather critical data for informed foundation design and construction decisions.

f. **Course Learning Outcomes:**

CLO 1	Analyze subsurface soil conditions to assess suitability for various types of foundations.
CLO 2	Design shallow and deep foundation systems based on soil bearing capacity and structural load requirements.
CLO 3	Evaluate site investigation data to determine appropriate foundation solutions for diverse ground conditions.
CLO 4	Apply principles of soil mechanics to solve practical problems related to bearing capacity and settlement.
CLO 5	Identify suitable ground improvement techniques to enhance soil performance and foundation stability.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION TO FOUNDATION:** Types of foundation, Factors affecting the selection of type of foundations, steps in choosing types of foundation based on soil condition	15%	8
2	**SHALLOW FOUNDATION:** Introduction, significant depth, design criteria, modes of shear failures. Detail study of bearing capacity theories (Prandtl, Rankine, Terzaghi, Skempton), bearing capacity determination using IS Code, Presumptive bearing capacity. Settlement, components of settlement & its estimation, permissible settlement, Proportioning of footing for equal settlement, allowable bearing pressure. Bearing capacity from in-situ tests(SPT, SCPT, PLATE LOAD), Factors affecting bearing capacity including Water Table. Bearing capacity of raft/mat foundation as per codal provisions	30%	15
3	**PILE FOUNDATION**: Introduction, load transfer mechanism, types of piles and their function, factors influencing selection of pile, their method of installation and their load carrying characteristics for cohesive and granular soils, piles subjected to vertical loads- pile load carrying capacity from static formula,dynamic formulae (ENR and Hiley), penetration test data & Pile load test (IS 2911). Pile group: carrying capacity, efficiency and settlement. Negative skin friction.	30%	20
4	**FOUNDATIONS ON PROBLEMATIC SOIL:** Significant characteristics of expansive soil, footing on such soils, Problems and preventive measures. Under-reamed pile foundation-its concept, design & field installation. Significant characteristics of silt and loess, problems & remedial measures footing on such soils	25%	5

i. Text Book and Reference Book:

1. Punmia .B.C, "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd
2. P. Purushothama Raj; Soil Mechanics and Foundation Engineering; Pearson Education
3. Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi Taylor D.W.; Fundamentals of Soil Mechanics; Asia Publishing

House, Mumbai.
4. V. N. S. Murthy; Soil Mechanics & Foundation Engineering; Sai Kripa Technical Consultants, Banglore.
5. Gopal Ranjan, Rao A.S.R.; Basic and applied soil mechanics; New age int. (p) ltd

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a. **Course Name:** Foundation Engineering Laboratory
b. **Course Code:** 303104322
c. **Prerequisite:** Basic Soil Mechanics.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will develop a comprehensive understanding of the properties and behavior of soils, including concepts such as soil classification, shear strength, compressibility, and bearing capacity, as they relate to foundation design.
CLOBJ 2	Students will acquire the skills to design different types of foundation systems, such as shallow foundations (footings, mats) and deep foundations (piles, caissons), ensuring stability and safety under various loading conditions.
CLOBJ 3	Students will learn to analyze the interaction between soil and structural elements, considering factors like settlement, lateral earth pressures, and load distribution, to optimize foundation performance.
CLOBJ 4	Students will be able to apply geotechnical investigation techniques, including site exploration, soil testing, and field assessments, to gather critical data for informed foundation design and construction decisions.

f. **Course Learning Outcomes:**

CLO 1	Perform standard laboratory tests to determine soil properties such as permeability, shear strength, and compaction.
CLO 2	Interpret laboratory test results to evaluate the engineering behavior of different soil types.
CLO 3	Demonstrate the procedures for determining bearing capacity and settlement characteristics through experimental methods.
CLO 4	Calibrate geotechnical instruments used in the assessment of soil and foundation parameters.
CLO 5	Prepare detailed laboratory reports that effectively communicate test methods, data analysis, and engineering conclusions.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Disturbed and undisturbed sampling, identification of methods for disturbed sampling, identification of methods for undisturbed sampling
2	Sketches of Shallow and Deep foundation
3	Standard Penetration test
4	Theory of Static cone penetration test and dynamic cone penetration test
5	Plate load test
6	Tutorial on Shallow Foundation
7	Tutorial on Pile Foundation
8	Free swell test for Expansive soils

i. Text Book and Reference Book:

1. Punmia .B.C, "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd
2. P. Purushothama Raj; Soil Mechanics and Foundation Engineering; Pearson Education
3. Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi Taylor D.W.; Fundamentals of Soil Mechanics; Asia Publishing House, Mumbai.
4. V. N. S. Murthy; Soil Mechanics & Foundation Engineering; Sai Kripa Technical Consultants, Banglore.
5. Gopal Ranjan, Rao A.S.R.; Basic and applied soil mechanics; New age int. (p) ltd.

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a. **Course Name:** Rock Mechanics
b. **Course Code:** 303104323
c. **Prerequisite:** Classification of rock, Stress and Strain characteristics of rocks, Failure theories, Mode of failure.
d. **Rationale:** Rock mechanics is understanding the behaviour and characteristics of rocks and minerals present in it.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a thorough understanding of the physical and mechanical properties of rock materials, including strength, deformability, and anisotropy, and their significance in rock engineering.
CLOBJ 2	Students will learn to analyze the behavior of rock masses under various stress conditions, including concepts such as rock failure, stress distribution, and fracture mechanics.
CLOBJ 3	Students will be able to apply rock mechanics principles to the design and analysis of structures such as tunnels, slopes, foundations, and underground excavations, ensuring stability and safety.
CLOBJ 4	Students will develop practical skills in conducting field and laboratory tests to assess rock properties and behavior, including methods like uniaxial compressive strength tests, triaxial tests, and in-situ stress measurements.
CLOBJ 5	Students will gain the ability to evaluate and use rock mass classification systems (e.g., RMR, Q-system, GSI) for engineering applications, enabling them to make informed decisions in rock engineering projects.

f. **Course Learning Outcomes:**

CLO 1	Understand Engineering properties of rock
CLO 2	Understand Classification of rocks
CLO 3	Understand Laboratory testing of rocks
CLO 4	Understand Failure criteria
CLO 5	Understand Various techniques to improve insitu strength of rocks
CLO 6	Understand Choose appropriate methods to improve stability of rock mass

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	

3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION** Rock, Defination, Importance of Rock Mechanics in today's life, Formation of Rock, Geological Classification of Rock **,** Important definitions related to rock, Engineering Classification of rock, Rock Quality Designation, Core Recovery	**30%**	**12**
2	**STRESS IN ROCKS** Strength and Elasticity of rock, Stress Strain Characteristics, Mode of fracture	**20%**	**12**
3	**STRENGTH OF ROCK** Factors affecting strength of rock, Physical properties of rock, Mechanical behavior of rock, Compression test on rock, Tensile test on rock, Brazilion test on rock, Triaxial Shear test on rock, Factors affecting compressive strength of rock.	**30%**	**12**
4	**FAILURE THEORIES** Criterion of failure, Concepts of failure, Classical Concepts, Modern Concepts, Murrel Extension of Griffith Theory	**20%**	**12**

i. Text Book and Reference Book:

1. Rock Mechanics for Engineers by Verma B.P, Khanna Publishers, New Delhi.
2. Introduction to Rock Mechanics by R.E.Goodman, John Wiley & Sons, New York.
3. Fundamentals of Rock Mechanics, Fourth Edition, by Jaeger, Cook and Zimmerman, Blackwell Publishing, New York.
4. Kiyoo Mogi "Experimental Rock Mechanics" Taylor & Francis Group, UK, 2007.
5. T. Ramamurthy, "Engineering in Rocks for slopes, foundations and tunnels", PHI Learning Pvt. Limited, 2010.

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a. **Course Name:** Rock Mechanics Laboratory
b. **Course Code:** 303104324
c. **Prerequisite:** Classification of rock, Stress and Strain characteristics of rocks, Failure theories, Mode of failure.
d. **Rationale:** Rock mechanics is understanding the behaviour and characteristics of rocks and minerals present in it.

e. **Course Learning Objective:**

CLOBJ 1	Students will gain a thorough understanding of the physical and mechanical properties of rock materials, including strength, deformability, and anisotropy, and their significance in rock engineering.
CLOBJ 2	Students will learn to analyze the behavior of rock masses under various stress conditions, including concepts such as rock failure, stress distribution, and fracture mechanics.
CLOBJ 3	Students will be able to apply rock mechanics principles to the design and analysis of structures such as tunnels, slopes, foundations, and underground excavations, ensuring stability and safety.
CLOBJ 4	Students will develop practical skills in conducting field and laboratory tests to assess rock properties and behavior, including methods like uniaxial compressive strength tests, triaxial tests, and in-situ stress measurements.
CLOBJ 5	Students will gain the ability to evaluate and use rock mass classification systems (e.g., RMR, Q-system, GSI) for engineering applications, enabling them to make informed decisions in rock engineering projects.

f. **Course Learning Outcomes:**

CLO 1	Understand the Engineering properties of rock
CLO 2	Understand the Classification of rocks
CLO 3	Understand Laboratory testing of rocks
CLO 4	Understand Failure criteria
CLO 5	Understand Various techniques to improve insitu strength of rocks
CLO 6	Understand Choose appropriate methods to improve the stability of rock mass

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	

0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Demonstration of different types of Rocks and Minerals
2	Study of laboratory tests on physical and Engineering properties of Rocks
3	Visit to GERI for demonstration of various tests on Rocks
4	Presentations related to Rock Mechanics

i. Text Book and Reference Book:

1. Rock Mechanics for Engineers by Verma B.P, Khanna Publishers, New Delhi.
2. Introduction to Rock Mechanics by R.E.Goodman, John Wiley & Sons, New York.
3. Fundamentals of Rock Mechanics, Fourth Edition, by Jaeger, Cook and Zimmerman, Blackwell Publishing, New York.
4. Kiyoo Mogi “Experimental Rock Mechanics” Taylor & Francis Group, UK, 2007.
5. T. Ramamurthy, “Engineering in Rocks for slopes, foundations and tunnels”, PHI Learning Pvt. Limited, 2010.

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a. **Course Name:** Soil Mechanics
b. **Course Code:** 303104325
c. **Prerequisite:** Geotechnical Engineering I subject.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of the physical, chemical, and mechanical properties of soils, including soil classification systems, to effectively characterize different soil types.
CLOBJ 2	Students will learn to analyze soil behavior under various loading conditions, including concepts such as stress-strain relationships, consolidation, compaction, and shear strength.
CLOBJ 3	Students will be able to apply the principles of soil mechanics to the design and analysis of foundations, retaining walls, and other geotechnical structures, ensuring stability and safety.
CLOBJ 4	Students will develop practical skills in conducting laboratory and field soil tests, such as Atterberg limits, triaxial tests, and Standard Penetration Tests (SPT), and interpreting the results for engineering applications.
CLOBJ 5	Students will learn to evaluate soil-structure interaction, considering factors such as settlement, lateral earth pressures, and bearing capacity, to optimize the design and performance of geotechnical systems.

f. **Course Learning Outcomes:**

CLO 1	Should be able to assess soil behavior with the mineralogy present and advanced soil testing of soils such as in thermal, chemical, magnetic fields
CLO 2	Should be able to do seepage analysis for finding discharge calculation and stability of structure
CLO 3	Should be able to determine the safety analysis for slopes with different methods proposed in the syllabus
CLO 4	Should be in a position to do various laboratory experiments to determine design parameters according field application

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**SHEAR STRENGTH** Introduction – shear strength of cohesive and cohesion less soils – Mohr coulomb's failure theory – Concept of effective stress – Direct shear test, Triaxial compression test, unconfined compression test– Laboratory and field vane shear test, factors affecting the shear strength – Types of shear test according to drainage condition – Modified failure envelope.	**25%**	**10**
2	**STRESS DISTRIBUTION** Introduction – Boussinesq and Westergaard analysis for Point load , Comparison of Boussinesq and Westergaard Ananlysis – stress distribution in soil media – Stress distribution for line load, Strip load, Rectangular footing, Uniformly loaded circular footing, Pressure bulb – Newmark's chart – Contact pressure theory	**25%**	**13**
3	**STABILITY OF SLOPES** Introduction, Infinite and finite slopes – Factor of safety, Type of slope failure, Stability of infinite slopes – Stability of finite slopes: C- analysis, Friction circle method, Method of slices, Taylor's stability number, Bishop's method – Stability analysis of upstream and downstream slope of an earthen dam.	**25%**	**13**
4	**LATERAL EARTH PRESSURE** Introduction, Earth pressure at rest condition, Rankine's theory for active and passive earth pressure for horizontal and sloping cohesionless backfill, Rankine's theory for active and passive earth pressure for horizontal cohesive backfill, Coloumb's wedge theory for active and passive earth pressure, Rebhann's and Culmann's graphical solutions for earth pressure	**25%**	**12**

i. Text Book and Reference Book:

1. Punmia .B.C, "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd.
2. Raju .K.V.B .and Ravichandran .P.T, "Mechanics of Soils", Ayyappaa Publications.
3. Gopal Ranjan and Rao. A.S.R, "Basic and Applied Soil Mechanics", New age international (p) Ltd..
4. Arora .K.R, "Soil Mechanics and Foundation Engineering", Standard Publication Distributors.
5. Terzaghi .K and Peck .R.B, "Soil Mechanics in Engineering Practice", John Wiley.

6. Lambe .T.W, Whitman, “Soil Mechanics”, John Wiley Ltd..
7. Murthy, V.N.S, A text book of Soil Mechanics and Foundation Engineering, UBS Publishers & Distributors Pvt. Ltd., New Delhi 1999.

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a. **Course Name:** Soil Mechanics Laboratory
b. **Course Code:** 303104326
c. **Prerequisite:** Geotechnical Engineering I subject.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of the physical, chemical, and mechanical properties of soils, including soil classification systems, to effectively characterize different soil types.
CLOBJ 2	Students will learn to analyze soil behavior under various loading conditions, including concepts such as stress-strain relationships, consolidation, compaction, and shear strength.
CLOBJ 3	Students will be able to apply the principles of soil mechanics to the design and analysis of foundations, retaining walls, and other geotechnical structures, ensuring stability and safety.
CLOBJ 4	Students will develop practical skills in conducting laboratory and field soil tests, such as Atterberg limits, triaxial tests, and Standard Penetration Tests (SPT), and interpreting the results for engineering applications.
CLOBJ 5	Students will learn to evaluate soil-structure interaction, considering factors such as settlement, lateral earth pressures, and bearing capacity, to optimize the design and performance of geotechnical systems.

f. **Course Learning Outcomes:**

CLO 1	Should be able to assess soil behavior with the mineralogy present and advanced soil testing of soils such as in thermal, chemical, magnetic fields
CLO 2	Should be able to do seepage analysis for finding discharge calculation and stability of structure
CLO 3	Should be able to determine the safety analysis for slopes with different methods proposed in the syllabus
CLO 4	Should be in a position to do various laboratory experiments to determine design parameters according field application

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Auger Boring
2	Standard Proctor Test
3	California Bearing Ratio Test
4	Direct Shear Box Test
5	Triaxial Test

i. Text Book and Reference Book:

1. Punmia .B.C, "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd.
2. Raju .K.V.B .and Ravichandran .P.T, "Mechanics of Soils", Ayyappaa Publications.
3. Gopal Ranjan and Rao. A.S.R, "Basic and Applied Soil Mechanics", New age international (p) Ltd..
4. Arora .K.R, "Soil Mechanics and Foundation Engineering", Standard Publication Distributors.
5. Terzaghi .K and Peck .R.B, "Soil Mechanics in Engineering Practice", John Wiley.
6. Lambe .T.W, Whitman, "Soil Mechanics", John Wiley Ltd..
7. Murthy, V.N.S, A text book of Soil Mechanics and Foundation Engineering, UBS Publishers & Distributors Pvt. Ltd., New Delhi 1999.

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a. **Course Name:** Environmental Geo-Technology
b. **Course Code:** 303104327
c. **Prerequisite:** Geotechnical Engineering and Environmental Engineering.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a solid understanding of how geotechnical principles apply to environmental challenges, including the interaction between soil, rock, groundwater, and contaminants.
CLOBJ 2	Students will learn to analyze the mechanisms of contaminant transport in soils, including processes like adsorption, diffusion, and biodegradation, and their implications for soil and groundwater pollution.
CLOBJ 3	Students will be able to design geotechnical systems and structures, such as liners, barriers, and containment systems, aimed at minimizing environmental impact and controlling the spread of pollutants.
CLOBJ 4	Students will develop the ability to apply geotechnical techniques for site remediation and waste management, including methods for landfill design, soil stabilization, and the remediation of contaminated sites.

f. **Course Learning Outcomes:**

CLO 1	Have an exposure to interdisciplinary issues pertaining to environment and geotechnical engineering
CLO 2	Be trained to develop sustainable and environmentally sound solutions for geotechnical problems
CLO 3	Understand the relevance of various legal aspects involved in addressing environmental consequences associated with geotechnical issues

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	**FUNDAMENTALS OF GEOENVIRONMENTAL ENGINEERING** Scope of geoenvironmental engineering, multiphase behavior of soil – role of soil in geoenvironmental applications – importance of soil physics, soil chemistry, hydrogeology, biological process – sources and type of ground contamination – impact of ground contamination on geoenvironment, case histories on geoenvironmental problems.	**10%**	**3**
2	**SOIL WATER-CONTAMINANT INTERACTION** Soil mineralogy characterization and its significance in determining soil behavior – soil-water interaction and concepts of double layer – forces of interaction between soil particles. Concepts of unsaturated soil – importance of unsaturated soil in geo environmental problems, measurement of soil suction, water retention curves, water flow in saturated and unsaturated zone. Soil-water-contaminant interactions and its implications – Factors effecting retention and transport of contaminants.	**35%**	**20**
3	**LANDFILLS** Principles and Planning of Landfills, Liners for Landfills, Landfill Covers, Generation and Control of Leachate and Gas from Landfills, Stability of Slopes and Settlement of Land.	**30%**	**16**
4	**ADVANCED SOIL CHARACTERIZATION** Contaminant analysis, water content and permeability measurements – electrical and thermal property evaluation – use of GPR for site evaluation, introduction to geotechnical centrifuge modeling.	**20%**	**9**

i. Text Book and Reference Book:

1. Rowe R.K.,"Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
2. Reddi L.N. and Inyang, H. I.,"Geoenvironmental Engineering,Principles and Applications" Marcel Dekker Inc. New York, 2000.
3. Yong, R. N.,"Geoenvironmental Engineering, Contaminated Soils,Pollutant Fate, and Mitigation" CRC Press, New York, 2001.
4. Sharma H.D. and Reddy K.R.,"Geoenvironmental Engineering:Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
5. Fredlund D.G. and Rahardjo, H.,"Soil Mechanics for Unsaturated Soils" Wiley-Interscience, USA, 1993.
6. Mitchell, J.K.,"Fundamentals of Soil Behavior" Wiley, 2005. 7. Hillel D.,"Introduction to Environmental Soil Physics" Academic Press, New York, 2003.

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a. **Course Name:** Environmental Geo-Technology Laboratory
b. **Course Code:** 303104328
c. **Prerequisite:** Geotechnical Engineering and Environmental Engineering.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a solid understanding of how geotechnical principles apply to environmental challenges, including the interaction between soil, rock, groundwater, and contaminants.
CLOBJ 2	Students will learn to analyze the mechanisms of contaminant transport in soils, including processes like adsorption, diffusion, and biodegradation, and their implications for soil and groundwater pollution.
CLOBJ 3	Students will be able to design geotechnical systems and structures, such as liners, barriers, and containment systems, aimed at minimizing environmental impact and controlling the spread of pollutants.
CLOBJ 4	Students will develop the ability to apply geotechnical techniques for site remediation and waste management, including methods for landfill design, soil stabilization, and the remediation of contaminated sites.

f. **Course Learning Outcomes:**

CLO 1	Have an exposure to interdisciplinary issues pertaining to environment and geotechnical engineering
CLO 2	Be trained to develop sustainable and environmentally sound solutions for geotechnical problems
CLO 3	Understand the relevance of various legal aspects involved in addressing environmental consequences associated with geotechnical issues

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **List of Practical:**

Sr. No.	Content
1	Consolidation Test
2	Presentation on topics of Environmental Geotechnology
3	Case studies related to Environmental Geotechnology
4	Study of Tests related to Thermal and Hydraulic Properties of Soil

i. Text Book and Reference Book:

1. Rowe R.K.,"Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
2. Reddi L.N. and Inyang, H. I.,"Geoenvironmental Engineering,Principles and Applications" Marcel Dekker Inc. New York, 2000.
3. Yong, R. N.,"Geoenvironmental Engineering, Contaminated Soils,Pollutant Fate, and Mitigation" CRC Press, New York, 2001.
4. Sharma H.D. and Reddy K.R.,"Geoenvironmental Engineering:Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
5. Fredlund D.G. and Rahardjo, H.,"Soil Mechanics for Unsaturated Soils" Wiley-Interscience, USA, 1993.
6. Mitchell, J.K.,"Fundamentals of Soil Behavior" Wiley, 2005. 7. Hillel D.,"Introduction to Environmental Soil Physics" Academic Press, New York, 2003.

