Course Curriculum

Third Year

B. Tech. in Civil and Environmental Engineering

In line with National Education Policy 2020

(Effective from AY 2026-27 for Affiliated Institutes)

Dr. Babasaheb Ambedkar Technological University

Lonere 402 103, Dist- Raigad, Maharashtra, INDIA

Established vide Maharashtra Act No. XXII of 1989 and Act. No. XXIX of 2014
"Vidyavihar", P.O. Lonere, Dist. Raigad, Pin 402 103, Maharashtra, India
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Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for Third Year B. Tech.

Civil and Environmental Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	ISE	MSE	ESE	Total	
Semester-V										
1	26AF1922PC501	Design of Steel Structures	3	0	0	20	20	60	100	3
2	26AF1922PC502	Railway, Airport and Bridge Engineering	3	0	0	20	20	60	100	3
3	26AF1922PC503	Air Pollution Control	3	0	0	20	20	60	100	3
4	26AF1922PC504	Concrete Technology	3	0	0	20	20	60	100	3
5	Refer Bucket	OPEN ELECTIVE-III	3	0	0	20	20	60	100	3
6	Refer Bucket	Multi-Disciplinary Minor-III	3	0	0	20	20	60	100	3
7	26AF1922PCL507	Design of Steel Structures Lab	0	0	2	25	-	25	50	1
8	26AF1922PCL508	Air Pollution Control Lab	0	0	2	25	-	25	50	1
9	26AF1922PCL509	Concrete Technology Lab	0	0	2	25	-	25	50	1
10	26AF1922HM510	Soft Skills Development	0	2	0	-	-	-	AU	GR
11	26AF1922VS511	Construction Equipment and Site Safety Management	0	2	0	50	-	50	100	2
		TOTAL	**18**	**4**	**6**	**245**	**120**	**485**	**850**	**23**
Semester-VI										
1	26AF1922PC601	Design of Concrete Structures	3	0	0	20	20	60	100	3
2	26AF1922PE602	Program Elective-I	3	0	0	20	20	60	100	3
3	26AF1922PE603	Program Elective -II	3	0	0	20	20	60	100	3
4	26AF1922PE604	Program Elective-III	3	0	0	20	20	60	100	3
5	26AF1922PC605	Industrial Waste Management	3	0	0	20	20	60	100	3
6	Refer Bucket	Multi-Disciplinary Minor-IV	3	0	0	20	20	60	100	3
7	26AF1922PCL607	Design of Concrete Structures Lab	0	0	2	50	-	50	100	1
8	26AF1922PEL608	Program Elective-II- Lab	0	0	2	25	-	25	50	1
9	26AF1922PEL609	Program Elective-III- Lab	0	0	2	25	-	25	50	1
10	26AF1922EL610	Seminar	0	0	2	25	-	25	50	1
11	26AF1922EL611	Project Phase-I	0	0	4	50	-	50	100	2
		TOTAL	**18**	**0**	**12**	**295**	**120**	**535**	**950**	**24**

Course Type	Course Code	Course Name
Program Elective-I	26AF1922PE602A	Water Quality Engineering
	26AF1922PE602B	Pollution control and Treatment
	26AF1922PE602C	Environment Health and Safety
Program Elective-II	26AF1922PE603A	Highway Engineering
	26AF1922PE603B	Urban Transportation Planning
	26AF1922PE603C	Tunneling & Underground Excavation
Program Elective-III	26AF1922PE604A	Geotechnical Engineering
	26AF1922PE604B	Soil Mechanics & Foundation Engineering

Course Type	Course Code	Course Name
Open elective-III	26AF1ARPOEM05H	Material Testing & Evaluation
	26AF1ARPOEM05O	Rehabilitation & Retrofitting of Structures
	26AF1ARPOEM05P	Sustainable Construction Methods
Multi-Disciplinary Minor-III	Refer Bucket	Refer Bucket
Multi-Disciplinary Minor-IV	Refer Bucket	Refer Bucket

ELECTIVE / OPEN ELECTIVE/ MULTIDISCIPLINARY MINOR COURSES

Below listed courses will be offered as per student's requirement and availability of subject expert with the approval of the head of the department.

OPEN ELECTIVE OTHER THAN PARTICULAR PROGRAM

Sr.No.	Course Offered	Teaching Scheme (Hrs)				Credits
		L	T	P	TOTAL	
1	Environmental Chemistry and Microbiology	02	00	00	02	03
2	Environmental Policies and Legislation	02	00	00	02	03
3	Environmental Impact Assessment	02	00	00	02	03
4	Advanced Surveying	03	00	00	03	03
5	Modern Surveying	03	00	00	03	03
6	Material Testing and Evaluation	03	00	00	03	03
7	Rehabilitation and Retrofitting of Structures	03	00	00	03	03
8	Sustainable construction materials	03	00	00	03	03

PROGRAM ELECTIVE COURSE

Sr.No.	Course Offered	Teaching Scheme (Hrs)				Credits
		L	T	P	TOTAL	
1	Water Quality Engineering	03	00	00	03	03
2	Pollution control and Treatment	03	00	00	03	03
3	Environment Health and Safety	03	00	00	03	03
4	Highway Engineering	03	00	00	03	03
5	Urban Transportation Planning	03	00	00	03	03
6	Tunneling & Underground Excavation	03	00	00	03	03
7	Geotechnical Engineering	03	00	00	03	03
8	Soil Mechanics and Foundation Engg	03	00	00	03	03
9	Advanced Environmental Engineering	03	00	00	03	03
10	Environmental Modeling & Simulation	03	00	00	03	03
11	Noise Pollution	03	00	00	03	03
12	Professional Practices	03	00	00	03	03
13	Construction Cost Analysis	03	00	00	03	03
14	Estimation and Costing	03	00	00	03	03

Note: The elective courses listed in the Course Contents structure are indicative. Students shall ensure availability of Course Contents prior to registration.

HONORS- CIVIL ENGINEERING

Sr.No.	Course Offered	Teaching Scheme (Hrs)				Credits
		L	T	P	TOTAL	
1	Finite Element Method	03	00	00	03	03
2	Elements of Remote Sensing	03	00	00	03	03
3	Advanced Structural Design	03	00	00	03	03
4	Theory of Plates and Shells	03	00	00	03	03
5	Structural Dynamics	03	00	00	03	03

RESEARCH - CIVIL ENGINEERING

Sr.No.	Course Offered	Teaching Scheme (Hrs)				Credits
		L	T	P	TOTAL	
1	Problem Identification and Definition	03	01	00	04	04
2	Experimental Work/Analytical Tools and Prototype Development	03	01	00	04	04
3	Research Project Phase-I	00	00	12	12	06
4	Research Project Phase-II	03	01	12	12	06

SELF STUDY COURSE(MOOC/SWAYAM/NPTEL)

Sr.No.	Course Offered	Duration of Online Course
1	Research Methodology	08 to 12 weeks
2	Problem Identification and Definition	
3	Literature Review	
4	Publication & Ethics	
5	Data Analysis	

Teaching Scheme: Students must enroll any above mentioned course on online platform like MOOC/SWAYAM or can attend the offline workshops during the SEM-VII/VIII as per availability and produce the certificate to faculty co coordinator of institute/department. Assessment work can be done by faculty coordinator based on the student's performance.

MULTIDISCIPLINARY MINOR BUCKET
for AFFILIATED INSTITUTES
MINOR DEGREE IN CIVIL & ENVIRONMENTAL ENINGEERING
(For other than B.Tech. in Civil & Environmental Engineering program students)

Semester	Subject Code	Subject Name	Total Credit
SEM-III	25AF1922MD306	Introduction to Engineering Geology	3
SEM-III	25AF1922MD306A	Water Supply Engineering	3
SEM-IV	25AF1922MD406	Waste Water Engineering	3
SEM-V	25AF1922MD506	Concrete Technology	3
SEM-VI	25AF1922MD606	Project Management	3
SEM-VII	25AF1922MD706	Construction Equipment and Site Safety Management	2
MINIMUM CREDITS REQUIRED TO COMPLETE A MINOR DEGREE IN CIVIL ENGINEERING			**14**

MINOR DEGREE IN PLANNING ENINGEERING
(only for B.Tech. in Civil & Environmental Engineering program students)

Semester	Subject Code	Subject Name	Total Credit
SEM-III	25AFMDPLAN306A	Site Planning	3
SEM-III	25AF1922MD306	Introduction to Engineering Geology	3
SEM-IV	25AFMDPLAN406A	Fundamentals of Urban Design	2
SEM-IV	25AFMDPLAN406B	Town and Urban Planning	2
SEM-V	25AFMDPLAN506A	Real Estate Development and Management	3
SEM-V	25AFMDPLAN506B	Planning Legislation	3
SEM-VI	25AFMDPLAN606A	Disaster Mitigation and Management	3
SEM- VI	25AFMDPLAN606B	Project Management	3
SEM-VII	25AFMDPLAN706A	Sustainable Building Planning	3
SEM-VII	25AFMDPLAN706B	Appropriate Building Technologies	3
MINIMUM CREDITS REQUIRED TO COMPLETE A MINOR DEGREE IN PLANNING ENGINEERING			**14**

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for Third Year B. Tech.

Civil and Environmental Engineering

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	26AF1ARPOEM05P	Sustainable Construction Methods
Multi-Disciplinary Minor-III	Refer Bucket	Refer Bucket
Multi-Disciplinary Minor-IV	Refer Bucket	Refer Bucket

Type of course:

Basic Science: **BS**	Engineering Science: **ES**
Program Elective: **PE**	Program Core: **PC**
Modern Indian Language: **MIL**	Indian Knowledge System: **IK**
Value Education Course: **VEC**	Ability Enhancement Course: **AE**
Vocational and Skill Enhancement: **VS**	Audit Course: **AU**
Open Elective: **OE** (Other than particular program)	Co-curricular & Extracurricular Activities: **CC**
Multidisciplinary Courses: **MD**	Humanities, Management, language and Commerce: **HM**

Detailed Course Contents

SUBJECT CODE	Design of Steel Structures	CREDITS
26AF1922PC501		3

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives: Students will be able to	
COBJ1	To impart knowledge of steel structural systems, material properties, loading conditions, and design philosophies.
COBJ2	To introduce the principles of Working Stress Method and Limit State Method for steel structure design.
COBJ3	To familiarize students with the analysis and design of riveted, bolted, and welded connections.
COBJ4	To develop the ability to design tension members, compression members, columns, and flexural members as per codal provisions.
COBJ5	To enable students to apply plastic analysis concepts and modern steel design practices for structural engineering applications.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain the fundamentals of steel structures, design philosophies, and codal provisions for structural design.
CO2	Design riveted, bolted, and welded connections using Working Stress and Limit State approaches.
CO3	Design axially loaded tension and compression members, including built-up columns and their components.
CO4	Analyze and design laterally supported and unsupported steel beams subjected to bending and shear.
CO5	Apply Limit State Method and basic plastic analysis concepts in the design of steel structural elements.

Course Contents

Module 1	**Introduction of Working Stress Method and Design of Connections**	**Hrs. 8**

Introduction, types of steel structures, grades of structural steel, various types of loads acting on steel structures, advantages/disadvantages of steel structures, working stress and limit state design philosophy.

Introduction to Working State Method to design of steel structures, relevance to other materials such as timber, masonry, soil, fluid, concrete, modern materials stainless steel, aluminum, composites etc. permissible stresses, concept of factor of safety.

Riveted and bolted connections, Welded connections-assumptions, types, design of fillet welds, intermittent fillet weld, failure of welded joints, welded joints vs bolted and riveted joints.

Module 2	**Working Stress Design of Axially Loaded Members and Compression Members**	**Hrs. 6**

Tension members: Common sections, net effective area, load capacity, connection using weld / bolts.

Compression members: Common sections used, effective length and slenderness ratio, permissible stresses, load carrying capacity,

Design of columns subjected to axial and eccentric loading, design of built-up columns, design of lacing, battening

Module 3	Working Stress Design of Flexural Members and Introduction to Plastic Analysis	Hrs. 6
Types of c/s, lateral stability of beams, lateral torsional buckling, bending and shear strength design procedure for laterally supported and unsupported beams, design of basic cross-section for plate girders Introduction to Plastic Analysis: Hinge Formation, Collapse Mechanism, Approaches in Steel Structure design based on Plastic Analysis Method		
Module 4	**Introduction to Limit State Method and Design of Connections**	**Hrs.8**
Introduction to Limit state design method, limit states of strength and serviceability, probabilistic basis for design, the partial safety factor for load and resistance, various design load combinations, Provisions in IS 800:2007 for Design of Welded and bolted connections, design of fillet welds, failure of welded joints, design of bolted joints, treatment for axially loaded and eccentric connections		
Module 5	**Limit State Approach to design of axially loaded members & Flexural Members**	**Hrs. 8**
Design of axially loaded tension members, axially loaded compression members, Design of columns subjected to axial and eccentric loading, bending and shear strength design procedure for laterally supported beams		

Notes: 1) Contents in Module 1 to part of 3 shall be taught with help of relevant text or reference books based on elastic design concept, IS 800: 1984. Contents in Module 4 & 5 shall be taught with help of relevant text or reference books based on limit state design concept as per IS 800: 2007.
2) Use of IS 800: 1984 and 2007, IS 875 (All Parts), IS: Handbook No.1 for Steel Section & Steel Table is permitted for theory examination.

