Course Curriculum

Third Year

B. Tech. in Civil & Infrastructure 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
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Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for Third Year B. Tech.

Civil & Infrastructure Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	ISE	MSE	ESE	Total	
Semester-V										
1	26AF1918PC501	Design of Steel Structures	3	0	0	20	20	60	100	3
2	26AF1918PC502	Bridge &Tunnel Engineering	3	0	0	20	20	60	100	3
3	26AF1918PC503	Concrete Technology	3	0	0	20	20	60	100	3
4	26AF1918PC504	Geotechnical Engineering	3	0	0	20	20	60	100	3
5	26AFARPOE505	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	26AF1918PCL507	Design of Steel Structures Lab	0	0	2	25	-	25	50	1
8	26AF1918PCL508	Concrete Technology Lab	0	0	2	25	-	25	50	1
9	26AF1918PCL509	Geotechnical Engineering Lab	0	0	2	25	-	25	50	1
10	26AF1918HM510	Soft Skills Development	0	2	0	-	-	-	AU	GR
11	26AF1918VS511	Construction Equipment and Site Safety Management	0	2	0	50	-	50	100	2
		TOTAL	**18**	**4**	**6**	**245**	**120**	**485**	**900**	**23**
Semester-VI										
1	26AF1918PC601	Design of Concrete Structures	3	0	0	20	20	60	100	3
2	26AF1918PE602	Program Elective-I	3	0	0	20	20	60	100	3
3	26AF1918PE603	Program Elective -II	3	0	0	20	20	60	100	3
4	26AF1918PE604	Program Elective-III	3	0	0	20	20	60	100	3
5	26AF1918PC 605	Foundation Engineering	3	0	0	20	20	60	100	3
6	Refer Bucket	Multi-Disciplinary Minor-IV	3	0	0	20	20	60	100	3
7	26AF1918PCL607	Design of Concrete Structures Lab	0	0	2	50	-	50	100	1
8	26AF1918PEL608	Program Elective-II- Lab	0	0	2	25	-	25	50	1
9	26AF1918PEL609	Program Elective-III- Lab	0	0	2	25	-	25	50	1
10	26AF1918EL610	Seminar	0	0	2	25	-	25	50	1
11	26AF1918 EL611	Project Phase-I	0	0	4	50	-	50	100	2
		TOTAL	**19**	**0**	**8**	**295**	**120**	**485**	**900**	**24**

Course Type	Course Code	Course Name
Program Elective-I	26AF1918PE602A	Airport Engineering
	26AF1918PE602B	Integrated Region and Smart City
Program Elective-II	26AF1918PE603A	Railway Engineering
	26AF1918PE603B	Pavement Design and Management
Program Elective-III	26AF1918PE604A	Intelligent Transportation Systems
	26AF1918PE604B	Advanced Traffic Management Systems

Course Type	Course Code	Course Name
Open Elective-III	26AF1ARPOEM05H	Material Testing Engineering
	26AF1ARPOEM05O	Ropeway Engineering
	26AF1ARPOEM05P	Road Safety Audits
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	Building Materials & Composites	02	00	00	02	02
2	Design of Masonry Structures	02	00	00	02	02
3	Energy Efficient Buildings	02	00	00	02	02
4	Advanced Surveying	03	00	00	03	03
5	Modern Surveying	03	00	00	03	03
6	Material Testing Engineering	03	00	00	03	03
7	Ropeway Engineering	03	00	00	03	03
8	Road Safety Audits	03	00	00	03	03

PROGRAM ELECTIVE COURSE

Sr.No.	Course Offered	Teaching Scheme (Hrs)				Credits
		L	T	P	TOTAL	
1	Airport Engineering	03	00	00	03	03
2	Integrated Region and Smart City	03	00	00	03	03
3	Railway Engineering	03	00	00	03	03
4	Pavement Design and Management Environment	03	00	00	03	03
5	Intelligent Transportation Systems	03	00	00	03	03
6	Advanced Traffic Management Systems	03	00	00	03	03
7	Infrastructure Planning	03	00	00	03	03
8	Port & Harbour Engineering	03	00	00	03	03
9	Industrial Waste water Management	03	00	00	03	03
10	Professional Practices	03	00	00	03	03
11	Construction Cost Analysis	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 & INFRASTRUCTURE ENINGEERING
(other than B.Tech. in Civil & Infrastructure Engineering program students)

Semester	Subject Code	Subject Name	Total Credit
SEM-III	25AF1918MD306	Introduction to Engineering Geology	3
SEM-III	25AF1918MD306A	Urban Transportation Planning	3
SEM-IV	25AF1918MD406	Highway Engineering	3
SEM-V	25AF1918MD506	Concrete Technology	3
SEM-VI	25AF1918MD606	Engineering Economics and Project Management	3
SEM-VII	25AF1918MD706	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 & Infrastructure Engineering program students)

Semester	Subject Code	Subject Name	Total Credit
SEM-III	25AFMDPLAN306A	Site Planning	3
SEM-III	25AF1918MD306	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 & Infrastructure Engineering

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3	26AF1918PC503	Concrete Technology	3	0	0	20	20	60	100	3
4	26AF1918PC504	Geotechnical Engineering	3	0	0	20	20	60	100	3
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8	26AF1918PCL508	Concrete Technology Lab	0	0	2	25	-	25	50	1
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		TOTAL	**18**	**4**	**6**	**245**	**120**	**485**	**900**	**23**

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Open elective-III	26AF1ARPOEM05H	Material Testing Engineering
	26AF1ARPOEM05O	Ropeway Engineering
	26AF1ARPOEM05P	Road Safety Audits
Multi-Disciplina Minor-III	Refer Bucket	Refer Bucket
Multi-Disciplina 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
26AF1918PC501							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 Mechanics, Mechanics of Solids

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	Bridge &Tunnel Engineering						CREDITS
26AF1918PC502							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:	
COBJ 1	To understand the fundamentals, planning, and site selection of bridges.
COBJ 2	To study standard bridge loadings and design codes for road and railway bridges.
COBJ 3	To learn the analysis and design of bridge superstructures and substructures.
COBJ 4	To understand the principles and methods of tunnel engineering.
COBJ 5	To study modern tunneling methods and tunneling equipment.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain bridge classification, planning, and hydrological considerations.
CO2	Apply standard loading and design provisions for bridge structures.
CO3	Understand the design concepts of bridge superstructures, substructures, and foundations.
CO4	Describe different tunnel excavation methods and supporting systems.
CO5	Explain drilling, blasting, TBM, and other modern tunneling techniques.

Course Contents

Module 1	**Introduction**	**Hrs. 8**

History of bridges, components and definitions, classification of road bridges, span length, history of analysis, Survey and alignment, geotechnical investigations and interpretations River Bridge: Selection of bridge site and planning, collection of bridge design data, hydrological calculation, waterway calculation, scour calculation, depth of foundation, freeboard. Road Bridge: Selection of bridge site and planning, collection of bridge design data, vertical clearance.

Module 2	**Standard loading for bridge design as per different codes**	**Hrs. 8**

Road Bridges: IRC, BS code, AASHTO code. dead load, live load, impact factor, centrifugal force, wind loads, hydraulic forces, longitudinal forces, seismic forces, earth pressure, buoyancy, lane concept, equivalent loads, traffic load, width of roadway and footway, use of influence lines for maximum forces in members, transverse distribution of live loads among deck longitudinal, load combinations for different working state and limit state designs.

Railway Bridges: Loadings for railway bridges, rail road data, pre-design considerations, rail road v/s highway bridges.

Module 3	Superstructures & Substructure	Hrs. 8

Selection of main bridge parameters, design methodologies, choices of superstructure types: orthotropic plate theory, load distribution techniques, grillage analysis, finite element analysis (Preferable), different types of superstructures (RCC and PSC), Longitudinal analysis of bridge, slab bridge and voided slab bridge, beam-slab bridge, box girder bridge.