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a. **Course Name:** Traffic Engineering
b. **Course Code:** 303104331
c. **Prerequisite:** Knowledge of Transportation Engineering and Mathematics up to B.E. / B. Tech level.
d. **Rationale:** The objective of the course of Traffic Engineering is to provide safety to the road users and regulating traffic flow on the roads. It is necessary to understand the traffic flow parameters for a Traffic Engineer. Traffic Engineer should understand the basic of design of signals, intersection, capacity and level of service to provide safe, efficient and economic transportation of goods and passengers. It is important to know the methods of traffic survey and various traffic control devices. Accidents in urban area increase rapidly. It is necessary to educate the students about the prevention of accidents. The traffic engineer should know about the Environmental impact of a traffic flow and its remedial measures.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a thorough understanding of traffic flow theory, including concepts such as traffic capacity, congestion, and level of service, to analyze and manage vehicular movement effectively.
CLOBJ 2	Students will develop the skills to design and evaluate traffic control systems, including traffic signals, signs, and road markings, to optimize traffic safety and efficiency.
CLOBJ 3	Students will be able to apply traffic modeling and simulation techniques to assess and predict traffic patterns, evaluate the impact of transportation projects, and make data-driven decisions for traffic management.
CLOBJ 4	Students will learn to evaluate traffic safety and performance using tools and metrics such as accident analysis, traffic flow measurements, and safety audits, to develop strategies for improving road safety and reducing accidents.

f. **Course Learning Outcomes:**

CLO 1	Analyze traffic surveys to assess traffic characteristics and patterns
CLO 2	Evaluate highway capacity and level of service using standard methodologies.
CLO 3	Design traffic control devices in accordance with regulatory standards.
CLO 4	Analyze road accident data to identify causes and preventive measures.
CLO 5	Assess environmental impacts of traffic systems for sustainable solutions.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
2	**0**	**0**	**2**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction** The human-vehicle-environment system, Characteristics of road users; Characteristics of vehicles; Characteristics of highways, Fundamental variables of traffic flow and their interrelationship.	**15%**	**7**
2	**Traffic Surveys** Volume studies; Speed studies; O-D survey Travel time and Delay studies; Pedestrian studies; Parking studies. Accident studies	**25%**	**12**
3	**Highway Capacity Analysis** Highway Capacity and Level of Service; Measurement Techniques, HCM Methods, Design hourly volumes and speed, its uses	**13%**	**6**
4	**Traffic control devices** Introduction about the Signs, Markings, Signal and their warrants; Design of signalized intersections, Fixed and vehicle actuated signals, Rotary Design and Capacity.	**20%**	**10**
5	**Road Accidents Analysis** Accident characteristics road, driver, vehicle; Accident recording and analysis; Highway safety improvement program; Safety audit.	**14%**	**7**
6	**Environmental Considerations** Air pollution; kinds of pollutants, air pollution standards; Measures of air quality and control; Measurement of sound levels, acceptable limits; Prediction of noise levels, traffic noise control	**13%**	**6**

i. Text Book and Reference Book:

1. Principles of Transportation Engineering By Chakroborty Partha, Das Animesh
2. Traffic Engineering and Transportation Planning (TextBook) By L.R. Kadiyali | Khanna Publishers
3. Principles of Traffic and Highway Engineering (TextBook) By Nicholas J. Garber, Lester A. Hoel, Nicholas J. Garber, Lester A. Hoel

4. Traffic Engineering Design: Principles and Practice (TextBook) By Mike Slinn, Paul Matthews, Peter Guest, Butterworth Heinemann
5. Transport Planning and Traffic Engineering By Coleman A. O 'Flaherty, Butterworth-Heinemann.

(22)

a. **Course Name:** Traffic Engineering Laboratory
b. **Course Code:** 303104332
c. **Prerequisite:** Knowledge of Transportation Engineering and Mathematics up to B.E. / B. Tech level.
d. **Rationale:** The objective of the course of Traffic Engineering is to provide safety to the road users and regulating traffic flow on the roads. It is necessary to understand the traffic flow parameters for a Traffic Engineer. Traffic Engineer should understand the basic of design of signals, intersection, capacity and level of service to provide safe, efficient and economic transportation of goods and passengers. It is important to know the methods of traffic survey and various traffic control devices. Accidents in urban area increase rapidly. It is necessary to educate the students about the prevention of accidents. The traffic engineer should know about the Environmental impact of a traffic flow and its remedial measures.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a thorough understanding of traffic flow theory, including concepts such as traffic capacity, congestion, and level of service, to analyze and manage vehicular movement effectively.
CLOBJ 2	Students will develop the skills to design and evaluate traffic control systems, including traffic signals, signs, and road markings, to optimize traffic safety and efficiency.
CLOBJ 3	Students will be able to apply traffic modeling and simulation techniques to assess and predict traffic patterns, evaluate the impact of transportation projects, and make data-driven decisions for traffic management.
CLOBJ 4	Students will learn to evaluate traffic safety and performance using tools and metrics such as accident analysis, traffic flow measurements, and safety audits, to develop strategies for improving road safety and reducing accidents.

f. **Course Learning Outcomes:**

CLO 1	Analyze traffic survey data to assess traffic characteristics and patterns.
CLO 2	Evaluate highway capacity and level of service using standard methodologies in practical applications.
CLO 3	Design traffic control devices in compliance with regulatory standards through case-based exercises.
CLO 4	Interpret road accident data to identify underlying causes and recommend effective preventive measures.
CLO 5	Assess the environmental impacts of traffic systems using laboratory case studies.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Direct Manual Method For Traffic Volume Stud
2	Indirect Manual Method for Traffic Volume Study
3	Spot Speed studies by Pavement Marking Method
4	Spot Speed studies by Radar Gun
5	Parking Studies
6	Traffic Stream Parameters Study
7	Examples of design of rotary and signalised intersections

i. Text Book and Reference Book:

1. Principles of Transportation Engineering By Chakroborty Partha, Das Animesh
2. Traffic Engineering and Transportation Planning (TextBook) By L.R. Kadiyali | Khanna Publishers
3. Principles of Traffic and Highway Engineering (TextBook) By Nicholas J. Garber, Lester A. Hoel, Nicholas J. Garber, Lester A. Hoel
4. Traffic Engineering Design: Principles and Practice (TextBook) By Mike Slinn, Paul Matthews, Peter Guest, Butterworth Heinemann
5. Transport Planning and Traffic Engineering By Coleman A. O 'Flaherty, Butterworth-Heinemann.

(23)

a. **Course Name:** Railway and Metro System
b. **Course Code:** 303104333
c. **Prerequisite:** Transportation Engineering.
d. **Rationale:** Enable to plan and design the different components of railway engineering. Metro rail is important mode of surface & underground transportation. Metro rails are economic for the short distance transportation of passengers. India has the large Metro rail network and covering major cities. At present in the India, new construction of metro is running on. There is a very good scope of developing high speed trains and special corridors for freight transportation in India.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of the key components of railway and metro systems, including track infrastructure, rolling stock, signaling systems, and station design
CLOBJ 2	Students will develop the ability to design and plan various aspects of rail and metro infrastructure, such as track alignment, station layouts, and depots, ensuring efficient and safe operation.
CLOBJ 3	Students will learn to analyze rail and metro operations, including train scheduling, capacity management, and operational efficiency, to optimize performance and service quality.
CLOBJ 4	Students will be able to apply relevant safety and regulatory standards to the design, construction, and operation of rail and metro systems, ensuring compliance with industry norms and enhancing passenger safety.
CLOBJ 5	Students will gain skills in implementing modern technologies in railway and metro systems, such as automated train control, real-time tracking, and energy-efficient systems, to improve operational efficiency and sustainability.

f. **Course Learning Outcomes:**

CLO 1	Identify the Components of Railway Track, different Railway Gauges
CLO 2	Design track Gradients as per given requirements and Discuss various Types of Track Turnouts
CLO 3	Understanding Interlocking system
CLO 4	Analyze needs of metro construction project
CLO 5	Prepare construction schedules and manage metro construction projects

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
2	**0**	**0**	**2**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**GEOMETRIC DESIGN OF RAILWAY TRACK** Right of way and formation, field investigation, geometric design elements, safe speed on curves, speeds computation string lining of curves, gradients, grade compensation, railway cant and cant deficiency, traction. **COMPONENT OF RAILWAY TRACK AND ROLLING STOCK** Permanent way, forces acting, rails, the function of rails, rail fixtures and fastenings, sleepers and ballast, rail joints, elements of junctions and layouts, types of traction, locomotives and other rolling stock, brake systems, resistance due to friction, wave action, wind, gradient, curvature, starting, tractive effort of a locomotive, hauling power of a locomotive	**30%**	**16**
2	**TRACK CONSTRUCTION** Special considerations and construction practices, track laying, Introduction of the maintenance programme, Monsoon, Pre-Monsoon & Post-Monsoon Maintenance, Causes for Maintenance, Routine Maintenance, Tools for Railway Track Maintenance & Their Functions,Surface Defects and Their Remedial Measures, track drainage, track circuited lengths, track tolerances, mechanized method, off-track tampers, shovel packing, ballast confinement and directed track maintenance, bridge maintenance, renewal, classification of renewal works, through sleeper renewals, mechanized relaying, track renewal trains	**30%**	**12**
3	**METRO PROJECT FUNDAMENTALS** Concept of rapid transit systems, requirements of rapid transit systems. types of rapid transit systems, concept of metro rail transit system, terminology of metro construction, advantages and disadvantages of metro, metro construction projects in India	**25%**	**10**
4	**METRO RAIL**	**15%**	**6**

	Fundamentals of railway construction, terminology of railway and its components, Railway systems, Railway track construction, Components of railway track, Rail signaling, Introduction to electric supply for metro rail		

i. Text Book and Reference Book:

1. M Ramachandran, Metro Rail Projects in India: a Study in Project Planning, Oxford University Press, New Delhi, 2011
2. R K Goel, B Singh and J Zhao, Underground Infrastructures: Planning, Design and Construction, Butterworth-Heinemann, Oxford, 2012.
3. S Chandra, Railway Engineering, Oxford University Press, New Delhi, 2008.
4. K S Elliott, Precast Concrete Structures, CRC Press, Boca Raton, 2016.
5. K N Jha, Construction Project Management: Theory and Practice, Pearson Education, New Delhi, 2015
6. Satish Chandra and M. Agrawal, Railway Engineering, Second Edition, Oxford University Press, 2013.
7. Agarwal, M.M. Indian Railway Track, Prabha & Co., New Delhi, India, 1988.
8. Chandra S. and M.M. Agarwal Railway Engineering, Oxford University Press, New Delhi, India, 2007.
9. Gupta, B.L. Text Book of Railway Engineering, Standard Publishers, New Delhi, India, 1982.
10. Rangwala, S.C. Principles of Railway Engineering, Charotar Publishing House, Anand, India, 1988.
11. S.C. Saxena and S.P. Arora, A text book of Railway engineering, DhanpatRai, 2001.

(24)

a. **Course Name:** Railway and Metro Systems Laboratory
b. **Course Code:** 303104334
c. **Prerequisite:** Transportation Engineering.
d. **Rationale:** Enable to plan and design the different components of railway engineering. Metro rail is important mode of surface & underground transportation. Metro rails are economic for the short distance transportation of passengers. India has the large Metro rail network and covering major cities. At present in the India, new construction of metro is running on. There is a very good scope of developing high speed trains and special corridors for freight transportation in India.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of the key components of railway and metro systems, including track infrastructure, rolling stock, signaling systems, and station design
CLOBJ 2	Students will develop the ability to design and plan various aspects of rail and metro infrastructure, such as track alignment, station layouts, and depots, ensuring efficient and safe operation.
CLOBJ 3	Students will learn to analyze rail and metro operations, including train scheduling, capacity management, and operational efficiency, to optimize performance and service quality.
CLOBJ 4	Students will be able to apply relevant safety and regulatory standards to the design, construction, and operation of rail and metro systems, ensuring compliance with industry norms and enhancing passenger safety.
CLOBJ 5	Students will gain skills in implementing modern technologies in railway and metro systems, such as automated train control, real-time tracking, and energy-efficient systems, to improve operational efficiency and sustainability.

f. **Course Learning Outcomes:**

CLO 1	Identify the Components of Railway Track, different Railway Gauges
CLO 2	Design track Gradients as per given requirements and Discuss various Types of Track Turnouts
CLO 3	Understanding Interlocking system
CLO 4	Analyze needs of metro construction project
CLO 5	Prepare construction schedules and manage metro construction projects

g. **Teaching & Examination Scheme:**

Teaching Scheme	Evaluation Scheme

L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Draw the Sketch of Permanent way
2	Draw the Sketch of Different type of Rails
3	Sketches of Different Fixtures and Fastenings, Rail joints used in railway track
4	Numerical on Geometric design of railway track
5	Sketch Different Components of Metro Track
6	Case Study of Metro Construction in India

i. Text Book and Reference Book:

1. M Ramachandran, Metro Rail Projects in India: a Study in Project Planning, Oxford University Press, New Delhi, 2011
2. R K Goel, B Singh and J Zhao, Underground Infrastructures: Planning, Design and Construction, Butterworth-Heinemann, Oxford, 2012.
3. S Chandra, Railway Engineering, Oxford University Press, New Delhi, 2008.
4. K S Elliott, Precast Concrete Structures, CRC Press, Boca Raton, 2016.
5. K N Jha, Construction Project Management: Theory and Practice, Pearson Education, New Delhi, 2015
6. Satish Chandra and M. Agrawal, Railway Engineering, Second Edition, Oxford University Press, 2013.
7. Agarwal, M.M. Indian Railway Track, Prabha & Co., New Delhi, India, 1988.
8. Chandra S. and M.M. Agarwal Railway Engineering, Oxford University Press, New Delhi, India, 2007.
9. Gupta, B.L. Text Book of Railway Engineering, Standard Publishers, New Delhi, India, 1982.
10. Rangwala, S.C. Principles of Railway Engineering, Charotar Publishing House, Anand, India, 1988.
11. S.C. Saxena and S.P. Arora, A text book of Railway engineering, DhanpatRai, 2001.

(25)

a. **Course Name:** Airport and Dock Harbour
b. **Course Code:** 303104335
c. **Prerequisite:** Knowledge of Transportation Engineering.
d. **Rationale:** With the growth in population and vehicular ownership, the undesirable outcome of the transportation system is increase in the number of accidents. Loss of lives is detrimental for the economy and progress of the nation. It is prime consideration to provide maximum safety to the people during and after construction of highways. It is necessary for the transportation engineer to know about the causes of accidents and environmental pollution due to highway or other transportation facility construction activities. The mitigation measures shall be taken properly to minimize the accidents and environmental pollution. The road safety audit includes all these aspects in systematic way. Therefore, the study of this subject will enable to provide all necessary features regarding road safety to the students.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of the key infrastructure components of airports and dock harbours, including runways, taxiways, terminals, docks, piers, and cargo facilities
CLOBJ 2	Students will develop the ability to design efficient and effective layouts for airports and dock harbours, considering factors such as traffic flow, safety, capacity, and operational efficiency.
CLOBJ 3	Students will learn to apply transportation and logistics principles to optimize the operations of airports and dock harbours, including cargo handling, passenger flow management, and multimodal connectivity.
CLOBJ 4	Students will be able to evaluate and ensure compliance with safety and regulatory standards for airport and dock harbour operations, including security measures, environmental regulations, and safety protocols.
CLOBJ 5	Students will gain skills in incorporating modern technologies and sustainability practices into the design and operation of airports and dock harbours, such as advanced navigation systems, energy-efficient solutions, and waste management practices.

f. **Course Learning Outcomes:**

CLO 1	Understand the implementation of Docks, Harbour and Airport Engineering on engineering concepts which are applied in field of Water and Air Transportation Engineering
CLO 2	Knowledge of Docks, Harbour and Airport engineering practices applied to real life problems
CLO 3	Understand the theoretical and practical aspects of Docks, Harbour

CLO 4	Understand the Components of Airport
CLO 5	Design of the Airport

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
2	0	0	2	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction to Airport**: History ,National airport authority, Air craft's and its characteristics, Air port classifications , Objective, FAA recommendation for master plan, Regional planning, Data required before site selection, Airport site selection, Surveys for site selection, Estimation of future air traffic needs	25%	14
2	**Airport Design**: Runway orientation, Wind rose ,Basic runway length, Runway geometric design `,Taxiway Design Controlling factors, Geometric design standards, Exit taxiways, Separation clearance, Turnaround or bypass taxiway ,Terminal Area Design Building function ,Site location, Passenger and baggage flow chart ,Parking area ,Apron, Hanger, Airport Grading and Drainage Grading –purpose, Computation of earthwork Drainage-requirement ,Design surface and subsurface drainage system	25%	16
3	**Introduction to Dock and Harbour:** History, Advantages and disadvantages of water transportation, Modern trends in water transportation, Elements of water transportation, Historical development in India, Classification of harbours, Ports development in India, Port authorities, Bodies and association , Selection of site and planning of harbours, Ship characteristics, Characteristics of good harbour, Size of harbour,	25%	8

4	**Marine Structure** General design aspects, Breakwaters, function, types general design principles, Wharves, Quays, Jetties, Piers, Pier heads, Dolphin, Fenders, Mooring Accessories	**25%**	**8**

i. Text Book and Reference Book:

1. Alonzo Def. Quinn, Design and Construction of Ports and Marine Structure, McGraw - Hill Book Company, New York
2. Ashford N. and Wright P.H., Airport Engineering, John Wiley and Sons, Inc., New York.
3. Horonjeff R and Mackelvey F.X., Planning and Design of Airports fourth Intl.edition,McGraw Hill Book Co., New Delhi.
4. Dr. S. K. Khanna, M.G.Arora and S.S. Jain, Airport Planning & Design, Nem Chand & Bros., Roorkee.
5. S. P. Bindra, A Course in Docks and Harbour Engineering, 1992, Dhanpat Rai & Sons, New Delhi
6. R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 1995, Charotar Pub House, Anand.
7. G.V. Rao Airport Engineering, Tata McGraw Hill Pub. Co., New Delhi.

(26)

a. **Course Name:** Airport and Dock Harbour Laboratory
b. **Course Code:** 303104336
c. **Prerequisite:** Knowledge of Transportation Engineering.
d. **Rationale:** With the growth in population and vehicular ownership, the undesirable outcome of the transportation system is increase in the number of accidents. Loss of lives is detrimental for the economy and progress of the nation. It is prime consideration to provide maximum safety to the people during and after construction of highways. It is necessary for the transportation engineer to know about the causes of accidents and environmental pollution due to highway or other transportation facility construction activities. The mitigation measures shall be taken properly to minimize the accidents and environmental pollution. The road safety audit includes all these aspects in systematic way. Therefore, the study of this subject will enable to provide all necessary features regarding road safety to the students.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of the key infrastructure components of airports and dock harbours, including runways, taxiways, terminals, docks, piers, and cargo facilities
CLOBJ 2	Students will develop the ability to design efficient and effective layouts for airports and dock harbours, considering factors such as traffic flow, safety, capacity, and operational efficiency.
CLOBJ 3	Students will learn to apply transportation and logistics principles to optimize the operations of airports and dock harbours, including cargo handling, passenger flow management, and multimodal connectivity.
CLOBJ 4	Students will be able to evaluate and ensure compliance with safety and regulatory standards for airport and dock harbour operations, including security measures, environmental regulations, and safety protocols.
CLOBJ 5	Students will gain skills in incorporating modern technologies and sustainability practices into the design and operation of airports and dock harbours, such as advanced navigation systems, energy-efficient solutions, and waste management practices.

f. **Course Learning Outcomes:**

CLO 1	Understand the implementation of Docks, Harbour and Airport Engineering on engineering concepts which are applied in field of Water and Air Transportation Engineering
CLO 2	Knowledge of Docks, Harbour and Airport engineering practices applied to real life problems
CLO 3	Understand the theoretical and practical aspects of Docks, Harbour

CLO 4	Understand the Components of Airport
CLO 5	Design of the Airport

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Draw sketches of layout of airport with its component
2	Prepare a report on types of runway and taxiway
3	Prepare layout of port and its components
4	Examples on airport design
5	Case study of an airport in India
6	Case study of Dock & Harbour in India

i. Text Book and Reference Book:

1. Alonzo Def. Quinn, Design and Construction of Ports and Marine Structure, McGraw - Hill Book Company, New York
2. Ashford N. and Wright P.H., Airport Engineering, John Wiley and Sons, Inc., New York.
3. Horonjeff R and Mackelvey F.X., Planning and Design of Airports fourth Intl.edition,McGraw Hill Book Co., New Delhi.
4. Dr. S. K. Khanna, M.G.Arora and S.S. Jain, Airport Planning & Design, Nem Chand & Bros., Roorkee.
5. S. P. Bindra, A Course in Docks and Harbour Engineering, 1992, Dhanpat Rai & Sons, New Delhi
6. R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 1995, Charotar Pub House, Anand.
7. G.V. Rao Airport Engineering, Tata McGraw Hill Pub. Co., New Delhi.