Text Books:	
1	Duggal S. K., "Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
2	Gambhir, "Fundamentals of Structural Steel Design", Tata McGraw Hill Pub. Co. Ltd., New Delhi
3	Negi L. S., "Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
4	Chandra Ram, "Design of Steel Structures", Vol. I & Vol. II, Standard Book House, New Delhi
5	Dayaratnam P., "Design of Steel Structures", Wheeler Publishing, New Delhi
6	Subramanian N., "Steel Structures: Design and Practice" Oxford Univ. Press, Delhi
7	Vazirani V.N. and Ratwani M.M., "Design and Analysis of Steel Structures"
8	Sai Ram K. S., "Design of Steel Structures", Pearson Education, 2nd Edition
Reference Books:	
1	Arya A. S. and Ajamani J.L., "Design of Steel Structures", Nemchand and Brothers, Roorkee
2	Vazirani&Ratwani, "Design of Steel Structures", Standard Book House, New Delhi
3	Duggal S. K., "Limit State Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
4	Publications of Bureau of Indian Standards, New Delhi, IS 800:1984, IS 800:2007, IS 875 (Part I to V)
5	Gaylord E.H. and Gaylord C.N., "Design of Steel Structures" McGraw Hill, New York
6	Lothers J.E., "Design in Structural Steel" Vol.-I, Prentice Hall New Jersy
7	Salmon and Johnson, "Steel Structures: Design and Behaviour", Harper and Row, New York
8	Steel Designers Manual.

SUBJECT CODE	Railway, Airport and Bridge Engineering			CREDITS			
26AF1922PC502				3			
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	To understand railway track components, rail behavior, and train resistance.
COBJ2	To learn railway geometric design, curves, super-elevation, signaling, and interlocking.
COBJ3	To study bridge site selection, hydraulic design, and bridge loading standards.
COBJ4	To gain knowledge of bridge foundations, inspection, and strengthening methods.
COBJ5	To learn airport planning and the design of runways and taxiways considering aircraft and wind factors.

Course Outcomes: Students will be able to	
CO1	Calculate railway track requirements and identify causes of rail creep and wear.
CO2	Design railway curves, turnouts, and super-elevation for safe train movement.
CO3	Plan bridge design by determining span, scour depth, and loading standards.
CO4	Evaluate bridge foundations and suggest inspection or strengthening methods.
CO5	Develop airport layouts, runway orientation, and taxiway design based on aircraft and wind conditions.

Course Contents

Module 1	**Introduction, Tractive resistances & Permanent way:**	**Hrs. 8**

Principles of Transportation, Route surveys and alignment, railway track, development and gauges, Hauling capacity and tractive effort.

i) Rails: types, welding of rails, wear and tear of rails, rail creep.

ii) Sleepers: types and comparison, requirement of a good sleeper, sleeper density.

iii) Rail fastenings: types, Fish plates, fish bolts, spikes, bearing plates, chain keys, check and guard rails.

iv) Ballast: Requirement of good ballast, various materials used as ballast, different methods of plate laying, calculation of materials required, relaying of track

Module 2	**Geometric Design & Signaling and interlocking:**	**Hrs. 8**

Cross sections, Super elevation, Equilibrium, Cant and Cant deficiency, various curves, speed on curves., general equipment, layouts, marshalling yards, design of simple turnouts, Types of signals in stations and yards, principles of signalling and inter-locking.

Module 3	**Bridge Site Investigation and Planning**	**Hrs. 8**

Loading Standards &Component parts: Selection of site, alignment, collection of bridge design data: essential surveys, hydraulic design, scour, depth of bridge foundation, Economical span, clearance, afflux, type of road & railway bridges.: Design loads and forces, Impact factor, Indian loading standards for Railways Bridges and Highway Bridges, Bridge super structure and sub-structures, abutments, piers, wing walls, return walls, approaches.

Module 4	Bridge Foundations, Construction, Testing and Strengthening of Bridges	Hrs. 6
Different types of foundation: piles and wells, sinking of wells, coffer-dams. Choice of bridges and choice of materials, details of construction underwater and above water, sheet piles coffer dams, Bridge inspection and Data collection, strengthening of bridges, Bridge failure.		
Module 5	**Airport Engineering**	**Hrs. 6**
Airport site selection, Air craft characteristics, various surface of an airport, Windrose diagram, Geometric elements of run way and taxiway, holding apron, parking configuration, terminal building visual aids, air traffic control, airport marking and lighting.		

Text Books:	
1	Chakraborty and Das; Principles of transportation engineering; PHI
2	Rangwala SC; Railway Engineering; Charotar Publication House, Anand
3	Rangwala SC; Bridge Engineering; Charotar Publication House, Anand
4	Ponnuswamy; Bridge Engineering; TMH
5	Railway Engineering by Arora &Saxena – Dhanpat Rai& Sons
Reference Books:	
1	Railway Track by K.F. Antia
2	Air-port Engineering by S. K. Khanna and M. G. Arora
3	Principles and Practice of Bridge Engineering S.P. Bindra – Dhanpat Rai& Sons
4	Bridge Engineering - J.S. Alagia - Charotar Publication House, Anand
5	Railway, Bridges & Tunnels by Dr. S.C. Saxena.

SUBJECT CODE	Air Pollution Control						CREDITS
26AF1922PC503							3
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	To understand sources, types, and effects of air pollutants on humans and the environment.
COBJ2	To study meteorological factors and pollutant dispersion mechanisms in the atmosphere.
COBJ3	To learn air sampling, monitoring, and analysis techniques.
COBJ4	To understand photochemical smog, odour, and indoor air pollution phenomena and control measures.
COBJ5	To study air pollution control equipment, vehicular pollution, and environmental legislation.

Course Outcomes: Students will be able to	
CO1	Explain sources, classification, and impacts of air pollutants on health and environment.
CO2	Analyze meteorological parameters and predict dispersion of air pollutants using models.
CO3	Apply air sampling and monitoring techniques to assess air quality.
CO4	Understand air pollution problems and their control methods.
CO5	Learn air pollution control equipment and environmental standards.

Course Contents

Module 1	**Introduction, Sources& Effects of Air Pollution**	**Hrs. 6**

The Structure of the atmosphere, Composition of dry ambient air and properties of air. BIS Definition and scope of Air Pollution, Scales of air pollution, Types of exposures. Air Pollutants, Classifications, Natural and Artificial, Primary and Secondary, point and Non-Point, Line and Area Sources of air pollution. Stationary and mobile sources, composition of particulate& gaseous pollutant, units of measurement. Effect of different air pollutants on man, animals, vegetation, property, aesthetic value and visibility, air pollution

episodes. Global effects of air pollution- global warming, ozone depletion, acid rain and heat island effect.

Module 2	**Meteorology and Air pollution**	**Hrs. 6**

Solar radiation, wind circulation, factors affecting dispersion of pollutants, Lapse rate, Stability conditions, wind velocity profile, Maximum mixing depth (MMD), visibility, Wind rose diagram, General characteristics of stack plume (Plume behaviour). Gaussian diffusion model for finding ground level concentration. Plume rise. Formulae for stack height and determination of minimum stack height.

Module 3	**Air Sampling and Analysis**	**Hrs. 6**

Air pollution survey, basis and statistical considerations of sampling sites. Devices and methods used for sampling gases and particulates. Stack emission monitoring, isokinetic sampling. Analysis of air samples chemical and instrumental methods. Ambient air quality monitoring.

Module 4	Photochemical Smog, Odour Pollution and Indoor Pollution	Hrs. 6
Chemistry of air pollution, Chain reactions of hydrocarbons, nitrogen oxide, Sulphuric oxides and intermediates, photochemical smog formation, air pollution indices -aerosols, fog, smog index. Odour pollution: Theory, sources, measurement and methods of control of odour pollution. Indoor air pollution: Causes of air pollution, sources and effects of indoor air pollutants, changes in indoor air quality, control of indoor air pollutants and air cleaning systems.		
Module 5	**Control of Air Pollution, Gaseous Pollutants and Legislation**	**Hrs. 6**
By process modification, change of raw materials, fuels, process equipment and process operation by use of air pollution control equipment for particulate and gaseous pollutants. Design of control equipment as Settling chamber, cyclone, fabric filter, Electro static precipitator and Wet scrubber. Principles of removal of gaseous pollutants, design of incineration, absorption adsorption systems. Control of air pollution from automobiles. Vehicular pollution, composition, quantity and control. Air (Prevention and Control) Pollution Act, 1981.Emission standards for stationary and mobile sources. National Ambient air quality standards, 2009		

Text Books:	
1	M. N. Rao et al. Air Pollution, Tata Mc-Graw Hill Publication.
2	H. C. Perkins, Air Pollution.
3	Peavy and Rowe, Environmental Engineering, Mc-Graw Hill Publication.
4	N.D. Nevers, Air Pollution Control Engineering, Mc-Graw Hill Publication
Reference Books:	
1	N. D. Nevers, Air Pollution Control Engineering, Waveland Press, 3rd Edition.
2	J. F. Kuo, Air Pollution Control Engineering for Environmental Engineers, CRC Press, 2nd Edition.
3	L. K. Wang, N. C. Pereira and Y. T. Hung, Air Pollution Control Engineering, Humana Press.
4	P. C. Chiang and X. Gao, Air Pollution Control and Design, Springer, 2022.
5	H. Brauer and Y. B. G. Varma, Air Pollution Control Equipment, Springer.
6	J. C. Mycock, Handbook of Air Pollution Control Engineering and Technology, CRC Press.

SUBJECT CODE	Concrete Technology	CREDITS
26AF1922PC504		3

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	Understand the fundamental ingredients of concrete and their properties
COBJ2	Learn the production process, behavior, and testing of fresh and hardened concrete
COBJ3	Apply principles of concrete mix design using IS and DOE methods
COBJ4	Explore special concretes and modern admixtures for advanced applications
COBJ5	Gain knowledge of repair and rehabilitation techniques for distressed concrete structures

Course Outcomes: Students will be able to	
CO1	Understand cement, aggregates, water, and admixtures used in concrete.
CO2	Learn concrete production and test fresh concrete properties.
CO3	Analyse hardened concrete properties and quality testing methods.
CO4	Design concrete mixes using standard methods and quality control.
CO5	Understand special concretes and repair methods for damaged structures.

Course Contents

Module 1	**Introduction to Concrete and Ingredients of Concrete**	**Hrs. 6**

Cement and Aggregate– Manufacture, Chemical Composition, Hydration, Physical and Mechanical **Properties**, Classification, Types and Application of Cement, Classification of Aggregate, Physical and Mechanical Properties of Aggregate, Deleterious Materials in Aggregate, Alkali-Aggregate Reaction, Fineness and Gradation of Aggregates Using Sieve Analysis, Tests on Aggregates. Water and Admixtures – Quality of Water for Use in Concrete, Role of Admixture, Classification and Types of Admixtures Like Accelerators, Retarders, Plasticizers, Super Plasticizers, Mineral Admixtures-Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag.

Module 2	**Production, Properties and Testing of Fresh Concrete**	**Hrs. 6**

Production and Properties of Fresh Concrete: Nominal mixes, Water-cement ratio, Process of manufacturing fresh concrete-batching, mixing, transportation, compaction, curing of concrete, curing methods, influence of temperature, maturity rule, workability and factors affecting workability, cohesion and segregation. Tests on fresh concrete – Workability by slump cone, compaction factor, Vee-Bee consistometer and flow table apparatus.

Module 3	**Properties and Testing of Hardened Concrete**	**Hrs. 6**

Hardened concrete – Strength of concrete, factors affecting strength, micro-cracking and stress-strain relationship, relation between tensile and compression strength, impact strength, abrasion resistance, creep and shrinkage. Testing of hardened concrete –Destructive tests -compression strength, flexural strength, indirect tensile strength, core test. Non-destructive tests: rebound hammer, ultrasonic pulse velocity, pull-out test and impact echo test.

Module 4	Concrete Mix Design and Methods of Mix Design	Hrs. 8
Mix Design– Concept and objectives of concrete mix design, factors affecting the mix design, quality control, variability of laboratory test result, acceptance criteria, Grade designation and IS requirements as per IS 456 (Exposure conditions, minimum & maximum cement content and maximum W/C ratio. Methods of Mix Design: IS code method and DOE method (with and without mineral admixture), Use of spreadsheet/programming/ software for concrete mix design		
Module 5	**Special concretes, Repair and rehabilitation of concrete**	**Hrs. 6**
Special concretes– Lightweight concrete and its types, foam concrete, no fines concrete, self-compacting concrete, high density concrete, fiber reinforced concrete, geo-polymer concrete and Ferrocement technique. Repair and rehabilitation of concrete-Distress in structure– causes and precautions, damage assessment of structural elements, repairing techniques and repairing materials. Cracks in concrete: Causes, types, prevention, repairs of cracks – materials and methods.		