Different types of bridge bearings and expansion joints, Design of bearings and joints. Parapets for highway bridges: Definitions, classification of bridge parapets, various details Substructure: Pier, abutment, wing walls, importance of soil structure interaction Foundations: open foundation, pile foundation, well foundation, examples - simply supported bridge, continuous bridge

Module 4	Tunnel Engineering	Hrs. 8

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 5	Tunneling methods	Hrs. 8

Tunneling by Drilling and Blasting: 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. Tunneling by Road headers and Impact Hammers: 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.

Text Books:

1	D.J. Victor, Essentials of Bridge Engineering, Oxford & IBH Publishing Co. Pvt. Ltd.
2	S. Ponnuswamy, Bridge Engineering, McGraw Hill Education.
3	N. Krishna Raju, Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd.
4	Saxena S. C. (2015). Tunnel Engineering, DhanpatRai Publications
5	Srinivasan R., (2016). Harbour, Docks and Tunnel Engineering, Charotar Pub. House

Reference Books:

1	Raina V K, "Handbook for Concrete Bridges" Vol. 1 and 2, Shroff Publishers, Mumbai
2	Raina V. K., Concrete Bridge Practice, (Analysis, Design Economics), 4th Edition, Shroff Publishers, Mumbai
3	Raina V. K., "World of Bridges", Shroff Publishers, Mumbai
4	Stack, B. (1982). Handbook of Mining and Tunnelling Machinery, Wiley, New York
5	Bickel J.O. and. Kuesel T.R, (2018). Tunnel Engineering Handbook, CBS Publishers and Distributors Pvt. Ltd

SUBJECT CODE	Concrete Technology						CREDITS
26AF1918PC503							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 Learn about different ingredients of concrete.
COBJ2	Understand the manufacturing of concrete
COBJ3	To Learn about use of concrete as per type of construction.
COBJ4	Understand behavior of concrete after casting.
COBJ5	To learn about increasing strength of concrete.

Course Outcomes: Students will be able to	
CO1	Understand the various types and properties of ingredients of concrete
CO2	Understand the fresh properties of fresh concrete.
CO3	Understand effect of admixtures on the behavior of the fresh and hardened concrete.
CO4	Understand the fresh properties of harden concrete.
CO5	Formulate concrete design mix for various grades of concrete.

Course Contents

Module 1	**Ingredients of Concrete**	**Hrs. 6**
Cement-manufacturing process, physical properties, hydration of cement, hydration products, chemical compounds in cement, types of cement, Aggregates- classification of aggregates, physical properties, mechanical properties, fineness and gradation of aggregates using sieve analysis, tests on aggregates. Water-specifications of water to be used for concert, quality of water for use in concrete,		
Module 2	**Properties of Fresh Concrete**	**Hrs. 6**
Nominal mix concrete, types of batching, mixing, transportation, placing including pumping and compaction techniques, workability, factors affecting workability, methods of measuring workability, segregation and bleeding, setting time, curing of concrete, types of curing, temperature effects on fresh concrete.		
Module 3	**Properties of Harden Concrete**	**Hrs. 6**
Desired properties of concrete, strength, durability, characteristic strength, compressive, tensile and flexure strength		

of concrete, stress-strain relationship tests on concrete, modulus of elasticity, effect of w/c ratio and admixtures on strength, creep and shrinkage of concrete, durability of concrete: minimum & maximum cement content, strength & durability relationship, exposure to different conditions, factors contributing to cracks in concrete, sulphate attack, alkali aggregate reaction.		
Module 4	**Admixtures &** Special **concretes**	**Hrs. 6**
Admixtures -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. Special concretes – Lightweight concrete and its types, self-compacting concrete, high density concrete, fiber reinforced concrete, High Strength Concrete, High Performance concrete, geo-polymer concrete and Ferrocement technique.		
Module 5	**Concrete Mix Design**	**Hrs. 6**
Factors Governing Mix Design, Methods of Mix Design. factors affecting the mix design, Methods of Expressing Proportions, Trial Mixes, Acceptance Criteria, Factors Causing Variations, Quality Measurement in Concrete Construction, Non-destructive Testing of Concrete-rebound hammer test, ultrasonic pulse velocity test.		

Text Books:	
1	Gambhir M. L. “Concrete Technology”, Tata Mc-Graw Hill 2015 15th edition
2	Shetty M. S. “Concrete Technology”, S. Chand 2005
3	Krishnaswamy, “Concrete Technology”, Dhanapat Rai and Sons
Reference Books:	
1	Orchard, “Concrete Technology”, Applied Science Publishers
2	Neville A. M., “Concrete Technology”, Pearson Education
3	Neville A. M., “Properties of Concrete”, Pearson Education
4	Relevant Publications by Bureau of Indian Standards, New Delhi
5	Latest revisions of IS:10262, IS:456, IS 4926

SUBJECT CODE	Geotechnical Engineering	CREDITS
26AF1918PC504		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 index properties of soil and its classification.
COBJ2	To study the mechanics of compaction and clay mineralogy.
COBJ3	To learn the concept of permeability and dewatering.
COBJ4	To know how to evaluate the quantity of seepage discharge.
COBJ5	To study the shear strength of soil

Course Outcomes: Students will be able to	
CO1	Classify soil based on index properties of soil.
CO2	Explain the principal of compaction and demonstrate quality control in field.
CO3	Determine the permeability of soil and explain methods of dewatering.
CO4	Evaluate the quantity of seepage discharge and design criteria of graded filter.
CO5	Measure the shear strength of different types of soil using various methods.

Course Contents

Module 1	**Introduction**	**Hrs. 10**

History of development of soil mechanics, formation of soil, its significance to the field problems. Soil properties and its classification, Definition of soil, soil as a three-phase system, weight volume relationship, Index properties of course and fine-grained soil, BIS classification of fine grained and coarse-grained soil.

Module 2	**Compaction of Soil**	**Hrs. 7**

Mechanics of compaction, factors affecting compaction, standard and modified Proctor test, their field Determination, zero air void line, concept of wet of optimum and dry of optimum, different structures of soil, field compaction and their control, CBR test and CBR values for soaked and unsoaked conditions.

Module 3	**Permeability of Soil**	**Hrs. 7**

Darcy's law and its validity, discharge and seepage velocity, factors affecting permeability, determination of coefficient of permeability in laboratory and field, permeability for stratified soil deposits, drainage and dewatering of soil and its various methods.

Module 4	**Shear Strength and Seepage Analysis**	**Hrs. 10**

A physical concept of shear strength, introduction of Mohr's stress diagram, Mohr's failure criteria, Mohr-Coulomb's theory and development of failure envelopes, unconfined compression test, laboratory measurement

of shear strength for different drainage conditions by direct shear test, triaxial test, merits and demerits of various shear strength tests. Laplace equation and its derivation in Cartesian coordinate system, its application for the computation of discharge seepage, seepage pressure, quick sand condition, concept of flow net, characteristics and uses of flow net, preliminary problem of discharge, estimation of discharge through homogenous earthen embankment, Terzaghi's design criteria for graded filter, concept of piping and criteria of stability against piping		
Module 5	**Stresses in soils**	**Hrs. 7**
State of stress at a point, stress distribution in soil mass, Boussinesq's theory and its applications, point load and uniformly loaded area, Newmark's Influence Chart, its preparation and use. Consolidation of Soil: Definition, Spring analogy, Terzaghi's theory of one-dimensional consolidation, Consolidometer test,		

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	Dr. B.C.Punmia A.K.Jain, "Soil Mechanics and Foundations" Laxmi Publications(P)Ltd
6	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"
5	Lambe T.W, "Soil Testing" by Willey Eastern Ltd., New Delhi

SUBJECT CODE	OPEN ELECTIVE-III	CREDITS
26AF1ARPOEM05H	Material Testing 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 basic properties and behavior of engineering materials.
COBJ2	To study various civil engineering materials and their applications.
COBJ3	To learn the characteristics and uses of composite materials.
COBJ4	To understand modern construction materials and techniques.
COBJ5	To study material testing methods and testing equipment.