Semester 6

(1)

a. **Course Name:** Design of Steel Structures
b. **Course Code:** 303104351
c. **Prerequisite:** Knowledge of Structural Engineering, Basic structural analysis and Mechanics of Solid.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of the properties and behavior of steel as a construction material, including its strength, ductility, and connection characteristics.
CLOBJ 2	Students will develop the ability to design various steel structural elements, such as beams, columns, connections, and braces, ensuring that they meet strength, stability, and serviceability requirements.
CLOBJ 3	Students will be proficient in applying relevant design codes and standards (such as AISC, Eurocode, or IS codes) to the design of steel structures, ensuring compliance with safety, performance, and regulatory requirements.
CLOBJ 4	Students will learn to analyze steel structures for stability, load effects, and structural performance, including understanding concepts such as buckling, torsion, and lateral-torsional buckling, to ensure safe and efficient design.

f. **Course Learning Outcomes:**

CLO 1	Design tension members using appropriate steel sections and connections in accordance with IS 800:2007.
CLO 2	Design flexural members, including beams and girders, considering lateral stability and shear strength.
CLO 3	Design welded plate girders, accounting for shear buckling, stiffeners, and serviceability criteria.
CLO 4	Develop structural designs for industrial buildings, incorporating elements like trusses, gantry girders, and bracing systems.
CLO 5	Apply earthquake-resistant design principles to steel structures, ensuring compliance with relevant codes and standards.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
2	**0**	**0**	**2**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION** Steel as structural material, Eng. Structures, Philosophy of Design, Property of steel material specification, Limit state design	5%	4
2	**LOADING** Various load on structure, Load calculation, Load combination.	15%	4
3	**CONNECTIONS** General Design consideration introduction to welded, Bolted connections semi rigid and rigid connection, Beam to beam and beam to column connection, moment resistant connection.	15%	8
4	**DESIGN OF STRUCTURAL MEMBERS** Design of tension members - Design of compression members, built of compression members, - Design of flexural members-Design of slab base gusseted base foundation, Introduction to plate girder. - Introduction to plate girders.	20%	15
5	**INDUSTRIAL ROOF** Analysis and design of typical industrial roof trusses with gantry girder	20%	11
6	**INNOVATIVE STEEL STRUCTURES STUDY** Design of steel foot over bridge	25%	06

i. Text Book and Reference Book:

1. N.Subramanian; Steel Structures, Oxford Publication
2. V. L. Shah and Veena Gore, Limit State Design of Steel StructuresIS:800-2007, Structures 3. M. R. Shiyekar, Limit State Design in Structural Steel, PHI Learning
3. S. S. Bhavikatti, Design of Steel Structures by Limit State Methods as Per IS 800-2007, I K International Publishing House
4. Arya A.S. & Ajamani J.L.; Design of Steel Structures; Nemchand & Bros., Roorkee 6. Dayaratnam P.; Design of Steel Structures; Wheel or pub. co., Delhi
5. Ramamrutham S. & Narayanan R.; Design of Steel Structures; Dhanpatrai & Sons, Delhi 8. K. S. Sai Ram; Design of Steel Structures, Pearson
6. IS: 800 – 2007, Code of practice for General Construction in steel
7. 10. IS: 875 - (Part I to V)- Code of practice for structural safety of building loading

standards 11. IS: 226 – Structural steel

8. 12. SP: 6(1) - Structural steel section

(2)

a. Course Name: Design of Steel Structures Laboratory

b. Course Code: 303104352

c. Prerequisite: Knowledge of Structural Engineering, Basic structural analysis and Mechanics of Solid.

d. Rationale: Basic Civil Engineering knowledge is essential for all Engineers.

e. Course Learning Objective:

CLOBJ 1	Students will gain a comprehensive understanding of the properties and behavior of steel as a construction material, including its strength, ductility, and connection characteristics.
CLOBJ 2	Students will develop the ability to design various steel structural elements, such as beams, columns, connections, and braces, ensuring that they meet strength, stability, and serviceability requirements.
CLOBJ 3	Students will be proficient in applying relevant design codes and standards (such as AISC, Eurocode, or IS codes) to the design of steel structures, ensuring compliance with safety, performance, and regulatory requirements.
CLOBJ 4	Students will learn to analyze steel structures for stability, load effects, and structural performance, including understanding concepts such as buckling, torsion, and lateral-torsional buckling, to ensure safe and efficient design.

f. Course Learning Outcomes:

CLO 1	Design tension members using appropriate steel sections and connections as per IS 800:2007 provisions in laboratory assignments
CLO 2	Design flexural members, including beams and girders, considering lateral stability and shear strength through practical case studies.
CLO 3	Design welded plate girders by addressing shear buckling, stiffener arrangement, and serviceability criteria in design exercises.
CLO 4	Prepare structural designs for industrial buildings incorporating trusses, gantry girders, and bracing systems using standard procedures.
CLO 5	Apply earthquake-resistant design provisions to steel structures based on IS codes and perform practical design checks.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
0	**0**	**4**	**2**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Numerical on Design of Connections
2	Numerical on Design of tension members
3	Design of compression members
4	Numerical for Plastic Analysis and Design of Flexural Members
5	Numerical on Design of Welded Plate Girders
6	Numerical on Design of Industrial Building
7	Introductory on Seismic Design of Steel Structures as per IS 18168

i. Text Book and Reference Book:

1. N.Subramanian; Steel Structures, Oxford Publication
2. V. L. Shah and Veena Gore, Limit State Design of Steel StructuresIS:800-2007, Structures 3. M. R. Shiyekar, Limit State Design in Structural Steel, PHI Learning
3. S. S. Bhavikatti, Design of Steel Structures by Limit State Methods as Per IS 800-2007, I K International Publishing House
4. Arya A.S. & Ajamani J.L.; Design of Steel Structures; Nemchand & Bros., Roorkee 6. Dayaratnam P.; Design of Steel Structures; Wheel or pub. co., Delhi
5. Ramamrutham S. & Narayanan R.; Design of Steel Structures; Dhanpatrai & Sons, Delhi 8. K. S. Sai Ram; Design of Steel Structures, Pearson
6. IS: 800 – 2007, Code of practice for General Construction in steel
7. 10. IS: 875 - (Part I to V)- Code of practice for structural safety of building loading standards 11. IS: 226 – Structural steel
8. 12. SP: 6(1) - Structural steel section
9. 13. SP: 6(6) - Application of plastic theory in design of steel structures
10. IS 18168 Earthquake Resistant Design of Steel Buildings Code of Practise

(3)

a. **Course Name:** Estimation, Costing and Valuation
b. **Course Code:** 303104353
c. **Prerequisite:** Knowledge of estimation and costing, their specifications and rate analysis.
d. **Rationale:** This subject is the application of practical work and methods, which describes the estimation for the accurate idea of cost of materials. This subject is specifically aim to develop understanding of various market rates and specification which is useful for the students in theory as well as in practical work.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of various cost estimation techniques, including unit rate analysis, quantity takeoff, and historical cost data, to accurately estimate project costs.
CLOBJ 2	Students will develop the ability to apply different costing methods, such as detailed cost estimates, preliminary cost estimates, and life-cycle costing, to various types of construction projects.
CLOBJ 3	Students will learn to perform accurate valuation of properties and assets, using methods such as comparative analysis, income capitalization, and cost approach, to determine market value and investment potential.
CLOBJ 4	Students will acquire skills in developing and managing project budgets, including cost planning, cost control, and financial reporting, to ensure projects are completed within budget and financial constraints.
CLOBJ 5	Students will be able to interpret and apply relevant regulations, standards, and best practices in estimation, costing, and valuation, ensuring compliance with industry norms and enhancing the accuracy and reliability of financial assessments.

f. **Course Learning Outcomes:**

CLO 1	Calculate the estimated cost of any proposed civil engineering structure and the value of any old structure.
CLO 2	Measure quantities of various items of civil works from working drawings of residential building.
CLO 3	Evaluate the cost estimates for construction projects, including labor, materials, and overhead.
CLO 4	Formulate the valuation of land and buildings by various methods.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
2	0	0	2	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION:** Purpose of Estimating, Types of Estimates	5%	2
2	**BUILDING ESTIMATE:** Main items of work & their units of Measurement, Methods of measurement-Methods of estimating quantities, Estimating quantities of Residential Building upto G+1. Introduction of estimates of other civil engineering work like RCC Footing, Column, Beam & Slab, Staircase, Septic Tank, Retaining Wall etc. Bar bending schedule and quantity of steel using latest IS code detailing, Coupler	30%	16
3	**SPECIFICATION:** Objectives and importance of specifications. Specification of works. Language of specification writing	12%	6
4	**RATE ANALYSIS**: Importance of rate analysis. Factors affecting rate analysis. Schedule of Rates (SOR). Task work: Labour requirement for different items of work. Material requirement for different items of work. Rate analysis of different items of work.	12%	6
5	**ABSTRACTING, BILLING & TENDER:** Purpose of Abstract, Preparation of Abstract, Measurement & Billing, Measurement Book. Checking of Bill & Final Bill, PWD practices, Tender Notice, Tender document, Contract, Types of Contract, Conditions of contract, Agreement, E Procurement, Arbitration	21%	10

6	**VALUATION:** Purpose of Valuation, Personal property& real property, Forms of Value. Depreciation, Sinking Fund, Lease hold property & Free hold property. Obsolescence, Gross income, outgoings and Net income. Capitalized Value. Rental Method of Valuation and typical problems.	**20%**	**8**

i. Text Book and Reference Book:

1. B.N Dutta, Estimation and Costing In Civil Engineering, UBS Publishers Distributors, Ltd.
2. S.C Rangwala, Estimating and Costing, Charotar Publishing House. G.S Birdi, Textbook of Estimation & Costing, Dhanpat Rai and Sons, Delhi.
3. PWD Handbook and SOR, IS CODE-1200.
4. S.C Rangwala, Valuation of Real Properties, Charotar Publication

(4)

a. **Course Name:** Estimation, Costing and Valuation Laboratory
b. **Course Code:** 303104354
c. **Prerequisite:** Knowledge of estimation and costing, their specifications and rate analysis.
d. **Rationale:** This subject is the application of practical work and methods, which describes the estimation for the accurate idea of cost of materials. This subject is specifically aim to develop understanding of various market rates and specification which is useful for the students in theory as well as in practical work.

e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of various cost estimation techniques, including unit rate analysis, quantity takeoff, and historical cost data, to accurately estimate project costs.
CLOBJ 2	Students will develop the ability to apply different costing methods, such as detailed cost estimates, preliminary cost estimates, and life-cycle costing, to various types of construction projects.
CLOBJ 3	Students will learn to perform accurate valuation of properties and assets, using methods such as comparative analysis, income capitalization, and cost approach, to determine market value and investment potential.
CLOBJ 4	Students will acquire skills in developing and managing project budgets, including cost planning, cost control, and financial reporting, to ensure projects are completed within budget and financial constraints.
CLOBJ 5	Students will be able to interpret and apply relevant regulations, standards, and best practices in estimation, costing, and valuation, ensuring compliance with industry norms and enhancing the accuracy and reliability of financial assessments.

f. **Course Learning Outcomes:**

CLO 1	Describe the estimated cost of any proposed civil engineering structure and the value of any old structure.
CLO 2	Measure quantities of various items of civil works from working drawings of residential building.
CLO 3	Determine the rates of items of civil works by incorporating labor, materials, and overhead costs using standard procedures.
CLO 4	Apply different methods for valuation of land and buildings to determine market and investment values.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	4	2	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Study based on building estimation
2	Numerical on rate analysis of quantities used in civil works
3	Example on valuation of land
4	Example on valuation of buildings

i. Text Book and Reference Book:

1. B.N Dutta, Estimation and Costing In Civil Engineering, UBS Publishers Distributors, Ltd.
2. S.C Rangwala, Estimating and Costing, Charotar Publishing House. G.S Birdi, Textbook of Estimation & Costing, Dhanpat Rai and Sons, Delhi.
3. PWD Handbook and SOR, IS CODE-1200.
4. S.C Rangwala, Valuation of Real Properties, Charotar Publication

(5)

a. **Course Name:** Ground Water Hydrology
b. **Course Code:** 303104361
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level, Fluid Mechanics and Hydrology.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a thorough understanding of groundwater flow principles, including the concepts of aquifers, groundwater recharge, discharge, and flow dynamics within different geological settings
CLOBJ 2	Students will develop the ability to analyze key aquifer properties, such as hydraulic conductivity, porosity, and storativity, and their impact on groundwater movement and availability.
CLOBJ 3	Students will learn to apply groundwater modeling techniques to simulate and predict groundwater flow and contaminant transport, using tools and software to support water resource management and environmental protection.
CLOBJ 4	Students will acquire practical skills in conducting groundwater investigations, including field sampling, monitoring well installation, and data analysis, to assess groundwater quality, quantity, and sustainability.
CLOBJ 5	Students will be able to evaluate the impact of human activities, such as land use changes, pumping, and pollution, on groundwater systems and develop strategies for mitigating adverse effects and promoting sustainable groundwater management.

f. **Course Learning Outcomes:**

CLO 1	Explain aquifer types and groundwater occurrence using hydrogeological parameters to understand subsurface water flow systems.
CLO 2	Apply Darcy's law and flow net concepts to analyze groundwater movement for predicting aquifer behavior and discharge.
CLO 3	Evaluate well performance and interaction through groundwater flow equations to assess drawdown and well interference effects.
CLO 4	Conduct pumping and slug tests to determine aquifer characteristics for effective well design and water extraction planning.
CLO 5	Design wells and filtration systems using construction and screening methods to ensure efficient and sustainable groundwater use.
CLO 6	Assess groundwater quality and recharge methods to mitigate seawater intrusion and contamination for integrated groundwater resource management.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction:** Groundwater in Hydrologic Cycle – Occurrence of groundwater – Hydrogeology Hydrometeorology – soil sample analysis, Water bearing materials, Types of aquifers – parameters of Aquifers – Determination of specific yield and permeability	15%	6
2	**Groundwater Hydraulics I:** Groundwater Movement, Darcy's law and its limitations, Stream lines and flow net analysis – Potential flow theory – Discharge and draw down for various condition of groundwater flow	15%	6
3	**Groundwater Hydraulics II:** Principles of groundwater flow and its equation – Dupuit – Forchheimer assumptions – Influent and Effluent streams, Evaluation of well loss parameters – Partial penetration of wells – Interference of wells – Collector wells and Infiltration galleries.	20%	9
4	**Pumping Test Analysis:** Determining aquifer parameters for unconfined, leaky and non-leaky aquifers – steady and transient conditions - Slug test – Locating hydro geological boundaries – Image well theory – Determination of well characteristics and specific capacity of wells – Well characteristics of large diameter wells.	20%	9
5	**Well Design and Construction:** Well design criteria – Construction of wells – Well drilling methods – Filter design – Artificial and natural packing – Well castings and screens – Production test – Maintenance of production wells.	15%	6
6	**Special Topics:**	15%	6

	Methods of artificial groundwater recharge – Groundwater assessment and balancing – Seawater intrusion in coastal aquifers – Land Subsidence - Wells in hard rock areas, Impact of climate change on groundwater hydrology, Groundwater Quality and Contamination, Management of Groundwater: concepts of basin management, conjunctive use Artificial groundwater recharge: concepts, recharge methods, recharge mounds, induced recharge		

i. Text Book and Reference Book:

1. Hsieh Wen Shen , River Mechanics, Vol. I & II, H.W.Shen, Colorado,USA, 1971.
2. Garde R. J. and RangaRaju K. G., Mechanics of sediment transportation and alluvial stream problems, Third edition, New Age International (P) Limited, New Delhi, 2000.
3. Garde R. J., River morphology, New Age International Publisher, New Delhi-110042, 2006.
4. Ashley R., Garvin S., Pasche E. and Vassilopoulos A., Advances in Urban Flood Management, Balkema, 2007 2
5. Saul A, Floods and Flood Management, Springer, 1992

(6)

a. **Course Name:** Ground Water Hydrology Laboratory
b. **Course Code:** 303104362
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level, Fluid Mechanics and Hydrology.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a thorough understanding of groundwater flow principles, including the concepts of aquifers, groundwater recharge, discharge, and flow dynamics within different geological settings
CLOBJ 2	Students will develop the ability to analyze key aquifer properties, such as hydraulic conductivity, porosity, and storativity, and their impact on groundwater movement and availability.
CLOBJ 3	Students will learn to apply groundwater modeling techniques to simulate and predict groundwater flow and contaminant transport, using tools and software to support water resource management and environmental protection.
CLOBJ 4	Students will acquire practical skills in conducting groundwater investigations, including field sampling, monitoring well installation, and data analysis, to assess groundwater quality, quantity, and sustainability.
CLOBJ 5	Students will be able to evaluate the impact of human activities, such as land use changes, pumping, and pollution, on groundwater systems and develop strategies for mitigating adverse effects and promoting sustainable groundwater management.

f. **Course Learning Outcomes:**

CLO 1	Determine aquifer properties like specific yield and permeability using laboratory tests to analyze groundwater availability in hydrologic systems.
CLO 2	Apply Darcy's law and flow analysis methods to calculate groundwater discharge and drawdown for evaluating aquifer behavior.
CLO 3	Evaluate drawdown in wells using partial penetration and interaction scenarios to optimize well performance.
CLO 4	Conduct pumping and slug tests to determine aquifer behavior under steady and unsteady conditions for groundwater development planning.
CLO 5	Design wells and evaluate performance using well design criteria and field test results to ensure sustainable groundwater extraction.
CLO 6	Assess artificial recharge and intrusion through basin design and critical pumping analysis to manage groundwater sustainably in sensitive zones.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Example on Groundwater Hydraulics
2	Example on Pumping Test Analysis
3	Example on Well Design and Construction
4	Case Study on Special Topics

i. Text Book and Reference Book:

1. Hsieh Wen Shen , River Mechanics, Vol. I & II, H.W.Shen, Colorado,USA, 1971.
2. Garde R. J. and RangaRaju K. G., Mechanics of sediment transportation and alluvial stream problems, Third edition, New Age International (P) Limited, New Delhi, 2000.
3. Garde R. J., River morphology, New Age International Publisher, New Delhi-110042, 2006.
4. Ashley R., Garvin S., Pasche E. and Vassilopoulos A., Advances in Urban Flood Management, Balkema, 2007 2
5. Saul A, Floods and Flood Management, Springer, 1992

(7)

a. **Course Name:** River and Sedimentation Engineering
b. **Course Code:** 303104363
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level, Fluid Mechanics and Hydrology.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a thorough understanding of river hydraulics, including flow dynamics, sediment transport, and river morphology, to analyze and interpret river behavior and channel changes.
CLOBJ 2	Students will develop the ability to analyze sediment transport processes, including the mechanisms of erosion, deposition, and sediment load distribution, to understand their effects on river systems and infrastructure.
CLOBJ 3	Students will learn to design river engineering structures such as dams, weirs, levees, and riverbanks, considering factors like sediment management, flood control, and ecological impacts.
CLOBJ 4	Students will acquire skills in applying river management and restoration techniques to address issues such as habitat degradation, pollution, and riverbank instability, promoting sustainable river systems.
CLOBJ 5	Students will be able to evaluate the impact of human activities, such as land development, mining, and water diversion, on river systems and sedimentation patterns, and develop strategies for mitigating adverse effects and enhancing river system resilience.

f. **Course Learning Outcomes:**

CLO 1	Explain sediment properties and motion to assess erosion potential for sediment management.
CLO 2	Evaluate flow resistance in alluvial streams to develop stage-discharge curve for river flow analysis.
CLO 3	Classify river forms and features to interpret channel behavior for river morphology assessment.
CLO 4	Analyze meandering, braiding, and delta processes to understand river instability for planning control measures.
CLO 5	Assess sediment transport and scour to ensure bed stability for safe hydraulic structure design.
CLO 6	Design river training works to protect banks and manage floods for sustainable river engineering.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Unit – I Introduction, Origin, Properties and Incipient Motion of Sediment Particles** Nature of sediment problems, Origin and formation of sediments, individual and bulk properties of sediments, competent velocity, lift force and critical tractive stress concept on cohesion less and cohesive soils	15%	6
2	**Unit – II Properties and Incipient Motion of Sediment Particles** regimes of flow; Resistance to flow in alluvial streams, resistance relations based on total resistance and division of resistance into grain and form resistance, preparation of stage discharge curves for alluvial streams	15%	6
3	**Unit – III River Morphology-I** Introduction, classification of Rivers, Mechanics of alluvial rivers including channel and flood plain features, Bars; Bends and Meanders, Thalweg; Braiding; Bifurcations etc. River Channel patterns,	15%	6
4	**Unit – IV River Morphology-II** Straight river channels, causes, characteristics and shapes of meanders and control, cutoff, Braided Rivers, Bed forms, Instability of rivers, Hydraulic geometry, Delta formation and control	15%	6
5	**Unit –V Sediment Transport Mechanics** Bed forms, Bed Load transport, Transport of suspended sediment, Critical Shear stress, Sediment Transport, Aggradation and Degradation; Local Scour at Bridge Piers and other Hydraulic Structures.	20%	9
6	**Unit-VI River Training and Flood Protection Work** River Training and Flood Protection Work Guidelines for planning and design of river embankments (levees), Planning, design, construction and maintenance of guide	20%	9

	banks and groynes for alluvial rivers, Application of Geo-synthetics and other materials in river training works		

i. Text Book and Reference Book:

1. Hsieh Wen Shen, River Mechanics, Vol. I & II, H.W.Shen, Colorado,USA, 1971.
2. Garde R. J. and Ranga Raju K. G., Mechanics of sediment transportation and alluvial stream problems, Third edition, New Age International (P) Limited, New Delhi, 2000.
3. Garde R. J., River morphology, New Age International Publisher, New Delhi-110042, 2006.
4. Irrigation & Water Power Engineering- B. C. Punmia and Pande B. B. Lal.
5. River Engineering by Margeret Peterson

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a. **Course Name:** River and Sedimentation Engineering Laboratory
b. **Course Code:** 303104364
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level, Fluid Mechanics and Hydrology.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a thorough understanding of river hydraulics, including flow dynamics, sediment transport, and river morphology, to analyze and interpret river behavior and channel changes.
CLOBJ 2	Students will develop the ability to analyze sediment transport processes, including the mechanisms of erosion, deposition, and sediment load distribution, to understand their effects on river systems and infrastructure.
CLOBJ 3	Students will learn to design river engineering structures such as dams, weirs, levees, and riverbanks, considering factors like sediment management, flood control, and ecological impacts.
CLOBJ 4	Students will acquire skills in applying river management and restoration techniques to address issues such as habitat degradation, pollution, and riverbank instability, promoting sustainable river systems.
CLOBJ 5	Students will be able to evaluate the impact of human activities, such as land development, mining, and water diversion, on river systems and sedimentation patterns, and develop strategies for mitigating adverse effects and enhancing river system resilience.

f. **Course Learning Outcomes:**

CLO 1	Analyze lift force and critical tractive stress to assess sediment motion initiation for erosion and stability studies.
CLO 2	Evaluate flow resistance using grain and form resistance relations to understand flow behavior in alluvial streams.
CLO 3	Describe braided rivers, bedforms, and delta processes to examine natural river dynamics for river morphology understanding.
CLO 4	Assess sediment transport and riverbed changes under aggradation and degradation conditions to ensure stable channel design.
CLO 5	Investigate local scour at hydraulic structures to determine sediment-induced damage risks for safe structural design.
CLO 6	Design river training structures like guide banks, groynes, and geo-synthetics to manage floods and protect riverbanks.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Properties and Incipient Motion of Sediment Particles
2	Example on Hydraulic geometry, Delta formation and control
3	Sediment Transport Mechanics
4	River Training and Flood Protection Work

i. Text Book and Reference Book:

1. Hsieh Wen Shen, River Mechanics, Vol. I & II, H.W.Shen, Colorado,USA, 1971.
2. Garde R. J. and Ranga Raju K. G., Mechanics of sediment transportation and alluvial stream problems, Third edition, New Age International (P) Limited, New Delhi, 2000.
3. Garde R. J., River morphology, New Age International Publisher, New Delhi-110042, 2006.
4. Irrigation & Water Power Engineering- B. C. Punmia and Pande B. B. Lal.
5. River Engineering by Margeret Peterson

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a. **Course Name:** Open Channel Flow
b. **Course Code:** 303104365
c. **Prerequisite:** Knowledge of Fluid Mechanics and Hydrology.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain practical experience in using modern tools and software for analyzing open channel flow, including computational fluid dynamics (CFD) models and hydraulic design software, to solve complex flow problems and optimize channel design.
CLOBJ 2	Students will develop the ability to analyze the flow characteristics and behavior in open channels, such as velocity distribution, discharge, flow regimes, and channel capacity, using empirical and theoretical methods.
CLOBJ 3	Students will learn to apply hydraulic design techniques for open channels, including the design of channel cross-sections, bed slope, and flow control structures, to ensure efficient and effective water conveyance.
CLOBJ 4	Students will acquire skills in evaluating erosion and sediment transport processes in open channels, including assessing sediment load, deposition patterns, and the impact of sediment on channel stability and performance.
CLOBJ 5	Students will gain practical experience in using modern tools and software for analyzing open channel flow, including computational fluid dynamics (CFD) models and hydraulic design software, to solve complex flow problems and optimize channel design.

f. **Course Learning Outcomes:**

CLO 1	Classify various GVF profiles
CLO 2	Compare between pipe flow and open channel
CLO 3	Understand the velocity and Pressure distribution in open channels
CLO 4	Understand the Hydraulic jump formation
CLO 5	Understand different types of non-uniform flow
CLO 6	Application of Specific energy curve

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	

3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**BASIC PRINCIPLES** Introduction, Difference between open channel flow and pipe flow, geometrical parameters of a channel, Review of free surface flow concepts including velocity and pressure distribution, Continuity, Momentum and Energy equation	**10%**	**2**
2	**SPECIFIC ENGERY** Specific energy, Specific energy curve and its limitations, critical depth and section factor for critical flow computations	**15%**	**4**
3	**RAPIDLY VARIED FLOW** Rapidly varied flow, specific force curve and its application in the analysis of hydraulic jump, hydraulic jump characteristics Flow Over Spillway, Flow Through Nonprismatic Channel	**20%**	**7**
4	**GRADUALY VARIED FLOW** Assumptions in GVF analysis, dynamic equation of GVF, classification of channel slopes, GVF profiles, its identification and computation, applications	**20%**	**7**
5	**SPATIALLY VARIED FLOW** Basic principles and assumptions, differential equations, analysis of flow profiles and flow through side weirs and bottom racks.	**15%**	**4**
6	**UNSTEADY FLOW** Wave celerity, classification of water waves according to relative depth, orbital motions, superposition, wave trains and wave energy, transformation of waves, dissipation of wave energy, positive and negative surges in rectangular channel	**20%**	**6**

i. Text Book and Reference Book:

1. Chaudhary Hanif M., Open Channel flow, Prantice-Hall of India Pvt. Ltd. New Delhi, 1993.
2. Chow V T, Open Channel Hydraulics, McGraw-Hill Book company, international editions, New Delhi,1973.
3. Subrmanya K, Flow in open channels, Second edition, Tata McGraw-Hill Publishing

Company Ltd., New Delhi, 2001
4. Srivastava Rajesh, Flow through open channels, Oxford University press, New Delhi, 2008.
5. French , R H, Open channel hydraulics, McGraw-Hill Publication, New York, 1985
6. Ranga Raju K.G., Flow through Open Channels, TATA MC Graw-Graw-Hill Publishing Company Limited, 1997

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a. **Course Name:** Open Channel Flow Laboratory
b. **Course Code:** 303104366
c. **Prerequisite:** Knowledge of Fluid Mechanics and Hydrology.
d. **Rationale:** Basic Civil Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain practical experience in using modern tools and software for analyzing open channel flow, including computational fluid dynamics (CFD) models and hydraulic design software, to solve complex flow problems and optimize channel design.
CLOBJ 2	Students will gain practical experience in using modern tools and software for analyzing open channel flow, including computational fluid dynamics (CFD) models and hydraulic design software, to solve complex flow problems and optimize channel design.
CLOBJ 3	Students will gain practical experience in using modern tools and software for analyzing open channel flow, including computational fluid dynamics (CFD) models and hydraulic design software, to solve complex flow problems and optimize channel design.
CLOBJ 4	Students will gain practical experience in using modern tools and software for analyzing open channel flow, including computational fluid dynamics (CFD) models and hydraulic design software, to solve complex flow problems and optimize channel design.
CLOBJ 5	Students will gain practical experience in using modern tools and software for analyzing open channel flow, including computational fluid dynamics (CFD) models and hydraulic design software, to solve complex flow problems and optimize channel design.

f. **Course Learning Outcomes:**

CLO 1	Classify various GVF profiles
CLO 2	Compare between pipe flow and open channel
CLO 3	Understand the velocity and Pressure distribution in open channels
CLO 4	Understand the Hydraulic jump formation
CLO 5	Understand different types of non-uniform flow
CLO 6	Application of Specific energy curve

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Free surface flow concepts including velocity and pressure distribution, Continuity, Momentum and Energy equation
2	Specific energy, Specific energy curve
3	Hydraulic jump characteristics Flow Over Spillway, Flow Through Nonprismatic Channel
4	River Training and Flood Protection Work
5	Dynamic equation of Gradually Varied Flow
6	Relative depth, orbital motions, superposition, wave trains and wave energy

i. Text Book and Reference Book:

1. Chaudhary Hanif M., Open Channel flow, Prantice-Hall of India Pvt. Ltd. New Delhi, 1993.
2. Chow V T, Open Channel Hydraulics, McGraw-Hill Book company, international editions, New Delhi,1973.
3. Subrmanya K, Flow in open channels, Second edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2001
4. Srivastava Rajesh, Flow through open channels, Oxford University press, New Delhi, 2008.
5. French , R H, Open channel hydraulics, McGraw-Hill Publication, New York, 1985
6. Ranga Raju K.G., Flow through Open Channels, TATA MC Graw-Graw-Hill Publishing Company Limited, 1997

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a. **Course Name:** EIA and Audit
b. **Course Code:** 303104371
c. **Prerequisite:** Knowledge of Physics, Chemistry and Mathematics up to 12^{th} science level and of Biology up to 10^{th} science level, Environmental Studies and Environmental Engineering.
d. **Rationale:** Basic knowledge of environmental impact assessment and auditing is essential for Civil engineers to understand and analyze the impact of any project on air, water and soil.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of the principles and processes involved in Environmental Impact Assessment (EIA), including scoping, impact prediction, mitigation measures, and reporting.
CLOBJ 2	Students will develop the skills to conduct EIA for various types of projects, including identifying potential environmental impacts, assessing their significance, and proposing effective mitigation strategies to minimize adverse effects.
CLOBJ 3	Students will learn to perform environmental audits to evaluate compliance with environmental regulations, assess the effectiveness of environmental management systems, and identify areas for improvement in environmental performance.
CLOBJ 4	Students will be able to apply relevant regulatory frameworks, standards, and best practices in both EIA and environmental auditing, ensuring that assessments and audits are conducted in accordance with legal requirements and industry norms.

f. **Course Learning Outcomes:**

CLO 1	State basics of environmental impact assessment and its applications in environmental engineering field
CLO 2	Explain methods of analysis for determining impact of any project on environment
CLO 3	Identify major aspects of any project causing adverse effect on ecosystem
CLO 4	Plan environmental audit of any industry as per standard guidelines

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**EIA: Introduction and Planning** Evolution of EIA – EIA at project – Regional and policy levels – EIA legislative and Environmental clearance procedures in India – EIA methodologies – Screening and scoping criteria – Rapid and Comprehensive EIA – Environmental health impact assessment –Significance of public participation / hearing in EIA – Resettlement and rehabilitation issues.	20%	9
2	**EIA: Methodologies and Strategies** Baseline collection of data – Significant impacts – Assessment of impacts of physical, biological and socio – economic environment – Environmental Risk Analysis, Definition of Risk, Matrix Method - Impact prediction tools / techniques such as ad-hoc method, checklist method etc – Development of environment management plan – Post project monitoring – EIA report and EIS – Review process – EIA case studies / histories for industrial projects – water resources and irrigation projects – ports and harbors – mining – transportation and other projects sectors.	20%	9
3	**Environmental Management** Environmental Management plan – Disaster Management – Post project monitoring –Life cycle assessment – ISO – 14000, Environmental Management System ISO-14001.	10%	5
4	**Environmental Audit Scheme – Overview** Uncontrolled pollution due to industries, Environmental Audit: Definition of Environment Audit and its importance for industries. Environmental management system audits Types of audits, General audit methodology and basic structure of audit. Elements of an audit process and its	30%	13

	importance. Concept of ISO14000 Requirements of Rule 14 for Environmental Audit under Environmental protection Act 1986, Parameters to be analyzed, Laboratory Instruments required and brief specifications, Definitions of a. Signatory, b. Consumption Audit, c. Pollution audit, d. Hazardous audit, d. Solid waste audit, e. Disposal audit, f. Cost audit, g. Investment audit, h. Voluntary		
5	**Environmental Audit Process** Pre-audit Activities for the Manager Selecting the audit team, planning the audit Pre-audit Activities for the Auditor Drawing up the audit specification, obtaining information before the audit, Checklists, Case studies of red category industries. Conducting the Audit The opening meeting, Evaluation of the EMS, Interviewing, Site tour and observations Evaluating the Audit Results Evaluation of the audit results, the closing meeting, Recommendations, the audit report Environmental Reporting Purpose of producing an environmental report, writing the report, Independent validation	**20%**	**9**

i. Text Book and Reference Book:

1. Larry W. Canter, "Environmental Impact Assessment", Tata Mcgraw Hill Co, Singapore, 1996.
2. Munn R.E., "Environmental Impact Assessment", John Wiley & Sons, Toronto, 1979
3. Suresh K. Dhameja, "Environmental Engineering and Management", S. K. Kataria & Sons, Delhi. 2004.
4. Relevant MoEF Notifications and CPCB / GPCB Acts & Rules. New Delhi, 2006.
5. Hillary, R., Environmental Management Systems and Cleaner Production, Wiley Publishers, New York, 1997.
6. Environmental Audit Scheme at a Glance, Environment Audit, Gujarat Pollution Control Board,2015
7. https://gpcb.gujarat.gov.in/webcontroller/viewpage/publications

(12)

a. **Course Name:** EIA and Audit Laboratory
b. **Course Code:** 303104372
c. **Prerequisite:** Knowledge of Physics, Chemistry and Mathematics up to 12^{th} science level and of Biology up to 10^{th} science level, Environmental Studies and Environmental Engineering.
d. **Rationale:** Basic knowledge of environmental impact assessment and auditing is essential for Civil engineers to understand and analyze the impact of any project on air, water and soil.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a comprehensive understanding of the principles and processes involved in Environmental Impact Assessment (EIA), including scoping, impact prediction, mitigation measures, and reporting.
CLOBJ 2	Students will develop the skills to conduct EIA for various types of projects, including identifying potential environmental impacts, assessing their significance, and proposing effective mitigation strategies to minimize adverse effects.
CLOBJ 3	Students will learn to perform environmental audits to evaluate compliance with environmental regulations, assess the effectiveness of environmental management systems, and identify areas for improvement in environmental performance.
CLOBJ 4	Students will be able to apply relevant regulatory frameworks, standards, and best practices in both EIA and environmental auditing, ensuring that assessments and audits are conducted in accordance with legal requirements and industry norms.

f. **Course Learning Outcomes:**

CLO 1	State basics of environmental impact assessment and its applications in environmental engineering field
CLO 2	Explain methods of analysis for determining impact of any project on environment
CLO 3	Identify major aspects of any project causing adverse effect on ecosystem
CLO 4	Plan environmental audit of any industry as per standard guidelines

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	EIA legislative and Environmental clearance procedures in India
2	Environmental health impact assessment –Significance of public participation / hearing in EIA
3	Environmental Risk Analysis, Definition of Risk
4	Environmental Management plan
5	Parameters to be analyzed, Laboratory Instruments required and brief specifications
6	Interviewing, Site tour and observations Evaluating the Audit

i. Text Book and Reference Book:

1. Larry W. Canter, "Environmental Impact Assessment", Tata Mcgraw Hill Co, Singapore, 1996.
2. Munn R.E., “Environmental Impact Assessment”, John Wiley & Sons, Toronto, 1979
3. Suresh K. Dhameja, “Environmental Engineering and Management”, S. K. Kataria & Sons, Delhi. 2004.
4. Relevant MoEF Notifications and CPCB / GPCB Acts & Rules. New Delhi, 2006.
5. Hillary, R., Environmental Management Systems and Cleaner Production, Wiley Publishers, New York, 1997.
6. Environmental Audit Scheme at a Glance, Environment Audit, Gujarat Pollution Control Board,2015
7. https://gpcb.gujarat.gov.in/webcontroller/viewpage/publications

(13)

a. **Course Name:** Advanced Structural Analysis
b. **Course Code:** 303104373
c. **Prerequisite:** Basics of Civil Engineering.
d. **Rationale:** students will apply matrix methods.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a deep understanding of advanced analytical techniques used in structural analysis, such as finite element analysis, matrix methods, and nonlinear analysis, to evaluate complex structural systems
CLOBJ 2	Students will develop the ability to apply advanced structural analysis methods to determine the behavior of various structural elements and systems under different loading conditions, including dynamic and seismic loads.
CLOBJ 3	Students will learn to analyze complex structural systems, including multi-story buildings, large-span structures, and irregular geometries, using advanced computational tools and software.
CLOBJ 4	Students will acquire the skills to evaluate structural performance and safety, including assessing stability, serviceability, and failure mechanisms, to ensure that structures meet required design codes and standards.

f. **Course Learning Outcomes:**

CLO 1	Understand the difference between statically determinate & indeterminate structures
CLO 2	Know about analysis of building frames
CLO 3	Basic knowledge about the Matrix analysis
CLO 4	Application of Linear problems
CLO 5	Applications to Simple Problems
CLO 6	Use of Shape functions

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Fundamentals of Statically Determinate Structures:** Types of statically determinate & indeterminate structures, static and kinematic indeterminacy, stability of structures, principle of superposition, Maxwell's reciprocal theorems. Computation of internal forces in statically determinate structures such as plane truss, plane frame, grids	15%	8
2	**Statically indeterminate structure:** Method of consistent deformation and theorem of least work (including two-hinged/fixed arches, plane frames and simple grids); Approximate lateral load analysis of building frames (portal and cantilever methods); Displacements using principle of virtual forces.	15%	8
3	**Kinematically indeterminate structures:** Introduction to displacement methods, Slope deflection method, Moment distribution method.	20%	8
4	**Applications to Simple Problems** Beams, Plane Trusses, Plane Rigid Jointed Frames and Grids by Structure Approach and Member Approach	15%	8
5	**Introduction to advanced topics:** Matrix analysis of grids and space frames using conventional stiffness method and reduced stiffness method; Elastic instability and second- order analysis; Introduction to finite element analysis.	20%	8
6	**Linear Element** Shape Functions, Solution for Poisson's Equation, General One Dimensional Equilibrium Problem.	15%	8

i. Text Book and Reference Book:

1. Matrix Analysis of Framed Structures, By Weaver and Gere
2. The Finite Element Method, By P. E. and Ward J. P | Addison-Wesley Publication Co
3. Computer Methods in Structural Analysis, By Meek J. L., E and F N
4. The Finite Element Method, By Desai and Able | CBS Publication
5. Structural Analysis, By C.S.Reddy

(14)

a. **Course Name:** Advanced Structural Analysis Laboratory
b. **Course Code:** 303104374
c. **Prerequisite:** Basics of Civil Engineering.
d. **Rationale:** students will apply matrix methods.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a deep understanding of advanced analytical techniques used in structural analysis, such as finite element analysis, matrix methods, and nonlinear analysis, to evaluate complex structural systems
CLOBJ 2	Students will develop the ability to apply advanced structural analysis methods to determine the behavior of various structural elements and systems under different loading conditions, including dynamic and seismic loads.
CLOBJ 3	Students will learn to analyze complex structural systems, including multi-story buildings, large-span structures, and irregular geometries, using advanced computational tools and software.
CLOBJ 4	Students will acquire the skills to evaluate structural performance and safety, including assessing stability, serviceability, and failure mechanisms, to ensure that structures meet required design codes and standards.

f. **Course Learning Outcomes:**

CLO 1	State basics of environmental impact assessment and its applications in environmental engineering field
CLO 2	Explain methods of analysis for determining impact of any project on environment
CLO 3	Identify major aspects of any project causing adverse effect on ecosystem
CLO 4	Plan environmental audit of any industry as per standard guidelines

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Statically Determinate Structures
2	Statically indeterminate structure
3	Kinematically indeterminate structures
4	Applications to Simple Problems
5	Introduction to advanced topics
6	Linear Element

i. Text Book and Reference Book:

1. Matrix Analysis of Framed Structures, By Weaver and Gere
2. The Finite Element Method, By P. E. and Ward J. P | Addison-Wesley Publication Co
3. Computer Methods in Structural Analysis, By Meek J. L., E and F N
4. The Finite Element Method, By Desai and Able | CBS Publication
5. Structural Analysis, By C. S. Reddy

(15)

a. **Course Name:** Geometric Design of Highways
b. **Course Code:** 303104375
c. **Prerequisite:** Knowledge of Civil Engineering up to B.E./B.Tech level.
d. **Rationale:** The course provides Geometric design, transportation facilities, route layout and selection.
e. **Course Learning Objective:**

CLOBJ 1	Students will gain a thorough understanding of the fundamental principles of geometric design for highways, including alignment, cross-sections, and design standards to ensure safety and efficiency
CLOBJ 2	Students will develop the skills to design horizontal and vertical alignments for highways, considering factors such as curvature, sight distance, superelevation, and grade to optimize vehicle performance and safety.
CLOBJ 3	Students will learn to apply relevant design criteria and standards, such as those from the American Association of State Highway and Transportation Officials (AASHTO) or similar organizations, to create compliant and effective highway designs.
CLOBJ 4	Students will acquire the ability to evaluate and optimize highway geometry, including intersection design, lane width, and shoulder design, to address factors such as traffic volume, land use, and environmental impact.