Text Books:	
1	Concrete Technology by M. S. Shetty, S Chand, New Delhi-110055
2	Concrete Technology by M. L. Gambhir, Tata McGraw-Hill
3	Concrete technology by A. M. Neville, J.J. Brooks, Pearson
4	Concrete Technology by A. R. Shantakumar, Oxford University Press, 2018.
Reference Books:	
1	Properties of Concrete by A. M. Neville, Longman Publishers
2	Concrete Technology by R.S. Varshney, Oxford and IBH
3	Concrete Mix Design by A. P. Remideos, Himalaya Publishing House
4	Concrete Structures, Repair, Rehabilitation and Retrofitting by J. Bhattacharjee, CBS Publishers & Distributors Pvt. Ltd
5	Durability Design of Concrete Structures, by A. Sarja and E. Vesiari, E & FN Spon Publication, 1996

SUBJECT CODE	OPEN ELECTIVE-III	CREDITS
26AF1ARPOEM05H	Material Testing & Evaluation	3

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	To understand the basic properties and importance of materials used in concrete.
COBJ2	To study how engineering materials behave under compression and tension.
COBJ3	To learn the basics of crack formation and how cracks grow in materials.
COBJ4	To understand standard testing methods used to check material properties.
COBJ5	To gain practical knowledge of measuring and applying mechanical properties in real construction work.

Course Outcomes: On completion of course, students will be able to	
CO1	Understand the role of materials in Civil Engineering.
CO2	Learn the properties and testing of steel and concrete.
CO3	Understand special materials and modern construction techniques.
CO4	Apply material testing methods and relevant codes.
CO5	Evaluate test results and prepare a technical laboratory report.

Course Contents

Module 1	**Introduction To Civil Engineering Materials**	**Hrs. 7**

Introduction and uses of cement, sand, aggregates, concrete, mortar and grouts, masonry mortars, rendering, cementations grouts RCC, clay bricks, calcium silicate bricks, concrete blocks., rubbles, steel, mechanical properties of steel, different applications Floor and roofing tiles, slates, timber, strength of timber, engineered wood products metals, glass for glazing, glass fibres, glass wool Water proofing agents: any five water proofing agents, difference between wetting agents and water proof agent

Module 2	**Basic Properties of Materials**	**Hrs. 7**

Importance of materials in civil engineering construction, types of materials such as ceramics, concrete, composites, optical /electronics materials, glass, metals, nano-materials, polymers and plastics, wood and other materials, comparison of strengths of various materials. Some basic properties of materials such as temperature, energy, specific heat, thermal conductivity, coefficient of thermal expansion, comparison for environmental impact, health and safety.

Module 3	**Special Materials**	**Hrs. 7**

Composite Materials: RCC, FRC, AAC (Autoclaved aerated concrete) blocks, WPC (Wood-plastic composites) Material, Cera sheets, 3D wall WPC panels, polymer based materials, steel/concrete composite bridge decks, fibre reinforced plastics structural insulated panels. New Techniques in Constructions-Introduction, 3D printing, photo catalytic admixture, self-healing concrete, Biomaterials, zero cement concrete, hemp lime, wood-glass epoxy composites, bamboo.

Module 4	Testing Procedures of Materials	Hrs. 7
Material Testing, Machines and Equipment Requirements---Necessity of material testing, various testing methods, destructive tests, classification of destructive tests---static, impact and cyclic testing, nondestructive testing- its classification, visual inspection, penetration test, ultrasonic test. Testing Procedures for bricks, reinforcing steel, fine aggregates, coarse aggregates. Documenting the experimental program, including the test procedures, collected data, method of interpretation and final results.		
Module 5	**Testing and Evaluation Procedures of Materials**	**Hrs. 7**
Quality control- Use of test data/ testing reports in the material selection for various civil engineering projects /construction, Sampling, Acceptance criterion, Code of practice and guidelines in this regard for Cements; Aggregates; Concrete (plain and reinforced); Soils; Bitumen and asphaltic materials; Timbers; Glass and Plastics; Structural Steel.		

Text Books:	
1	Chudley, R., Greeno (2006), 'Building Construction Handbook',R. Butterworth- Heinemann 6th Edition.
2	Deodhar S.V. (1990) Civil Engineering Materials' Allied Publishers, N. Delhi.
3	Rangwala S.C. (1983) Civil Engineering Materials', Dhanpat Rai and Sons, N. Delhi
Reference Books:	
1	B.I.S., 1980, "National Building Code of India', ISI, New Delhi
2	Kyriakos Komvopoulos (2011), ' Mechanical Testing of Engineering Materials', Cognella
3	E.N. Dowling (1993), ' Mechanical Behaviour of Materials', Prentice Hall, International Edition
4	N. Subramania, 'Building Materials,Testi ng, and Sustainability', Publisher: Oxford University Press, New Delhi

SUBJECT CODE	OPEN ELECTIVE-III	CREDITS
26AF1ARPOEM05O	Rehabilitation & Retrofitting of Structures	3

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	To understand deterioration and need for repair of structures
COBJ2	To study causes and types of structural distress and cracking
COBJ3	To learn condition assessment and testing methods
COBJ4	To understand repair, rehabilitation and retrofitting techniques
COBJ5	To study maintenance, protection and structural health monitoring

Course Outcomes: Students will be able to	
CO1	Explain deterioration and causes of distress
CO2	Identify cracks and types of structural damage
CO3	Carry out condition assessment and testing
CO4	Apply repair and retrofitting techniques
CO5	Use maintenance and monitoring methods for durability

Course Contents

Module 1	**Introduction**	**Hrs. 4**

Overview of distress, deterioration in concrete structures, Scenario of distressed structures world over, Need for repairs and upgrading of structures, General introduction to process (Road-map) to a durable concrete repair

Module 2	**Deterioration of concrete structures**	**Hrs. 8**

Types of deterioration – Signs, causes & symptoms, Mechanism of deterioration, contributing factors like permeability, inadequate durability & micro-structure of concrete. Physical deterioration due to moisture, temperature, shrinkage, freeze-thaw, abrasion, erosion, cavitation, crystallization of salts, Efflorescence, exposure to severe environment like marine exposure. Chemical deterioration due to corrosion of reinforcement (chloride induced, carbonation induced), Alkali-silica reaction, sulphate attack, Acid attack.

Deterioration due to water leakage, fire – detection & mitigation of the same. Deterioration due to ageing, inadequate maintenance, Design & construction deficiencies, overloading etc. Visual deterioration of structures- Types of cracks, causes & characteristics of cracking in various structural components like beam, column, slab, masonry walls. Measurement of cracks, interpretation of the cause of particular type of crack.

Module 3	**Conditional/damage assessment & Evaluation of structures**	**8 Hrs.**

Structural assessment: Conditional evaluation / Structural Appraisal of the structure – Importance, objective & stages, Conditional/damage assessment procedure, Preliminary & Detailed investigation – Scope, Objectives, Methodology & Rapid visual inspection of structures,Damage Assessment allied Tests (Destructive, Semi-destructive, Non- destructive): Field & laboratory testing procedures for evaluating the structure for strength, corrosion activity, performance & integrity, durability. Interpretation of the findings of the tests.

Module 4	Repairs, rehabilitation & Retrofitting of concrete structures	8 Hrs.
Repair materials - Criteria for durable concrete repair, Methodology, performance requirements, repair options, selection of repair materials, Preparatory stage of repairs, Different types of repair materials & their application, types of repair techniques. Retrofitting/Strengthening: Need for retrofitting, Design philosophy of strengthening structures, Techniques available for strengthening including conventional and advanced techniques. Seismic retrofit of concrete structures: Deficiencies in structure requiring seismic retrofit, Design philosophy, Techniques to enhance the seismic resistance of structures, advanced techniques for making seismic resistant structures		
Module 5	**Allied topics**	**8 Hrs.**
Protection & maintenance of structures - Importance of protection & maintenance, Categories of maintenance, Building maintenance. Corrosion mitigation techniques to protect the structure from corrosion. Long term health monitoring / Structural health monitoring (SHM)– Definition and motivation for SHM, Basic components of SHM and its working mechanism, SHM as a tool for proactive maintenance of structures.		

Text Books:	
1	Concrete microstructure, Properties and materials – P Kumar Mehta and Paulo J.M.Monterio
2	Handbook on Repairs and Rehabilitation of RCC buildings – CPWD, Government of India.
3	Concrete technology – A.R.Shanthakumar, Oxford University Press, India
4	Concrete Technology by M.L.Gambhir, Tata McGraw-Hill Education, Third Edition
5	Appraisal and Repair of Reinforced concrete by R.Holland, Thomas Telford Ltd. London.
Reference Books:	
1	J.H.Bungey, S.G.Millard & M.G.Grantham , Testing of Concrete in Structures, 4th Edition, Taylor & Francis, London & New York, 2006.
2	V. M. Malhotra, Nicholas J. Carino 2004 “Handbook on Nondestructive Testing of Concrete”
3	“Repair and Strengthening of Concrete structures” , FIP guide, Thomas Telford, London.
4	Concrete Structures, Protection, Repair and Rehabilitation by R.Dodge Woodson.
5	Structural Condition assessment by Robert T. Ratay
6	Repairs and rehabilitation of concrete structures by P. I. Modi & C. N. Patel, PHI Publication.

SUBJECT CODE	OPEN ELECTIVE-III	CREDITS
26AF1ARPOEM05P	Sustainable Construction Methods	3

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	To introduce the concepts of sustainability in the built environment.
COBJ2	To familiarize students with sustainable and alternative building materials.
COBJ3	To explore eco-friendly and cost-effective construction methods and technologies.
COBJ4	To understand green building standards and regulations.
COBJ5	To introduce digital and smart technologies for sustainable construction.

Course Outcomes: Students will be able to	
CO1	Explain the fundamental concepts of sustainability.
CO2	Describe the properties and uses of sustainable building materials.
CO3	Identify suitable construction techniques and practices for sustainable buildings.
CO4	Discuss the standards and guidelines for sustainable buildings.
CO5	Comment on the role of BIM and automation in sustainable construction.

Course Contents

Module 1	**Introduction to Sustainability**	**Hrs. 6**

Impacts of global warming, sustainability indicators - Carbon foot print, Embodied energy and carbon, sustainability analysis - Lifecycle Analysis, EIA - Concept of Green Buildings.

Module 2	**Sustainable building materials**	**Hrs. 8**

Introduction to sustainable building materials, qualities, use, examples - Natural building materials, locally available and locally manufactured materials – wood, earth, stone and lime-based materials. Alternative Building Materials - Overview and definition of alternative or appropriate building materials - Alternative materials developed and promoted by government organisations like CSIR labs: CBRI and SERC, GRIHA, ASTRA (IISc), BMTPC, HUDCO and its building centers - Alternative materials developed and promoted by non-government organisations DA, Auroville, TERI.

Module 3	**Sustainable methods & technologies**	**Hrs. 5**

Eco friendly and low-cost techniques - Different substitute, for wall construction - Flemish Bond - Rat Trap Bond – Arches – Panels - Cavity Wall – Ferro, Cement and Ferro Concrete constructions – different pre cast members using these materials -Alternate roofing systems - Filler Slab - Composite Beam and Panel Roof -Pre-engineered and ready to use building elements - wood products -steel and plastic –Mivan technique - Contributions of agencies - Costford - Nirmithi Kendra – Habitat

Module 4	**Green building rating systems**	**Hrs. 5**

Green building rating systems – Guidelines from IGBC – LEED rating system, TERI-GRIHA rating system. Codes - Energy Conservation Building Code (BEE), National Building Code. Green Building Case studies – Residential, Institutional, and Commercial. Concept of Net Zero buildings – Use of BIPV and other renewable energy in buildings

Module 5	ICT for Sustainable Construction	Hrs. 4
Building Information modelling – Introduction to BIM, concepts and benefits, BIM for construction scheduling, cost estimation and construction management. Building Automation – Concepts, components of BA, applications of BA for functional efficiency of buildings.		

Text Books:	
1	Sustainable Building - Design Manual Pt 1 & 2, The Energy and Resources Institute, TERI, 2004
2	Automation Systems in Smart and Green Buildings (Modern Building Technology), Er. V K Jain, Khanna Publishers.
3	Jagadish. K.S. Alternative Building Materials and Technologies, New age International Pvt Ltd Publishers, 2008
4	Energy Conservation Building Code of India, User manual, 2007
5	P.K. Singh, Rainwater Harvesting: Low cost indigenous and innovative technologies, Macmillan Publishers India, 2008
Reference Books:	
1	Ross Spiegel.G, Green Building Materials A Guide to Product Selection and Specification,
2	Traci Rose Rider, Stacy Glass, Jessica McNaughton, Understanding Green Building Materials, W.W.Norton and Company, 2011
3	BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors- Chuck Eastman, et al.
4	Jagadish. K.S. Building with stabilised mud, I.K. International Publishing House Pvt. Limited, 2007

SUBJECT CODE	Design of Steel Structures Lab						CREDITS
26AF1922PCL507							1
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Objectives:	
COBJ1	To understand analysis and design of industrial structures.
COBJ2	To learn design of steel components like trusses, frames, and girders.
COBJ3	To apply structural analysis methods for different types of loads.
COBJ4	To study design of special structures like water tanks and chimneys.
COBJ5	To develop skills in structural detailing and practical design.