Course Outcomes: Students will be able to	
CO1	Explain the physical and mechanical properties of engineering materials.
CO2	Identify and describe the applications of civil engineering materials.
CO3	Compare conventional and composite construction materials.
CO4	Understand modern construction techniques and sustainable materials.
CO5	Perform and interpret destructive and non-destructive material tests.

Course Contents

Module 1	**Basic Properties of Materials**	**Hrs. 8**

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. some basic properties of materials such as temperature, energy, specific heat, thermal conductivity, coefficient of thermal expansion, mechanical properties of metals, stress, strain modulus of elasticity, stress-strain behavior, elastic and plastic deformations, elastic properties of materials, tensile properties, ductility, resilience and toughness, compressive, shear and torsional deformation, hardness. Variability of material properties.

Module 2	**Civil Engineering Materials**	**Hrs. 8**

introduction to cement and concrete, uses of cement, strength of cement and concrete ,sand, coarse aggregates, mortar and grouts, masonry mortars, rendering, cementitious grouts, RCC, clay bricks ,calcium silicate bricks, concrete blocks., rubbles, steel , steel grades, 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, bituminous materials, binder properties, binder mixtures, asphalt mixture.

Module 3	**Composite Materials**	**Hrs. 6**

RCC, FRC, steel/concrete composite bridge decks, fiber reinforced plastics structural insulated panels. Comparison

of Different Materials, Introduction, comparison of strengths of various materials, comparison for environmental impact, health and safety.		
Module 4	**Modern Construction Techniques**	**Hrs. 6**
Introduction,3D printing, photo catalytic admixture, self-healing concrete, zero cement concrete, hemp lime, wood-glass epoxy composites, bamboo.		
Module 5	**Material Testing**	**Hrs. 8**
Machines and Equipment Requirements---Necessity of material testing, various testing methods, destructive tests, classification of destructive tests---static, impact and cyclic testing, non-destructive testing—its classification, visual inspection, penetration test, magnetic detection, ultrasonic test, radiography test and spark test. Types of testing machines, UTM and CTM, force and displacement controlled machines, loading frames. Hardness testing machines, fracture tests.		

Text Books:	
1	Deodhar S.V. (1990) Civil Engineering Materials' Allied Publishers, N. Delhi.
2	RangwalaS.C. (1983) Civil Engineering Materials', DhanpatRai and Sons, N. Delhi.
Reference Books:	
1	B.I.S., 1980, "National Building Code of India', ISI, New Delhi.
2	Handbook of Material Testing, Indian Railways Institute of Civil Engineering,Pune

SUBJECT CODE	OPEN ELECTIVE-III	CREDITS
26AF1ARPOEM05O	Ropeway 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 history, types, and components of ropeway systems.
COBJ2	To study the design principles and requirements of ropeway systems and wire ropes.
COBJ3	To learn the design of ropeway towers, foundations, and anchorage systems.
COBJ4	To understand planning, construction, operation, and maintenance of ropeways.
COBJ5	To study quality control, material testing, and safety provisions in ropeway systems.

Course Outcomes: Students will be able to	
CO1	Explain the types, components, and applications of ropeway transport systems.
CO2	Apply basic design principles for wire ropes and ropeway systems.
CO3	Understand the design concepts of ropeway towers and foundations.
CO4	Describe the construction, installation, and maintenance procedures of ropeways.
CO5	Understand safety measures and quality control practices in ropeway systems.

Course Contents

Module 1	**Introduction**	**Hrs. 8**

Historical background of ropeway transport, types of ropeways and their components, surface ropeway for passengers, aerial ropeway for passengers & goods gravity ropeway for goods, socio-economic and technical study, topographic study and engineering survey, geological and geotechnical study.

Module 2	**Design of ropeway system**	**Hrs. 8**

General design requirements and design provisions. Wire-Rope Design: Introduction to wire-ropes and their specifications loads on wire-rope wire-rope geometry deformation of wire-rope and its calculation nonlinear behavior of wire-rope and its analysis & design.

Module 3	**Design of Towers**	**Hrs. 6**

Design of Towers, design of tower foundation and wire-rope anchorage, Introduction to electro-mechanical system design, rate analysis, cost estimate, estimating and costing of gravity goods ropeway.

Module 4	**Ropeway Maintenance**	**Hrs. 6**

Planning, construction and maintenance of ropeway system construction planning setting out construction equipment transportation, handling and hoisting of wire-rope construction, installation and maintenance test operation and commissioning

Module 5	Safety Provisions	Hrs. 4
Quality Control and Safety, material testing, safety measures.		

Text Books:	
1	Aerial ropeways and funicular railways — ZBIGNIEW SCHINEIGET, Pergsmon press, Oxford London
2	M. Kazakevitch. Zakora, "Cable Stabilization for Wind and Moving Load Effect", Journal of Wind Engineering and Industrial Aerodynamics (1998)
3	Technical Guidelines for Gravity Goods Ropeway; Do LIDAR, Ministry of Local Development Gyawali, D. & Dixit, A, "Ropeways in Nepal",
4	Technical Brief Gravity Ropeway, Practical Action Nepal
Reference Books:	
1	IS 9706:1997, IS code for aerial ropeway for transport of material
2	IS 5229:1998, IS code for aerial ropeway for transport of passengers
3	Approved code of practice for passenger ropeways in New Zealand, 1998

SUBJECT CODE	OPEN ELECTIVE-III	CREDITS
26AF1ARPOEM05P	Road Safety Audits	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 and importance of road safety engineering.
COBJ2	To study road safety legislation, planning, and safe road design principles.
COBJ3	To learn accident data analysis, risk assessment, and safety evaluation methods.
COBJ4	To understand road safety audit procedures and highway safety measures.
COBJ5	To study road crash investigation and factors affecting road accidents.

Course Outcomes: Students will be able to	
CO1	Explain the concepts, importance, and measures of road safety engineering.
CO2	Apply safe road design principles for roads and intersections.
CO3	Analyze accident data and evaluate road safety measures.
CO4	Conduct road safety audits and identify highway blackspots.
CO5	Understand crash investigation procedures and causes of road accidents.

Course Contents

Module 1	**Introduction**	**Hrs. 6**
Road safety in India – an overview, international road safety comparison, road traffic injury as a public health problem, traffic safety legislations and enforcement, education and road safety (non-engineering measures), Planning for network, land use and road environment for safety.		
Module 2	**Designing for safety**	**Hrs. 6**
Designing for safety, road Link designs, junctions, accident and injury data recording, statistical issues in road safety, risk assessment models, speed and safety, evaluation of safety measures, highway safety (roadside hazard management), highway construction zone safety.		
Module 3	**Urban roads**	**Hrs. 6**
Safe urban roads and traffic calming at intersections, pedestrian safety and vulnerable road users (VRUs), variables influencing driver speed, ITS and asset management, road accident costing prehospital care, urban road safety audit, highway blackspots identification highway blackspot inspection.		
Module 4	**Road safety audit**	**Hrs. 6**
Road safety audit process, design stage road safety audit, road safety audit in road works & pre-opening safety audit, safety audit of existing roads, road safety audit checklists, audit of construction site, most frequent problems, experiences in other countries, benefits of road safety measures what works and what does not work.		

Module 5	Road crash investigation	Hrs. 6
Introduction to road crash investigation: The importance of crash investigation for road safety, crash causation–causes, the relationship between crashes and traffic offences, definitions, investigations and prosecutions, series of events, pre-crash, crash, and post-crash factors, the human element, perception and reaction, crash reporting and its importance for predictive policing and engineering interventions.		