f. **Course Learning Outcomes:**

CLO 1	Apply design standards and guidelines for horizontal and vertical alignment of highways.
CLO 2	Design cross-sectional elements of roads, including lane width, shoulders, medians, and sight distances.
CLO 3	Analyze traffic and terrain data to determine suitable geometric parameters for highway layouts.
CLO 4	Evaluate the safety and efficiency of geometric design elements under various traffic and environmental conditions.
CLO 5	Develop highway design plans using software tools and manual calculations based on geometric design principles.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Geometric Design: General:** Geometric design provisions for various transportation facilities as per AASHTO, IRC and other guidelines, Discussion of controls governing geometric design, route layout and selection.	**15%**	**7**
2	**Elements of design:** Sight distances, Horizontal alignment, gradients, Transition curves, super-elevation and side friction, extra widening of pavement.	**20%**	**10**
3	**Vertical alignment:** Grades, crest and sag curves. Highway cross ±sectional elements and their design for rural highways, Urban streets and hill roads.	**20%**	**10**
4	**At grade intersections** Sight distance consideration and principles of design, Channelization, mini roundabouts, layout of roundabouts, Inter Changes, major and minor interchanges, entrance and exit ramps, acceleration and deceleration lanes, Bicycle and pedestrian facility design, Parking layout and design, Terminal layout and design.	**45%**	**21**

i. Text Book and Reference Book:

1. Traffic Engineering and Transportation Planning (TextBook) L.R. Kadiyali; Khanna Publishers
2. Traffic Engineering Design: Principles and Practice (TextBook) Mike Slinn, Paul Matthews, Peter Guest, Butterworth Heinemann
3. Principles of Highway Engineering and Traffic Analysis (TextBook) Fred L. Mannering, Scott S. Washburn, Walter P. Kilaresk
4. Highway Traffic Analysis and Design (TextBook) by R.J Salter and N.B Hounsell

(16)

a. **Course Name:** Geometric Design of Highways Laboratory
b. **Course Code:** 303104376
c. **Prerequisite:** Knowledge of Civil Engineering up to B.E./B.Tech level.
d. **Rationale:** The course provides Geometric design, transportation facilities, route layout and selection.

e. **Course Learning Objective:**

CLOBJ 1	Students will gain a thorough understanding of the fundamental principles of geometric design for highways, including alignment, cross-sections, and design standards to ensure safety and efficiency
CLOBJ 2	Students will develop the skills to design horizontal and vertical alignments for highways, considering factors such as curvature, sight distance, superelevation, and grade to optimize vehicle performance and safety.
CLOBJ 3	Students will learn to apply relevant design criteria and standards, such as those from the American Association of State Highway and Transportation Officials (AASHTO) or similar organizations, to create compliant and effective highway designs.
CLOBJ 4	Students will acquire the ability to evaluate and optimize highway geometry, including intersection design, lane width, and shoulder design, to address factors such as traffic volume, land use, and environmental impact.

f. **Course Learning Outcomes:**

CLO 1	Conduct surveys and collect field data necessary for geometric highway design, including road alignment and topography.
CLO 2	Apply geometric design principles to develop horizontal curves, vertical curves, and sight distance layouts.
CLO 3	Utilize design software (e.g., AutoCAD Civil 3D, MX Road) to create detailed highway alignment plans and profiles.
CLO 4	Interpret design outputs and verify compliance with relevant road design standards and specifications.
CLO 5	Prepare comprehensive design reports and drawings that document the planning, methodology, and results of highway design projects.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	

0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Geometric design provisions for various transportation
2	Sight distances, Horizontal alignment, gradients, Transition curves, super-elevation calculation
3	Grades, crest and sag curves
4	Sight distance consideration and principles of design
5	Deceleration lanes, Bicycle and pedestrian facility design, Parking layout and design, Terminal layout and design.

i. Text Book and Reference Book:

1. Traffic Engineering and Transportation Planning (TextBook) L.R. Kadiyali; Khanna Publishers
2. Traffic Engineering Design: Principles and Practice (TextBook) Mike Slinn, Paul Matthews, Peter Guest, Butterworth Heinemann
3. Principles of Highway Engineering and Traffic Analysis (TextBook) Fred L. Mannering, Scott S. Washburn, Walter P. Kilaresk
4. Highway Traffic Analysis and Design (TextBook) by R.J Salter and N.B Hounsell

Semester 7

(1)

a. **Course Name:** Construction Project Management and Economics
b. **Course Code:** 303104401
c. **Prerequisite:** Basic knowledge of civil engineering, estimation, engineering economics, management principles, and math is essential.
d. **Rationale:** To effectively plan, execute, and analyze construction projects, foundational knowledge in engineering, costing, economics, and management is crucial.
e. **Course Learning Objective:**

CLOBJ 1	Understand the structure, phases, and stakeholders of construction projects, along with the roles of project managers and ethical responsibilities.
CLOBJ 2	Develop and apply planning techniques such as WBS, Gantt charts, CPM, and PERT for effective project scheduling.
CLOBJ 3	Manage site resources efficiently, including manpower, materials, machinery, and funds using standard practices and tools.
CLOBJ 4	Apply principles of construction economics, cost management, quality control, safety, and modern project monitoring techniques like BIM and Lean Construction.

f. **Course Learning Outcomes:**

CLO 1	Apply various project organization structures and their impact on construction project execution.
CLO 2	Develop construction planning strategies, including scheduling and resource allocation, using appropriate tools and techniques.
CLO 3	Analyze basic construction methods to select suitable techniques for various construction activities.
CLO 4	Evaluate the selection and utilization of construction equipment based on project requirements and economic considerations.
CLO 5	Apply principles of construction economics and cost management to optimize project budgets and financial performance.
CLO 6	Implement project monitoring and control techniques to ensure timely and efficient completion of construction projects.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**20**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Project organization:** A construction project, Phases of construction project, Importance of construction and construction industry, Indian construction industry, need of construction management, Stakeholders of construction management. Construction company structure of construction organization, Organizing for construction project management, Management levels, Traits of project manager and co-ordinators. Ethical conduct for engineers, Factors for success of a construction organization.	10%	4
2	**Construction planning:** Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. Network crushing and cost time trade off, PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion, Precedence network ladder network, Line of balance method.	20%	8
3	**Planning and organizing construction site and resources:** Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: Material management functions, Inventory management. Job layout Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and	15%	8

	conflicts; resource aggregation, allocation, smoothening and leveling. Common Good Practices in Construction		
4	**Construction economics and cost management**: Time value of money, Cash flow diagrams, Discounting factors and Inflation, Annualized cost, Breakeven point, Benefit – cost analysis, Payback period, Economic decision making, Effect of inflation on cash flow, RERA [Real Estate (Regulation and Development) Act 2016] Compliance, Cost statement, Value management in construction, Steps, Value engineering application in a typical case study.	25%	8
5	**Project Monitoring & Control**: Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.	25%	8

i. Text Book and Reference Book:

1. Construction Project Management: Theory and Practice' Kumar Neeraj Jha; Pearson Education
2. Project Planning and Control with PERT and CPM Punamia, B.C. and Khandelwal, K.K; Laxmi Publications
3. Construction Engineering & Management Seetharaman, S; Umesh Publications

(2)

a. **Course Name:** Construction Project Management and Economics Laboratory
b. **Course Code:** 303104402
c. **Prerequisite:** Basic knowledge of civil engineering, estimation, engineering economics, management principles, and math is essential.
d. **Rationale:** To effectively plan, execute, and analyze construction projects, foundational knowledge in engineering, costing, economics, and management is crucial.
e. **Course Learning Objective:**

CLOBJ 1	Understand the structure, phases, and stakeholders of construction projects, along with the roles of project managers and ethical responsibilities.
CLOBJ 2	Develop and apply planning techniques such as WBS, Gantt charts, CPM, and PERT for effective project scheduling.
CLOBJ 3	Manage site resources efficiently, including manpower, materials, machinery, and funds using standard practices and tools.
CLOBJ 4	Apply principles of construction economics, cost management, quality control, safety, and modern project monitoring techniques like BIM and Lean Construction.

f. **Course Learning Outcomes:**

CLO 1	Apply various project organization structures and assess their impact on construction project execution through case studies and simulations.
CLO 2	Develop construction planning strategies, including scheduling and resource allocation, using software tools like MS Project or Primavera in practical sessions.
CLO 3	Select suitable construction methods for various activities by analyzing site conditions and method performance through hands-on demonstrations or virtual labs.
CLO 4	Evaluate the selection and usage of construction equipment based on project requirements and economic factors using real-world data and case-based analysis.
CLO 5	Apply construction economics and cost management principles to optimize project budgets through budgeting exercises and cost analysis scenarios.
CLO 6	Implement project monitoring and control techniques to track and enhance project performance using earned value management or other tracking tools in lab-based activities.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Tutorial:

Sr. No.	Content
1	Gantt Chart Mile Stone Chart, Line of Balance
2	PERT
3	CPM
4	Network Crashing
5	Construction Economics
6	MS-Project

i. Text Book and Reference Book:

1. Construction Project Management: Theory and Practice' Kumar Neeraj Jha; Pearson Education
2. Project Planning and Control with PERT and CPM Punamia, B.C. and Khandelwal, K.K; Laxmi Publications
3. Construction Engineering & Management Seetharaman, S; Umesh Publications

(3)

a. **Course Name:** Water Resourse Engineering
b. **Course Code:** 303104403
c. **Prerequisite:** Knowledge of Fluid Mechanics and Hydrology.
d. **Rationale:** Students will be able to understand various forces necessary to be considered in the design of gravity dam, earthen dam, spillways etc. They will also be able to understand elementary design of energy dissipation works
e. **Course Learning Objective:**

CLOBJ 1	To introduce the classification, selection criteria, and components of various types of dams and their design considerations.
CLOBJ 2	To understand the structural behavior, forces, and failure modes acting on gravity and embankment dams.
CLOBJ 3	To explore the purpose, types, and design aspects of spillways, diversion headworks, and cross-drainage works.
CLOBJ 4	To study the design and alignment of irrigation canals and related regulatory structures for efficient water distribution.

f. **Course Learning Outcomes:**

CLO 1	Apply fundamental concepts and design principles in the analysis of gravity dams.
CLO 2	Design embankment dams considering geotechnical and hydraulic factors.
CLO 3	Evaluate the design and functioning of various types of spillways and their components.
CLO 4	Design diversion headworks to assess their performance in water conveyance systems.
CLO 5	Manage conveyance and distribution systems for efficient water delivery.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction to Dam & Design and construction of gravity dam:** Determining capacity of a dam; Classification of dams; introduction of check dam; Factors governing selection of type of dam; Selection of dam site. Introduction; Forces acting on a gravity dam; Principal and shear stresses; Modes of failure of dam; Elementary Profile of a gravity dam	25%	11
2	**Embankment dams:** Types of earth dams; Foundations for earth dams; Typical cross sections of earth dams; Causes of failure of earth dams; Criteria for safe design of earth dams; Safety against overtopping; Determination of seepage line; Characteristics of seepage line; Stability analysis; Rockfill dams	15%	6
3	**Spillways:** Essential requirements of a spillway; Spillway capacity; Components of spillway; Types of spillway	10%	4
4	**Diversion headworks:** Types of diversion headworks; Location of canal headworks; Components of diversion headworks; Weir; Barrage; Considerations in the design of weir / barrage; Bligh's creep theory; Theory of seepage flow; Kosla's theory	15%	6
5	**Conveyance and distribution systems**: Classification of irrigation canal; Canal alignment; Design of unlined canal by Lacey's Method, Design of lined canal by Manning's equation; Longitudinal section of a canal; Balancing depth of a canal; Cross section of a canal	20%	9
6	**Canal regulation Works & Cross drainage works:** Canal Head Regulator & Cross Regulator, Canal Falls; Necessity and location of falls; Classification of falls;	15%	6

	Types of cross drainage works; Factors affecting suitability of aqueduct and siphon aqueduct; Classification of aqueducts and siphon aqueducts.		

i. Text Book and Reference Book:

1. Hydrology and Water Resources Engineering (TextBook) S. K Garg; Khanna Publishers
2. Irrigation, water resources and water Power Engineering (TextBook) P N Modi
3. Hydrology and Water Resources Engineering K C Patra; Narosa
4. Irrigation Theory and Practice A M Michael

(4)

a. Course Name: Water Resourse Engineering Laboratory

b. Course Code: 303104404

c. Prerequisite: Knowledge of Fluid Mechanics and Hydrology.

d. Rationale: Students will be able to understand various forces necessary to be considered in the design of gravity dam, earthen dam, spillways etc. They will also be able to understand elementary design of energy dissipation works

e. Course Learning Objective:

CLOBJ 1	To introduce the classification, selection criteria, and components of various types of dams and their design considerations.
CLOBJ 2	To understand the structural behavior, forces, and failure modes acting on gravity and embankment dams.
CLOBJ 3	To explore the purpose, types, and design aspects of spillways, diversion headworks, and cross-drainage works.
CLOBJ 4	To study the design and alignment of irrigation canals and related regulatory structures for efficient water distribution.

f. Course Learning Outcomes:

CLO 1	Demonstrate the fundamental concepts of dam engineering.
CLO 2	Design embankment dams by considering geotechnical and hydraulic factors through case-based lab projects.
CLO 3	Evaluate the design and performance of various types of spillways and their components in practical design assignments.
CLO 4	Design diversion headworks and assess their performance in water conveyance systems using practical scenarios.
CLO 5	Manage conveyance and distribution systems for efficient water delivery in operational and planning exercises.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Tutorial:

Sr. No.	Content
1	Evaluation of forces acting on a gravity dam
2	Analysis of modes of failure of a dam
3	Elementary profile of a gravity dam
4	Design criteria for safe design of earth dams
5	Determination of seepage line for an earth dam and analyzing its safety against overtopping
6	Stability analysis for an earth dam
7	Design considerations of weir / barrage
8	Bligh's creep theory and Khosla's theory
9	Design of unlined canal by Laceys Method
10	Design of lined canal by Mannings equation

i. Text Book and Reference Book:

1. Hydrology and Water Resources Engineering (TextBook) S. K Garg; Khanna Publishers
2. Irrigation, water resources and water Power Engineering (TextBook) P N Modi
3. Hydrology and Water Resources Engineering K C Patra; Narosa
4. Irrigation Theory and Practice A M Michael

(5)

a. **Course Name:** Bridge Engineering
b. **Course Code:** 303104411
c. **Prerequisite:** Knowledge of bridges, Reinforced Concrete Structures, Steel Structures, Pre-stressed Concrete
d. **Rationale:** Bridges are one of the most important structures. Learning bridge engineering is crucial for creating safe, efficient, and sustainable transportation infrastructure, enabling efficient connectivity and economic growth.
e. **Course Learning Objective:**

CLOBJ 1	To introduce the classification, importance, and fundamental design considerations in bridge engineering, including traffic loading and site selection.
CLOBJ 2	To develop understanding of various types of RCC and steel bridges along with their structural components and applications.
CLOBJ 3	To familiarize students with special types of modern bridges such as cable-stayed, suspension, and arch bridges.
CLOBJ 4	To understand the functions and construction of essential bridge components including bearings, piers, abutments, and foundations.

f. **Course Learning Outcomes:**

CLO 1	Identify different types of bridges and their structural components based on function, material, and span.
CLO 2	Analyze loads and forces acting on bridges, including dead load, live load, wind, seismic, and temperature effects.
CLO 3	Design superstructure and substructure elements of bridges using relevant codes and specifications.
CLO 4	Evaluate the suitability of foundation systems and bearings for various site conditions.
CLO 5	Assess the performance, durability, and maintenance needs of existing bridge structures through inspection techniques.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
2	0	0	2	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction** Classification of Bridges, Importance of Bridges, Selection of Bridge Site, Traffic Projection, Loads on Bridges, Sub-soil Exploration, IRC codes	**20**	**7**
2	**RCC bridges** Culverts – Box Culverts, Pipe Culverts, Bridge Deck, Box Girder, T-girder, I-girder, PSC bridges	**20**	**6**
3	**Steel Bridges** Railway bridges, Plate Girder bridges, Steel Truss Bridges	**20**	**6**
4	**Other types of bridges** Cable-Stayed bridge, Suspension bridge, Arch bridge, Double-deck bridges, Curved Bridges	**20**	**6**
5	**Bridge Components** Bearings, Piers and Abutments, Sub-structure – pile, caissons, well foundation	**20**	**7**

i. Text Book and Reference Book:

1. Design of Bridges - By N. Krishna Raju | Tata McGraw Hill
2. Bridge Engineering - By Ponnu Swamy | Tata McGraw Hill
3. Bridge Engineering - By Rangawala | Charotar
4. Design of Concrete Bridges - By Praveen Nagarajan | Wiley
5. Design of Bridge Structures - By Jagadeesh and Jayaram | PHI

(6)

a. **Course Name:** Bridge Engineering Laboratory
b. **Course Code:** 303104412
c. **Prerequisite:** Knowledge of bridges, Reinforced Concrete Structures, Steel Structures, Pre-stressed Concrete
d. **Rationale:** Bridges are one of the most important structures. Learning bridge engineering is crucial for creating safe, efficient, and sustainable transportation infrastructure, enabling efficient connectivity and economic growth.
e. **Course Learning Objective:**

CLOBJ 1	To introduce the classification, importance, and fundamental design considerations in bridge engineering, including traffic loading and site selection.
CLOBJ 2	To develop understanding of various types of RCC and steel bridges along with their structural components and applications.
CLOBJ 3	To familiarize students with special types of modern bridges such as cable-stayed, suspension, and arch bridges.
CLOBJ 4	To understand the functions and construction of essential bridge components including bearings, piers, abutments, and foundations.

f. **Course Learning Outcomes:**

CLO 1	Conduct experiments to study the behavior of bridge components under various loading conditions.
CLO 2	Demonstrate the use of models and testing equipment to evaluate structural responses of bridge elements.
CLO 3	Measure deflection, strain, and stress in bridge specimens using sensors and data acquisition systems.
CLO 4	Analyze test results to assess the performance and failure modes of bridge structures.
CLO 5	Prepare detailed laboratory reports presenting methodologies, observations, data analysis, and conclusions.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	0	2	1	-	-	**20**	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Tutorial :

Sr. No.	Content
1	List five bridge types suitable for urban and rural areas. Identify which bridge type fits a hilly terrain with a deep gorge.
2	For a two-lane bridge with projected traffic of 2500 vehicles/day, determine if IRC Class A or Class AA loading is appropriate.
3	A borehole log shows clay up to 5m, then sand till 15m. Recommend suitable foundation with justification.
4	Identify the appropriate IRC code for the design of RCC superstructure. Provide clause reference for effective span of slab bridges.
5	Design a box culvert 3m×3m for a discharge of 5 cumecs under Class A loading.
6	Design a 7.5m wide deck slab for two-lane road with 4m span using IRC Class A loading.
7	Compute initial prestressing force for a PSC I-girder of 20m span subjected to IRC 70R loading.
8	Full design of 15m T-Girder deck for two-lane road, including dead and live loads, support reactions, and reinforcements.
9	Determine the depth and thickness of web and flanges for a 25m span plate girder bridge.
10	Analyze a Pratt truss with 6 panels, 4m each, for live load of 100kN at each node.
11	Estimate the main cable tension for a suspension bridge of 300m main span carrying uniform load.
12	Calculate the horizontal thrust of a semicircular arch with span 40m and rise 10m under UDL of 20kN/m.
13	Design elastomeric bearing for a bridge carrying 700kN reaction with rotation of 0.002 radians.
14	Design a solid RCC pier of 8m height for a river bridge carrying two spans of 25m each.
15	Estimate safe load for a group of 4 piles (300mm dia, 10m length) in clay with Cu = 75 kN/m^2.