Course Outcomes: On completion of course, students will be able to	
CO1	Analyze and design industrial sheds and building structures.
CO2	Design steel components such as trusses, plate girders, and gantry girders.
CO3	Apply influence line concepts in bridge analysis.
CO4	Design elevated water tanks and steel chimneys.
CO5	Prepare structural drawings and detailing for practical applications.

Course Contents

Term work shall consist of detailed analytical report for structural design and drawing of any one of the following from Group A/B/C as per IS 800-2007.

Group A
1) Drawing of structural steel sections, types of trusses, types of connections 2) Industrial Shed: Roof Truss with Necessary Bracing System, Purlins, Column and Column Bases
Group B
1) Drawing of structural steel sections, types of trusses, types of connections 2) Industrial Shed: Gantry Girder, Columns with Necessary Bracing System, Purlins, Column and Column Bases
Group C
1) Drawing of structural steel sections, types of trusses, types of connections 2) Analysis and design of any structural steel building with Portal or Gable Frames of Solid or Open Web Sections with Necessary. Bracing System, Purlins, Column and Column Bases

SUBJECT CODE	Air Pollution Control Lab			CREDITS			
26AF1922PCL508				1			
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Objectives:	
COBJ1	To understand sampling and measurement of particulate matter in ambient air.
COBJ2	To analyze gaseous air pollutants like SO_2, NOx, and O_3.
COBJ3	To study meteorological parameters affecting air quality.
COBJ4	To develop skills in data analysis such as emission rates and wind rose diagrams.
COBJ5	To understand indoor air quality and its impact on human health.

Course Outcomes: On completion of course, students will be able to	
CO1	Identify methods to measure particulate and gaseous air pollutants.
CO2	Explain meteorological parameters affecting air pollution.
CO3	Describe air quality data and wind rose diagrams.
CO4	Explain air pollution control equipment, vehicular pollution, and environmental legislation.
CO5	Identify steps in air sampling and environmental data recording.

Course Contents

Practical Work consists of at least six performances from list below and detailed reporting in form of journal.

Experiment No.1	Sampling of Suspended Particulate Matter (SPM) in ambient air and the determination of its concentration
Experiment No.2	Sampling of PM10 in ambient air and the determination of its concentration
Experiment No.3	Sampling of PM2.5 in ambient air and the determination of its concentration
Experiment No.4	Sampling of PM1 in ambient air and the determination of its concentration
Experiment No.5	Measurement of Sulphur dioxide (SO2) concentration in the ambient air
Experiment No.6	Measurement of Nitrogen dioxide (NOX) concentration in the ambient air
Experiment No.7	Measurement and analysis of Metrological parameters and ambient weather parameters: i. Wind speed ii. Wind direction iii. Solar radiation iv. Relative humidity v. temperature
Experiment No.8	Measurement and analysis of Metrological parameters and ambient weather parameters: To plot Wind Rose Diagram
Experiment No. 9	To calculate emission rates (ER) for different exhaust gases emitting from vehicular tailpipe
Experiment No. 10	To calculate the air change rate (ACH) of indoor environment air and deposition rate of particulate concentration of different sizes
Experiment No. 11	Estimation of respiratory deposition doses (RDD) to the human beings under different conditions
Experiment No. 12	Ambient Air Sampling and Analysis of Ozone

SUBJECT CODE	Concrete Technology Lab			CREDITS			
26AF1922PCL509				1			
2 hours / week				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Objectives:	
COBJ1	To develop an understanding of the fundamental properties of cement, aggregates, and concrete through laboratory testing.
COBJ2	To learn standard laboratory tests for construction materials.
COBJ3	To evaluate the quality, strength, and durability of cement and concrete.
COBJ4	To interpret test results and relate them to construction practices.
COBJ5	To develop skills in material testing, quality control, and sustainable construction.

Course Outcomes: Students will be able to	
CO1	Test cement properties and check its suitability for construction.
CO2	Perform aggregate tests to evaluate quality and grading.
CO3	Test concrete workability using standard methods.
CO4	Analyse concrete strength properties for structural use.
CO5	Apply non-destructive tests to assess concrete quality and durability.

Course Contents

Practical Work consists of at least **ten** performances from list below and detailed reporting. Practical examination shall be based on above.

(A) CEMENT TESTS:	
Experiment No.1	Determination of Standard Consistency of Cement
Experiment No.2	Determination of Fineness of Cement
Experiment No.3	Determination of Setting Time of Cement
Experiment No.4	Determination of Soundness of Cement
Experiment No.5	Determination of Strength of Cement
(B) AGGREGATE TEST:	
Experiment No.6	Determination of Sieve Analysis of Aggregates
Experiment No.7	Determination of Bulk Density of Fine Aggregate
Experiment No.8	Determination of Shape of Aggregates (Flakiness Index & Elongation Index)
(C) CONCRETE TESTS:	
Experiment No. 9	Determination of Workability of Concrete by Slump Cone Test
Experiment No. 10	Determination of Workability of Concrete by Compaction Factor Test
Experiment No. 11	Determination of Compressive Strength of Concrete
Experiment No. 12	Determination of Flexural Strength of Concrete
Experiment No. 13	Determination of Splitting Tensile Strength of Concrete
Experiment No. 14	Determination of Non-Destructive Testing of Concrete

SUBJECT CODE	Soft Skills Development	CREDITS
26AF1922HM510		GR

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	2	0	2	-	-	-	AU

Course Objectives	
COBJ1	To develop English language proficiency and effective communication skills for engineering environments.
COBJ2	To nurture self-awareness, self-discipline, and self-management for personal and professional growth.
COBJ3	To equip students with time management and motivational strategies to enhance productivity.
COBJ4	To foster positive interpersonal relationships and teamwork skills in engineering project contexts.
COBJ5	To develop digital literacy and effective presentation skills for Civil & Environmental Engineering practice.

Course Outcomes: On completion of course, students will be able to	
CO1	Demonstrate English speaking skills, apply 5 Ws & 1 H and 7 Cs of communication
CO2	Evaluate personal strengths and weaknesses, manage emotions, and apply self-discipline and goal-setting in engineering team contexts.
CO3	Apply time management techniques and motivational strategies to achieve academic and professional targets efficiently.
CO4	Build positive interpersonal relationships, demonstrate empathy, handle interview situations, and exhibit effective teamwork.
CO5	Design and deliver effective technical presentations using digital tools and data visualization for engineering audiences.

Course Contents

Module 1	**Development of Proficiency in English**	**Hrs. 7**

Speaking Skills: Vocal clarity, fluency, and effective articulation in formal and informal settings.

Feedback & Questioning Technique: Active listening, constructive feedback, one-on-one and group discussions. Objectivity in Argument: Logical reasoning and structured argumentation in both one-on-one and group contexts. 5 Ws & 1 H of Effective Communication: What, Why, When, Where, Who, How – planning and delivering clear messages.7 Cs of Effective Communication: Clarity, Correctness, Completeness, Conciseness, Consideration, Coherence, Courtesy. Etiquettes and Manners: Professional behaviour in the workplace, construction sites, and client meetings. On-Verbal Communication: Study of different pictorial expressions of body language and their analysis.

Module 2	**Self-Management**	**Hrs. 6**

Self-Evaluation: Recognizing one's own strengths, weaknesses, limits, and deficiencies. Self-Discipline & Self-Criticism: Accountability and constructive self-reflection in academic and project work. Self-Awareness: Understanding personal values, biases, and dependency on others. Planning & Goal Setting: SMART goal framework for academic milestones and career objectives. Managing Self-Emotions, Ego, and Pride: Emotional regulation in team and project settings.Leadership & Team Dynamics: Leadership styles, roles in project teams, and conflict resolution.

Module 3	Time Management Techniques	Hrs. 6
Time Management Concept: Principles of prioritization and scheduling in engineering project contexts. Attendance, Discipline & Punctuality: Professional standards expected in academic and workplace settings. Acting in Time: Decision-making under deadlines; avoiding procrastination in project milestones. Quality / Productive Time: Maximizing output quality; balancing efficiency and thoroughness. Practice by Game Playing & Learning Strategies: Simulation exercises to achieve set targets within time.		
Module 4	**Motivation / Inspiration**	**Hrs. 6**
Motivation Concepts: Intrinsic vs. extrinsic motivation; Maslow's Hierarchy of Needs. Ability to Shape and Direct Working Methods: Self-defined criteria for personal and professional performance. Ability to Think for Oneself: Independent thinking, critical reasoning, and self-directed problem-solving. Apply Oneself to a Task Independently: Self-motivation techniques based on needs and field situations. Motivation Techniques Based on Needs & Field Situations: Practical motivation strategies for engineering practice. Resilience & Growth Mindset: Bouncing back from failures and setbacks in academic and project work.		
Module 5	**Interpersonal Skills & Computing Skills**	**Hrs. 6**
Positive Relationship: Building trust, mutual understanding, and collaboration in engineering teams. Positive Attitudes & Empathy: Comprehending others' opinions and facing them with understanding. Mutuality, Trust, and Emotional Bonding: Developing a reliable and supportive team culture. Handling Situations – Interview Skills: Preparation, body language, and communication for interviews. Importance of Interpersonal Skills: Application in Civil & Environmental Engineering workplaces. Designing an Effective Presentation: Contents, appearance, and themes in a presentation. Tone and Language in a Presentation: Formal technical language vs. simplified communication. Role and Importance of Digital Tools: MS PowerPoint, Canva, and tools for effective engineering presentations.		

Text Books:	
1	Mitra, Barun. Personality Development and Soft Skills. Oxford University Press, 2016.
2	Ramesh, Gopalswamy. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success. Pearson Education, 2013.
3	Covey, Stephen R. Seven Habits of Highly Effective People: Powerful Lessons in Personal Change. Simon & Schuster Ltd., 2013.
4	Rosenberg, Marshall B. Nonviolent Communication: A Language of Life. Puddle Dancer Press, 2015.
Reference Books:	
1	Kumar, Sanjay, and Pushp Lata. Communication Skills. Oxford University Press, 2018.
2	Heller, Robert. Effective Leadership. DK Publishing, 2011.
3	Carnegie, Dale. How to Win Friends and Influence People. Simon & Schuster
4	Pease, Allan, and Barbara Pease. The Definitive Book of Body Language. Orion Publishing,
5	Tracy, Brian. Maximum Achievement: Strategies and Skills that Will Unlock Your Hidden Powers. Simon & Schuster, 2011.

SUBJECT CODE	Construction Equipment & Site Safety Management			CREDITS			
26AF1922VS511				2			
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	2	0	2	50	00	50	100

Course Objectives	
COBJ1	Identify functions of earthmoving machinery (tractors, power shovels, draglines) and calculate equipment cycle times, production rates, and efficiencies.
COBJ2	Learn techniques for hard rock excavation, including drilling, blasting, and dewatering methods.
COBJ3	Gain knowledge of Ready Mix Concrete (RMC) plant management, concrete transportation (vertical/horizontal), and specialized methods like slip formwork and underwater concreting.
COBJ4	Understand prefabricated construction methods, steel erection techniques, and the use of cranes (tower, crawler).
COBJ5	Understand road construction (asphalt plants, sensor pavers), railway track construction, and diaphragm wall construction.

Course Outcomes: On completion of course, students will be able to	
CO1	Understand the planning of new project with site accessibility and services required.
CO2	Comprehend the various civil construction equipment's.
CO3	Familiar with layout of RMC plant, production, capacity and operation process.
CO4	Recognize various aspect of road construction, construction of diaphragm walls, railway track construction etc.
CO5	Apply safety measures to prevent accidents and understand the principles of disaster management on construction sites.

Course Contents

Module 1	**Introduction to Construction Equipment**	**Hrs. 8**
The classification of construction equipment, the fundamental criteria for selecting appropriate machinery based on productivity, cost-effectiveness, project suitability, The estimation of ownership and operating costs, understanding equipment depreciation, replacement policies, introduction to automation trends in construction equipment.		
Module 2	**Earthmoving and Material Handling Equipment**	**Hrs. 8**
Types of earthmoving machinery such as excavators, bulldozers, backhoe loaders, and scrapers, along with compacting equipment like rollers and rammers, material handling tools including different types of cranes, hoists, conveyors, forklifts. Emphasis is placed on equipment used for foundation works, the importance of safety protocols and inspection routines for all these machines.		
Module 3	**Road Construction and Concreting Equipment**	**Hrs. 8**
The equipment used in road construction including pavers, graders, and milling machines. Equipment for concrete-related operations such as batching plants, transit mixers, concrete pumps, and slip-forming machines, advanced techniques such as shotcreting, the use of asphalt mixing and laying equipment, practical		

case studies to illustrate the effective deployment of such equipment in real-world projects.		
Module 4	**Construction Site Safety Management**	**Hrs. 8**
The concept of construction safety, common hazards, and accident trends in the industry, safety measures such as proper signage, the use of personal protective equipment (PPE), the role of site layout in enhancing safety, risks associated with working at heights, excavation, trenching, fire hazards, and electrical safety, emergency planning and basic first aid procedures.		
Module 5	**Safety Laws, Regulations, and Management Systems**	**Hrs. 8**
The legal and regulatory framework governing construction safety, relevant national standards and international benchmarks such as OSHA and ISO 45001. Statutory compliance, conducting safety audits and inspections, preparation of safety reports, risk assessment methods, job hazard analysis (JHA), the implementation of comprehensive Safety Management Systems (SMS), behavior-based safety approaches.		

Guidelines for Assignments/Assessment:	
1	The candidate shall perform minimum five assignments consisting aspects of the Course.
2	Faculty member can do the (internal & external) assessment through Quiz/ Exam. (MCQ/descriptive) /PPT/ Poster/Drawing/small project activity and must maintain the record of the same.

Text Books:	
1	Sharma, S.C., Construction Equipment and Management, Khanna Publishers.
2	Hinze, J., Construction Safety, Prentice Hall.
3	Peurifoy, R.L., Construction Planning, Equipment, and Methods, McGraw-Hill.
4	Goetsch, D.L., Construction Safety and Health, Pearson
5	Mahesh Varma, Construction Equipment and Its Planning and Application, Metropolitan Book Co. Pvt. Ltd.
Reference Books:	
1	IS Codes and OSHA Construction Safety Manuals.
2	CPWD Safety Code and Manuals.

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for Third Year B. Tech.

Civil and Environmental Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	ISE	MSE	ESE	Total	
Semester-VI										
1	26AF1922PC601	Design of Concrete Structures	3	0	0	20	20	60	100	3
2	26AF1922PE602	Program Elective-I	3	0	0	20	20	60	100	3
3	26AF1922PE603	Program Elective -II	3	0	0	20	20	60	100	3
4	26AF1922PE604	Program Elective-III	3	0	0	20	20	60	100	3
5	26AF1922PC605	Industrial Waste Management	3	0	0	20	20	60	100	3
6	Refer Bucket	Multi-Disciplinary Minor-IV	3	0	0	20	20	60	100	3
7	26AF1922PCL607	Design of Concrete Structures Lab	0	0	2	50	-	50	100	1
8	26AF1922PEL608	Program Elective-II- Lab	0	0	2	25	-	25	50	1
9	26AF1922PEL609	Program Elective-III- Lab	0	0	2	25	-	25	50	1
10	26AF1922EL610	Seminar	0	0	2	25	-	25	50	1
11	26AF1922EL611	Project Phase-I	0	0	4	50	-	50	100	2
		TOTAL	**18**	**0**	**12**	**295**	**120**	**535**	**950**	**24**

Course Type	Course Code	Course Name
Program Elective-I	26AF1922PE602A	Water Quality Engineering
	26AF1922PE602B	Pollution control and Treatment
	26AF1922PE602C	Environment Health and Safety
Program Elective-II	26AF1922PE603A	Highway Engineering
	26AF1922PE603B	Urban Transportation Planning
	26AF1922PE603C	Tunneling & Underground Excavation
Program Elective-III	26AF1922PE604A	Geotechnical Engineering
	26AF1922PE604B	Soil Mechanics & Foundation Engineering

Course Type	Course Code	Course Name
Open elective-III	26AF1ARPOEM05H	Material Testing & Evaluation
	26AF1ARPOEM05O	Rehabilitation & Retrofitting of Structures
	26AF1ARPOEM05P	Sustainable Construction Methods
Multi-Disciplinary Minor-III	Refer Bucket	Refer Bucket
Multi-Disciplinary Minor-IV	Refer Bucket	Refer Bucket

Type of course:

Basic Science: **BS**	Engineering Science: **ES**
Program Elective: **PE**	Program Core: **PC**
Modern Indian Language: **MIL**	Indian Knowledge System: **IK**
Value Education Course: **VEC**	Ability Enhancement Course: **AE**
Vocational and Skill Enhancement: **VS**	Audit Course: **AU**
Open Elective: **OE** (Other than particular program)	Co-curricular & Extracurricular Activities: **CC**
Multidisciplinary Courses: **MD**	Humanities, Management, language and Commerce: **HM**

SUBJECT CODE	Design of Concrete Structures						CREDITS
26AF1922PC601							3
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Pre-requisite: Engineering Mechanic, Mechanics of Solids, Structural Mechanics

Course Objectives	
COBJ1	To understand the fundamentals and philosophies of reinforced concrete design.
COBJ2	To study analysis and design of RC structural elements using Working Stress Method.
COBJ3	To learn limit state design concepts for shear, bond, and flexure.
COBJ4	To understand the design and detailing of beams, slabs, and staircases using LSM.
COBJ5	To study the design of columns and footings under different loading conditions.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain the behavior and design philosophies of reinforced concrete structures.
CO2	Design RC beams, columns, and footings using Working Stress Method.
CO3	Apply limit state concepts for shear, bond, and flexural design.
CO4	Design and detail beams, slabs, and staircases using Limit State Method.
CO5	Analyze and design compression members and isolated footings using LSM principles.

Course Contents

Module 1	**Fundamentals and Working Stress Method**	**Hrs. 6**
Basic aspects of structural design, design philosophies (WSM, ULM, LSM), Stress-strain behavior of concrete and steel, Comparison of WSM, ULM, and LSM, factor of safety, load estimation, Introduction to Working Stress Method, permissible stresses, assumptions, Basic design of RC sections using WSM principles.		
Module 2	**Structural Design Using WSM**	**Hrs. 10**
Stress block parameters and section classification (under/over-reinforced, balanced), Flexural design of singly and doubly reinforced beams, Shear design principles and detailing of reinforcement, Design of axially and uniaxially eccentrically loaded short columns, Design of isolated column footings, WSM as per IS:456-2000 Annexure B.		
Module 3	**Limit State Method - Philosophy, Shear, and Bond**	**Hrs. 8**
Limit State approach: definition, types, and classifications of limit states, Characteristic loads and strengths, partial safety factors, Strain variation and stress distribution diagrams, serviceability requirements, Design for shear: types of shear failure, reinforcement types, minimum shear steel, Design for bond: development length, anchorage, detailing as per IS code.		
Module 4	**Limit State Design in Flexure - Beams, Slabs, and Staircases**	**Hrs. 8**
Design of singly and doubly reinforced beams using LSM, Design of flanged beams (L and T sections),Design and detailing of one-way and two-way slabs under various loading/supports, Deflection and crack control criteria, Design of staircases: dog-legged and open-well, effective span, and load distribution.		

Module 5	Compression Members and Footings - Limit State Design	Hrs. 8
Design of axially and eccentrically loaded short columns (rectangular and circular), Construction of interaction diagrams for uni-axial bending, Concept of bi-axial bending and interaction surface (theoretical introduction), Design and detailing of isolated footings for axial and uniaxial loads, Practical considerations in reinforcement layout and anchorage.		

Text Books:	
1	Varghese, P. C. Limit State Design of Reinforced Concrete, PHI Learning.
2	Pillai, S. U., & Menon, D. Reinforced Concrete Design, McGraw-Hill.
3	Jain, A. K. Limit State Design of RCC, Nem Chand & Bros.
4	Subramanian, N. Design of Reinforced Concrete Structures, Oxford University Press.
5	Punmia, B. C. Reinforced Concrete Structures, Laxmi Publications.
Reference Books:	
1	IS:456-2000 – Code of Practice for Plain and Reinforced Concrete, BIS.
2	Handoo, B. L. Concrete Structures, Satya Prakashan.

SUBJECT CODE	PROGRAM ELECTIVE-I	CREDITS
26AF1922PE602A	Water Quality Engineering	3

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	To understand sources of water, water quality parameters, and standards for drinking water.
COBJ2	To study unit operations and processes involved in water treatment such as aeration, sedimentation, coagulation, and filtration.
COBJ3	To understand the design principles of water treatment units.
COBJ4	To study disinfection and water softening techniques for safe water supply.
COBJ5	To understand rural water supply systems and rainwater harvesting methods.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain water quality parameters, standards, and their role in preventing water-borne diseases.
CO2	Analyze treatment processes such as aeration, sedimentation, and coagulation.
CO3	Design basic units of water treatment systems like sedimentation tanks and filters.
CO4	Evaluate filtration, disinfection, and softening techniques for water treatment.
CO5	Apply concepts of rural water supply and rainwater harvesting for sustainable water management.

Course Contents

Module 1	**Introduction**	**Hrs. 6**
Introduction – Sources of water, Importance of water quality and standards. Objectives of Water treatment. Flow chart on overall water supply project, Unit diagrams on water treatment systems. Suitability of Intake Structures.		
Module 2	**Treatment Operations**	**Hrs. 6**
Treatment Operations – Gas transfer two film theory- Water in air system and Air in water system. Types of Aeration and limitations. Principles of Sedimentation. Design criteria and design of Sedimentation tanks.		
Module 3	**Coagulation and Flocculation-**	**Hrs. 6**
Coagulation and Flocculation- Theory of Coagulation. Types of Coagulants, reactions, Coagulant Aids, Determination of Optimum dose of Coagulants. Design Criteria and numerical problems on estimation of coagulants.		
Module 4	**Filtration and Disinfection**	**Hrs. 6**
Filtration – Theory of Filtration, types of filters used in treatment plants, Hydraulics of Filter bed. Design criteria and Design of Filters, Filter Back wash, Operational troubles and trouble shooting. Water disinfection, methodologies. theory of disinfection, Chemistry of Chlorination and Break Point Chlorination.		
Module 5	**Water Softening**	**Hrs. 6**
Water Softening - Ions causing Hardness, Degree of Hardness, Removal techniques, Problems associated with hardness. Fluoridation and De-fluoridation techniques. Rural water supply systems. Rain water Harvesting processes and utilization.		

Text Books:	
1	Fair, G.M., Geyer J.C and Okun, (1969) "Water and Waste water Engineering" Vol II, John Wiley Publications.
2	Weber W.J., (1975) "Physico - Chemical Processes for Water Quality Control".
3	AWWA, (1971), "Water Quality and Treatment "McGraw Hill.
4	CPHEEO Manual, (1991), "Water Supply and Treatment", GO Publications.
Reference Books:	
1	Peavy, H.S., Rowe and Tchobonoglous,G., (1985), "Environmental Engineering", McGraw Hill
2	Viessman Jr, Hammer J. M, Perez, E.M, and Chadik, P. A, Water Supply and Pollution Control, PHI Learning, New Delhi, 2009
3	Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, Environmental Engineering, McGraw Hill., 1984
4	CPHEEO Manual, (1991), "Water Supply and Treatment", GO Publications.

SUBJECT CODE	PROGRAM ELECTIVE-I	CREDITS
26AF1922PE602B	Pollution control and Treatment	3

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives:	
COBJ1	To understand air pollutants, smog, acid rain, and their effects.
COBJ2	To study water and soil pollution and their impacts.
COBJ3	To learn about radioactive and heavy metal pollution and health hazards.
COBJ4	To understand noise and thermal pollution and their control methods.
COBJ5	To learn oil pollution causes, impacts, and control techniques.

Course Outcomes: Students will be able to	
CO1	Explain air pollution sources, reactions, and effects.
CO2	Analyze water and soil pollution and suggest control measures.
CO3	Assess the effects of radioactive and heavy metal pollution.
CO4	Apply methods to control noise and thermal pollution.
CO5	Analyze oil pollution and suggest monitoring and control methods.

Course Contents

Module 1	**Introduction**	**Hrs. 6**

Introduction: Definition and sources of pollution, different types of pollution and their global, regional and local effects. Air Pollution: Types and sources of air pollutants; Reaction of pollutants in air forming Smog, PAN, Acid rain; Atmospheric Diffusion and Plume Behavior, Effects of air pollutants on plants.

Module 2	**Water Pollution and Soil Pollution**	**Hrs. 6**

Water Pollution: Sources of water and their contamination, Types of pollutants, Industrial effluents-pulp and papermills, Sugar, Distillery, Domestic wastes, Effluents from water treatment plants. Eutrophication – causes, effects and control measures.

Soil pollution: Plants as soil pollution indicators, Formation of salts in soils, Causes of soil pollution, Effects of Fungicides and weedicides on soil components and pollution. Different kinds of synthetic fertilizers (N, P, K), their toxicity and Environmental effects, control of soil pollution

Module 3	**Radioactive Pollution and Heavy Metal Pollution**	**Hrs. 6**

Radioactive Pollution: Types of radiations (Alpha, Beta, Gamma), Units of radioactivity, Sources of radioactive material in environment, Biological impact and health hazards associated with radiation, control of Radioactive pollution. Fate and movement of radioactive material in Environment. Heavy Metal Pollution: Sources of heavy metals, Accumulation of heavy metals in abiotic environment and biotic components, Bioaccumulation, Biomagnification, Toxic effects (Lead, Mercury, Arsenic).

Module 4	Noise Pollution and Thermal Pollution	Hrs. 6
Noise Pollution: Basic properties of sound, Units, Sources of Noise Pollution, Effects of noise pollution, Measurement of sound. Measures to control noise pollution in industries - automotive type silencers, vibration isolation, damping, lagging. Protection of personnel – ear plugs, ear muffs, helmets, isolation. Thermal pollution: Definition and Sources, effects of thermal pollution – physical, chemical, biological, control of thermal pollution.		
Module 5	**Oil Pollution**	**Hrs. 6**
Oil pollution: introduction, major oil spills in the world, fate and movement of oil after spillage - spreading, evaporation, emulsification, dispersion, dissolution, sedimentation, biodegradation. Effects and control of oil pollution, Remote sensing in water quality monitoring.		

Text Books:	
1	S.S.Dara, Environmental Chemistry and Pollution Control, S. Chand and Co Ltd., New Delhi
2	Environmental. Protection and Pollution Control Manual – Karnataka State Pollution Central Board.
3	B.K. Sharma, and H. Kaur, Environmental Chemistry.
Reference Books:	
1	Handbook of Environmental Health and Safety – principle and practices , Vol. II.

SUBJECT CODE	PROGRAM ELECTIVE-I	CREDITS
26AF1922PE602C	Environment Health and Safety	3

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives:	
COBJ1	To understand the fundamentals of occupational health and industrial toxicology.
COBJ2	To study various chemical, biological, and physical hazards in working environments.
COBJ3	To learn safety practices and risk control measures in the construction industry.
COBJ4	To analyze the impact of air and water pollution on environment and human health.
COBJ5	To develop knowledge of safe working environments and environmental protection techniques.

Course Outcomes: Students will be able to	
CO1	Explain occupational health issues and toxicological effects in industries.
CO2	Analyze chemical and biological hazards affecting human health in workplaces
CO3	Describe various measures to ensure safety in Construction industry.
CO4	Explain the effect of air and water pollution on the environment.
CO5	Apply safety and environmental protection measures in workplaces.

Course Contents

Module 1	**Introduction to Occupational Health and Toxicology**	**Hrs. 6**
Introduction to Occupational Health and Toxicology: Safety at work – Socio – Economic reasons. Introduction to health and safety in various industries. Occupational related diseases Musculoskeletal disorders, hearing impairment, carcinogens, silicosis, asbestosis, pneumoconiosis – Toxic materials and substances used in work, exposure limits, toxicological investigation, Industrial Hygiene, Arrangements by organisations to protect the workers.		
Module 2	**Chemical hazards**	**Hrs. 6**
Chemical hazards- Dust, fumes, vapour, fog, gases; Methods of Control. Biological hazards Classification of Biohazardous agents– bacterial agents, viral agents, fungal, parasitic agents, infectious diseases, control of biological agents at workplaces. Noise, noise exposure regulation and control.		
Module 3	**Safety in Construction industry**	**Hrs. 6**
Safety in Construction industry - Scaffolding and Working platform, Welding and Cutting, Excavation Work, Concreting, control measures to reduce the risk. Electrical Hazards, Protection against voltage fluctuations, Effects of shock on human body. Radiation Hazards, Types and effects of radiation on human body, disposal of radioactive waste.		

Module 4	Air Pollution	Hrs. 6
Air Pollution - air pollutants from industries, effect on human health, animals, plants and materials - depletion of ozone layer-concept of clean coal combustion technology. Water Pollution - water pollutants-health hazards - effluent quality standards. Waste Management -waste identification, characterization and classification, recycling and reuse.		
Module 5	**Safe working environment**	**Hrs. 6**
Safe working environment - The basic purpose and benefits of safety inspection, First-aid appliances, shelters, rest rooms and lunch rooms, use of personal protective equipment, Role of an individual in conservation of natural resources, Methods for controlling water pollution, role of individuals in prevention of pollution.		

Text Books:	
1	Environmental and Health and Safety Management by By Nicholas P. Cheremisinoff and
2	Madelyn L. Graffia, William Andrew Inc. NY, 1995.
3	Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005.
4	The Facility Managers Guide to Environmental Health And Safety by Brian Gallant,
Reference Books:	
1	Industrial safety and health, David L. Goetsch, Macmillan Publishing Company, 1993.
2	Handbook of environmental health and safety, Vol I & II, Herman Kooren, Michael Bisesi, Jaico Publishing House, 1999.
3	Slote. L, Handbook of Occupational Safety and Health, John Wiley and Sons, NewYork.
4	Heinrich H.W, Industrial Accident Prevention, McGraw-Hill Company,NewYork,1980.
5	S.P.Mahajan, “Pollution control in process industries”, Tata McGraw Hill Publishing Company, New Delhi, 1993.

SUBJECT	PROGRAM ELECTIVE-II	CREDITS
26AF1922PE603A	Highway Engineering	3

Teaching Workload/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	To understand the development, classification, and alignment of highways.
COBJ2	To learn highway geometric design, sight distance, curves, and super-elevation.
COBJ3	To study traffic flow, signal design, and level of service.
COBJ4	To understand properties of pavement materials and mix design methods.
COBJ5	To learn the design principles of flexible and rigid pavements.

Course Outcomes: On completion of course, students will be able to	
CO1	Identify sources of water pollution and factors affecting water quality.
CO2	Perform and interpret water quality tests.
CO3	Compare water quality standards for different uses.
CO4	Understand basic water treatment plant design and treatment methods.
CO5	Analyze pollution impacts on surface and groundwater.

Course Contents

Module 1	**Highway planning and alignment**	**Hrs. 6**
Introduction: Role of transportation, Modes of transportation, characteristics of highway transport, Road development and planning in India, Road's classification, patterns, Engineering surveys for highway locations.		
Module 2	**Geometric Design of Highway**	**Hrs. 10**
Factors controlling the geometric design, Basic consideration for the design of highway, Cross-sectional element, Sight distance, Curve, Design of horizontal alignment, Transition curves, Set back distance, and Design of vertical alignment.		
Module 3	**Traffic Engineering**	**Hrs. 8**
Functions of traffic engineering, Traffic characteristics, Traffic studies on flow and speed, Peak hour factor, Accident study, Statistical analysis of traffic data, Microscopic and macroscopic parameters of traffic flow, Fundamental relationships, Traffic signs, Signal design by Webster's method, Types of intersection, Highway capacity, Level of service		
Module 4	**Highway materials and testing**	**Hrs. 8**
Subgrade soil, Plate bearing test, California bearing ratio test, Desirable properties of road aggregates, Test for road aggregates, Bitumen, Tar, Marshall mix design		
Module 5	**Principles of Pavement Design**	**Hrs. 6**
Types of pavement structure, Functions of pavement components, Design factors, Design of flexible pavement, Design of rigid pavement, Design of joint.		

Text Books:	
1	Kadiyali, L. R., & Lab, N. B. (2012). Principle and Practices of Highway Engineering. Khanna
2	Khanna, S. K., & Justo, C. E. G. (2011). Highway Engineering. Khanna Publishers.
3	Rangawala, S. C. (2015). Highway Engineering. Charotar Publishing House Pvt. Ltd.
4	Khisty, C. J., & Lall, B. K. (2002). Transportation Engineering: An Introduction (3rd ed.). Prentice
5	Ministry of Road Transport and Highways (MoRTH). (2013). Specifications for Road and Bridge
Reference Books:	
1	Kadiyali, L. R., & Lab, N. B. (2012). Principle and Practices of Highway Engineering. Khanna
2	Khanna, S. K., & Justo, C. E. G. (2011). Highway Engineering. Khanna Publishers.

SUBJECT	PROGRAM ELECTIVE-II	CREDITS
26AF1922PE603B	Urban Transportation Planning	3

Teaching Workload/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	To understand urbanization, city forms, and their impact on transport demand.
COBJ2	To learn different mass transit systems like BRTS, Metro, and para-transit.
COBJ3	To study transport surveys, data collection, and Traffic Analysis Zones.
COBJ4	To understand transport modeling methods like trip generation and gravity model.
COBJ5	To learn transit performance, routing, scheduling, and freight movement.

Course Outcomes: On completion of course, students will be able to	
CO1	Identify urban transport problems and their relation to city structure.
CO2	Compare and select suitable mass transit systems for urban corridors.
CO3	Conduct transport surveys and organize traffic data for analysis.
CO4	Apply transport models to predict travel demand and patterns.
CO5	Analyze and improve transit operations and urban goods movement.

Course Contents

Module 1	**Fundamentals of Urbanization and Urban Transport Planning**	**Hrs. 6**

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

Module 2	**Urban Mass Transportation Systems and Transit Modes**	**Hrs. 6**

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.

Module 3	**Data Collection and Surveys for Urban Transport Planning**	**Hrs. 8**

Survey and data collection for urban landuse 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.

Module 4	**Travel Demand Modeling and Transportation Analysis**	**Hrs. 6**

Travel demand modeling: Four stage modeling: Factors affecting trip generation, methods of trip generation - zonal regression and cross category /classification analysis, Trip distribution-growth factor methods, gravity model, Desire line diagram. Trip Assignment models, Factors affecting mode choice and route choice. Captive rider and choice rider.

Module 5	Mass Transit Operations and Urban Goods Movement	Hrs. 8
Mass transit systems: Introduction to routing and scheduling, parameters to measure performance of transit system. Corridor identification and corridor screen line analysis. As per developments suitability of transit system. Introduction to goods movement study for urban area. Problems and issues of urban goods movement. Factors affecting goods movement, components of urban goods traffic.		

Text Books:	
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.
Reference Books:	
1	John Black, Urban Transport Planning: Theory and Practice, Routledge.
2	Vukan R. Vuchic, Urban Transit Systems and Technology, Wiley.
3	Sudhakar Yedla, Urban Transportation and the Environment, Springer.

SUBJECT	PROGRAM ELECTIVE-II	CREDITS
26AF1922PE603C	Tunneling & Underground Excavation	3

Teaching Workload/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	To understand types of tunnels and suitable excavation methods based on geology.
COBJ2	To learn drilling, blasting, and mucking operations in tunneling.
COBJ3	To study modern tunneling machines like TBM, road headers, and impact hammers.
COBJ4	To understand challenges and support systems in urban and deep tunnels.
COBJ5	To learn shield tunneling methods like slurry and EPB for soft ground.

Course Outcomes: On completion of course, students will be able to	
CO1	Identify tunnel types and select suitable tunneling methods.
CO2	Understand tunneling operations and required machinery.
CO3	Explain excavation methods for large and deep tunnels.
CO4	Suggest suitable tunneling methods for given conditions.
CO5	Evaluate shield tunneling methods for urban and weak soil conditions.

Course Contents

Module 1	**Tunneling Methods**	**Hrs. 6**
Types and purpose of tunnels; factors affecting choice of excavation technique; Methods - soft ground tunneling, hard rock tunneling, shallow tunneling, deep tunneling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered and remedial measures.		
Module 2	**Tunneling by Drilling and Blasting**	**Hrs. 8**
Unit operations in conventional tunneling; Drilling – drilling principles, drilling equipment, drilling tools, drill selection, specific drilling; Blasting - explosives, initiators, blasting mechanics, blast holes nomenclature; types of cuts- fan, wedge and others; blast design, tunnel blast performance - powder factor, parameters influencing, models for prediction; mucking and transportation equipment selection.		
Module 3	**Tunneling by Road headers and Impact Hammers**	**Hrs. 8**
Cutting principles, method of excavation, selection, performance, limitations and problems. Tunneling by Tunnel Boring Machines: Boring principles, method of excavation, selection, performance, limitations and problems; TBM applications		
Module 4	**Excavation of large and deep tunnels Introduction**	**Hrs. 6**
Purpose and use of large and deep tunnels; excavation issues governing large and deep tunnels; excavation methods of large and deep tunnels - unit operations, different equipment, types of rocks. pressure and methods to deal, roof and wall supports, case studies from hydel, road and rail tunnels.		

Module 5	Shield Tunneling	Hrs. 8
Introduction; advantages of shield tunnelling; classification; different types of shields tunnelling techniques – open shield, close shield, half shield; conventional shields, special features in shield tunnelling; factors affecting selection of a shield; slurry shield, earth pressure balance shield, slime shields, other shield development methods, problems encountered with possible remedies.		

Text Books:	
1	Srinivasan R., (2016). Harbour, Docks and Tunnel Engineering, Charotar Pub. House.
2	Saxena S. C. (2015). Tunnel Engineering, DhanpatRai Publications.
3	Tatiya R. R., (2013), Surface and Underground Excavation, CRC Press.
Reference Books:	
1	John O. Bickel, Thomas R. Kuesel, Elwyn H. King, Tunnel Engineering Handbook, Springer.
2	Dimitrios Kolymbas, Tunnelling and Tunnel Mechanics: A Rational Approach to Tunnelling, Springer.
3	Bernhard Maidl, Markus Thewes, Ulrich Maidl, Handbook of Tunnel Engineering, Wiley.
4	Hasan Tosun, Theory and Practice of Tunnel Engineering, Intech Open.

SUBJECT CODE	PROGRAM ELECTIVE-III	CREDITS
26AF1922PE604A	Geotechnical Engineering	3

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	To understand the fundamental physical and engineering properties of soils and their classification.
COBJ2	To analyse the hydraulic behaviour of soil (permeability and seepage).
COBJ3	To determine the shear strength parameters of soil for stability analysis.
COBJ4	To evaluate the compaction and consolidation characteristics of soil for settlement analysis.
COBJ5	To understand the pressure exerted by soil on retaining structures.

Course Outcomes: On completion of course, students will be able to	
CO1	Identify and classify soils based on their properties.
CO2	Analyze permeability, seepage, and effective stress in soils.
CO3	Determine shear strength parameters using laboratory tests.
CO4	Evaluate compaction, consolidation, and settlement of soils.
CO5	Calculate earth pressure on retaining structures using standard theories.

Course Contents

Module 1	**Module 1: Introduction**	**Hrs. 8**
Definition of soil and soil engineering, Application areas of soil mechanics, Three Phase system, Soil moisture, Soil minerals, Soil structure, Terzaghi's effective stress concept, Effective and neutral pressure		
Module 2	**Soil Consistency**	**Hrs. 10**
Index properties of soil: Different unit weights of soil, and their determination, unit weight of solids, unit weights of soil mass, method for determination of field density viz. sand replacement and core cutter, Specific Gravity determination methods void ratio and porosity, degree of saturation, Inter relation between weight volume state, density indexes, Atterberg's limits and their significance, Soil Classification: Soil classification based on particle size and consistency, I.S. classification system		
Module 3	**Flow of Water Through Soil: Permeability**	**Hrs. 10**
Head, gradient and potential, Darcy's law, Factors affecting permeability, Field and Laboratory methods of determining permeability, Seepage pressure, quick sand condition, Derivation of Laplace equation, Flow net: characteristics& application, construction of flow net, piping phenomenon, Permeability through stratified soil, Discharge and seepage velocity.		
Module 4	**Shear Strength**	**Hrs. 10**
Concept of shear, Coulomb's theory and failure envelope, Principle stress, stress analysis (Total stress approach and effective stress approach), representation of stresses on Mohr's circle for different types		

of soil such as cohesive and cohesionless, saturated and partly saturated soil etc, Application of shear stress parameters in the field, Different types of shear tests: Unconsolidated undrained, Consolidated undrained and consolidated drained choice of the type of test, box shear test, triaxial compression test with pore pressure and volume change measurement, Unconfined compression test, vane shear test		
Module 5	**Compressibility of Soils**	**Hrs. 10**
Theory of compaction, factors influencing compaction, compacted density, Laboratory Standard and modified compaction test, Method and measurement of field compaction, Field compaction control Consolidation Compressibility: Definition, compressibility of laterally confined soil, compression of sand and clay, e-p and e-log p curve, compression index. Consolidation: Terzaghi's theory of one dimensional consolidation, consolidation test, determination of coefficient of consolidation, degree of consolidation, relevance of one dimensional consolidation to field condition, time factor Earth Pressure Theories: Earth pressure at rest, active and passive conditions, Elementary idea about Rankin's and Coulomb's earth pressure. Graphical methods for active earth pressure.		

Text Books:	
1	Kasamalkar B. J., "Geotechnical Engineering", Pune Vidyarthi Griha Prakashan Pune
2	Murthy V.N.S., "Soil Mechanics & Foundation Engineering", U.B.S. Publishers and Distributors N. Delhi
3	Punmia B.S., "Soil Mechanics & Foundation Engineering", Laxmi Publications
4	Arora K. R., "Soil Mechanics" Standard Publishers, N. Delhi
5	Gopal R Rao "Basic Soil Mechanics"
Reference Books:	
1	Alam Singh, "Text book of soil mechanics in theory and practice", Asian Pub. House, Mumbai
2	Taylor D.W., "Fundamentals of Soil mechanics"
3	Terzaghi and Peak "Soil mechanics" John Willey and Sons, New-York
4	Scott R. F., "Principal of soil mechanics"

SUBJECT CODE	PROGRAM ELECTIVE-III	CREDITS
26AF1922PE604B	Soil Mechanics & Foundation Engineering	3

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	To understand soil mechanics, soil structure, and index properties.
COBJ2	To determine Atterberg's limits and classify soils for engineering use.
COBJ3	To calculate shear strength parameters and perform shear tests.
COBJ4	To apply effective stress concepts to analyze soil behaviour.
COBJ5	To evaluate slope stability and determine factors of safety.

Course Outcomes: Students will be able to	
CO1	Understand different soil properties and behaviour
CO2	Understand stresses in soil and permeability and seepage aspects.
CO3	Understand different types foundations
CO4	Analyze the stability of slope
CO5	Aalyzes factor of safety for soil slopes.

Course Contents

Module 1	**Introduction**	**Hrs. 6**

Introduction to Soil Mechanics: Definition of soil and soil engineering, Application areas of soil mechanics, Three Phase system, Soil moisture, Soil minerals Soil structure, Terzaghi's effective stress concept, Effective and neutral pressure. Introduction to Foundation Engineering: General requirements to be satisfied for satisfactory performance of foundations, Soil exploration: Necessity, Planning, Exploration Methods, Soil Sampling Disturbed and undisturbed.

Module 2	**Soil Consistency**	**Hrs. 8**

Index properties of soil: Different unit weights of soil, and their determination, unit weight of solids, unit weights of soil mass, method for determination of field density viz. sand replacement and core cutter, Specific Gravity determination methods void ratio and porosity, degree of saturation, inter relation between weight volume state, density indexes, Atterberg's limits and their significance, Soil Classification: Soil classification based on particle size and consistency

Module 3	**Shear Strength**	**Hrs. 8**

Concept of shear, Coulomb's theory and failure envelope, Principle stress, stress analysis (Total stress approach and effective stress approach), representation of stresses on Mohr's circle for different types of soil such as cohesive and cohesionless, saturated and partly saturated soil etc, Application of shear stress parameters in the field, Different types of shear tests: Unconsolidated undrained, Consolidated undrained and consolidated drained choice of the type of test, box shear test, triaxial compression test with pore pressure and volume change measurement, Unconfined compression test, vane shear test.

Module 4	Foundation	Hrs. 8
Shallow Foundations: Assumptions & Limitations of Rigid Design Analysis, Safe Bearing Pressure, Settlement of Footings, Design of isolated, Combined, Strap Footing (Rigid analysis), Raft Foundation (Elastic Analysis), I. S. Code of Practice for Design of Raft Foundation Deep foundations: Pile Foundation: Classification, Pile Driving, Load Carrying Capacity of Piles, Single Pile Capacity, Dynamic Formulae, Static Formulae, Pile Load Tests, Penetration Tests, Negative skin Friction, Under Reamed Piles		
Module 5	**Slope Stability**	**Hrs. 6**
Different Definitions of Factors of Safety, Types of Slope Failures, Stability of an Infinite Slope of Cohesion less Soils, Stability Analysis of an Infinite Slope of Cohesive Soils, Stability of Finite Slopes- Slip Circle Method, Semi Graphical and Graphical Methods, Friction Circle Method, Stability Number: Concept and its use		

Text Books:	
1	Arora K.R., "Soil Mechanics and Foundation Engineering", Standard publication 2009
2	Murthy V.N.S., "Soil Mechanics & Foundation Engineering", U.B.S. Publishers and Distributors N. Delhi
3	Punmia B.C., "Soil Mechanics & Foundation Engineering", Laxmi Publications
4	Kasamalkar B. J., "Geotechnical Engineering", Pune Vidyarthi Griha Prakashan Pune
5	Nayak N.V., "Foundation Design Manual", Dhanpat Rai And Sons
6	Brahma S.P., "Foundation Engineering", Tata McGraw-Hill 5th Edition
Reference Books:	
1	Alam Singh, "Text book of soil mechanics in theory and practice", Asian Pub. House, Mumbai
2	Taylor D.W., "Fundamentals of Soil mechanics"
3	Terzaghi and Peak "Soil mechanics" John Willey and Sons, New-York
4	Teng W.C., "Foundation Design", Prentice-Hall Inc
5	Tomlinson M.J., "Foundation Design & Construction", Prentice-Hall; 7th edition
6	Lee, "Sheet Piles" Concrete Publication,1961

SUBJECT CODE	Industrial Waste Management				CREDITS		
26AF1922PC605					3		
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	Explain the sources, characteristics, and classification of industrial wastewater.
COBJ2	Understand the environmental impacts of industrial effluent disposal on water bodies, land, and ecosystems.
COBJ3	Describe treatment objectives, strategies, and techniques for industrial wastewater management.
COBJ4	Illustrate manufacturing processes and wastewater generation in major industries.
COBJ5	Explain concepts of Effluent Treatment Plants (ETP), CETP, environmental legislation, and management practices.

Course Outcomes: Students will be able to	
CO1	Explain the characteristics and classification of industrial wastewater.
CO2	Assess the impacts of industrial effluent disposal on environment and public health.
CO3	Analyze and develop treatment strategies and flow sheets based on wastewater characteristics.
CO4	Apply appropriate treatment methods for removal of pollutants from industrial wastewater.
CO5	Evaluate and apply concepts of ETP, CETP, environmental regulations, and sustainable management practices.

Course Contents

Module 1	**Introduction**	**Hrs. 6**

Water use in industry, Industrial water quality requirements, Deterioration of water quality, Classification and characterization of Industrial wastewater, Standards of Disposal, Monitoring of wastewater flow, Quality and quantity variations in waste discharge. Liquid wastes from industries – their volumes and characteristics, Effect of disposal into natural water courses, Municipal sewers and on land, River standards and effluent standards. Designated Water Quality Standards, Type of samples- Grab and Composite.

Module 2	**Treatment objectives and strategies**	**Hrs. 6**

Waste Volume reduction, Strength reduction techniques, Segregation, proportioning, Waste Neutralization methods for acidic and alkaline waste, Equalization tank- online and offline, design problem. Recycle, reuse and byproduct recovery, Concept of Zero liquid Discharge (ZLD)

Treatment objectives and strategies, Treatment techniques for removal of specific pollutants in industrial wastewaters, e.g., oil and grease, cyanide, fluoride, calcium, magnesium, toxic organics, heavy metals, radioactivity.

Module 3	**Manufacturing processes for industries**	**Hrs. 6**

Manufacturing process flow sheets along with sources and characteristics of wastewater for various industries sugar, Distillery, Textile, Tannery, Paper and pulp mill, dairy, Fertilizer, steel mill, power

plant etc. Development of Treatment flowsheets based on characteristics of industrial wastewater. Industrial wastewater Treatment alternatives (Treatment Flowsheets) for above listed industries Dewatering and disposal of sludge – floatation, vacuum filtration, centrifugation, filter press and membrane filters.

Module 4	**Effluent Treatment Plants**	**Hrs. 6**

Water pollution control act and Environmental Protection act - organizational set up of central and state boards for water pollution control, other important provisions. Classification of river on water use, minimal national standards, socio-economic aspects of water pollution control. Modern Trends in Environmental Engineering, Cleaner Production Technologies, Environmental Bio-Technology, Bioremediation. Common Effluent Treatment Plants (CETPs): Concept, Need, Objectives, Methodology, grouping of industries, Location, Design, Operation and Maintenance Problems and Economical aspects.

Module 5	**Treatability and environmental aspects**	**Hrs. 6**

Treatability index, Population equivalent, Treatability aspects of raw industrial wastewater with domestic sewage, partially treated industrial wastewater with domestic sewage, completely treated industrial wastewater with domestic sewage. Stream and effluent standards, Introduction to Water Quality Index (WQI) Introduction to environmental impact assessment and environmental audit. ISO 14000- introduction, how it is helpful to industries. Importance of Environmental management plan and environmental monitoring plan, Consent to operate and consent to establish.

Text Books:	
1	Metcalf and Eddy,1995, Wastewater Engineering - Collection, Treatment, Disposal and Reuse,McGraw Hill Pub. Co.
2	Nelson Leonard Nemerow,2007 Industrial Waste Treatment, Butterworth-Heinemann,
3	Nelson Nemerow, Theories and Practices of Industrial waste treatment
4	M. N. Rao & Datta. Waste water treatment:IS Standard guide for treatment and disposal of various industries.
5	Industrial Waste Treatment: Contemporary Practice and Vision for the Future
Reference Books:	
1	Woodard, F., Industrial Waste Treatment Handbook, Butterworth-Heinemann, Woodard & Curran Numerson, N.L., Liquid Waste from Industry – Theories, Practice and Treatment

SUBJECT CODE	Design of Concrete Structures Lab						CREDITS
26AF1922PCL607							1
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	50	-	50	100

Course Objectives:	
COBJ1	To develop skills in analysis and design of RCC structures.
COBJ2	To understand design of foundations such as footings, raft, and pile foundations.
COBJ3	To learn design of special structures like retaining walls, staircases, and water tanks.
COBJ4	To prepare reinforcement detailing drawings using manual and CAD methods.
COBJ5	To apply basic computer tools like MS Excel for structural design calculations.

Course Outcomes: On completion of course, students will be able to	
CO1	Identify and interpret design requirements of RCC structural elements. (Remembering/Understanding)
CO2	Analyze structural behavior under various loading conditions. (Analyzing)
CO3	Design RCC components as per IS 456 provisions. (Applying/Creating)
CO4	Create detailed structural drawings using manual and CAD tools. (Creating)
CO5	Justify design choices and evaluate structural safety and serviceability. (Evaluating)

Course Contents

Term work shall consist of detailed analytical report for structural design and drawing of the following RC structures:

A (Compulsory)	Design and detailing of G+1 RCC framed structure.
B (Any one of the listed)	The introduction, analysis and design of these topics shall be studied in self-study mode. If required the subject teacher should address the student's queries during tutorials). 1) Retaining wall 2) Elevated water tank: analysis and design of staging and tank body. 3) Staircase of special form such as helicoidal stair 4) Shell roofs : simple cylindrical, conical shells 5) Special foundation type such as combined footing, raft, pile foundation
Use of computer programs such as MS Excel is desirable for post-processing of results.	

SUBJECT CODE	PROGRAM ELECTIVE-II LAB	CREDITS
26AF1922PEL608A	Highway Engineering Lab	1

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Objectives:	
COBJ1	To understand properties and testing of aggregates used in construction.
COBJ2	To evaluate characteristics of bitumen for pavement works.
COBJ3	To perform standard laboratory tests for road construction materials.
COBJ4	To assess strength and durability of materials like aggregates and soil.
COBJ5	To understand the suitability of materials for pavement design.

Course Outcomes: On completion of course, students will be able to	
CO1	Evaluate stone samples based on IRC specifications for pavement use.
CO2	Classify bitumen grades and select suitable types for different climates.
CO3	Determine safe heating and mixing limits of bituminous materials.
CO4	Relate poor test results with pavement failures like rutting and potholes.
CO5	Interpret CBR values and calculate pavement thickness requirements.

Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal. Practical examination shall be based on above.

Experiment No.1	To determine crushing strength of given aggregate sample
Experiment No.2	To estimate the aggregate impact value of given sample
Experiment No.3	To determine the abrasion value of given aggregate sample by conducting Los -Angeles's abrasion test.
Experiment No.4	To determine the penetration value of the given bitumen sample
Experiment No.5	To determine the softening point of the given bitumen sample.
Experiment No.6	To determine the flash and fire point of given bitumen sample
Experiment No.7	To determine the viscosity of given bitumen sample by Tar Viscometer
Experiment No.8	To determine the ductility value of the given bitumen sample
Experiment No. 9	To determine California bearing ratio of representative soil sample

SUBJECT CODE	PROGRAM ELECTIVE-II LAB	CREDITS
26AF1922PEL608B	Urban Transportation Planning Lab	1

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Objectives:	
COBJ1	To understand traffic data collection methods like surveys and volume counts.
COBJ2	To analyze travel patterns using origin-destination and desire line mapping.
COBJ3	To develop trip generation models based on survey data.
COBJ4	To evaluate performance of public transport systems.
COBJ5	To understand basic concepts of traffic network analysis and trip assignment.

Course Outcomes: On completion of course, students will be able to	
CO1	Conduct field surveys and apply expansion factors for traffic analysis.
CO2	Check and validate survey data using screen line analysis.
CO3	Prepare OD matrices and desire line diagrams to study travel patterns.
CO4	Use regression methods to predict future travel demand.
CO5	Analyze efficiency and operational performance of mass transit systems.

Course Contents

Practical Work consists of performing experiments from list below and detailed reporting in form of journal. Practical examination shall be based on above.

Experiment No.1	Roadside Interview & Volume Count: Conduct a roadside interview (intercept survey) to collect trip origin-destination data and perform simultaneous volume counts to establish a "Screen Line" check.
Experiment No.2	Household Travel Survey (HIS); Design and execution of a digital or paper-based questionnaire for a specific "Traffic Analysis Zone" (TAZ) to capture socio-economic data and trip generation rates.
Experiment No.3	Desire Line Mapping: Using data from Exp. 1 & 2, students will represent spatial travel demand between zones by plotting "Desire Lines" with widths proportional to trip volumes.
Experiment No.4	Trip Generation Modeling: Statistical analysis of survey data to develop a Zonal Regression model, identifying how variables like income or vehicle ownership affect trip frequency.
Experiment No.5	Public Transit Performance Analysis: Field study of a local BRTS or Metro station to measure boarding/alighting rates, dwell times, and frequency to calculate the line's actual capacity vs. theoretical capacity.
Experiment No.6	Network Coding & Trip Assignment; A desktop exercise where students "code" a simplified urban road network (nodes and links) and manually assign trips using the "All-or-Nothing" or "User Equilibrium" principle.

SUBJECT CODE	PROGRAM ELECTIVE-II LAB	CREDITS
26AF1922PEL608C	Tunneling & Underground Excavation Lab	1

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Objectives:	
COBJ1	To understand basic concepts of tunnel excavation and drilling techniques.
COBJ2	To analyze performance of tunneling machines and cutting tools.
COBJ3	To study material handling and excavation cycle operations in tunneling.
COBJ4	To evaluate ground behavior and settlement using simulation tools.
COBJ5	To understand properties of materials and forces involved in tunneling operations.

Course Outcomes: On completion of course, students will be able to	
CO1	Design safe blasting operations by calculating hole patterns and explosive requirements.
CO2	Analyze TBM and Road header performance based on rock conditions.
CO3	Maintain face stability in soft ground tunneling using proper pressure balance methods.
CO4	Optimize mucking and hauling operations for efficient excavation.
CO5	Evaluate the suitability of shallow tunneling methods like pipe jacking and jacked box techniques.

Course Contents

Practical Work consists of performing experiment from list below and detailed reporting in form of journal. Practical examination shall be based on above.

Experiment No.1	To design a drill-hole layout (Wedge or Fan cut) for a specific tunnel face area and calculate the required Powder Factor.
Experiment No.2	To calculate the Penetration Rate and Disc Cutter wear based on provided rock strength (UCS) and machine torque data.
Experiment No.3	To simulate the "Unit Operations" cycle, calculating the number of dumpers/conveyors needed to keep pace with excavation speed.
Experiment No.4	A software-based experiment (e.g., using PLAXIS or RS2) to predict ground settlement above a "Cut and Cover" or Shield tunnel.
Experiment No.5	To test the properties of bentonite slurry used in Slurry Shields, focusing on viscosity and sand content for face stability.
Experiment No.6	To simulate the shallow tunneling process using a scaled model to measure the jacking force required to push a pipe through different soil types.

SUBJECT CODE	PROGRAM ELECTIVE-III LAB	CREDITS
26AF1922PEL609A	Geotechnical Engineering Lab	1

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Objectives:	
COBJ1	To determine physical properties of soil such as specific gravity and grain size distribution.
COBJ2	To evaluate consistency and classification of soils using Atterberg limits.
COBJ3	To study permeability and compaction characteristics of soil.
COBJ4	To analyze shear strength of soil using different laboratory tests.
COBJ5	To understand consolidation behavior and field density of soils.

Course Outcomes: On completion of course, students will be able to	
CO1	Determine different engineering properties of soil
CO2	Identify and classify soils based on standard geotechnical engineering practices
CO3	Perform laboratory compaction and in-place density tests
CO4	Perform and interpret direct shear tests and estimate shear strength parameters
CO5	Ability to assess consolidation and field density of soils.

Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal. Practical examination shall be based on above.

Experiment No.1	Specific gravity determination of course and fine-grained soil
Experiment No.2	Particle size distribution: a. Mechanical sieve analysis b. Wet sieve analysis
Experiment No.3	Determination of Atterberg's consistency limits
Experiment No.4	Permeability: Determination of coefficient of permeability
Experiment No.5	Field density determination
Experiment No.6	Direct shear box test
Experiment No.7	Proctor compaction test
Experiment No.8	Triaxial test
Experiment No. 9	Unconfined compression test
Experiment No. 10	One-dimensional consolidation test

SUBJECT CODE	PROGRAM ELECTIVE-III LAB	CREDITS
26AF1922PEL609B	Soil Mechanics & Foundation Engineering Lab	1

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Objectives:	
COBJ1	To understand basic properties of soil such as moisture content and specific gravity.
COBJ2	To perform grain size analysis and classify different types of soil.
COBJ3	To study consistency limits and permeability characteristics of soil.
COBJ4	To evaluate compaction and field density of soil.
COBJ5	To analyze shear strength and consolidation behavior of soil.

Course Outcomes: On completion of course, students will be able to	
CO1	Determine different Engineering properties of soil.
CO2	Identify and classify soils based on standard Geotechnical Engineering practices.
CO3	Perform Laboratory compaction and in-place density tests.
CO4	Perform and interpret direct shear tests and estimate shear strength parameters.
CO5	Determine the compressibility parameters, coefficient of consolidation and pre-consolidation pressure of saturated cohesive soils.

Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal. Practical examination shall be based on above.

Experiment No.1	Determination of moisture content & specific gravity
Experiment No.2	Field density test
Experiment No.3	Grain Size analysis – Sieve analysis & Hydrometer analysis
Experiment No.4	Determination of Atterberg's consistency limit
Experiment No.5	Determination of coefficient of permeability – Constant & Falling Head
Experiment No.6	Procter compaction test
Experiment No.7	Vane Shear Test
Experiment No.8	Direct shear box test
Experiment No. 9	Tri-axial test
Experiment No. 10	Unconfined compression test
Experiment No. 11	One dimensional consolidation test

SUBJECT CODE	Seminar	CREDITS
26AF1922EL610		1

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Objectives	
COBJ1	Identify technical / practical problems in the field of civil engineering.
COBJ2	Inculcate the ability to describe, interpret and analyze technical content.
COBJ3	Develop competence in preparing report which will enhance critical thinking and
COBJ4	To develop presentation and communication skills.
COBJ5	To analyze and interpret technical information effectively.

Course Outcomes: On completion of course, students will be able to	
CO1	Appraise the current civil engineering research / techniques / developments / interdisciplinary areas.
CO2	Review and organize literature survey utilizing technical resources, journals etc.
CO3	Evaluate and draw conclusions related to technical content studied.
CO4	Demonstrate the ability to perform critical writing by preparing a technical report.
CO5	Develop technical writing and presentation skills.

Guidelines for seminar work

1	The seminar report should include the following elements. Internal guides may use a continuous evaluation sheet for each student, which will contribute to the term work assessment.
2	**Introduction:** Background of the selected topic, its relevance to civil engineering, the need for the study, objectives, and scope along with any limitations.
3	**Literature Review:** Summary and analysis of literature from books, journals, conference papers, technical reports, and other scholarly documents—preferably from the last five years.
4	**Theoretical Content:** Core subject matter related to the topic, including models, equations, methods, or relevant case studies.
5	**Conclusion:** Final observations, outcomes of the study, and potential future scope.
6	**References:** Properly cited sources used throughout the seminar report.

Guidelines for Assessment

Examination: The students must prepare presentation on seminar topic and present in Presence of pair of examiners through a viva-voce examination.

SUBJECT CODE	Project Phase-I	CREDITS
26AF1922EL611		2

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	4	4	50	-	50	100

Course Objectives	
COBJ1	To identify a real-world civil engineering problem.
COBJ2	To conduct detailed literature review and problem formulation.
COBJ3	To define project objectives, methodology, and expected outcomes.
COBJ4	To develop preliminary design / experimental / analytical framework.
COBJ5	To prepare a comprehensive project proposal report.

Course Outcomes: On completion of course, students will be able to	
CO1	Identify and define a research/industry problem in Civil Engineering.
CO2	Conduct critical literature review using reputed journals (Scopus, SCI, etc.).
CO3	Develop methodology and work plan for the project.
CO4	Perform preliminary analysis/design/experimental planning.
CO5	Prepare and present a technical project proposal.

Guidelines for Project Phase-I	
Project work can be done in a group of students. (Min2-Max.4.)	
1	**Problem Identification:** Students shall select a suitable project topic from any specialization of Civil Engineering and obtain approval of the topic and project title from the allotted guide. A clear and well-defined problem statement must be prepared.
2	**Literature Review:** A comprehensive review of at least **10–15 research papers** from reputed journals shall be conducted. Based on the review, research gaps must be identified and a comparative analysis table should be prepared.
3	**Project Planning:** The objectives and scope of the project shall be finalized. An appropriate methodology (Experimental / Analytical / Numerical / Field-based) must be defined along with a detailed work schedule.
4	**Preliminary Work:** Preliminary activities such as pilot study, experimental setup design, software modelling framework, and material procurement planning shall be carried out as applicable.
5	**Documentation and Presentation:** The synopsis/report and presentation must be completed within the stipulated time.
Internal guides may use a continuous evaluation sheet for each student, which will contribute to the term work assessment. ***Project dairy must be maintained with guide to keep the records of students-guide interactions during the semester***.	

Guidelines for Assessment

Panel of staff members along with a guide will assess the project phase -I work based on these parameters-

Topic, Contents and Presentation, regularity, Punctuality and Timely Completion, Question and Answers, Report, Paper presentation/Publication, Attendance and Active Participation.

Following evaluation criteria can be used as a guideline

Component	**Marks**
Literature Review	20
Problem Formulation	15
Methodology & Planning	20
Seminar Presentation	20
Report Quality	25
Total	**100**