Text Books:	
1	IRC: SP:88-2019, "Manual on road safety audit", Indian Roads Congress Aug 2019.
2	M Practical Road Safety Auditing, 3rd edition by Martin Belcher, Steve Proctor, Phil Cook, ICE Publishing USA.
3	Importance of Road Safety in India, by Lok Sabha Secretariat Link - http://164.100.47.193/Refinput/New_Reference_Notes/English/Road_Safety.pdf
4	Road Safety and Traffic Management Policies, Regulations and Strategies by D P Gupta Link - http://tripp.iitd.ac.in/assets/newsimage/1-RoadSafetyPresentation-August2018.pdf
Reference Books:	
1	Advancing Road Safety in India Implementation is the key by National Institute of Mental Health and Neuro Sciences Bengaluru - 560 029, India Link - https://nimhans.ac.in/wp-content/uploads/2019/02/UL_BR_b007_Summery-rprt.pdf
2	Road Safety in India: Status Report 2020 by Dinesh Mohan, Geetam Tiwari, Kavi Bhalla, Transportation Research & Injury Prevention Programme, Indian Institute of Technology Delhi. Link - http://tripp.iitd.ac.in/assets/publication/Road_Safety_in_India2018.pdf

SUBJECT CODE	Design of Steel Structures Lab	CREDITS
26AF1918PCL507		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 Outcomes: On completion of course, students will be able to	
CO1	Illustrate the geometric and dimensional characteristics of various structural steel sections, types of trusses, and types of structural connections through detailed engineering drawings.
CO2	Analyze and design industrial shed structures using portal or gable frame systems with appropriate bracing, purlins, columns, and base plates, considering practical loading conditions.
CO3	Evaluate the structural behavior of trussed roof systems with bracing and perform detailed design of purlins, columns, and column bases for industrial applications.
CO4	Design gantry girders along with supporting columns, bracings, and associated structural elements for industrial sheds subjected to moving loads from cranes.
CO5	Analyze and design structural systems involving composite steel–RCC construction with emphasis on load-sharing behavior, member design, and detailing.

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: Plate Girder, 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	Concrete Technology Lab	CREDITS
26AF1918PCL508		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 Outcomes: Students will be able to	
CO1	Analyze the properties of concrete and their verification.
CO2	Calculate different parameters for fresh concrete.
CO3	Understand properties of aggregates.
CO4	Design concrete mix.
CO5	Learn testing of concrete.

Course Contents

Practical Work consists of at least eight to 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	Geotechnical Engineering Lab	CREDITS
26AF1918PCL509		1

2 hours / week				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	25	-	25	50

Course Outcomes: On completion of course, students will be able to	
CO1	Determine basic physical properties of soils for classification.
CO2	Evaluate soil compaction characteristics using Proctor tests.
CO3	Measure in-situ density and bearing capacity of soils.
CO4	Assess soil permeability and consolidation for drainage and settlement.
CO5	Analyze soil shear strength parameters for stability analysis.

Course Contents

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

Experiment No 1	To find out specific gravity of soil solids by Pycnometer Method
Experiment No 2	Determination of moisture content by oven drying method
Experiment No 3	To detect field density of the soil by core cutter method
Experiment No 4	To ensure grain size distribution by mechanical sieve analysis.
Experiment No 5	To work out Atterberg's limits (LL, PL and SL)
Experiment No 6	To determine compaction properties by Standard Proctor Test
Experiment No 7	To figure out of permeability of soil by using falling head test
Experiment No 8	To decide shear strength parameters by direct shear test.
Experiment No 9	To find out shear strength by unconfined compressive strength test.
Experiment No 10	To determine of shear strength parameters by Triaxial shear test.
Experiment No 11	Determination of C.B.R. value by conducting laboratory CBR test. (soaked/unsoaked)
Experiment No 12	To decide Coefficient of consolidation by conducting consolidation test
Experiment No 13	To work out Compaction properties of soil by modified proctor test
Experiment No 14	To determine permeability of soil by using constant head method
Experiment No 15	To analyze the stability of an earth slope using GEO5's Slope Stability module, determine the Factor of Safety (FOS) using Bishop's Simplified Method, and study the influence of soil shear strength parameters (cohesion c and angle of internal friction φ) on slope stability.
Use of computer programs such as MS Excel is desirable for post-processing of results.	

SUBJECT CODE	Soft Skills Development						CREDITS
26AF1918HM510							AU
Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	2	0	2	-	-	-	GR

Course Objectives	
COBJ1	To inculcate soft skills so that students can work efficiently in the corporate sector and government organisations.
COBJ2	To provide knowledge of conflict management while working in large organisations
COBJ3	To develop management skills required in routine work environment
COBJ4	To polish the personality of the learners in order to make them good leaders and employees
COBJ5	To imbibe qualities like manners and etiquettes, coordination, mutual understanding for their colleagues while working in a group.

Course Outcomes: On completion of course, students will be able to	
CO1	Learners will acquire interpersonal communication skills
CO2	Learners will develop the ability to work independently
CO3	Learners will develop the qualities like self-discipline, self-criticism and self-management
CO4	Learners will have the qualities of time management and discipline
CO5	Learners would be able to present themselves as an inspiration for others

Course Contents

Module 1	**Introduction to Soft Skills and Personality Development**	**Hrs. 8**
Introduction to Soft Skills, Need of Soft Skills, New Approach to Learning, Human Perceptions: Understanding People, Types of Soft Skills: Self-Management Skills, Interpersonal Skills, what is Personality, Personality Development.		
Module 2	**Self-Management & Self-Management Techniques**	**Hrs. 8**
Self-Management, Stress Management: Types of Stress: Self-Awareness about Stress, Regulating Stress: Making The Best out of Stress, Self-Evaluation, Self- discipline, Self-criticism, Recognition of one's own limits and deficiencies, dependency, etc. - Self-Awareness, Self-Management, identifying one's strengths and weaknesses, Planning & Goal setting, Managing self-emotions, ego, pride		
Module 3	**Interpersonal Skills Development**	**Hrs. 5**
Positive Relationship, Positive Attitudes, Empathies: comprehending others' opinions, points of views, and face them with understanding, Mutuality, Trust, Emotional Bonding, Handling Situations (Interview), Importance of interpersonal skills, Creative Thinking, Critical Thinking.		

Module 4	Problem Solving Techniques	Hrs. 5
Conflict Resolution Skills: Seeking Win-Win Solution (Negotiation Skills), Inter-Personal Conflicts: Two Examples, Inter-Personal Conflicts: Two Solutions, Types of Conflicts: Becoming a Conflict Resolution Expert		
Module 5	**Motivation/ Inspiration and Motivation Techniques**	**Hrs. 5**
Ability to shape and direct working methods according to self-defined criteria, Ability to think for oneself, apply oneself to a task independently with self-motivation, Motivation techniques based on needs and field situations, Leadership and Team Dynamics.		

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.

SUBJECT CODE	Construction Equipment and Site Safety Management			CREDITS
26AF1918VS511				2

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	2	0	2	50	-	50	100

Course Objectives	
COBJ1	To understand the classification, selection, and cost analysis of construction equipment.
COBJ2	To study earthmoving and material handling equipment used in construction.
COBJ3	To learn road construction and concreting equipment and their applications.
COBJ4	To understand construction site safety practices and hazard management.
COBJ5	To study safety laws, regulations, and safety management systems in construction projects.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain the types, selection criteria, and cost aspects of construction equipment.
CO2	Describe the operation and applications of earthmoving and material handling equipment.
CO3	Understand the use of road construction and concreting equipment in projects.
CO4	Apply construction safety measures and emergency response procedures.
CO5	Understand safety regulations, audits, and safety management systems in construction.