16	Design a 20m simply supported RCC deck with pile foundation and elastomeric bearings. Include full calculations.

i. Text Book and Reference Book:

1. Design of Bridges - By N. Krishna Raju | Tata McGraw Hill
2. Bridge Engineering - By Ponnu Swamy | Tata McGraw Hill
3. Bridge Engineering - By Rangawala | Charotar
4. Design of Concrete Bridges - By Praveen Nagarajan | Wiley
5. Design of Bridge Structures - By Jagadeesh and Jayaram | PHI

(7)

a. **Course Name:** Soil & Ground Water Contamination
b. **Course Code:** 303104413
c. **Prerequisite:** Basic knowledge of Soil Mechanics (Geotechnical Engineering-I), Environmental Engineering
d. **Rationale:** Basic Civil Engineering and Environmental Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	To understand the planning, execution, and field testing methods involved in geotechnical site investigation for soil characterization.
CLOBJ 2	To explore the principles of soil mineralogy and soil-water interactions, including their influence on soil behavior and contaminant transport.
CLOBJ 3	To identify the sources and mechanisms of soil and groundwater contamination, and understand the processes involved in their interaction and movement.
CLOBJ 4	To gain knowledge of remediation techniques including bioremediation, and develop the ability to assess, select, and manage appropriate site remediation methods.

f. **Course Learning Outcomes:**

CLO 1	Select appropriate soil investigation/testing technique/method and get true sub soil parameters used for selection of type of foundation as per codal guidelines.
CLO 2	Able to explain the characteristics and sources of soil and groundwater pollution.
CLO 3	Will analyze how soil mineralogy affects soil behavior, including compaction, shear strength, and swelling/shrinkage.
CLO 4	Will develop a deep understanding of unsaturated soil behavior, soil-water-contaminant interactions, and their implications for environmental sustainability and public health.
CLO 5	Equipped with the knowledge, skills, and competencies necessary to effectively assess, remediate, and manage contaminated sites, contributing to environmental protection, public health, and sustainable development.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	0	0	2	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction to site investigation** Planning and Execution of soil exploration Programme – Boring methods – Soil sampling methods -Types of samplers, Introduction to field tests like standard penetration test, plate load test, GPR, EIR , EMI	25	8
2	**Soil Mineralogy** Soil mineralogy characterization and its significance in determining soil behavior soil-water interaction and concepts of double layer – forces of interaction between soil particles.	10	5
3	**Soil and Water** Sources of soil and groundwater contamination	10	5
4	**Soil-Water Interactions** Concepts of unsaturated soil - measurement of soil suction water retention curves - water flow in saturated and unsaturated zone. Soil-water-contaminant interactions and its implications – Factors effecting retention and transport of contaminants.	15	6
5	**Contaminant Site Remediation** Site characterization – risk assessment of contaminated site - remediation methods for soil and groundwater – selection and planning of remediation methods – some examples of in-situ remediation.	20	8
6	**Bioremediation** Concepts of Bioremediation Techniques Managing a bioremediation project, Engineering Aspect of bioremediation: goals and advantage of bioremediation	20	8

i. Text Book and Reference Book:

1. Sharma H.D. and Reddy K.R., "Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
2. Alvarez-Benedi J. and Munoz-Carpena, R., "Soil-Water Solute Process Characterization: An Integrated Approach" CRC Press, New York, 2005.
3. Nazaroff, W.W., Alvarez-Cohen, L. (2001) Environmental Engineering Science. John Wiley & Sons, Inc.
4. Contaminated land: Investigation, assessment and remediation; ICE design and practice guide M Harris & S Herbert 1994 Thomas Telford, London.
5. Bioremediation Engineering: Design and application. McGraw-Hill Inc. 8. Donald L. Wise. (1995).
6. Remediation of Hazardous Waste Contaminated Soils (Environmental Science & Pollution) 1st Edition. CRC Press
7. Method for standard penetration test for soil- IS:2131
8. Code of practice for subsurface investigation for foundation- IS:1892

(8)

a. **Course Name:** Soil & Ground Water Contamination Laboratory
b. **Course Code:** 303104414
c. **Prerequisite:** Basic knowledge of Soil Mechanics (Geotechnical Engineering-I), Environmental Engineering
d. **Rationale:** Basic Civil Engineering and Environmental Engineering knowledge is essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	To understand the planning, execution, and field testing methods involved in geotechnical site investigation for soil characterization.
CLOBJ 2	To explore the principles of soil mineralogy and soil-water interactions, including their influence on soil behavior and contaminant transport.
CLOBJ 3	To identify the sources and mechanisms of soil and groundwater contamination, and understand the processes involved in their interaction and movement.
CLOBJ 4	To gain knowledge of remediation techniques including bioremediation, and develop the ability to assess, select, and manage appropriate site remediation methods.

f. **Course Learning Outcomes:**

CLO 1	Select appropriate soil investigation/testing technique/method and get true sub soil parameters used for selection of type of foundation as per codal guidelines.
CLO 2	Able to explain the characteristics and sources of soil and groundwater pollution.
CLO 3	Will analyze how soil mineralogy affects soil behavior, including compaction, shear strength, and swelling/shrinkage.
CLO 4	Will develop a deep understanding of unsaturated soil behavior, soil-water-contaminant interactions, and their implications for environmental sustainability and public health.
CLO 5	Equipped with the knowledge, skills, and competencies necessary to effectively assess, remediate, and manage contaminated sites, contributing to environmental protection, public health, and sustainable development.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical's:

Sr. No.	Content
1	Soil Sampling and Analysis (Auger Boring and other common tests)
2	pH measurement
3	Sieve Analysis
4	Hydrometer Analysis
5	Study of groundwater analysis methods
6	Methods of contaminant analysis such as chromatography
7	Case Studies / Projects
8	Site Visits

i. Text Book and Reference Book:

9. Sharma H.D. and Reddy K.R., "Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
10. Alvarez-Benedi J. and Munoz-Carpena, R., "Soil-Water Solute Process Characterization: An Integrated Approach" CRC Press, New York, 2005.
11. Nazaroff, W.W., Alvarez-Cohen, L. (2001) Environmental Engineering Science. John Wiley & Sons, Inc.
12. Contaminated land: Investigation, assessment and remediation; ICE design and practice guide M Harris & S Herbert 1994 Thomas Telford, London.
13. Bioremediation Engineering: Design and application. McGraw-Hill Inc. 8. Donald L. Wise. (1995).
14. Remediation of Hazardous Waste Contaminated Soils (Environmental Science & Pollution) 1st Edition. CRC Press
15. Method for standard penetration test for soil- IS:2131
16. Code of practice for subsurface investigation for foundation- IS:1892

(9)

a. **Course Name:** Pavement Design Evaluation
b. **Course Code:** 303104415
c. **Prerequisite:** Transportation Engineering
d. **Rationale:** 1-To Design appropriate Pavement for the roads, 2-To enable the construction procedure of roads 3. To know the maintenance of the roads, 4-To know new techniques in the road construction.
e. **Course Learning Objective:**

CLOBJ 1	To understand the types, components, and functions of pavements, along with the fundamental factors influencing pavement design and analysis.
CLOBJ 2	To analyze the stresses and strains in flexible and rigid pavements using appropriate theories and software tools.
CLOBJ 3	To apply design methodologies for flexible and rigid pavements, including subgrade and material considerations as per IRC guidelines.
CLOBJ 4	To explore overlay design and pavement maintenance strategies for both flexible and rigid pavements, incorporating IRC recommendations.

f. **Course Learning Outcomes:**

CLO 1	Explain the fundamental principles and types of pavements, including their structural components and functional requirements.
CLO 2	Analyze pavement behavior under various loading and environmental conditions using appropriate analytical methods.
CLO 3	Design overlay systems for existing pavements to enhance performance and extend service life.
CLO 4	Develop solutions for flexible and rigid highway pavements in accordance with relevant codes and standards.
CLO 5	Implement maintenance strategies for pavements, considering economic and environmental factors.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
2	**0**	**0**	**2**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	**FUNDAMENTALS OF PAVEMENT** Types of pavement. Pavement composition and the function of each component. Factors governing design and analysis of pavement. Introduction to various approaches to design the pavement	15	5
2	**PAVEMENT ANALYSIS** Stresses and strains in flexible and rigid pavement. Analysis of flexible pavement. Analysis of rigid pavement.	15	6
3	**Design of Highway Pavement :** Flexible Pavement: Factors affecting pavement design, ESWL, EWLF, VDF, Stress analysis – Boussinesq's theory, Burmister's two- and three-layer theory, Flexible pavement design as performance criteria- subgrade rutting criteria and fatigue cracking criteria for bituminous layer. Pavement design using IITPAVE software for granular base and granular sub base, cementitious base, cementitious sub base. Overview on Pavement design for low volume road using locally available material as per IRC SP-72. Drainage consideration in pavement design Rigid Pavement: Design factors, Westergaard's stress analysis, load stress, temperature stress, Design based on fatigue behaviour of concrete, IRC-58 design method – Fatigue concept (using IIT RIGID), Design of joints, Friberg's analysis of dowel bar design, Design of tie bar. Overview on Pavement design for low volume road as per IRC SP-62	30	20
4	**INTRODUCTION TO OVERLAY DESIGN:** Strengthening of flexible pavement by overlay - Flexible overlay, Rigid overlay. Strengthening of rigid pavement by overlay – Flexible overlay over rigid pavement, Rigid overlay over rigid pavement, Unboned rigid overlay, Partially bonded rigid overlay.	25	5
5	**Maintenance of pavement** Flexible pavement: IRC-82, need of maintenance, types, planning, system approach, types of defects, symptoms, location, cause, severity level and treatment. Preventive and periodical renewals, its warrants and treatments. Rigid pavement- Maintenance and its methodology as per IRC: SP:83, Design of overlay	15	6

i. Text Book and Reference Book:

1. L R Kadiyali and N B Lal, Principles and Practices in Highway Engineering (including Expressway and Airport Engineering), Khanna Publishers, New Delhi, 2017
2. Y H Huang, Pavement Analysis and Design, Pearson Prentice Hall, New Delhi, 2013.
3. E J Yoder and M W Witczak, Principles of Pavement Design, Wiley India Pvt. Ltd., New Delhi, 2012
4. R B Mallick and T El-Korchi, Pavement Engineering – Principles and Practice, CRC Press, Taylorand Francis Group, Boca Raton, Florida, 2013
5. Relevant IRC and AASHTO Codes of Practices.

(10)

a. **Course Name:** Pavement Design Evaluation Laboratory
b. **Course Code:** 303104416
c. **Prerequisite:** Transportation Engineering
d. **Rationale:** 1-To Design appropriate Pavement for the roads, 2-To enable the construction procedure of roads 3. To know the maintenance of the roads, 4-To know new techniques in the road construction.
e. **Course Learning Objective:**

CLOBJ 1	To understand the types, components, and functions of pavements, along with the fundamental factors influencing pavement design and analysis.
CLOBJ 2	To analyze the stresses and strains in flexible and rigid pavements using appropriate theories and software tools.
CLOBJ 3	To apply design methodologies for flexible and rigid pavements, including subgrade and material considerations as per IRC guidelines.
CLOBJ 4	To explore overlay design and pavement maintenance strategies for both flexible and rigid pavements, incorporating IRC recommendations.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate the fundamental principles and types of pavements, including their structural components and functional requirements through practical models or case studies.
CLO 2	Analyze pavement behavior under various loading and environmental conditions using appropriate analytical methods in laboratory exercises
CLO 3	Design overlay systems for existing pavements to improve performance and extend service life through practical design problems
CLO 4	Develop design solutions for flexible and rigid highway pavements as per relevant codes and standards in lab assignment
CLO 5	Implement maintenance strategies for pavements, considering economic and environmental factors in practical scenarios.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Examples on Bituminous mix design
2	Examples on stress analysis of flexible pavement for single layer, two layer and multi-layer
3	Problem on case study on design of Flexible pavement for NH/SH
4	Problem on stress analysis of rigid pavement as per Westergaard theory
5	Design of dowel bar as per Friberg's analysis and design of tie bar
6	Design of Rigid pavement for fatigue damage as per IRC:58
7	Example on determination of overlay thickness

i. Text Book and Reference Book:

1. L R Kadiyali and N B Lal, Principles and Practices in Highway Engineering (including Expressway and Airport Engineering), Khanna Publishers, New Delhi, 2017
2. Y H Huang, Pavement Analysis and Design, Pearson Prentice Hall, New Delhi, 2013.
3. E J Yoder and M W Witczak, Principles of Pavement Design, Wiley India Pvt. Ltd., New Delhi, 2012
4. R B Mallick and T El-Korchi, Pavement Engineering – Principles and Practice, CRC Press, Taylorand Francis Group, Boca Raton, Florida, 2013
5. Relevant IRC and AASHTO Codes of Practices.

(11)

a. **Course Name:** Green Sustainable Building
b. **Course Code:** 303104417
c. **Prerequisite:** Material Testing & Evaluation, Computer-Aided Civil Engineering Drawing
d. **Rationale:** Green Sustainable Buildings gives an understanding of Sustainable Sites, Energy efficiency, Water Efficiency, Green Building Concepts
e. **Course Learning Objective:**

CLOBJ 1	To understand the principles of sustainable design and assess the life cycle impacts of building materials, environmental factors, and energy dynamics.
CLOBJ 2	To explore strategies for enhancing site sustainability, water and energy efficiency, and indoor environmental quality in building design.
CLOBJ 3	To evaluate material selection, resource management, and waste reduction practices with a focus on green building standards and rating systems.
CLOBJ 4	To apply sustainable design concepts through case studies and projects that incorporate environmental, technical, and economic considerations in green buildings.

f. **Course Learning Outcomes:**

CLO 1	Identify and list the key principles of green building design and sustainability.
CLO 2	Explain the importance of sustainable practices in building design and their impact on the environment and society.
CLO 3	Demonstrate the ability to apply sustainable design principles in a hypothetical building project, including material selection and energy efficiency measures.
CLO 4	Illustrate case studies of green buildings to assess their environmental impact, energy efficiency, and adherence to sustainability principles.
CLO 5	Evaluate different green building certifications (e.g., LEED, BREEAM) and their effectiveness in promoting sustainability in the construction industry.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	

2	**0**	**0**	**2**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction** Life cycle impacts of materials and products, Sustainable design concepts, Strategies of Design for the Environment, The sun-earth relationship and the energy balance on the earth's surface, climate, wind–solar radiation and solar temperature, Sun shading and solar radiation on surfaces, Energy impact on the shape and orientation of buildings, Thermal properties of building materials	**20**	**5**
2	**Sustainable Sites** Soil erosion & pollution control measures, Alternate transportation strategies, Stormwater management, Reduction of heat island effect, Minimizing night sky pollution	**10**	**3**
3	**Water Efficiency** Water efficient plumbing fixtures, Effective irrigation techniques, Waste water treatment & reuse	**10**	**3**
4	**Energy Efficiency** Holistic energy performance & evaluation of buildings, Commissioning of building energy systems, Refrigerant management, Renewable energy systems, Measurement & verification of energy & water systems	**12**	**4**
5	**Materials & Resources** 3 – R concept (Reduce, Reuse & Recycle), Waste management during construction as well as post-occupancy, Opportunities for reuse of existing building elements & salvaged materials, Selection of eco-friendly building materials	**12**	**3**
6	**Indoor Environmental Quality** Indoor air quality management during construction & post-occupancy, Strategies for effective ventilation, day-lighting & views, Enhancement of thermal comfort by design, Use of low emitting interior materials, Indoor pollution source control	**10**	**3**

7	**Green Building Concepts** Green building concept, Green building rating tools, Leeds and IGBC codes, Material selection, Embodied energy, Operating energy, Facade systems, Ventilation systems, Transportation, Water treatment systems, Water efficiency, Building economics	**14**	**4**
8	**Green Building Design Case Study** Students work through a controlled analysis and design process to produce drawings and models of their green building project. Topics include building form, orientation, and site considerations; conservation measures; energy modeling; heating system and fuel choices; renewable energy systems; material choices; and construction budget, Students will research green construction and design in a particular construction context and report their results to the class.	**12**	**3**

i. Text Book and Reference Book:

1. Sustainable Construction: Green Building Design and Delivery (TextBook) - By Kibert, C. | John Wiley & Sons
2. A Handbook of Sustainable Building Design and Engineering: An Integrated Approach to Energy, Health and Operational Performance - By Dejan Mumovic, Mat Santamouris | Routledge; 2nd edition (30 October 2018), Pub. Year 2018
3. Renewable Energy Sources for Sustainable Development - By N. S. Rathore | New India Publishing Agency
4. Sustainable Development in Practice: Case Studies for Engineers and Scientists - By Adisa Azapagic and Slobodan Perdan | Wiley–Blackwell; 2nd edition, Pub. Year 2011

(12)

a. **Course Name:** Green Sustainable Building Laboratory
b. **Course Code:** 303104418
c. **Prerequisite:** Material Testing & Evaluation, Computer-Aided Civil Engineering Drawing
d. **Rationale:** Green Sustainable Buildings gives an understanding of Sustainable Sites, Energy efficiency, Water Efficiency, Green Building Concepts
e. **Course Learning Objective:**

CLOBJ 1	To understand the principles of sustainable design and assess the life cycle impacts of building materials, environmental factors, and energy dynamics.
CLOBJ 2	To explore strategies for enhancing site sustainability, water and energy efficiency, and indoor environmental quality in building design.
CLOBJ 3	To evaluate material selection, resource management, and waste reduction practices with a focus on green building standards and rating systems.
CLOBJ 4	To apply sustainable design concepts through case studies and projects that incorporate environmental, technical, and economic considerations in green buildings.

f. **Course Learning Outcomes:**

CLO 1	Identify and list the key principles of green building design and sustainability.
CLO 2	Explain the importance of sustainable practices in building design and their impact on the environment and society.
CLO 3	Demonstrate the ability to apply sustainable design principles in a hypothetical building project, including material selection and energy efficiency measures.
CLO 4	Illustrate case studies of green buildings to assess their environmental impact, energy efficiency, and adherence to sustainability principles.
CLO 5	Evaluate different green building certifications (e.g., LEED, BREEAM) and their effectiveness in promoting sustainability in the construction industry.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **List of Tutorials:**

Sr. No.	Content
1	Green building concept
2	Orientation and Site Considerations
3	Conservation Measures
4	Energy Modelling
5	Heating System And Fuel Choices
6	Renewable Energy Systems
7	Green Construction And Design
8	Green Building Rating Tools

i. Text Book and Reference Book:

1. Sustainable Construction: Green Building Design and Delivery (Text Book) - By Kibert, C. | John Wiley & Sons
2. A Handbook of Sustainable Building Design and Engineering: An Integrated Approach to Energy, Health and Operational Performance - By Dejan Mumovic, Mat Santamouris | Routledge; 2nd edition (30 October 2018), Pub. Year 2018
3. Renewable Energy Sources for Sustainable Development - By N. S. Rathore | New India Publishing Agency
4. Sustainable Development in Practice: Case Studies for Engineers and Scientists - By Adisa Azapagic and Slobodan Perdan | Wiley–Blackwell; 2nd edition, Pub. Year 2011

(13)

a. **Course Name:** Environmental Chemistry
b. **Course Code:** 303104421
c. **Prerequisite:** knowledge of basic chemistry
d. **Rationale:** The subject deals with qualitative and quantitative analysis of water and accurate determination of parameters.
e. **Course Learning Objective:**

CLOBJ 1	To familiarize students with laboratory glassware, plasticware, and measuring instruments used in analysis
CLOBJ 2	To understand chemical concepts such as molarity, normality, stoichiometry, and preparation of solutions
CLOBJ 3	To apply methods of volumetric and gravimetric analysis for water and wastewater evaluation
CLOBJ 4	To understand the use of optical and electrical methods for instrumental chemical analysis.

f. **Course Learning Outcomes:**

CLO 1	Prepare standard and high-purity solutions using principles of general and analytical chemistry.
CLO 2	Calibrate and use laboratory glassware and instruments for accurate environmental measurements
CLO 3	Explain and perform water sampling, testing, and analytical procedures for water and wastewater.
CLO 4	Demonstrate the practical application of volumetric and gravimetric methods in environmental assessment
CLO 5	Analyze laboratory data with precision and evaluate environmental quality parameters.
CLO 6	Utilize instrumental techniques like optical, emission, and electrical methods in environmental chemical testing.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	

2	**-**	**-**	**3**	**60**	**00**	**20**	**20**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION** Glass ware, Plastic ware and measuring instruments, calibration of lab ware and instruments, cleaning solutions; cleaning and washing procedures for chemical and microbiological analysis	**5%**	**4**
2	**DISTILLED AND DEMATERIALIZED WATERS:** Methods of preparing distilled waters, Methods of preparing dematerialized water: Reverse osmosis, ion-exchange and electro dialysis, Methods of preparing high purity waters.	**10%**	**6**
3	**GENERAL CHEMICAL CONCEPTS:** Molar, Molal, Normal solutions, Valency, oxidation state and Bonding, Chemical Equations and weight Relationship, gas laws and its applications; units of expression of results and their interrelationships, precision and accuracy..	**25%**	**10**
4	**PREPARATION OF STANDARD SOLUTIONS:** Relationship of atomic, molecular, formula and equivalent weights and solutions, Requirements of primary standards, Secondary Standards and their standardization, characteristics of common laboratory chemicals	**20%**	**8**
5	**VOLUMETRIC AND GRAVIMETRIC ANALYSIS:** Sampling methods, Concept and applications of Quantitative analysis: Precipitation, filtration, Drying, Desiccation, Concept and applications of Volumetric analysis in engineering field	**25%**	**8**
6	**STANDARD METHODS FOR ANALYSIS OF WATER AND WASTEWATER**	**5%**	**4**
7	**INSTRUMENTAL ANALYSIS:** Concept of Optical Methods of Analysis, Emission Methods, Dispersion and scattering methods, Electrical methods	**10%**	**5**

i. Text Book and Reference Book:

1. Chemistry for Environmental Engineering by Clair N. Sawyer and Perry L. McCarty
2. Standard Methods for Water and Wastewater Analysis by AWWA

(14)

a. **Course Name:** Environmental Chemistry Laboratory
b. **Course Code:** 303104422
c. **Prerequisite:** knowledge of basic chemistry
d. **Rationale:** The subject deals with qualitative and quantitative analysis of water and accurate determination of parameters
e. **Course Learning Objective:**

CLOBJ 1	To introduce the laboratory setup and instruments used in environmental chemical analysis.
CLOBJ 2	To develop skills in preparing and standardizing chemical solutions used in water quality testing.
CLOBJ 3	To practice the analysis of physical and chemical parameters of water including pH, solids, and hardness.
CLOBJ 4	To understand the application of analytical methods in solving real-world environmental problems.

f. **Course Learning Outcomes:**

CLO 1	Use laboratory glassware and instruments effectively in environmental analysis.
CLO 2	Prepare and standardize primary and secondary chemical solutions for testing.
CLO 3	Determine key physical and chemical parameters of water samples through laboratory methods.
CLO 4	Analyze data from laboratory experiments and draw meaningful environmental conclusions.
CLO 5	Perform numerical calculations related to pH, solids, hardness, alkalinity and acidity
CLO 6	Apply theoretical knowledge to interpret lab results in environmental context.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE**- Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE**- End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Introduction to laboratory & instruments
2	Calibration of different glass wares & Instruments (pH meter and Weigh balance)
3	Preparation of primary and secondary standards solutions and its standardization
4	Determination of pH
5	Determination of Solids
6	Determination of Hardness
7	Determination of Alkalinity
8	Determination of chlorides
9	Determination of sulphates
10	Numerical on pH
11	Numerical on Solids
12	Numerical on Hardness
13	Numerical on Acidity & Alkalinity

i. Text Book and Reference Book:

1. Chemistry for Environmental Engineering by Clair N. Sawyer and Perry L. McCarty
2. Standard Methods for Water and Wastewater Analysis by AWWA

(15)

a. **Course Name:** Engineering Geology
b. **Course Code:** 3031044423
c. **Prerequisite:** Geotechnical Engineering subject.
d. **Rationale:** Basic geology and environmental studies is essential for all Engineers..
e. **Course Learning Objective:**

CLOBJ 1	To understand the relevance of geology in civil engineering applications and infrastructure development.
CLOBJ 2	To study the internal structure and dynamic processes of the Earth including earthquakes and volcanism.
CLOBJ 3	To classify different types of rocks and analyze their formation, structure, and engineering significance.
CLOBJ 4	To understand geological hazards, plate tectonics, structural features, and mapping techniques.

f. **Course Learning Outcomes:**

CLO 1	Explain internal structure and processes of the Earth including continental drift and plate tectonics
CLO 2	Interpret and classify igneous, sedimentary, and metamorphic rocks based on their origin and structure
CLO 3	Understand causes and effects of geological hazards such as earthquakes, landslides, and volcanic activity.
CLO 4	Identify geological structures like folds, faults, and joints and assess their engineering implications
CLO 5	Predict engineering behaviour of rocks under various geological conditions
CLO 6	Interpret geological maps and use GIS and remote sensing in geotechnical analysis.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
2	**0**	**0**	**2**	**20**	**-**	**20**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION :** Branches of geology useful to civil engineering, scope of geological studies in various civil engineering projects. Department dealing with this subject in India and their scope of work- GSI, Granite Dimension Stone Cell, NIRM. Mineralogy-Mineral, Origin and composition.	10%	2
2	**INTERIOR OF EARTH** Internal structure of earth, study of core, mental and crust of the Earth. Processes responsible for volcanism (Process of volcanic eruption, types of volcanoes and volcanic hazard) and earthquake (Causes of earthquake occurrence, Distribution (seismic zoning), Seismo-tectonic setup of India, seismic hazard: Tsunamis, Active fault rupture, liquefaction). Plate Tectonics: Introduction to the concept of plate tectonics, mechanism responsible for plate movement, types of plate boundaries, processes and features associated with plate boundaries. Continental drift and sea floor spreading	25%	6
3	**CLASSIFICATION OF ROCK** Types of rock and origin: Igneous (extrusive and intrusive), sedimentary and metamorphic, ternary diagrams, definitions (structure, texture) Igneous Rock Agents, structure, texture, IUGG classification of intrusive and extrusive rocks Metamorphic Rock Causes of metamorphism (stress, temperature, tectonism, pore fluid), recrystallization, phase change, structure and texture Sedimentary Rock Sedimentation environments, structure, textural classification of siliclastic and carbonate rock	15%	4
4	**STRUCTURAL GEOLOGY** Introduction to primary and secondary geological structures. Study of geological faults, folds, joints and active faulting. Their origin, types and engineering consideration. Geological mapping: study of Strike and	25%	7

	dip using models and numerical problems, preparation of geological cross section.		
	GEOLOGICAL HAZARDS Major geological hazards Geological considerations in design of constructed facilities and infrastructure, causes and classification of landslides, stability assessment for soil and rock slopes, mitigation of landslide hazard, effect of earthquakes on constructed facilities and infrastructure, geotechnical and structural considerations in mitigation of earthquake hazard	25%	7

i. Text Book and Reference Book:

1. Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria & Sons.
2. Text Book of Engineering Geology, N. Chenna Kesavulu, 2nd Edition (2009), Macmillan Publishers India.
3. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982)
4. S. K. Ghosh, Structural Geology: Fundamentals and Modern Developments, Elsevier Ltd, 2013.
5. F. G. Bell, Engineering Geology Second Edition, Elsevier Ltd, 2007.

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a. **Course Name:** Engineering Geology Laboratory
b. **Course Code:** 3031044424
c. **Prerequisite:** Geotechnical Engineering subject.
d. **Rationale:** Basic geology and environmental studies is essential for all Engineers
e. **Course Learning Objective:**

CLOBJ 1	To introduce the fundamentals of mineralogy and petrology relevant to civil engineering
CLOBJ 2	To provide hands-on experience in identifying physical and structural properties of rocks and minerals.
CLOBJ 3	To develop understanding of geological structures and their relevance in civil engineering applications.
CLOBJ 4	To build competence in interpreting geological maps and assessing terrain suitability for construction

f. **Course Learning Outcomes:**

CLO 1	Identify and classify common rock-forming minerals using physical properties.
CLO 2	Describe and distinguish different types of igneous, sedimentary, and metamorphic rocks.
CLO 3	Interpret geological structures such as folds, faults, and joints from field observations and maps.
CLO 4	Apply structural geology concepts to civil engineering problems such as tunnelling and slope stability
CLO 5	Analyse and interpret simple geological maps and cross-sections
CLO 6	Use geological knowledge to assess site conditions for civil engineering projects.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**1**	**-**	**20**	**-**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content
1	Introduction to physical properties of minerals
2	Study of physical properties of Minerals
3	Study of physical properties of Igneous Rocks
4	Study of physical properties of Sedimentary Rocks
5	Study of physical properties of Metamorphic Rocks
6	Study of Structural Geology like Folds, Faults, Joints and Geological Maps
7	Interpretation of Simple Structural Geology Maps

i. Text Book and Reference Book:

1. Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria & Sons.
2. Text Book of Engineering Geology, N. Chenna Kesavulu, 2nd Edition (2009), Macmillan Publishers India.
3. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982)
4. S. K. Ghosh, Structural Geology: Fundamentals and Modern Developments, Elsevier Ltd, 2013.
5. F. G. Bell, Engineering Geology Second Edition, Elsevier Ltd, 2007.

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a. **Course Name:** Pre Stressed Concrete Structure
b. **Course Code:** 303104425
c. **Prerequisite:** Design of Reinforced Concrete Structures, Ductile Detailing of RCC structures, Beams
d. **Rationale:** Modern RCC bridges and flyovers are made with pre-stressed concrete as it enhances structural durability, allows for longer spans and reduced material usage, and improves the overall performance of concrete structures by leveraging the compressive strength of concrete and the tensile strength of steel.
e. **Course Learning Objective:**

CLOBJ 1	To introduce the fundamental concepts, systems, and materials used in prestressed concrete structures
CLOBJ 2	To develop understanding of stress analysis, load balancing, and behavior under flexure, shear, and torsion.
CLOBJ 3	To understand the mechanisms of pre-stress transfer and codal provisions regarding bond and anchorage.
CLOBJ 4	To equip students with the skills to design prestressed concrete members using limit state method.

f. **Course Learning Outcomes:**

CLO 1	Explain the fundamental concepts, principles, and types of pre-stressing techniques used in concrete structures.
CLO 2	Analyze the behavior of pre-stressed concrete members under various loading conditions using relevant theories and methods.
CLO 3	Design pre-stressed concrete elements by applying codal provisions and safety considerations for flexure, shear, and bond.
CLO 4	Evaluate losses in pre-stressing force and their impact on the performance of pre-stressed concrete structures.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	

2	**2**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION** Basic Concepts, types of pre-stressing – Pre and Post tensioning, systems and devices, materials, losses in pre-stress, Grouting, IS 1343: 2012	20%	6
2	**ANALYSIS OF PRE-STRESS AND BENDING** Basic assumptions, Resultant stress, Load Balancing, Stresses in tendons, Cracking moment, deflection of pre-stressed concrete members, flexural strength, shear and torsional resistance	20%	6
3	**TRANSMISSION OF PRE-STRESS** Transfer of pre-stressing force by bond. Transmission length, bond stresses, transverse tensile stresses, end-zone reinforcement, flexural bond stresses, Codal provisions.	20%	6
4	**LIMIT STATE DESIGN** Inadequacy of elastic and ultimate load methods, Philosophy of limit state, design loads and strength, Strength and serviceability limit states, crack widths	20%	6
5	**DESIGN OF PRE-STRESSED CONCRETE SECTIONS** Design for flexure, axial tension, shear and torsion, bond and bearing. Pre-stressed concrete pipes, tanks, slabs, beams, bridges	20%	8

i. Text Book and Reference Book:

1. Prestressed Concrete Design by Praveen Nagarajan
2. Design of Prestressed Concrete Structure by Lin. T.Y, Burns

a. **Course Name:** Pre Stressed Concrete Structure Laboratory
b. **Course Code:** 303104426
c. **Prerequisite:** Design of Reinforced Concrete Structures, Ductile Detailing of RCC structures, Beams
d. **Rationale:** Modern RCC bridges and flyovers are made with pre-stressed concrete as it enhances structural durability, allows for longer spans and reduced material usage, and improves the overall performance of concrete structures by leveraging the compressive strength of concrete and the tensile strength of steel**Course**
e. **Learning Objective:**

CLOBJ 1	To provide students with fundamental understanding of stress development in prestressed concrete
CLOBJ 2	To expose students to computation of various prestress losses including elastic shortening, creep, shrinkage, and relaxation
CLOBJ 3	To enable students to analyse service stress distribution, cracking, shear, and deflection behaviour in prestressed members
CLOBJ 4	To develop skills in evaluating complex scenarios including anchorage losses and composite section analysis

f. **Course Learning Outcomes:**

CLO 1	Calculate the losses in pre-stressing force due to various factors such as elastic shortening, creep, shrinkage, and relaxation.
CLO 2	Determine the stresses in pre-stressed concrete members at different stages of loading using appropriate formulas and codal provisions.
CLO 3	Compute the ultimate flexural capacity of pre-stressed concrete beams considering different pre-stressing methods.
CLO 4	Design pre-stressing tendons and concrete sections by solving numerical problems based on serviceability and safety criteria.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Stress in Tendons at Transfer
2	Loss of Prestress due to Elastic Shortening
3	Loss of Prestress due to Creep
4	Loss of Prestress due to Shrinkage
5	Loss of Prestress due to Relaxation of Steel
6	Ultimate Moment Capacity of a Prestressed Beam
7	Stress Distribution at Service Load
8	Check for Cracking at Service Loads
9	Design of End Block Reinforcement (Bursting Tension)
10	Calculation of Anchorage Slip Losses
11	Stress in Concrete at Transfer and Service
12	Minimum Eccentricity for Zero Tension
13	Shear Resistance of Prestressed Beam
14	Deflection of a Prestressed Beam
15	Composite Section Analysis

i. Text Book and Reference Book:

1. Prestressed Concrete Design by Praveen Nagarajan
2. Design of Prestressed Concrete Structure by Lin. T.Y, Burns

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a. **Course Name:** Urban Transport Planning
b. **Course Code:** 303104427
c. **Prerequisite:** Basic of Transportation
d. **Rationale:** Urbanization drives demand for housing, land use planning, and efficient transportation due to rising population and vehicle ownership. Expanding urban boundaries require integrated road, rail, and mass transit systems. Well-planned public transport reduces congestion, accidents, and pollution. This subject covers urban growth, transport planning, land use, and travel demand modelling.
e. **Course Learning Objective:**

CLOBJ 1	To introduce students to urbanization patterns, transportation issues, and urban transport system planning
CLOBJ 2	To enable understanding of mass transportation systems and their relevance in reducing congestion and pollution.
CLOBJ 3	To train students in survey techniques, data collection and modeling methods in urban transport planning.
CLOBJ 4	To develop competency in forecasting travel demand and designing efficient urban transport solutions.

f. **Course Learning Outcomes:**

CLO 1	Identify various modes of urban transportation, including public transit, cycling, walking, and personal vehicles, and their roles in urban settings.
CLO 2	Describe the principles of transportation planning, including demand forecasting, system evaluation, and land-use integration.
CLO 3	Analyze traffic flow characteristics and patterns in urban areas by applying appropriate data collection techniques and interpretation methodologies.
CLO 4	Assess safety, accessibility, and inclusivity within urban transportation systems, proposing strategies to address the mobility needs of all user groups, including vulnerable populations.
CLO 5	Evaluate the influence of automation technologies on urban transportation infrastructure development and management, considering aspects of safety, operational efficiency, and economic viability.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	0	0	2	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	**INTRODUCTION** Urbanization, urban class groups, transportation problems and identification, impacts of transportation on urban development, urban transport system planning process. Introduction to Preparation of comprehensive plan and transportation system management planning. Urban forms and structures: point, linear, radial, poly-nuclear	15%	5
2	**URBAN MASS TRANSPORTATION SYSTEMS:** Urban transit problems, travel demand, types of transit systems, public, private, para-transit transport, mass and rapid transit systems, BRTS and Metro rails, capacity, merits and comparison of systems, coordination, types of coordination.	15%	6
3	**SURVEY AND DATA COLLECTION FOR URBAN LAND USE AND TRANSPORTATION PLANNING MODELS,** Study area definition; division into traffic analysis zones; network identification and coding; types of trips, socio economic and trip characteristics of urban area; home interview survey/ Household Information Survey; roadside interview survey; goods transportation information survey, mass transit survey, Intermediate public transport/IPT surveys; methods of sampling and expansion factors; accuracy checks, screen line checks, consistency checks.	15%	10
4	**TRAVEL DEMAND MODELING:** Trip Generation ,Trip Distribution , Modal Split ,Route Assignment	35%	15
5	**MASS TRANSIT SYSTEMS:**	15%	6

	Introduction to routing and scheduling, parameters to measure performance of transit systems. Corridor identification and corridor screen line analysis. As per developments suitability of transit system		

i. Text Book and Reference Book:

1. Kadiyali L.R., Traffic Engineering and Transport Planning, Khanna Publishers
2. Khisty, C J., Transportation Engineering – An Introduction, Prentice-Hall, NJ
3. S.C. Saxena, Traffic Planning and Design, Dhanpat Rai Pub., New Delhi.
4. Partho Chakraborty and Animesh Das, Principles of Transportation Engineering, PHI
5. C. S. Papacostas, Fundamentals of Transportation System Analysis, PHI

(20)

a. **Course Name:** Urban Transport Planning Laboratory
b. **Course Code:** 303104428
c. **Prerequisite:** Basic of Transportation
d. **Rationale:** Urbanization drives demand for housing, land use planning, and efficient transportation due to rising population and vehicle ownership. Expanding urban boundaries require integrated road, rail, and mass transit systems. Well-planned public transport reduces congestion, accidents, and pollution. This subject covers urban growth, transport planning, land use, and travel demand modelling.
e. **Course Learning Objective:**

CLOBJ 1	To introduce the process of urbanization and its influence on transportation needs.
CLOBJ 2	To develop skills in identifying urban transport issues and designing comprehensive transportation plans
CLOBJ 3	To understand classification of transit systems and analyse mass transit operations like BRTS and Metro
CLOBJ 4	To enable students to conduct travel surveys, collect data, and perform basic travel demand modelling

f. **Course Learning Outcomes:**

CLO 1	Decide transportation modeling methods to simulate and analyze the impacts of proposed changes to urban transportation systems.
CLO 2	Assess traffic flow and operational patterns in urban areas, employing data collection methods and analytical tools.
CLO 3	Recommend the measures to improve safety and accessibility in urban transportation networks, ensuring equitable access for all users.
CLO 4	Examine transportation planning, including demand forecasting, system performance analysis, and the integration of land use and transportation strategies.

g. **Teaching & Examination Scheme:**

Teaching Scheme	Evaluation Scheme

L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Introduction to Urbanization and Urban Class Groups
2	Identification of Urban Transportation Problems
3	Urban Transport System Planning Process
4	Preparation of a Comprehensive Transportation Plan
5	Study of Urban Forms and Structures
6	Urban Transit Problems and Travel Demand
7	Classification of Transit Systems
8	Study of Mass and Rapid Transit Systems (BRTS & Metro)
9	Network Identification and Coding
10	Trip Types and Socio-Economic Characteristics
11	Home Interview Survey (Household Travel Survey)
12	Roadside Interview Survey and Data Analysis
13	Numerical on Trip Demand Modelling

i. Text Book and Reference Book:

1. Khisty, C J., Transportation Engineering – An Introduction, Prentice-Hall, NJ
2. S.C. Saxena, Traffic Planning and Design, Dhanpat Rai Pub., New Delhi.
3. Partho Chakraborty and Animesh Das, Principles of Transportation Engineering, PHI
4. C. S. Papacostas, Fundamentals of Transportation System Analysis, PHI

(21)

a. **Course Name:** Earthquake Engineering
b. **Course Code:** 303104431
c. **Prerequisite:** Basic knowledge of Soil Improvement Techniques
d. **Rationale: :** The students can have a knowledge regarding various techniques to modify the ground conditions and applications.
e. **Course Learning Objective:**

CLOBJ 1	To understand the fundamentals of earthquake geology, seismic waves, and seismic zoning relevant to building design.
CLOBJ 2	To analyze the dynamic behavior of buildings under earthquake forces using single and multi-degree of freedom systems.
CLOBJ 3	To comprehend the philosophy of earthquake-resistant design and apply IS code provisions for seismic analysis.
CLOBJ 4	To study ductile detailing and earthquake-resistant design approaches for steel structures as per national and international codes.

f. **Course Learning Outcomes:**

CLO 1	Explain the causes, characteristics, and effects of earthquakes on civil engineering structures.
CLO 2	Analyze structural response to seismic loads using dynamic analysis methods and response spectra.
CLO 3	Apply codal provisions (e.g., IS 1893, IS 13920) in the seismic design of buildings and infrastructure.
CLO 4	Evaluate the seismic vulnerability and retrofitting needs of existing structures.
CLO 5	Design earthquake-resistant structures by incorporating ductility, base isolation, and energy dissipation techniques.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
2	**0**	**0**	**2**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction** Interior of Earth, Plate Tectonics, Faults, Basic parameters of earthquake, Magnitude & Intensity, Scales, IS 4326 Seismograph, Seismic Zones of India, Seismic waves, their classification and characteristics, past earthquakes.	**20**	**3**
2	**Fundamentals of Earthquake Vibrations of Buildings** Static load v/s Dynamic load (force control and displacement control), simplified single degree of freedom system, mathematical modelling of buildings, natural frequency, resonance v/s increased response, responses of structures to different types of vibrations like free and forced, damped and un-damped vibration, response of the building to earthquake ground motion, Response to multi-degree (maximum three) of freedom systems, mode shapes.	**25**	**10**
3	**Design Philosophy** Philosophy of earthquake resistant design, earthquake proof v/s earthquake resistant design, four virtues of earthquake resistant structures (strength, stiffness, ductility and configuration), seismic structural layout, Introduction to IS: 1893 (Part I), IS 875 (Part V)—seismic load: Seismic Coefficient Method – base shear and its distribution along the height. Introduction to Response spectrum, IS code provisions.	**25**	**10**
4	**Ductile Detailing** Concepts of Detailing of various structural components as per IS: 13920 provisions.	**10**	**3**
5	**Earthquake Resistant Design of Steel Structures** The design philosophy for steel structures, Introduction to international codes. Performance of steel structures in past earthquakes, Capacity design concept, Ductility of steel buildings, Seismic behavior of steel buildings, Stability considerations, Analysis of buildings using equivalent static and response spectrum methods. Seismic Design and detailing of Moment Resistant Frames (MRFs), IS 18168: 2023	**20**	**6**

i. Text Book and Reference Book:

1. Earthquake Resistant Design of Structures - By Pankaj Agarwal and Manish Shrikhande

2. Earthquake Resistance Design of Structures - By S K Duggal
3. Design of Earthquake Resistant Buildings - By Minoru Wakabayashi
4. Dynamics of Structures with Earthquake Engineeirng - By A K Jain

(22)

a. **Course Name:** Earthquake Engineering Laboratory
b. **Course Code:** 303104432
c. **Prerequisite:** Basic knowledge of Soil Improvement Techniques
d. **Rationale: :** The students can have a knowledge regarding various techniques to modify the ground conditions and applications.
e. **Course Learning Objective:**

CLOBJ 1	To understand the fundamentals of earthquake geology, seismic waves, and seismic zoning relevant to building design.
CLOBJ 2	To analyze the dynamic behavior of buildings under earthquake forces using single and multi-degree of freedom systems.
CLOBJ 3	To comprehend the philosophy of earthquake-resistant design and apply IS code provisions for seismic analysis.
CLOBJ 4	To study ductile detailing and earthquake-resistant design approaches for steel structures as per national and international codes.

f. **Course Learning Outcomes:**

CLO 1	Conduct experiments to observe the dynamic behavior of structural models under simulated seismic loads.
CLO 2	Demonstrate the use of shake tables and vibration testing equipment for earthquake response analysis.
CLO 3	Analyze acceleration, displacement, and frequency response data of structures subjected to ground motion.
CLO 4	Apply structural analysis software (e.g., ETABS, SAP2000) to model and evaluate seismic performance of buildings.
CLO 5	Interpret experimental and simulation results to assess the effectiveness of earthquake-resistant design strategies.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **List of Practicals:**