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 & Infrastructure Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	ISE	MSE	ESE	Total	
Semester-VI										
1	26AF1918PC601	Design of Concrete Structures	3	0	0	20	20	60	100	3
2	26AF1918PE602	Program Elective-I	3	0	0	20	20	60	100	3
3	26AF1918PE603	Program Elective -II	3	0	0	20	20	60	100	3
4	26AF1918PE604	Program Elective-III	3	0	0	20	20	60	100	3
5	26AF1918PC 605	Foundation Engineering	3	0	0	20	20	60	100	3
6	Refer Bucket	Multi-Disciplinary Minor-IV	3	0	0	20	20	60	100	3
7	26AF1918PCL607	Design of Concrete Structures Lab	0	0	2	50	-	50	100	1
8	26AF1918PEL608	Program Elective-II- Lab	0	0	2	25	-	25	50	1
9	26AF1918PEL609	Program Elective-III- Lab	0	0	2	25	-	25	50	1
10	26AF1918EL610	Seminar	0	0	2	25	-	25	50	1
11	26AF1918 EL611	Project Phase-I	0	0	4	50	-	50	100	2
		TOTAL	**19**	**0**	**8**	**295**	**120**	**485**	**900**	**24**

Course Type	Course Code	Course Name
Program Elective-I	26AF1918PE602A	Airport Engineering
	26AF1918PE602B	Integrated Region and Smart City
Program Elective-II	26AF1918PE603A	Railway Engineering
	26AF1918PE603B	Pavement Design and Managemer
Program Elective-III	26AF1918PE604A	Intelligent Transportation Systems
	26AF1918PE604B	Advanced Traffic Management Systems

Course Type	Course Code	Course Name
Open Elective-III	26AF1ARPOEM05H	Material Testing Engineering
	26AF1ARPOEM05O	Ropeway Engineering
	26AF1ARPOEM05P	Road Safety Audits
Multi-Disciplina Minor-III	Refer Bucket	Refer Bucket
Multi-Disciplina 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
26AF1918PC601		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
26AF1918PE602A	Airport Engineering	3

Teaching Work Load/week (Hrs.)				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	03	20	20	60	100

Course Objectives	
COBJ1	To understand the history, development, and classification of airports and air transport systems.
COBJ2	To study airport planning, site selection, and airport elements.
COBJ3	To learn runway and taxiway design principles and configurations.
COBJ4	To understand airfield pavement design, grading, and drainage systems.
COBJ5	To study terminal planning, air traffic control, and airport visual aids.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain the fundamentals and classification of airports and air transport systems.
CO2	Apply airport planning concepts and site selection criteria.
CO3	Understand runway and taxiway design requirements and layouts.
CO4	Describe airfield pavement, drainage, and maintenance systems.
CO5	Understand terminal planning, air traffic control, and airport lighting systems.

Course Contents

Module 1	**Introduction**	**Hrs. 6**
History, development, policy of air transport, aircrafts, aerodromes, air transport authorities, air transport activities, air crafts and its characteristics, airport classifications as per ICAO. .		
Module 2	**Airport Planning and Elements**	**Hrs. 8**
Airport Planning: Regional planning-concepts and advantages, location and planning of airport as per ICAO and FAA. Airport Master plan, Airport site selection, Zoning laws, **Airport Elements** -airfield, terminal area, zoning laws, classification of obstructions, approach zone, turning zone, airport capacity, runway capacity, estimation of future air traffic, development of new airport, requirements of an ideal airport layout.		
Module 3	**Run Way Design**	**Hrs. 8**
Run Way Design: Wind rose and orientation of runway, wind coverage and crosswind component, factors affecting runway length, basic runway length and corrections to runway length, runway geometrics and runway patterns (configurations), Runway marking, threshold limits cross section of runway.		

Taxiway Design: Controlling factors, taxiway geometric elements, layout, exit taxiway, location and geometrics, holding apron, turnaround facility.		
Module 4	**Airfield Pavement, Grading and Drainage**	**Hrs. 8**
Aprons: locations, size, gate positions, aircraft parking configurations and parking systems, hanger-site selection, planning and design considerations, Fuel storage area, blast pads. Wind direction indicator. LCN system of Pavement Design, **Airfield Pavement:** Failures, Maintenance and Rehabilitation. **Grading and Drainage:** Airport grading-importance, operations, airport drainage aims, functions, special characteristics, basic requirements, Deign of drainage - surface and subsurface drainage systems,		
Module 5	**Air Traffic Control and Terminal**	**Hrs. 8**
Terminal Area: Elements and requirements, terminal building functions, space requirements, location planning concepts, vehicular parking area and circulation network. **Air Traffic Control and Visual Aids:** Need of Air traffic control, Air traffic control network, Air traffic control aids: landing information system, airport markings and lighting.		

Text Books:	
1	Dr. S. K. Khanna, M.G.Arora and S.S. Jain, "Airport Planning & Design", Nem Chand & Bros.
2	G.V. Rao, "Airport Engineering", Tata McGraw Hill Pub. Co., New Delhi 6.
3	S.C. Rangwala, P. S. Rangwala,"Airport Engineering", Charotar Publishing House Pvt. Ltd,
4	Robert Horonief, Francis X. McKelvey, William J. Sproule, Seth B. Young, "Planning & Design of Airports", Mc Graw Hill Publication.
Reference Books:	
1	Seth Young, Alexander T. Wells, "Airport Planning & Management", Macgraw Hill Professionals
2	Norman J. Ashford, Saleh Mumayiz, Paul H. Wright, "Airport Engineering: Planning, Design and Development of 21st Century Airports", John Wiley & Sons
3	Richard de Neufville, Amedeo Odoni, "Airport System: Planning, Design and Management", Mc Graw Hill Education.

SUBJECT CODE	Program Elective-I	CREDITS
26AF1918PE602B	Integrated Region and Smart City	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 concept, need, and infrastructure requirements of smart cities.
COBJ2	To study planning and development of sustainable smart city infrastructure.
COBJ3	To learn intelligent transportation systems and smart mobility concepts.
COBJ4	To understand water resource management and sanitation systems in smart cities.
COBJ5	To study infrastructure management systems and smart city policies in India and worldwide.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain the concepts, objectives, and challenges of smart cities.
CO2	Understand planning and development aspects of smart city infrastructure.
CO3	Describe intelligent transport systems and smart mobility services.
CO4	Apply concepts of sustainable water supply, sewerage, and flood management.
CO5	Understand infrastructure management systems and smart city policies and case studies.

Course Contents

Module 1	**Fundamental of smart city & Infrastructure**	**Hrs. 8**
Introduction of Smart City, Concept of smart city, Objective for smart cities, History of Smart city world and India. Need to develop smart city, Challenges of managing infrastructure in India and world, various types of Infrastructure systems, Infrastructures need assessment		
Module 2	**Planning and development of Smart city Infrastructure**	**Hrs. 6**
Energy and ecology, solar energy for smart city, Housing, sustainable green building, safety, security, disaster management, economy, cyber security, Project management.		
Module 3	**Intelligent transport systems**	**Hrs. 8**
Smart vehicles and fuels, GIS, GPS, Navigation system, traffic safety management, mobility services, E-ticketing.		
Module 4	**Management of water resources and related infrastructure**	**Hrs. 8**
Storage and conveyance system of water, sustainable water and sanitation, sewerage system, flood management, conservation system.		

Module 5	Infrastructure Management system & Policy for Smart city	Hrs. 8
Integrated infrastructure management systems for smart city, Infrastructure management system applications for existing smart city. Worldwide policies for smart city. Government of India - policy for smart city, Mission statement & guidelines, Smart cities in India, Case studies of smart city.		

Text Books:	
1	Smart City on Future Life - Scientific Planning and Construction by Xianyi Li
2	The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities) by Nicos Komninos
3	Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia by Anthony Townsend
4	Grig N.S., Infrastructure engineering and management, Wiley-Interseience
5	Hudson W.R., Haas R., Uddin W., Infrastructure Management, McGraw-Hill
Reference Books:	
1	Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science
2	Mission statement &guidelines on Smart City Scheme". Government of India - Ministry of Urban Development http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines(1).pdf

SUBJECT CODE	Program Elective-II	CREDITS
26AF1918PE603A	Railway 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 fundamentals, development, and importance of railway engineering.
COBJ2	To study railway alignment, track components, and track stresses.
COBJ3	To learn the functions and requirements of rails, sleepers, ballast, and fittings.
COBJ4	To understand the geometric design and resistance to traction of railway tracks.
COBJ5	To study points, crossings, and railway signaling systems.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain the basics, gauges, and importance of railway systems.
CO2	Understand railway alignment, track structure, and stresses on tracks.
CO3	Describe the functions and properties of rails, sleepers, ballast, and fittings.
CO4	Apply geometric design principles for railway tracks and curves.
CO5	Understand points, crossings, and signaling systems used in railways.

Course Contents

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

Introduction: History, Indian Railways, recent developments, Importance of railways

Railway Track Gauge: Different gauges on Indian Railways, affecting factors, Uniformity of gauge loading gauge, construction gauge, Problems caused by change of gauge.

Module 2	**Alignment of Railway lines**	**Hrs. 6**

Alignment of Railway lines: Importance, Basic requirements of an ideal alignment, selection of a good alignment, Rack railway, Survey for track alignment

Track and Track stresses: Components, requirements, Cross section of permanent way, Track modules Forces acting on Track, coning of wheels

Rails: Functions, requirement, types of rails, Standard rail sections, causes of creep, Effects of creep, Measures to reduce creep, bulking, kinks, failure, wear

Module 3	**Track Components**	**Hrs. 6**

Sleeper: Functions, requirements, types of sleepers, sleeper density and spacing of sleepers.

Ballast: Function, requirement, specifications of track ballast.

Track fittings: Fittings and fastening

Module 4	Geometric design of Track	Hrs. 8
Geometric design of Track: Necessity for geometric design, Details of geometric design of track, Track, Gradients, Grade compensation on curves. Degree of Curve, safe speed on curves, Transition curve, Compound curves, Reverse curves, Extra clearance on curves, widening of gauge on curves, vertical curves, cheek rails on curves. and Super elevation **Resistance to Traction:** Resistance to-friction, wave action, speed, track irregularity, wind, gradient, curvature		
Module 5	**Points and crossings & Signalling System**	**Hrs. 8**
Points and crossings: Functions, Turnout, points or switches, Crossings, Gauntleted track, triangle, double junctions, Single slip, double slip **Signal:** Objectives – Classification – Fixed signals – Stop signals – Signalling systems – Mechanical signalling system – Electrical signalling system – System for Controlling Train Movement – Interlocking – Modern signalling Installations.		

Text Books:	
1	Satish Chandra and M.M. Agrawal, "Railway Engineering", Oxford University Press, New Delhi
2	S.C. Saxena and S. P. Arora, "A Text Book of Railway Engineering", Dhanpat Rai & Sons, New Delhi
3	S.C. Rangwala, K.S. Rangwala and P.S. Rangwala, "Principles of Railway Engineering", Charotar Publishing House, Anand.
Reference Books:	
1	Arora S. P. and Saxena, "Railway Engineering", Dhanpat Rai Publishers, New Delhi

SUBJECT CODE	Program Elective-II	CREDITS
26AF1918PE603B	Pavement Design and Management	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 and components of pavement management systems.
COBJ2	To study pavement performance evaluation and distress analysis methods.
COBJ3	To learn pavement safety evaluation and deterioration modeling techniques.
COBJ4	To understand rehabilitation, maintenance, and priority programming of pavements.
COBJ5	To study MEPDG process and implementation of pavement management systems.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain the concepts, functions, and data requirements of pavement management systems.
CO2	Evaluate pavement performance using roughness, structural, and distress data.
CO3	Analyze pavement safety, skid resistance, and deterioration behavior.
CO4	Apply rehabilitation and maintenance strategies for pavement preservation.
CO5	Understand MEPDG design process and implementation of pavement management systems.

Course Contents

Module 1	**Introduction**	**Hrs. 8**

Definition-Components of Pavement Management Systems, Pavement Management Levels and functions: Network and Project levels of PMS Influence Levels-PMS Functions-Function of Pavement evaluation - Requirements of PMS;

Pavement Management Data Needs: Classes of Data Required- Importance of Construction and Maintenance History Data- Importance of Pavement Evaluation;

Inventory Data: Purpose of Inventory Data-Types of Inventory Data -Selection and Referencing of Pavement Management Sections- Collecting and Processing Section and Network Data-Traffic and Truck Load Data.

Module 2	**Pavement Performance**	**Hrs. 6**

Serviceability-Performance Concept - Pavement Roughness - Equipment for Evaluating Roughness - IRI - Relating Roughness to Serviceability - Structural Condition – Non destructive Measurement and Analysis - Deflection Measurements - Ground Penetrating Radar - Destructive Structural Evaluation - Structural Capacity Index Concepts - Network versus Project Level Applications of Structural Capacity Evaluation; Pavement Surface Distress Condition Surveys: Purpose - Manual Methods of Survey - Automated Survey Methods - Types of Distress

Module 3	Pavement Safety Evaluation	Hrs. 8

Major Safety Components - Skid Resistance Evaluation - Basic Concepts of Skid Resistance and the importance of Pavement Texture - Methods of Measuring and Reporting Skid Resistance - Change of Skid Resistance with Time, Traffic and Climate;

Combined Measures of Pavement Quality: Concept – Combined Indexes

Database Management: Introduction - Key Components – Advantages of Integrated Data Base Management - Success Factors for Effective Data Base Management

Pavement Deterioration Models: Clarification of Performance and deterioration Prediction- Parameters to be Predicted - Types.

Module 4	Rehabilitation and Maintenance Alternatives	Hrs. 8

Identification of Alternatives - Pavement Preservation – Decision Process and Expert Systems Approach to identifying Feasible. Alternative - Deterioration Modeling;

Priority Programming: Basic Approaches - Program Period - Functions - Methods - Budget Level Evaluation - Final Program Selection;

Framework for Pavement Design: Introduction - Focus on MEPDG - Structural Response Models - Characterization of Design Inputs - Variability, Reliability & Risk - Generating Alternative Design Strategies

Module 5	MEPDG Process for Pavement Design	Hrs. 8

Introduction - Calibration Issues - MEPDG Software - Levels of Use in the MEPDG - Life cycle pavement management - Principles - Design Inputs – Traffic Inputs - Climate Inputs - Pavement Performance;

MEPDG Rehabilitation of Existing Pavements: Introduction - Suggested Evaluation Data - Design with HMA - Design with PCC

Implementation of Pavement Management Systems: Key Components of Implementation - Role of Construction - Role of Maintenance - Research Management;

HDM-4: Functions - Structure - Program Analysis - Project Analysis;

Costs and Benefits of Pavement Management: Introduction - Quantifiable Benefits - Benefit/Cost of Developing and Using PMS – Examples

Text Books:	
1	Ralph Haas, Ronald W. Hudson and Lynne Cowe Falls, Pavement Asset Management, Scrivener Publishing (Wiley) Co.
2	Ralph Haas and Ronald W. Hudson, Pavement Management System, McGraw Hill Book Co.
Reference Books:	
1	Ralph Haas, Ronald Hudson Zanieswki. Modern Pavement Management, Kreiger Publications
2	Proceedings of North American Conference on Managing Pavement.
3	Proceedings of International Conference on Structural Design of Asphalt Pavements NCHRP, TRR and TRB Special Reports

SUBJECT CODE	Program Elective-III	CREDITS
26AF1918PE604A	Intelligent Transportation Systems	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, objectives, and benefits of intelligent transport systems.
COBJ2	To study telecommunication and information management in ITS.
COBJ3	To learn different functional areas of intelligent transport systems.
COBJ4	To understand user needs and ITS services for transportation management.
COBJ5	To study automated highway systems and their implementation.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain the concepts, history, and applications of intelligent transport systems.
CO2	Understand telecommunication and vehicle communication systems in ITS.
CO3	Describe various ITS functional areas and transportation systems.
CO4	Apply ITS services for traffic, public transport, and emergency management.
CO5	Understand automated highway systems and their practical implementation.

Course Contents

Module 1	**Introduction**	**Hrs. 6**
Definition of intelligent transport system (ITS), History of ITS, Objectives, Benefits, data collection techniques: Detectors, automatic vehicle location, automatic vehicle identification, geographic information system.		
Module 2	**Telecommunication in ITS**	**Hrs. 6**
Importance of telecommunication, information Management, Traffic management centers, vehicle roadside communication, vehicle positioning system.		
Module 3	**Functional areas**	**Hrs. 6**
Traffic management systems, traveller information system, commercial vehicle operations, vehicle control system, public transportation system, rural transportation system.		
Module 4	**User needs and services**	**Hrs. 6**
Travel and traffic management, Public transportation management, electronic payment, commercial vehicle operations, emergency management, advanced vehicle safety systems, information management.		
Module 5	**Automated highway systems**	**Hrs. 6**
Vehicles in platoons, integration of automated highway systems, implementations in developed countries and developing countries.		

Text Books:	
1	Sarkar, P. K. and Jain, A.K., Intelligent Transportation systems. PHI learning Pvt.ltd.
2	Chen P. K., & Miles, J., Recommendations for world road Association (PIARC). Its Hand books
3	Kan Paul Chen, John Miles, ITS Handbook 2000: Recommendations for World Road Association (PIARC), Artech House Publishers. , 2005 publications or the latest
Reference Books:	
1	M A Chowdhary and A Sadek. Fundamentals of Intelligent Transportation systems planning. Artech House Inc.,
2	Bob Williams. Intelligent transportation systems standards. Artech House, London
3	Sussman, J. M., Perspectives on Intelligent Transportation system (ITS), Springer Publishers. , 2005 publications or the latest

SUBJECT CODE	Program Elective-III	CREDITS
26AF1918PE604B	Advanced Traffic Management Systems	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 and importance of traffic engineering and traffic surveys.
COBJ2	To study macroscopic traffic flow characteristics and traffic stream models.
COBJ3	To learn traffic capacity analysis and breakdown phenomena on highways.
COBJ4	To understand traffic signal control and traffic operation management.
COBJ5	To study highway planning concepts and level of service analysis.

Course Outcomes: On completion of course, students will be able to	
CO1	Explain the role of traffic engineering and methods of traffic data collection.
CO2	Analyze traffic flow characteristics and traffic stream behavior.
CO3	Apply capacity analysis and shock wave concepts for traffic studies.
CO4	Understand traffic signal design, control, and operational management.
CO5	Explain highway planning principles and level of service concepts.

Course Contents

Module 1	**Traffic Surveys**	**Hrs. 6**
Role of Traffic Engineering, Road Traffic Administration in India, Laws and Regulations Related to Road Traffic.Statistical Surveys, Traffic Flow Surveillance through Vehicle Detectors, Travel Time Survey, Others		
Module 2	**Macroscopic Traffic Characteristics**	**Hrs. 6**
Traffic Stream Parameters, Basic Speed-Flow-Density Relationships, Traffic Stream Models, Temporal and Spatial Variation of Volume, Time Headway Distributions, Car-Following Theory, Queuing Diagram		
Module 3	**Capacity Analysis and Breakdown Phenomena**	**Hrs. 6**
Definition of Capacity and Prevailing Conditions Affecting Capacity, Bottlenecks and Breakdown Phenomena, Shock Wave Analysis, Traffic Stream Characteristics at Signalized Intersections		
Module 4	**Traffic Signal Control**	**Hrs. 6**
Signal Phasing and Control Variables, Saturation Flow Rate and Lost Times, Fundamentals of Signal Design and Timing, Signal Control Methodologies, Evaluation of Signalization, Design Traffic Volume. Traffic Operation and Demand Management, Assessment of Operational Conditions		
Module 5	**Highway Planning and Level of Service**	**Hrs. 6**
Hierarchical Functions of Highway Systems, Functional Classification as a Design Type, The Level of Service Concept		

Text Books:	
1	Roess, R.P., McShane, W. R. and Prassas, E. S., “Traffic Engineering”, Second Edition, Prentice Hall, New Jersey
2	May, A.D., “Traffic Flow Fundamentals”, Prentice Hall, New Jersey
Reference Books:	
1	O’Flaherty, C.A. (Ed.), “Transport Planning and Traffic Engineering”, Arnold, London.
2	Transportation Research Board, Special Report 209, “Highway Capacity Manual”, National Research Council, Washington, D.C.,

SUBJECT CODE	Foundation Engineering	CREDITS
26AF1918PC605		3

Lectures hours/week				Examination Scheme (Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Objectives	
COBJ1	To introduce soil exploration techniques and their importance in foundation engineering.
COBJ2	To understand and apply bearing capacity and settlement analysis theories.
COBJ3	To address challenges in designing foundations for problematic soils.
COBJ4	To study the design and analysis of shallow and deep foundations.
COBJ5	To examine slope stability and methods for its analysis and improvement.

Course Outcomes: On completion of course, students will be able to	
CO1	To identify and apply appropriate soil exploration and sampling methods.
CO2	Analyze the stability of slope by theoretical and graphical methods.
CO3	To compute bearing capacity and settlements using standard methods.
CO4	To design foundations for expansive, collapsible, and compressible soils.
CO5	To evaluate and design various foundation systems per IS codes.

Course Contents

Module 1	**Introduction**	**Hrs. 8**

General requirements to be satisfied for satisfactory performance of foundations, Soil exploration: Necessity, Planning, Exploration Methods, Soil Sampling Disturbed and undisturbed, Rock Drilling and Sampling, Core Barrels, Core Boxes, Core Recovery, Field Tests for Bearing Capacity evaluation, Test Procedure & Limitations

Module 2	**Bearing Capacity Analysis**	**Hrs. 10**

Failure Modes, Terzaghi's Analysis, Specialization of Terzaghi's Equations, Skempton Values for Nc, Meyerhof's Analysis, I.S. Code Method of Bearing Capacity Evaluation, Effect of Water Table, Eccentricity of load, Safe Bearing Capacity and Allowable Bearing Pressure, Settlement Analysis: Immediate Settlement - Consolidation Settlement, Differential Settlement, Tolerable Settlement, Angular distortion

Module 3	**Foundations for Difficult Soils**	**Hrs. 10**

Guidelines for Weak and Compressible Soils, Expansive soil, Parameters of Expansive Soils, Collapsible Soils and Corrosive Soils, Causes of Moisture changes in Soils, Effects of Swelling on Buildings, Preventative measures for Expansive Soils, Design of Foundation on Swelling Soils, Ground Improvement Methods: for general considerations, for Cohesive Soils, for Cohesionless Soils,

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

Module 4	Deep foundations	Hrs. 8
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, Group Action of Piles, Caissons Foundations: Box, Pneumatic, Open Caissons, Forces, Grip Length, Well Sinking, Practical Difficulties and Remedial Measures Sheet Piles: Classification, Design of Cantilever Sheet Pile in Cohesionless and Cohesive soils. Design of Anchored Sheet Pile by Free Earth Support Method, Cellular Cofferdams: Types, Cell Fill Stability Considerations		
Module 5	**Slope Stability**	**Hrs. 8**
Different Definitions of Factors of Safety, Types of Slope Failures, Stability of an Infinite Slope of Cohesionless 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	Kasamalkar, B.J., "Foundation Engineering", Pittsburgh vintage Grand Prix
2	Murthy V.N.S., "Soil Mechanics and Foundation Engineering", CRC Press 2002
3	Arora K.R., "Soil Mechanics and Foundation Engineering", Standard publication 2009
4	Punmia B. C., "Soil Mechanics and Foundation Engineering", Laxmi publication 16th 2017
5	Nayak N.V., "Foundation Design Manual", Dhanpat Rai and Son
6	Brahma S.P., "Foundation Engineering", Tata McGraw-Hill 5th Edition
7	Bowles J.E., "Foundation analysis & Design", McGraw-Hill Higher Education 5th edition
Reference Books:	
1	Teng W.C., "Foundation Design", Prentice-Hall Inc
2	Tomlinson M.J., "Foundation Design & Construction", Prentice-Hall; 7th edition
3	Lee, "Sheet Piles" Concrete Publication,1961
4	Relevant Publications by Bureau of Indian Standards, New Delhi
5	IS 6403:1981, IS 1904:1986, IS 4091:1979

SUBJECT CODE	Design of Concrete Structures Lab						CREDITS
26AF1918PCL607							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 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
26AF1918PEL608A	Railway 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 Outcomes: On completion of course, students will be able to	
CO1	Conduct and interpret results from aggregate crushing, impact, abrasion, and shape tests to assess their suitability for use in road construction.
CO2	Perform penetration, softening point, ductility, flash & fire point, and viscosity tests to determine the performance characteristics of bituminous materials.
CO3	Assess binder content and stripping value to evaluate mix stability and moisture susceptibility in bituminous mixtures.
CO4	Conduct and analyze Marshall stability tests to evaluate the strength and deformation characteristics of bituminous mixes.
CO5	Gain hands-on experience in executing laboratory tests on aggregates and bitumen, and interpreting results as per relevant IS/ASTM standards.

Course Contents

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

Experiment No 1	Aggregate crushing value test
Experiment No 2	Aggregate impact value test
Experiment No 3	Los Angeles abrasion test
Experiment No 4	Aggregate shape test
Experiment No 5	Penetration test of bitumen
Experiment No 6	Softening point test of bituminous material
Experiment No 7	(a) Flash and fire point test of bituminous material (b) Viscosity test of bituminous material
Experiment No 8	Ductility test of bitumen
Experiment No 9	(a) Determination of binder content of asphalt mix (b) Determination of stripping value of aggregate
Experiment No 10	Marshall stability test of bituminous mix
Use of computer programs such as MS Excel is desirable for post-processing of results.	

SUBJECT CODE	Program Elective-II Lab	CREDITS
26AF1918PEL608B	Pavement Design and Management 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 Outcomes: On completion of course, students will be able to	
CO1	Perform pavement evaluation tests using standard equipment and methods.
CO2	Analyze pavement characteristics such as deflection, roughness, rutting, and skid resistance.
CO3	Design bituminous and concrete mixes using standard procedures and IS codes.
CO4	Apply IRC guidelines and CBR approach in pavement design.
CO5	Compare different pavement types and understand factors affecting pavement performance.

Course Contents

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

Experiment No 1	Grain Size Analysis – Sieve Analysis and Job Mix Calculation
Experiment No 2	Modified Proctor Compaction Test
Experiment No 3	California Bearing Ratio (CBR) Test on Stabilized Soil
Experiment No 4	Unconfined Compressive Strength (UCS) Test on Stabilized Soil
Experiment No 5	Impact Value Test on Aggregates and Shape Test
Experiment No 6	Los Angeles Abrasion Test
Experiment No 7	Water Absorption & Specific Gravity Test
Experiment No 8	Penetration Test and Softening Point Test on Bitumen
Experiment No 9	Ductility Test and Flash and Fire Point Test on Bitumen
Experiment No 10	Bitumen Content by Centrifuge Extractor
Experiment No 11	Design of RAP-Bituminous Mix and Marshall Stability Test
Experiment No 12	Modified Bitumen Performance Testing
Experiment No 13	Moisture Susceptibility Testing of Bituminous Mixes
Experiment No 14	Test on Concrete for Pavement
Use of computer programs such as MS Excel is desirable for post-processing of results.	

SUBJECT CODE	Program Elective-III Lab	CREDITS
26AF1918PE609A	Intelligent Transportation Systems 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 Outcomes: On completion of course, students will be able to	
CO1	Perform pavement evaluation tests using standard equipment and methods.
CO2	Analyze pavement characteristics such as deflection, roughness, rutting, and skid resistance.
CO3	Design bituminous and concrete mixes using standard procedures and IS codes.
CO4	Apply IRC guidelines and CBR approach in pavement design.
CO5	Compare different pavement types and understand factors affecting pavement performance.

Course Contents

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

Assignment No 1	Traffic Data Collection Technologies/ Performance Measures
Experiment No 1	Traffic Data Collection (Remote Traffic Microwave Sensor; Video Analytics) - Active Transportation and Demand Management (ATDM)
Assignment No 2	Advanced Traveler Information System & Forecasting Techniques
Experiment No 2	MATLAB for Traffic Data Forecasting - Macroscopic Traffic Flow Theory Basics
Assignment No 3	Active Traffic Management (ATM) – Variable Speed Limit
Assignment No 4	Active Traffic Management (ATM) – Ramp Metering
Assignment No 5	ITS Evaluation Techniques: Sketchup- Macro-, Meso-, Microsimulations
Use of computer programs such as MS Excel is desirable for post-processing of results.	

SUBJECT CODE	Program Elective-III Lab	CREDITS
26AF1918PE609B	Advanced Traffic Management Systems 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 Outcomes: On completion of course, students will be able to	
CO1	Conduct traffic surveys and collect traffic flow data effectively.
CO2	Analyze traffic characteristics, speed, delay, and volume data.
CO3	Evaluate road safety, parking problems, and signal timing performance.
CO4	Design basic traffic facilities and traffic management solutions.
CO5	Understand advanced traffic management, surveillance, and incident detection systems.

Course Contents

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

Experiment No 1	Collecting data of human and vehicle characteristics and PCU of vehicles coming to institution.
Experiment No 2	Survey on Origin – Destination for the traffic movements coming to institution.
Experiment No 3	Survey on Speed and delay studies for the traffic movements coming to institution.
Experiment No 4	Survey on Volume studies for the traffic movements coming to institution.
Experiment No 5	Design and Model making on traffic facilities.
Experiment No 6	Study on existing signal timings
Experiment No 7	Analysis of road accidents and parking problem.
Experiment No 8	Advance Traffic Management System (ATMS) using AI
Experiment No 9	Study of Video Surveillance System/ Traffic Monitor Camera System (TMCS)
Experiment No 10	Study of Video Incident Detection and Enforcement System (VIDES)
Use of computer programs such as MS Excel is desirable for post-processing of results.	

SUBJECT CODE	Seminar						CREDITS
26AF1918EL610							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 and practical challenges within the field of civil engineering.
COBJ2	Develop the ability to interpret, analyze, and communicate technical information effectively.
COBJ3	Strengthen skills in technical report writing and presentation through critical thinking and structured documentation
COBJ4	Learn referencing and plagiarism avoidance techniques.

Course Outcomes: On completion of course, students will be able to	
CO1	Understand and evaluate ongoing research, advancements, and interdisciplinary applications in civil engineering.
CO2	Conduct and organize a comprehensive literature survey using scholarly resources such as journals, books, and technical documents.
CO3	Analyze and derive conclusions from the selected technical topic.
CO4	Prepare and present a structured technical report demonstrating critical analysis.
CO5	Enhance their technical writing and oral communication 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

Panel of staff members along with a guide will assess the seminar 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.

SUBJECT CODE	Project Phase-I						CREDITS
26AF1918 EL611							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. (Min 2-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**