Sr. No.	Content
1	Equivalent Static Method for Seismic Design of Structures conforming to IS 1893 Part 1 2016.
2	Use of SAP2000 software (CSI America) in performing Seismic Analysis
3	Response Spectrum Method of Seismic Analysis
4	Introduction of Time-History Analysis using SAP2000 and Etabs Software (CSI America)
5	Earthquake Resistant Design of Steel Structures conforming to IS 18168: 2023

i. Text Book and Reference Book:

1. Earthquake Resistant Design of Structures - By Pankaj Agarwal and Manish Shrikhande
2. Earthquake Resistance Design of Structures - By S K Duggal
3. Design of Earthquake Resistant Buildings - By Minoru Wakabayashi
4. Dynamics of Structures with Earthquake Engineeirng - By A K Jain

(23)

a. **Course Name:** Ground Improvement Technique
b. **Course Code:** 303104433
c. **Prerequisite:** Basic knowledge of Soil Improvement Techniques
d. **Rationale: :** The students can have a knowledge regarding various techniques to modify the ground conditions and applications.
e. **Course Learning Objective:**

CLOBJ 1	To understand problematic soil types and identify suitable ground improvement techniques based on geotechnical conditions.
CLOBJ 2	To explore various soil stabilization methods, including chemical and mechanical techniques, with practical construction applications.
CLOBJ 3	To analyse advanced ground improvement methods for cohesive and cohesion less soils, including compaction, dewatering, and grouting techniques.
CLOBJ 4	To examine the use of geosynthetics and in-situ soil treatment methods for improving ground performance in civil engineering projects.

f. **Course Learning Outcomes:**

CLO 1	Develop an awareness of problematic soils and selection of ground improvement techniques based on soil conditions
CLO 2	Understand drainage, dewatering, and grouting technique in ground improvement method.
CLO 3	Aware of the ground improvement techniques.
CLO 4	Study the applications of geosynthetics.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
2	**0**	**0**	**2**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	**Content**	**Weightage**	**Teaching Hours**

1	**Problematic Soil and Ground Improvement Techniques** **Ground improvement** - Role of ground improvement in foundation engineering – Methods of ground improvement –geotechnical problems in alluvial, lateritic and black cotton soils – Selection of suitable ground improvement techniques based on soil conditions	**15**	**6**
2	**Soil Stabilization Technique** Cement stabilization and cement columns - Lime stabilization and lime columns - Stabilization using bitumen and emulsions - Stabilization using industrial wastes Construction techniques and applications – Case Studies of Soil Stabilization Technique	**15**	**6**
3	**Ground Improvement for Cohesionless and Cohesive Soils** In-situ densification of cohesionless and cohesive soils- Merits and Demerits of Compaction of soil - Shallow and deep compaction requirements and methods - Principles and methods of soil compaction - Dynamic compaction-Vibroflotation- Sand compaction – Stone columns - Deep Soil Mixing- Vibratory methods Dynamic compaction	**20**	**8**
4	**Dewatering Technique** Introduction – Necessity of dewatering – Factors affecting on Site selection for dewatering - Methods of Dewatering – Well points – Preloading, Vertical drains, vacuum consolidation – Electro Kinetic dewatering – Design of dewatering systems	**15**	**6**
5	**Grouting Technique** Introduction – Importance of grouting technique – Advantages and Limitations of grouting - Permeation grouting - Compaction routing - Jet grouting - Different varieties of grout materials - Grouting under difficult conditions.	**15**	**6**
6	**Geosynthetics Applications** Geosynthetics - Types – Functions of Geotextiles – Separation – Filtration – Drainage - reinforcement - Geomembranes - Containments and barriers - Application to Ground Anchors.	**15**	**6**
7	**In-Situ Soil Treatment Methods** Soil nailing, rock anchoring, micro-piles, design methods, construction techniques.	**5**	**2**

i. Text Book and Reference Book:

1. Ground Improvement Techniques . (TextBook) - By P. Purushottama Raj | " Laxmi Publications (P) Limited, 2006.
2. Construction and Geotechnical Methods in Foundation Engineering (TextBook) - By Koerner .R.M | McGraw Hill, new York, Pub. Year 1984
3. Advances in Ground Improvement (TextBook) - By Jie Han et. al. | Allied pub., 2009
4. An Introduction to Ground Improvement Engineering book - By Dr. Satyendra Mittal
5. Foundation Engineering Hand Book - By Winterkorn .H.F and Fang .H.Y | Van Nostrand Reinhold, Pub. Year 1994
6. Designing with Geosynthettics (TextBook) - By Koerner .R.M | Prentice Hall, New Jersey, Pub. Year 1999

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a. **Course Name:** Ground Improvement Technique Laboratory
b. **Course Code:** 303104434
c. **Prerequisite:** Basic knowledge of Soil Improvement Techniques
d. **Rationale: :** The students can have a knowledge regarding various techniques to modify the ground conditions and applications.
e. **Course Learning Objective:**

CLOBJ 1	To understand problematic soil types and identify suitable ground improvement techniques based on geotechnical conditions.
CLOBJ 2	To explore various soil stabilization methods, including chemical and mechanical techniques, with practical construction applications.
CLOBJ 3	To analyse advanced ground improvement methods for cohesive and cohesion less soils, including compaction, dewatering, and grouting techniques.
CLOBJ 4	To examine the use of geosynthetics and in-situ soil treatment methods for improving ground performance in civil engineering projects.

f. **Course Learning Outcomes:**

CLO 1	Develop an awareness of problematic soils and selection of ground improvement techniques based on soil conditions
CLO 2	Understand drainage, dewatering, and grouting technique in ground improvement method.
CLO 3	Aware of the ground improvement techniques.
CLO 4	Study the applications of geosynthetics.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **List of Practicals:**

Sr. No.	**Content**
1	Problematic Soil and Ground Improvement Techniques

2	Soil Stabilization Technique
3	Ground Improvement for Cohesionless and Cohesive Soils
4	Dewatering Technique
5	Grouting Technique
6	Geosynthetics Applications
7	In-Situ Soil Treatment Methods

i. Text Book and Reference Book:

1. Ground Improvement Techniques . (TextBook) - By P. Purushottama Raj | " Laxmi Publications (P) Limited, 2006.
2. Construction and Geotechnical Methods in Foundation Engineering (TextBook) - By Koerner .R.M | McGraw Hill, new York, Pub. Year 1984
3. Advances in Ground Improvement (TextBook) - By Jie Han et. al. | Allied pub., 2009
4. An Introduction to Ground Improvement Engineering book - By Dr. Satyendra Mittal
5. Foundation Engineering Hand Book - By Winterkorn .H.F and Fang .H.Y | Van Nostrand Reinhold, Pub. Year 1994
6. Designing with Geosynthettics (TextBook) - By Koerner .R.M | Prentice Hall, New Jersey, Pub. Year 1999

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a. **Course Name:** Waste-water Recycle Management
b. **Course Code:** 303104435
c. **Prerequisite:** Knowledge of the subject of Wastewater Recycling & Management
d. **Rationale: :** To explore treatment of wastewater, recycling of wastewater, and wastewater management techniques
e. **Course Learning Objective:**

CLOBJ 1	To understand the types, characteristics, and significance of wastewater management in addressing global environmental challenges.
CLOBJ 2	To learn and differentiate between various stages and methods of wastewater treatment including biological, chemical, and physical processes.
CLOBJ 3	To explore advanced treatment technologies and techniques for effective wastewater recycling and reuse.
CLOBJ 4	To examine regulatory frameworks, policies, and emerging innovations in wastewater treatment and smart water management systems.

f. **Course Learning Outcomes:**

CLO 1	Understand the importance of wastewater management for environmental sustainability and public health.
CLO 2	Learn the principles and processes involved in wastewater treatment.
CLO 3	Explore advanced technologies for wastewater recycling and reuse.
CLO 4	Analyze case studies and real-world examples of successful wastewater management strategies.
CLO 5	Develop skills to design, implement, and evaluate wastewater treatment systems.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
2	**0**	**0**	**2**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	**Introduction to Wastewater Management** Definition and types of wastewater, Importance of wastewater management, Global challenges and trends	12	7
2	**Wastewater Treatment Processes** Preliminary, primary, secondary, and tertiary treatment, Biological treatment methods (activated sludge, trickling filters, etc.), Chemical and physical treatment methods	18	9
3	**Advanced Wastewater Treatment Technologies** Membrane filtration (reverse osmosis, ultrafiltration, nanofiltration), Advanced oxidation processes, Nutrient removal techniques (denitrification, phosphorus removal)	18	9
4	**Wastewater Reuse and Recycling** Benefits and challenges of wastewater reuse, Water reclamation and reuse projects, Treatment methods for recycled water	17	5
5	**Regulatory Frameworks and Policies** Local, national, and international regulations, Permitting processes and compliance requirements	18	7
6	**Emerging Trends and Innovations** Novel technologies for wastewater treatment and recycling, Integration of smart systems and digital solutions	17	8

i. Text Book and Reference Book:

1. Wastewater Treatment for Pollution Control and Reuse - By Soli J Arceivala & Dr. Shyam R. Asolekar| McGraw Hill Education (India) Private Limited
2. Industrial Environment Assessment and Strategy - By Agrawal S. K. | APH Publishing Corporation
3. Waste Water Treatment - By M.N. Rao & A.K. Datta|CBS PUBLISHERS AND DISTRIBUTORS PVT LTD
4. Wastewater Treatment Technologies - By Mritunjay Chaubey | Wiley-Blackwell

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a. **Course Name:** Waste-water Recycle Management Laboratory
b. **Course Code:** 303104436
c. **Prerequisite:** Knowledge of the subject of Wastewater Recycling & Management
d. **Rationale: :** To explore treatment of wastewater, recycling of wastewater, and wastewater management techniques
e. **Course Learning Objective:**

CLOBJ 1	To understand the types, characteristics, and significance of wastewater management in addressing global environmental challenges.
CLOBJ 2	To learn and differentiate between various stages and methods of wastewater treatment including biological, chemical, and physical processes.
CLOBJ 3	To explore advanced treatment technologies and techniques for effective wastewater recycling and reuse.
CLOBJ 4	To examine regulatory frameworks, policies, and emerging innovations in wastewater treatment and smart water management systems.

f. **Course Learning Outcomes:**

CLO 1	Understand the importance of wastewater management for environmental sustainability and public health.
CLO 2	Learn the principles and processes involved in wastewater treatment.
CLO 3	Explore advanced technologies for wastewater recycling and reuse.
CLO 4	Analyze case studies and real-world examples of successful wastewater management strategies.
CLO 5	Develop skills to design, implement, and evaluate wastewater treatment systems.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**0**		**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **List of Practicles :**

Sr. No.	Content
1	Case Studies in Wastewater Management
2	Successful examples of wastewater treatment and reuse projects.
3	Perform basic water quality test: Dissolved Oxygen (DO).
4	Perform basic water quality test: Biological Oxygen Demand (BOD).
5	Perform basic water quality test: Chemical oxygen demand (COD).
6	Design Activated Sludge Process system.

i. Text Book and Reference Book:

1. Wastewater Treatment for Pollution Control and Reuse - By Soli J Arceivala & Dr. Shyam R. Asolekar| McGraw Hill Education (India) Private Limited
2. Industrial Environment Assessment and Strategy - By Agrawal S. K. | APH Publishing Corporation
3. Waste Water Treatment - By M.N. Rao & A.K. Datta|CBS PUBLISHERS AND DISTRIBUTORS PVT LTD
4. Wastewater Treatment Technologies - By Mritunjay Chaubey | Wiley-Blackwell

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a. **Course Name:** Intelligent Transportation System Laboratory
b. **Course Code:** 303104438
c. **Prerequisite:** Basic knowledge of Transportation Engineering, Communication Systems.
d. **Rationale: :** This course on Intelligent Transportation Systems (ITS) focuses on the application of advanced technologies to improve the transportation infrastructure and services. The syllabus covers the integration of communication, information, and control systems to optimize traffic management, reduce congestion, improve safety, and facilitate sustainable transportation solutions. Students will learn about sensors, communication protocols, data analytics, AI applications, and future trends in the ITS field.
e. **Course Learning Objective:**

CLOBJ 1	To understand the fundamental concepts, architecture, and components of Intelligent Transportation Systems and their significance in modern transport infrastructure.
CLOBJ 2	To explore various sensing, detection, and data acquisition technologies used in ITS for traffic monitoring and vehicle tracking.
CLOBJ 3	To analyze traffic management and control strategies including adaptive signal systems, congestion management, and smart parking solutions.
CLOBJ 4	To examine emerging trends such as autonomous vehicles, Mobility-as-a-Service (MaaS), and the integration of ITS in smart city development through global case studies.

f. **Course Learning Outcomes:**

CLO 1	Identify key components and technologies used in Intelligent Transportation Systems for traffic management and safety.
CLO 2	Apply communication and sensor technologies for real-time traffic data collection and analysis.
CLO 3	Analyze traffic flow patterns using ITS tools to enhance transportation system performance.
CLO 4	Evaluate the effectiveness of ITS applications such as adaptive signal control, electronic toll collection, and incident detection.
CLO 5	Design ITS-based solutions for urban mobility, congestion management, and sustainable transport planning.

g. **Teaching & Examination Scheme:**

Teaching Scheme	Evaluation Scheme

L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical's:

Sr. No.	Content
1	Introduction to Intelligent Transportation Systems
2	Google Earth for Road Network Visualization and Traffic Planning
3	Accident Data Analysis Using ADDAAS (Advanced Data Driven Accident Analysis Software)
4	**Vehicle Tracking and Route Mapping Using GPS Software**
5	**Signal Timing and Traffic Simulation Using VISSIM or Equivalent Software**
6	**Design and Analysis of Smart Parking Systems**
7	**RFID-Based Electronic Toll Collection System.**
8	**Automatic Number Plate Recognition (ANPR) and Video Analytics.**
9	**Travel Time and Speed Estimation Using GPS and GIS Tools.**
10	**ITS Data Analysis Using Excel for Traffic Pattern Detection**
11	**Integration of IoT Devices in ITS.**
12	**Case Study: ITS Applications in Indian Smart Cities (Surat, Pune, Ahmedabad, Delhi)**

i. Text Book and Reference Book:

1. "Intelligent Transportation Systems: Theory and Practice" Author(s)**:** Sumit Ghosh, et al.
2. Intelligent Transport Systems: Smart and Green Infrastructure Design" Author(s)**:** Asier Perallos, et al.
3. "Traffic Flow Theory: A State-of-the-Art Report" Author(s)**:** Michael Kyte, et al.

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a. **Course Name:** Intelligent Transportation System Laboratory
b. **Course Code:** 303104438
c. **Prerequisite:** Basic knowledge of Transportation Engineering, Communication Systems.
d. **Rationale: :** This course on Intelligent Transportation Systems (ITS) focuses on the application of advanced technologies to improve the transportation infrastructure and services. The syllabus covers the integration of communication, information, and control systems to optimize traffic management, reduce congestion, improve safety, and facilitate sustainable transportation solutions. Students will learn about sensors, communication protocols, data analytics, AI applications, and future trends in the ITS field.
e. **Course Learning Objective:**

CLOBJ 1	To understand the fundamental concepts, architecture, and components of Intelligent Transportation Systems and their significance in modern transport infrastructure.
CLOBJ 2	To explore various sensing, detection, and data acquisition technologies used in ITS for traffic monitoring and vehicle tracking.
CLOBJ 3	To analyze traffic management and control strategies including adaptive signal systems, congestion management, and smart parking solutions.
CLOBJ 4	To examine emerging trends such as autonomous vehicles, Mobility-as-a-Service (MaaS), and the integration of ITS in smart city development through global case studies.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate the use of ITS technologies such as traffic sensors, GPS, and RFID for data acquisition and monitoring.
CLO 2	Analyze real-time traffic data to evaluate system performance and propose operational improvements.
CLO 3	Implement ITS applications such as adaptive signal control, vehicle tracking, and travel time estimation.
CLO 4	Prepare technical reports and presentations that document experimental methods, system analysis, and ITS solutions.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	

0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. List of Practical's:

Sr. No.	Content
1	Introduction to Intelligent Transportation Systems
2	Google Earth for Road Network Visualization and Traffic Planning
3	Accident Data Analysis Using ADDAAS (Advanced Data Driven Accident Analysis Software)
4	Vehicle Tracking and Route Mapping Using GPS Software
5	Signal Timing and Traffic Simulation Using VISSIM or Equivalent Software
6	Design and Analysis of Smart Parking Systems
7	RFID-Based Electronic Toll Collection System.
8	Automatic Number Plate Recognition (ANPR) and Video Analytics.
9	Travel Time and Speed Estimation Using GPS and GIS Tools.
10	ITS Data Analysis Using Excel for Traffic Pattern Detection
11	Integration of IoT Devices in ITS.
12	Case Study: ITS Applications in Indian Smart Cities (Surat, Pune, Ahmedabad, Delhi)

i. Text Book and Reference Book:

1. "Intelligent Transportation Systems: Theory and Practice" Author(s)**:** Sumit Ghosh, et al.
2. Intelligent Transport Systems: Smart and Green Infrastructure Design" Author(s)**:** Asier Perallos, et al.
3. "Traffic Flow Theory: A State-of-the-Art Report" Author(s)**:** Michael Kyte, et al.

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a. **Course Name:** MAJOR PROJECT-1
b. **Course Code:** 303104406
c. **Prerequisite:** Fundamental concepts of civil engineering disciplines such as structural, environmental, transportation, and geotechnical engineering, Engineering mathematics and problem-solving techniques, Fundamentals of engineering drawing, design concepts, and construction practices.
d. **Rationale:** The course is designed to provide students with an opportunity to integrate theoretical knowledge with practical engineering applications through project-based learning. It encourages students to address real-world civil engineering problems by applying advanced concepts, modern tools, and innovative approaches.
e. **Course Learning Objective:**

CLOBJ 1	**To develop the ability to identify and analyze complex civil engineering problems** related to current technological advancements and societal needs.
CLOBJ 2	**To strengthen the application of advanced civil engineering principles and modern construction technologies** for designing innovative and effective engineering solutions.
CLOBJ 3	**To provide practical exposure in designing and developing prototypes or models** using specialized tools, engineering software, and hardware platforms for testing and validation.
CLOBJ 4	**To enhance leadership, teamwork, and project management skills** for effective planning, coordination, and execution of engineering projects.
CLOBJ 5	**To improve technical communication skills** through preparation of detailed technical reports and professional presentations.
CLOBJ 6	**To promote ethical practices, sustainability awareness, and professional responsibility** during the entire lifecycle of engineering projects.

f. **Course Learning Outcomes:**

CLO 1	Identify and critically analyze complex civil engineering problems arising from current technological trends and societal challenges.
CLO 2	Integrate advanced civil engineering principles and cutting-edge construction technologies to design innovative and effective solutions.
CLO 3	Design and develop comprehensive prototypes or models using specialized tools, software, and hardware platforms for validation and testing.
CLO 4	Lead and collaborate effectively within multidisciplinary teams to plan, coordinate, and execute project tasks, resources, and timelines successfully.

CLO 5	Prepare detailed technical documentation and deliver professional oral presentations to communicate project concepts, methodologies, and results to diverse audiences.
CLO 6	Exhibit ethical decision-making, sustainability considerations, and professional responsibility throughout the project lifecycle.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	28	14	-	-	200	-	300	500

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

Semester 8

(1)

a. **Course Name:** Industrial Internship/Research Project
b. **Course Code:** 303104454
c. **Prerequisite:** The Industrial Internship / Research Project in the final semester is designed to integrate and apply the knowledge gained throughout the Civil Engineering program. These prerequisites ensure that students possess the foundational understanding, technical competence, and professional readiness necessary to perform effectively in real-world engineering environments.
d. **Rationale:** These courses provide the essential theoretical foundation required to understand and solve engineering problems encountered during professional practice or research activities.
e. **Course Learning Objective:**

CLOBJ 1	To enable students to identify and analyze real-world civil engineering problems based on current technological trends and societal needs
CLOBJ 2	To develop the ability to apply fundamental civil engineering principles and construction technologies for proposing feasible and innovative solutions.
CLOBJ 3	To provide hands-on experience in designing and developing basic prototypes or models using appropriate tools, software, or hardware platforms.
CLOBJ 4	To promote teamwork and project management skills by encouraging students to collaboratively plan, organize, and execute project tasks within defined timelines.
CLOBJ 5	To enhance students' technical communication skills through preparation of technical documentation and effective oral presentations.
CLOBJ 6	To cultivate professional ethics, environmental awareness, and social responsibility during the planning and execution of engineering projects.

f. **Course Learning Outcomes:**

CLO 1	Identify problems relevant to civil engineering based on current trends or societal needs.
CLO 2	Apply fundamental concepts of civil engineering principles and construction technologies to propose effective solutions.
CLO 3	Develop a basic prototype or model using suitable tools, software, or hardware platforms.
CLO 4	Work effectively in a team to manage the project tasks, resources, and timelines efficiently.
CLO 5	Prepare technical documentation and oral presentations to communicate the project idea and outcomes clearly.

CLO 6	Demonstrate ethical practices, environmental awareness, and professional responsibility during the execution of the project.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	28	14	-	-	200	-	300	500

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination