Course Name: INTELLIGENT TRANSPORTATION SYSTEMS
Course Code: CE-701
(Semester VI)
Category: Minor
Course Broad Category: CORE ENGG (Professional Core Courses)

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1. **Course Prerequisite:**
   Class-XII level knowledge of Physics, Mathematics and Geography; Undergraduate level introductory knowledge of Transportation Engineering.

2. **Course Learning Objectives:**
   i. This course will enable students to have an awareness and scope of transport issues, such as, traffic safety, public transport, advanced vehicle management and control.
   ii. Students will also learn how Intelligent transport systems (ITS) involve the application of information technology and telecommunications to control traffic, inform travellers and drivers, operate public transport, automating payments, handle emergencies and incidents, operate commercial fleets and freight exchange, and automate driving and safety.
3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.
   Evaluation System –
   Attendance
   Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (10 Marks); Continuous Assessment 2 (10 Marks)]
   Mid-Term Exam (30 Marks)- Summative Assessment
   End-Semester Exam (50 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Intelligent Transportation Systems
   Course Code: CE-701
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	42L
1.	Basic elements of intelligent transportation systems (ITS): focusing on technological, systems and institutional aspects. Benefits of ITS -ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), process of video data collection	8L
2.	Telecommunications in ITS – The importance of telecommunications in the ITS system, information management, and traffic management centres (TMC). Vehicle – Road side communication – Vehicle Positioning System.	7L
3.	ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced	7L

Module	Topics	42L
	Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS)	
4.	ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, and Information Management.	8L
5.	Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.	6L
6.	ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS and sustainable mobility, Travel demand management: electronic toll collection, and ITS and road-pricing.	6L

7. References:

Text Book:

- Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House.
- Pradip Kumar Sarkar, Amit Kumar Jain, "Intelligent Transport Systems", PHI Learning Publishers
- Kan Paul Chen, John Miles, "Recommendations for World Road Association (PIARC)" ITS Hand Book 2000.
- Sussman, J. M., "Perspective on ITS", Artech House Publishers, 2005.

Reference Books:

- US Department of Transportation, "National ITS Architecture Documentation", 2007 (CDROM).
- Turban. E and Aronson. J. E, "Decision Support Systems and Intelligent Systems"

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To discuss the historical background and evolution of intelligent transportation systems (ITS).	Discuss	Understand
CO2	To describe the role of ITS and its benefits and challenges in improving the transportation experiences of users and system managers.	Describe	Understand
CO3	To use the engineering applications of ITS and ITS architecture.	Use	Apply
CO4	To appraise the technological requirements and suggest the appropriate systems in various functional areas of ITS	Appraise	Examine
CO5	To execute the knowledge of ITS standards and specifications.	Execute	Apply
CO6	To implement the ITS applications in various transportation modes to improve their safety and efficiency.	Implement	Apply

9. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	2	-	-
4	-	-	2	3	-	-
5	-	-	2	2	3	-
6	-	-	2	2	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	3	-	-	-	-	-	-	-	-	3
CO2	-	-	3	2	-	-	-	-	-	-	-	3
CO3	-	2	3	2	-	-	-	-	-	-	-	2
CO4	-	2	3	3	-	-	-	-	-	-	-	2
CO5	-	2	3	2	-	-	-	-	-	-	-	3
CO6	-	-	3	-	-	-	-	-	-	-	-	3

11. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1
CO2	3	1	1	2
CO3	3	1	1	1
CO4	3	2	1	1
CO5	2	2	1	2
CO6	3	1	1	2

Course Name: PAVEMENT MATERIALS
Course Code: CE-702
(Semester IV)
Category: Major
Course Broad Category: PROGRAM ELECTIVE COURSE

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1. **Course Prerequisite:**
   Class-XII level knowledge of Physics, Mathematics, Numerical Methods and Geography; Undergraduate level introductory knowledge of Transportation Engineering.

2. **Course Learning Objectives:**
   i. The objective of the course is to teach students the essential components and materials used in pavement, and interactions between different materials and layers.
   ii. The course aims to provide students with fundamental tests on pavement materials and to understand their properties.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.
   Evaluation System –
   Attendance
   Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (10 Marks); Continuous Assessment 2 (10 Marks)]
   Mid-Term Exam (30 Marks)- Summative Assessment
   End-Semester Exam (50 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Pavement Materials
   Course Code: CE-702
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	42L
1.	Introduction: Basic road construction materials: Types of basic materials, Suitability of different materials depending on their availability and characteristics, Economic, Environmental, and Social issues of material usage, Life cycle analysis, and its use in design	10L
2.	Soil: Classification; Index & Engineering properties of soil, Properties of sub-grade; Suitability of different type of soil for the construction of highway embankments and pavement layers; Field compaction and control. Introduction to Soil Stabilization: Physical and Chemical Modification: Stabilization with admixtures like cement, lime, calcium chloride, fly ash and bitumen. A critical look at the different laboratory and in-situ procedures for evaluating the mechanical properties of soils viz. CBR, Plate Load test, resilient modulus, DCPT	5L

Module	Topics	42L
3.	Aggregate: Characterization: Origin, classification, properties. Tests and specifications on road aggregates for flexible and rigid pavements. Importance of aggregate gradation problems on Rothfutch's and Critical sieve methods and Shape factor in mix design	7L
4.	Bitumen Binders: Different types, properties and uses, Tests on bitumen, Rheological and pavement performance-related properties, and Criteria for selection of different binders. Marshall Method of mix design, Additives & Modifiers in Bituminous mixes, problems on mix design	7L
5.	Cement: Requirements, design of mix for CC pavement, use of additives, IRC specifications & Tests, joint filler and sealer materials.	7L
6.	The modern trend of using Modified, Sustainable and Environment-friendly materials: Geo-Synthetics: Geo-synthetic clay liner – Construction details – Geo Synthetic Materials – Functions – Property characterization Modified bitumen: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen; Long term and short term aging and its effect on bitumen performance Plastic waste: Types of polymer, the applicability of polymer-based waste product in different layers of pavement	6L

7. References:

Text Book:

- Khanna, S. K., Justo, C. E. G., and Veeraraghavan, A., "Highway Engineering", Nem Chand & Bros
- Huang, Y. H., "Pavement Analysis and Design", Pearson Education, India
- Sustainable Highways, Pavements and Materials: An Introduction" by Kasthurirangan Gopalakrishnan, Createspace Independent Pub

Reference Books:

- "Life Cycle Cost Analysis in Pavement Design-Interim Technical Bulletin", Federal Highway Administration
- "Pavement Engineering: Principles and Practice" by Rajib B Mallick and Tahar El-Korchi, CRC Press

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To identify the engineering properties and characteristics of the different materials that concern the pavement engineer	Identify	Understand
CO2	To use the modern testing techniques of soil, granular and bituminous materials for pavement analysis and design	Use	Apply
CO3	To implement the use of different superlative aggregate tests and requirements	Implement	Apply
CO4	To solve the design mix of rigid pavement	Solve	Apply
CO5	To discuss the relationship between key materials and their properties along with the behavior of pavement component systems.	Discuss	Understand

CO6	To select the proper pavement techniques, the deflection of pavements, and methods of maintenance of pavements.	Select	Evaluate

9. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	2	-	-
4	-	-	2	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	2	2	0	2	2	2	2
CO2	3	2	3	3	2	2	1	0	3	3	2	2
CO3	3	2	3	3	2	2	1	0	3	3	2	2
CO4	3	3	3	3	3	2	3	0	2	2	2	3
CO5	3	3	3	3	3	2	3	0	2	2	3	2
CO6	3	3	3	3	3	2	3	0	2	3	3	2

11. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2
CO2	0	0	0	0
CO3	1	1	1	1
CO4	1	1	1	1
CO5	2	2	2	2
CO6	0	0	0	0

Course Name: TOTAL STATION AND GPS SURVEY
Course Code: CE-703
(Semester VII)
Category: Major
Course Broad Category: PROGRAM ELECTIVE COURSE

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1. **Course Prerequisite:**
   Class-XII level knowledge of Physics, Mathematics, and Geography; Undergraduate level introductory knowledge of Surveying and Geomatics.

2. **Course Learning Objectives:**
   i. The student will learn advanced surveying terms using a total station. Following the concept lecture, there will be hands-on field exercises
   ii. The course aims to provide students with tests to help acquire the practical understanding and basic skills needed to work in the surveying industry
3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.
   Evaluation System –
   Attendance
   Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (10 Marks); Continuous Assessment 2 (10 Marks)]
   Mid-Term Exam (30 Marks)- Summative Assessment
   End-Semester Exam (50 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: TOTAL STATION AND GPS SURVEY
   Course Code: CE-703
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	42L
1.	Introduction to advanced surveying: Concepts, Importance & Necessity of advanced surveying, Study of different surveying methods and instruments, Maps Projections and types, Coordinate Systems and Transformations.	6L
2.	Introduction of GPS: Concepts, Mechanism, and Pre-requirements of the GPS Survey, Coordinate and time systems, Satellite orbital motions, GPS observables, Estimation procedures, Propagation medium, Methods of post-processing GPS data, Instrument handling and setting, Fieldwork, Survey data post-processing, Survey data applications.	6L
3.	Use of GPS in Topographical Survey, Base, Rover, GPS Connections and Settings, Field Work: Point data collection (Easting, Northing, and Height), Electronic Distance Measurement Survey, Area Measurement Survey Height Measurement Survey, Survey Data Post Processing Survey Data Applications.	6L

Module	Topics	42L
4.	Introduction to Total Station: Principle and Function, REM, RDM, Use of Total station for data processing and analysis, Fieldwork: Point data collection (Easting, Northing and Height),	7L
5.	Electronic Distance Measurement Survey, Area Measurement Survey Height Measurement Survey, Survey Data Post Processing, Survey Data Applications.	7L
6.	Reconnaissance – Route surveys for highways, railways and waterways – Hydrographic survey- Tides – MSL – Sounding methods – Three point problem – River surveys – Measurement of current and discharge – Mine surveying Equipment – Weisbach triangle – Tunnel alignment and setting out – Transfer of azimuth – Gyro Theodolite – Shafts and audits - Cadastral survey- Legal – Real – Tax cadastre – Land record system – Settlement procedure – deformation studies.	10L

7. References:

Text Book:

- Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin
- R. Subramanian, Surveying and Levelling, Oxford University Press
- Alfred Leick, GPS satellite surveying, John Wiley & Sons
- Basak, N. N.: Surveying and Levelling, Tata McGraw-Hill Education, Delhi

Reference Books:

- Satheesh, G., Sathikumar, R. and Madhu, N. (2007): Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education, Delhi
- "Textbook of Surveying" by C. Venkatramaiah, University Press Publishers

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To Explain the concepts, importance, and necessity of advanced surveying, including different surveying methods, instruments, and coordinate transformations.	Explain	Understand
CO2	To Use GPS principles for topographical surveying, coordinate determination, and post-processing of survey data.	Use	Apply
CO3	To Operate Total Station for accurate data collection, electronic distance measurement, area and height surveys, and post-processing applications	Operate	Apply
CO4	To Execute reconnaissance and route surveys for highways, railways, and waterways, including hydrographic surveys and river current measurements.	Execute	Apply
CO5	To Organize mine surveying techniques, including tunnel alignment, transfer of azimuth, and the use of specialized equipment.	Organize	Analyze
CO6	To Demonstrate cadastral surveys for legal, tax, and land records, incorporating settlement procedures and deformation studies for land management.	Demonstrate	Apply

9. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	1	1	1	1
2	2	3	2	1	1	1
3	2	2	3	2	1	1
4	-	-	2	3	-	-
5	-	-	-	2	3	-
6	-	-	-	-	2	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**3**
CO2	**3**	**3**	**2**	**2**	**3**	**1**	**2**	**1**	**2**	**2**	**2**	**3**
CO3	**3**	**3**	**3**	**2**	**3**	**1**	**2**	**1**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**2**	**2**	**2**	**3**
CO5	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**3**
CO6	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**

11. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	2	3	2	2
CO3	2	3	3	2
CO4	2	2	3	2
CO5	2	2	3	1
CO6	2	2	2	3

Course Name: AIR AND NOISE POLLUTION CONTROL

Course Code: CE-704

(Semester VII)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE- 5 (PE)

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1. **Course Prerequisite:**
   Biology and Environmental Science; Undergraduate level knowledge of Statistics and Environmental Engineering

2. **Course Learning Objectives:**
   i. To develop an understanding of air pollutants, their sources, classification, and effects on human health, vegetation, and materials, while analyzing atmospheric phenomena such as photochemical smog, ozone layer depletion, acid rain, greenhouse effect, and global warming
   ii. To familiarize students with air and noise pollution measurement techniques, air quality standards, and control methods, including the design of pollution mitigation strategies for gaseous and particulate pollutants, noise pollution assessment, and regulatory compliance.
3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.
   Evaluation System –
   Attendance
   Internal Assessment (40 Marks)- Continuous Internal Assessment [Continuous Internal Assessment 1 (20 Marks); Continuous Internal Assessment 2 (20 Marks)]
   End-Semester Examination (60 Marks)- 60% of End-Semester Examination (100 Marks).

4. **Course Content:**
   Course Name: Air and Noise Pollution and Control
   Course Code: CE-704
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	42L
1.	Air Pollutants Sources; Classification; Effects on Human, Vegetation, Material Effects of Air pollution on Atmosphere: Photochemical Smog, Ozone Layer Depletion, Acid Rain, Greenhouse Effect and Global Warming	6L
2.	Air Pollutants Dispersion and Meteorology Point Source Gaussian Plume Model, Stability Classes, Stability Charts, Design of Stack Height Harnessing Solar Energy, Sustainable Water utilization in Construction Processes, Rainwater Harvesting and Greywater Recycling, Automatic Controls in Water Supply and Transportation Management.	8L

Module	Topics	42L
	Lapse Rate; Atmospheric Stability; Inversion; Plume Pattern	
3.	Air Quality and Control of Air Pollution Methods of Measurement: Gaseous pollutants, Particulate pollutants Air Quality Standards and Indices: Ambient Air Quality Standard, NAAQS, Emission Standard, Air Quality Indices Control of Gaseous Pollutants: Adsorption, Absorption, Condensation Control of Particulate Pollutants: Settling chambers, Cyclone separators, Wet collectors, Fabric filters, Electrostatic precipitators Control of Pollution from Automobiles	14L
4.	Basics of Noise and Its Measurement Basics of Acoustics; Sound Pressure, Power and Intensity and their Interrelations Noise Level; Interrelation between Noise, Pressure, Power and Intensity Levels; Noise Meter; Noise Networks; Frequency Band Analysis; Decibel Addition Measurement of Community Noise: LN, Leq, Ldn,, LNP	8L
5.	Source and Effect of Noise Psychoacoustics and noise criteria; effects of noise on health; annoyance rating schemes	2L
6.	Noise Pollution Control Noise Standards and Limits; Methods of Noise Pollution Control	4L

7. References:

Reference Books:

- Air Pollution and Control, Keshav Kant, Rajni Kant, Khanna Publishing House
- Environmental Engineering, S.C. Sharma, Khanna Publishing House
- Introduction to Environmental Engineering and Science, Masters, G.M., Ela, W.P., Prentice Hall / Pearson
- Environmental Engineering: A Design Approach., Sincero, A., Sincero, G., Prentice Hall
- Environmental Engineering. Volume-1 and Volume-2., Garg, S.K., Khanna Publishers
- Air Pollution, Rao, M.N., Rao, H.V.N., Tata McGraw Hill

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the basic concepts and terminologies regarding air pollution and noise pollution.	Explain	Understand
CO2	Demonstrate the physics of air pollution and noise pollution.	Demonstrate	Apply
CO3	Use the methods to solve the air pollution and noise pollution measurements.	Use	Apply
CO4	Examine different concepts of air and noise pollution for solving mathematical Problems.	Examine	Analyse
CO5	Examine air and noise quality with allowable standards and limits.	Examine	Analyse
CO6	Select and design proper techniques for air pollution, noise pollution, and control.	Select and Design	Creat

9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	3	3	-	-	-	-
3	-	3	3	3	3	3
4	-	-	3	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	-	2	-	-	-	-	-
CO2	1	2	3		2	-	2	-	-	-	-	1
CO3	1	2	3	2	2	-	2	-	-	-	-	1
CO4	1	2	3	3	2	-	2	-	-	-	-	2
CO5	1	2	2	2	-	-	2	-	-	-	-	-
CO6	1	-	-	-	-	-	2	3	-	-	-	-

11. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1
CO2	3	3	1	2
CO3	3	2	1	2
CO4	3	2	1	3
CO5	2	2	1	2
CO6	3	1	1	2

Course Name: PRESTRESSED CONCRETE
Course Code: CE-712
(Semester VII)
Category: MAJOR
Course Broad Category: ELECTIVE (PE)

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1. **Course Prerequisite:**
   Solid Mechanics, Concrete Technology, Structural Analysis I and II and Design of RC Structures.
   Course Learning Objectives:
   i. The course focuses on different types of loads, and methods used for designing reinforced concrete structural elements, such as beams, slabs, columns, footings, and staircases, while considering serviceability criteria.
   ii. Going through the course students would develop first-hand knowledge in preparing structural drawings, detailing, and producing accurate design calculations in the appropriate professional format for reinforced concrete structures.
2. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.
   Evaluation System –

   Total Marks: 100 [40(CIA) + 60% of (ESE)]
   - CIA 1 (Mid-Semester Evaluation) **20 Marks**
   - CIA 2 [Assignment(Case Studies/ Report writing / Simulations)/Mini- Project /Group Discussions/ Presentations/Open Book test/Quiz] **20 Marks**
   - ESE (Written Examination) Final comprehensive exam of 3hrs., covering the entire syllabus. The paper includes 5 compulsory questions (20 marks each). Each question must contain sub-parts derived from different Course Outcomes (COs). **100 Marks**

3. **Course Content:**
   Course Name: DESIGN OF RC STRUCTURES PRESTRESSED CONCRETE
   Course Code: CE-712
   Hours per Week: 3L-0T-0P
   Credits: 3

Module	Topics	42L
1.	Losses in Prestress: Losses in Prestress - Analysis of PSC flexural members –Basic concepts- Ultimate strength in flexure –Codal provisions. Losses in Prestress: Losses in Prestress –Codal provisions. Deflections of prestressed concrete members.	12L
2.	Shear and Torsional Resistance: Design of Shear Reinforcement, Design of Reinforcement for Torsion, Shear and Bending. Limit State Design Criteria: Inadequacy of Elastic and Ultimate Load Method, Criteria for Limit States, Strength and Serviceability. Design of Prestressed Concrete Section: for Flexure & methods by Lin and Magnel.	12L
3.	Anchorage Zone stresses in post tensioned members: Stress distribution in end block, anchorage zone reinforcement.	5L

Module	Topics	42L
4.	Statically Indeterminate Structures: Advantages of Continuous Member, Effect of Prestressing, Methods of Achieving Continuity and Method of Analysis of Secondary Moments.	5L
5.	Composite Construction of Prestressed and In-situ Concrete: Types, Analysis of Stresses.	4L
6.	Prestressed Concrete Poles and Sleepers: Design of Sections for Compression and Bending. Introduction to Partial Prestressing.	4 L

6. References:

Text Book:

- Prestressed Concrete N. Krishna Raju TMH.
- Prestressed Concrete Ramamuthram Dhanpat Rai Publishing Company.
- Prestressed Concrete Srikant Vanakudre Khanna Publishing House.
- Fundamentals of Prestressed Concrete N.C.Sinha and S.K.Roy S. Chand.

IS Codes:

- IS: 1343: 2012 : Prestressed Concrete — Code of Practice

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Understand the basic concepts of prestressed concrete members, losses in prestress and its deflection properties.	Identify	Understand
CO2	Develop the design criteria of prestressed concrete section for flexure and shear properties.	Develop	Create
CO3	Design the anchorage zone stress for post-tensioned members.	Design	Create
CO4	Use the methods for analysis of Statically Indeterminate Structures	Use	Apply
CO5	Explain the composite construction of prestress and In- situ concrete.	Explain	Understand
CO6	Design the prestressed concrete poles and sleepers and introduction of partial prestressing.	Design	Create

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3		-
5	-	-	-		3	-
6	-	-	-	-	-	3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	-	-	-	-	-	-	1
CO2	3	2	2	3	-	-	-	-	-	-	-	-
CO3	3	2	3	3	-	-	-	-	-	-	-	-
CO4	3	2	3	3	-	-	-	-	-	-	-	-
CO5	3	2	3	1	-	-	-	-	-	-	-	-
CO6	3	2	3	1	-	-	-	-	-	-	-	-

10. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1
CO2	3	3	2	2
CO3	3	3	2	2
CO4	3	3	2	2
CO5	3	3	2	3
CO6	3	3	2	3

Course Name: TRAFFIC ENGINEERING AND MANAGEMENT
Course Code: CE-713
(Semester IV)
Category: Major
Course Broad Category: PROGRAM ELECTIVE COURSE

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1. **Course Prerequisite:**
   Class-XII level knowledge of Physics, Mathematics; Undergraduate level introductory knowledge of Road Geometry and Traffic Engineering.

2. **Course Learning Objectives:**
   i. Students will gain insights into various traffic components, assess traffic characteristics, and analyze related issues.
   ii. Students will acquire the skills to design and conduct traffic surveys, enabling them to collect, analyze, and interpret traffic data effectively.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.
   Evaluation System –
   Attendance
   Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (10 Marks); Continuous Assessment 2 (10 Marks)]
   Mid-Term Exam (30 Marks)- Summative Assessment
   End-Semester Exam (50 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Traffic Engineering and Management
   Course Code: CE-713
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	42L
1.	Introduction – Objectives and scope of traffic engineering – Components of road traffic: vehicle, driver and road – Road user and vehicle characteristics and their effect on road traffic – Traffic manoeuvre	6L
2.	Traffic Stream Characteristics – Relationship between Speed, Flow and Density. Objectives, methods, equipment, data collection, analysis and interpretation (including case studies) of (a) Speed and delay, (b) Origin and destination, (c) Parking, (d) Accident and other studies.	10L
3.	Traffic operation and management, Design, Regulation and Management of Traffic Engineering Facilities: Control of traffic movements through time sharing and space sharing concepts, Intersection: traffic signal design, traffic signs and markings, Design of T, roundabout, mini-roundabout and other forms of at-grade crossings including provision for safe crossing of pedestrians and cyclists – Grade separated intersections; Road accidents and safety measures.	10L

Module	Topics	42L
4.	Bus stop location and bus bay design – Road lighting – Regulations on vehicles, drivers and traffic – Planning and design of traffic management measures: one-way streets, reversible lanes and roadways, turn regulation, transit and carpool lanes – Planning and design of pedestrian facilities – Traffic calming.	6L
5.	Traffic Control Devices and Environmental Control: Different methods of signal design – Redesign of existing signals including case studies – Signal coordination.	6L
6.	Air and Noise pollution of different transport modes – Visual impacts – Impacts on land development -Technological approaches to improving environment. Urban planning; Transport Demand Analysis.	4L

7. References:

Text Book:

- "Traffic Engineering and Transportation Planning", Kadiyali, L.R., Khanna Publishers
- "Transportation Engineering & Planning", Papacostas, C.S., and Prevedouros, P. D., Prentice Hall India
- "Traffic & Highway Engineering", Graber, N.J., and Hoel, L.A., Brooks/Cole
- "Transportation Engineering; An Introduction", Khisty, C.J., and Lal, B. K., Prentice-Hall India

Reference Books:

- Mannering, F.L., Kilareski, W.P., and Washburn, S.S., "Principles of Highway Engineering and Traffic Analysis", Willey India
- Khanna, S. K., Justo, C. E. G., and Veeraraghavan, A., "Highway Engineering", Nem Chand & Bros

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To explain the characteristics of traffic flow, traffic studies, capacity analysis and LOS, principles of traffic control devices and road accident study	Explain	Understand
CO2	To describe the principles of transportation planning, design of public transportation system	Describe	Understand
CO3	To use the traffic signals and traffic signs for road safety	Use	Apply
CO4	To examine the effectiveness of signalized and unsignalized intersections	Examine	Analyze
CO5	To relate the impact of traffic engineering decisions on environmental sustainability and urban development	Relate	Analyze
CO6	To support the effectiveness of Transportation planning in enhancing traffic efficiency and safety.	Develop	Evaluate

9. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	2	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	-	-	-
5	2	-	2	3	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	-	-	2	-	-	-	-	-
CO2	3	2	3	3	-	-	2	-	-	-	-	1
CO3	3	2	3	3	3	-	2	-	-	-	-	1
CO4	3	2	-	3	-	-	2	-	-	-	-	2
CO5	3	2	-	3	3	-	2	-	-	-	-	-
CO6	3	2	-	3	-	-	2	3	-	-	-	-

11. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1
CO2	3	3	2	1
CO3	3	1	2	1
CO4	2	1	2	2
CO5	2	1	1	2
CO6	2	1	1	2

Course Name: RAINWATER HARVESTING
Course Code: CE-714
(Semester VII)
Category: Major
Course Broad Category: PROGRAM ELECTIVE (PE)

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1. **Course Prerequisite:**
   Fluid Mechanics and Hydraulic Engineering.

2. **Course Learning Objectives:**
   i. Students will understand traditional and modern rainwater harvesting methods, water availability, and runoff estimation.
   ii. They will apply rainwater harvesting techniques for sustainable water management and analyze policies, challenges, and future prospects.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   Attendance
   Internal Assessment (40 Marks)- Continuous Internal Assessment [Continuous Internal Assessment 1 (20 Marks); Continuous Internal Assessment 2 (20 Marks)]
   End-Semester Examination (60 Marks)- 60% of End-Semester Examination (100 Marks).

4. **Course Content:**
   Course Name: Rainwater Harvesting
   Course Code: CE-714
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	42L	Syllabus coverage (%)
1.	**Rainwater Harvesting in Ancient India:** Traditional Rainwater Harvesting Systems (Stepwells, Tanks, Baolis, Kunds, Jhalaras, Johads, Bamboo Drip Irrigation); Indigenous Knowledge & Water Conservation Practices; Relevance in Modern Water Management.	6L	14
2.	**Water Crisis and the Need for Rainwater Harvesting:** Global & Indian Water Scenario; Causes of Water Scarcity; Depletion of Groundwater; Rainwater Harvesting as a Solution; Case Studies from Water-Stressed Regions.	7L	17
3.	**Rainfall Availability and Runoff Estimation:**	6L	14

Module	Topics	42L	Syllabus coverage (%)
	Hydrological Cycle; Precipitation Measurement & Analysis; Estimation of Rainwater Potential; Runoff Coefficients; Factors Affecting Runoff; Rainfall-Runoff Relationship.		
4.	**Rainwater Harvesting Techniques and Infrastructure:** Catchment Areas (Rooftops, Open Lands); Collection & Conveyance Systems (Gutters, Pipes); Storage Systems (Tanks, Ponds, Percolation Pits, Check Dams); Recharge Structures (Wells, Trenches, Aquifer Recharge).	8L	19
5.	**Inter-Basin Water Transfer and Large-Scale Water Management:** Concept of Inter-Basin Water Transfer; Major River Linking Projects in India; Surface Water vs. Groundwater Management; Impact on Agriculture & Urban Development; Environmental and Social Impacts.	8L	19
6.	**Policies, Challenges, and Future Prospects:** Government Policies & Regulations; BIS Standards; Incentives & Financial Support; Challenges in Implementation; Climate Change Impact on Rainwater Harvesting; Future Technologies & Smart Water Management Solutions.	7L	17

7. References:

Text Book:

- Rainwater Harvesting, G. N. Virupaksha, Khanna Publishing House.
- Rainwater Harvesting: The Collection of Rainfall and Runoff in Rural Areas, Arnold Pacey, Practical Action Pub.

Reference Books:

- Engineering Hydrology, K. Subramanya, McGraw Hill Education (India) Private Limited.
- Water Law in India: An Introduction to Legal Instruments, Philippe Cullet, Sujith Koonan, OUP India.

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Describe traditional rainwater harvesting systems in ancient India.	Describe	Understand
CO2	Explain the need for rainwater harvesting and water scarcity issues.	Explain	Understand
CO3	Analyze rainfall availability and runoff estimation methods.	Analyze	Apply
CO4	Use rainwater harvesting techniques for collection, storage, and recharge.	Use	Apply
CO5	Judge the impact of inter-basin water transfer on water management.	Judge	Evaluate

CO6	Appraise government policies and challenges in rainwater harvesting.	Appraise	Evaluate

9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	3	3	-	-	1	-	1	2
CO2	3	1	-	-	3	3	-	-	1	-	1	3
CO3	3	2	2	1	3	3	-	-	1	1	2	3
CO4	3	3	2	2	2	3	-	-	1	2	2	3
CO5	3	2	2	1	3	3	-	-	1	1	2	3
CO6	3	3	3	2	3	3	-	-	1	1	2	3

11. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	0
CO2	3	3	2	1
CO3	3	3	2	2
CO4	3	3	3	3
CO5	3	3	3	2
CO6	3	3	3	3

Course Name: BRIDGE ENGINEERING
Course Code: CE-722
(Semester VII)
Category: Major
Course Broad Category: CORE ENGG (Professional Elective Courses)

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1. **Course Prerequisite:**
   Design of RC Structures (CE(PC)501), Structural Analysis – I (CE(PC)503), Design of Steel Structures (CE(PC)604)

2. **Course Learning Objectives:**
   i. Students will be able to learn the types, components, and classifications of bridges, along with the principles of structural analysis and design as per relevant codes.
   ii. Students will be able to develop the ability to analyze loads (dead, live, seismic, wind, and impact) and design various bridge components, including superstructure, substructure, and bearings, ensuring strength, stability, and durability.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies and Field Visits.
   Evaluation System –
   Attendance
   Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (10 Marks); Continuous Assessment 2 (10 Marks)]
   Mid-Term Exam (30 Marks)- Summative Assessment
   End-Semester Exam (50 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Bridge Engineering
   Course Code: CE-722
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	42L
1.	**Introduction:** Definition and basic forms, components of a typical bridge, classification of bridges, site investigation, bridge hydrology and hydraulics. Loads: I.R.C loads, impact factors, wind loads, longitudinal forces, lateral forces and centrifugal forces. Bearings: Types of bearings, details of bearing, joints, design examples	6L
2.	**Design of reinforced concrete solid slab bridge:** Introduction, general design features, economic span, effective width method, simply supported and cantilever slab bridges, analysis and design.	6L

Module	Topics	42L
3.	**Design of box culvert bridge:** Introduction, design method and design example.	6L
4.	**Design of a T beam bridge:** Introduction, components, design of interior panel of slab, longitudinal and cross girders, Pigeaud's method, design example.	8L
5.	**Design of composite bridge:** General aspects, method of construction, analysis of composite section, shear connectors, design of composite beam.	8L
6.	**Design of steel bridges and cable stayed bridge:** General features, types of stress, design of railway truss bridge and plate girder bridge.	8L

5. **References:**

IS Codes:

- Relevant IRC and IS codes

Reference Books:

- N. Krishnaraju, Prestressed Concrete Bridges, CBS Publisher.
- Aswani, Vazirani & Ratwani, Design of concrete bridges, 2012, Khanna Publishers.
- Ponnuswamy, Bridge engineering, McGrawHill.

6. **Course Outcomes:**

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the fundamental concepts of bridge engineering by describing bridge components, classifications, site investigations, hydrology, and various loads, including IRC specifications.	Explain	Understand
CO2	Design reinforced concrete solid slab bridges using the effective width method, ensuring compliance with design standards and economic span considerations.	Design	Create
CO3	Implement structural design principles to box culvert bridges by implementing appropriate design methods and performing calculations for real-world applications.	Implement	Apply
CO4	Demonstrate the structural behavior of T-beam bridges by designing interior panels, longitudinal and cross girders, and using Pigeaud's method for analysis.	Demonstrate	Apply
CO5	Design composite bridges by analyzing composite sections, selecting appropriate	Design	Create

	shear connectors, and ensuring structural stability.		
CO6	Design steel and cable-stayed bridges by understanding different stress types, truss bridge behavior, and plate girder bridge design principles.	Design	Create

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	3	3	1	1	1	2	3
CO2	3	3	2	2	2	3	3	0	0	1	1	2
CO3	3	3	2	2	2	3	3	0	0	1	1	2
CO4	3	3	3	3	2	3	3	0	0	1	1	2
CO5	3	3	3	3	2	3	3	0	0	1	1	2
CO6	3	3	2	2	2	3	3	1	1	1	2	2

9. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1
CO2	3	3	2	1
CO3	3	3	2	1
CO4	3	3	2	1
CO5	3	3	2	1
CO6	3	3	2	1

Course Name: GROUND IMPROVEMENT TECHNIQUE
Course Code: CE-723
(Semester VII)
Category: Major
Course Broad Category: CORE ENGG (Professional Elective Courses)

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1. **Course Prerequisite:**
   Geotechnical Engineering (CE(PC)403), Foundation Engineering (CE(PE)501A)

2. **Course Learning Objectives:**
   - To introduce various problematic soils and familiarize students with ground improvement techniques, including mechanical modification methods such as deep compaction, blasting, vibro-compaction, dynamic tamping, and compaction piles.
   - To develop an understanding of ground improvement through drainage, dewatering, and grouting techniques, with a focus on the design of dewatering systems and stabilization of expansive soils.
   - To enhance students' knowledge of soil reinforcement techniques, including the concept of reinforced earth and the application of geosynthetics.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies and Field Visits.
   Evaluation System –
   Attendance
   Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (10 Marks); Continuous Assessment 2 (10 Marks)]
   Mid-Term Exam (30 Marks)- Summative Assessment
   End-Semester Exam (50 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Ground Improvement Technique
   Course Code: CE-723
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	42L
1.	**Introduction:** General principles of ground improvement, Factors affecting ground improvement methods, Different types of problematic soils, Emerging trends in ground Improvement	6L
2.	**Mechanical Stabilization:** Shallow and deep compaction requirements, Principles and methods of soil compaction, Shallow compaction and methods. Properties of compacted soil and compaction control, Deep compaction and Vibratory methods, Dynamic compaction..	8L

Module	Topics	42L
3.	**Hydraulic Modification:** Ground Improvement by drainage, Dewatering methods, Design of dewatering systems, Preloading, Vertical drains, Vacuum consolidation, Electro-kinetic dewatering, design and construction methods.	6L
4.	**Modification by Admixtures:** Cement stabilization and cement columns, Lime stabilization and lime columns. Stabilization using bitumen and emulsions, Stabilization using industrial wastes, Construction techniques and applications.	8L
5.	**Grouting:** Permeation grouting, compaction grouting, jet grouting, different varieties of grout materials, grouting under difficult conditions.	6L
6.	**In Situ Soil Treatment Methods:** Soil nailing and ground anchors, rock anchoring, micro-piles, design methods, construction techniques, Functions and applications of geosynthetics – geotextiles, geogrids, geomembranes; soil reinforcement using strips, bars and geosynthetics.	8L

5. **References:**

Text Book:

- Ground Improvement Techniques: Dr. P. Purushothanma Raj, Laxmi Publications (P) Ltd.
- Nihar Ranjan Patra : Ground Improvement Techniques ; Vikas Publishing house

Reference Books:

- Engineering Principles of Ground Modification: Manfred R. Hanusmann, McGraw-Hill publication.
- S. K. Gulhati and M. Datta, "Geotechnical Engineering", Tata McGraw Hill

6. **Course Outcomes:**

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Identify the type of problems in problematic soils and to suggest different ground improvement techniques to solve these problems.	Identify	Understand
CO2	Design the importance and suitability of shallow and deep compaction techniques like use of different rollers, dynamic tamping, explosion etc.	Design	Create
CO3	Define traditional dewatering system methods and design of drainage and dewatering systems for various civil engineering problems. Design the preloading and vertical drain systems for	Define	Remember

	consolidations.		
CO4	Implement the admixtures like cement and lime for treating expansive soil.	Implement	Apply
CO5	Discuss the importance and suitability of different grouting techniques and grout materials used frequently for underground and foundation constructions.	Discuss	Understand
CO6	Describe the in-situ soil improvement techniques such as use of ground anchors, rock bolts, micro-piles, soil nails, various geo-synthetic materials etc. and to introduce the design and construction techniques of those in-situ soil improvement techniques.	Describe	Understand

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	1	1	2	-	-	3	-	-	3
CO2	1	-	1	-	3	-	-	-	3	-	1	1
CO3	3	3	3	-	2	-	-	-	1	-	2	3
CO4	3	1	-	-	2	-	-	-	2	-	2	1
CO5	2	1	-	-	3	-	-	-	2	-	2	1
CO6	3	2	2	-	3	-	-	-	3	-	2	3

9. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	0	2	3	1
CO2	0	2	3	1
CO3	0	2	3	1
CO4	0	2	3	1
CO5	0	2	3	1
CO6	0	3	3	1

Course Name: CONTRACT MANAGEMENT
Course Code: CE-724
(Semester VII)
Category: Major
Course Broad Category: Program Elective Course- 7 (PE)

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1. **Course Prerequisite:**
   - Engineering Economics and Project Planning
   - Knowledge of Construction Laws and Regulations.
2. **Course Learning Objectives:**

a) Understand the principles and fundamentals of contract management in construction.
b) Learn about different types of contracts, contract formation, and legal implications.
c) Develop skills in contract administration, dispute resolution, and claims management.
d) Analyze procurement strategies, bidding processes, and contract execution.
e) Explore the role of technology, including contract management software, in modern construction projects.
f) Gain insights into risk management and financial aspects of contract administration.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies, Problem-solving sessions and tutorials, Guest Lectures and Group projects.
   Evaluation System –
   Attendance
   Continuous Internal Assessment (CIA) - 40 Marks [CIA 1(Mid-Semester Evaluation- 20 Marks); CIA 2 (Assignment/Mini-Project/Group Discussions/Presentations/Open Book test/Quiz- 20 Marks)].
   End-Semester Examination (ESE) - 100 Marks[60% of (ESE)]

4. **Course Content:**
   Course Name: Contract Management
   Course Code: CE-724
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	Lecture (42L)
1.	**Introduction to Contract Management** 1.1 Importance of contract management in construction 1.2 Elements of a contract 1.3 Contract law principles and legal frameworks	5L
2.	**Types of Contracts in Construction** 2.1 Fixed-price, cost-plus, and unit price contracts 2.2 Turnkey contracts and design-build contracts 2.3 EPC (Engineering, Procurement, and Construction) contracts	6L
3.	**Contract Formation and Procurement Strategies** 3.1 Tendering process and bid evaluation	5L

Module	Topics	Lecture (42L)
	3.2 Negotiation and award of contracts 3.3Public vs. private sector contracts	
4.	**Contract Administration and Execution** 4.1 Roles and responsibilities of contract managers 4.2 Contract documentation and compliance 4.3 Change orders and amendments	5L
5.	**Dispute Resolution and Claims Management** 5.1 Causes of disputes in construction contracts 5.2 Arbitration, mediation, and litigation 5.3 Claim types and settlement procedures	5L
6.	**Risk Management in Contracts** 6.1 Identifying and mitigating contract risks 6.2 Performance bonds and insurance in contracts 6.3 Delay penalties and liquidated damages	6 L
7.	**Financial and Legal Aspects of Contracts** 7.1 Contract financing and payment terms 7.2 Taxation and legal liabilities 7.3 Case studies on contract failures and best practices	5L
8.	**Technology in Contract Management** 8.1 Digital contract management tools 8.2 Role of AI and blockchain in contract management 8.3 Case studies on the use of technology in contract administration	5L

5. References:

Text Book:

1. Jimmie Hinze, *Construction Contracts*, McGraw-Hill.
2. Peter S. Reinhardt, *Construction Contract Law*, Routledge.
3. D. Chappell, *Construction Contracts: Questions and Answers*, Routledge.

Reference Books:

1. FIDIC, *Conditions of Contract for Construction (Red Book)*.
2. John Murdoch & Will Hughes, *Construction Contracts: Law and Management*, Taylor & Francis.
3. S. Keoki Sears, *Construction Project Management: A Practical Guide to Field Construction Management*, Wiley.

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the fundamentals of contract management and legal principles.	Explain	Understand
CO2	Identify and apply various types of contracts used in construction projects.	Identify	Understand
CO3	Develop procurement strategies and contract administration plans.	Develop	Create
CO4	Investigate contract disputes, claims, and risk management strategies.	Investigate	Create

CO5	Examine financial and legal aspects of construction contracts.	Examine	Analyze
CO6	Judge modern trends and technologies in contract management	Judge	Evaluate

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
Module 1	3	2	1	-	-	2
Module 2	2	3	2	-	-	2
Module 3	-	2	3	2	-	2
Module 4	-	1	2	3	-	2
Module 5	-	1	2	2	3	2
Module 6	-	-	-	3	2	2
Module 7	2	-	-	2	2	3
Module 8	2	2	2	2	3	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	1	2	-	2	1	-	2
CO2	2	3	2	2	2	1	2	-	2	1	-	2
CO3	1	2	3	3	2	1	1	-	2	1	-	2
CO4	1	2	2	3	2	3	2	1	2	1	-	2
CO5	1	1	1	2	1	2	2	2	2	1	-	2
CO6	1	1	-	1	1	2	3	2	2	1	-	2

9. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2
CO2	3	2	1	2
CO3	2	3	1	2
CO4	2	3	2	2
CO5	1	3	2	2
CO6	2	3	3	2

Course Name: INDIAN TOWN PLANNING AND ARCHITECTURE
Course Code: CE-732
(Semester VII)
Category: Minor
Course Broad Category: Indian Knowledge System

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1. **Course Prerequisite:**
   - Basics of Town Planning.
   - Sustainable Development and Environmental Considerations
2. **Course Learning Objectives:**
   A. Understand the historical evolution of town planning and architecture in India.
   B. Analyze the principles of Vastu Shastra and traditional planning concepts.
   C. Explore ancient Indian cities, their planning layouts, and architectural significance.
   D. Compare traditional Indian town planning with modern urban planning approaches.
   E. Investigate sustainable and climate-responsive architectural practices in historical Indian cities.
   F. Develop an appreciation for heritage conservation and the role of IKS in contemporary urban design.
3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies, Problem-solving sessions and tutorials, Guest Lectures Field Visits and Group projects.
   Evaluation System –
   Attendance
   Continuous Internal Assessment (CIA) - 40 Marks [CIA 1(Mid-Semester Evaluation- 20 Marks); CIA 2 (Assignment/Mini-Project/Group Discussions/Presentations/Open Book test/Quiz- 20 Marks)].
   End-Semester Examination (ESE) - 100 Marks[60% of (ESE)]

4. **Course Content:**
   Course Name: Indian Town Planning And Architecture
   Course Code: CE-732
   Hours per Week: 2L:0T:0P
   Credits: 2

Module	Topics	Lecture (28L)
1.	**Introduction to Indian Town Planning and Architecture** 1.1 Definition and significance of town planning 1.2 Evolution of Indian architecture and urban planning 1.3 Role of Indian Knowledge Systems (IKS) in town planning	3L
2.	**Ancient Indian Urban Planning** 2.1 Indus Valley Civilization (Harappa and Mohenjo-Daro) 2.2 Vedic town planning principles 2.3 Buddhist and Mauryan town planning models	4L
3.	**Vastu Shastra and Traditional Planning Principles** 3.1 Fundamentals of Vastu Shastra 3.2 Mandala concept and site planning	4L

Module	Topics	Lecture (28L)
	3.3 Orientation, proportions, and design principles in ancient Indian architecture	
4.	**Medieval and Colonial Town Planning in India** 4.1 Mughal and Rajput town planning 4.2 Colonial urban development (British, Portuguese, French influences) 4.3 Urban transformations in post-independence India	3L
5.	**Temple Architecture and Vernacular Design** 5.1 Dravidian, Nagara, and Vesara temple architecture 5.2 Traditional housing and settlement patterns across different regions 5.3 Sustainable materials and climatic adaptation in Indian architecture	4L
6.	**Modern Town Planning Approaches with IKS Integration** 6.1 Smart cities and sustainability principles from traditional Indian towns 6.2 Role of GIS, BIM, and digital tools in planning Case studies of contemporary cities incorporating IKS principles	4L
7.	**Heritage Conservation and Sustainable Urban Development** 7.1 Conservation of ancient towns and monuments 7.2 Adaptive reuse of heritage structures 7.3 Role of government and policies in heritage management	3L
8.	**Case Studies and Contemporary Applications** 8.1 Jaipur: The planned city based on Vastu principles 8.2 Chandigarh: A modern planned city vs. traditional Indian town planning 8.3 Revitalization of old towns and integration with smart city initiatives	3L

9. References:

Text Book:

A. Satish Chandra, *History of Architecture and Town Planning in India*, CBS Publishers.
B. V. S. Pramar, *Design Fundamentals in Architecture*, Somaiya Publications.
C. V. Doshi, *Traditional Indian Architecture: A Study of Its Typology*, Oxford & IBH.

Reference Books:

A. Percy Brown, *Indian Architecture (Buddhist and Hindu Periods)*.
B. James Fergusson, *History of Indian and Eastern Architecture*.
C. S. K. Joshi, *Town Planning and Sustainable Development in India*.
D. *Ancient Indian Architecture* – ASI (Archaeological Survey of India) Reports.

10. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the evolution of Indian town planning and architectural principles.	Explain	Understand

CO2	Contrast the concepts of Vastu Shastra and its impact on traditional planning.	Contrast	Analyze
CO3	Compare ancient and modern town planning methodologies.	Compare	Analyze
CO4	Explain the role of sustainability in historical Indian architecture.	Explain	Understand
CO5	Critique the significance of heritage conservation and urban revitalization.	Critique	Evaluate
CO6	Use GIS, BIM, and digital tools in contemporary urban planning with IKS integration	Use	Apply

11. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
Module 1	3	2	2	-	1	-
Module 2	3	2	3	2	1	-
Module 3	2	3	2	2	-	-
Module 4	2	1	3	2	2	2
Module 5	1	2	2	3	2	1
Module 6	-	-	2	2	3	2
Module 7	2	-	1	2	2	3
Module 8	2	2	2	2	2	3

12. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	1	2	1	2	2	-	2
CO2	2	3	2	2	2	1	2	1	2	2	-	1
CO3	1	2	3	3	2	1	1	1	2	2	-	1
CO4	1	2	3	3	2	3	2	1	2	2	-	2
CO5	1	1	1	2	1	2	2	2	2	2	-	2
CO6	1	1	1	2	1	2	3	2	2	2	-	2

13. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2
CO2	3	3	1	2
CO3	2	3	1	2
CO4	2	3	2	3
CO5	1	3	2	2
CO6	2	3	2	2

Course Name: DISASTER PREPAREDNESS & PLANNING

Course Code: CE-781

(Semester VII)

Category: SKILL ENHANCEMENT COURSE

Course Broad Category: MULTIDISCIPLINARY NON-CREDIT COURSE

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1. **Course Prerequisite:**
   Class-X level knowledge of Indian Geography and Undergraduate level knowledge of Environmental Engineering, Geotechnical Engineering, Hydrology & Water Resources Engineering.

2. **Course Learning Objectives:**
   i. To understand the fundamental concepts of disasters, hazards, vulnerability, risks, and their impact on society and the environment.
   ii. To understand different types of disasters, including natural and man-made, with a focus on India's hazard and vulnerability profile.
   iii. To understand the impacts of disasters on physical, social, economic, and political structures, along with the influence of climate change.
   iv. To examine disaster risk reduction strategies, including prevention, mitigation, preparedness, and response measures.
   v. To understand accessibility and emergency services for differently-abled individuals in disaster management contexts.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures and Field Visits.
   Evaluation System –
   Attendance
   Continuous Internal Assessment (CIA) - 40 Marks [CIA 1 (Mid-Semester Evaluation- 20 Marks); CIA 2 (Assignment/Mini-Project/Group Discussions/Presentations/Open Book test/Quiz- 20 Marks)].
   End-Semester Examination (ESE) - 100 Marks [60% of (ESE)]

4. **Course Content:**
   Course Name: Disaster Preparedness & Planning
   Course Code: CE-781
   Hours per Week: 3L:0T:0P
   Credits: 0

Module	Topics	42L	100%
1.	Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks severity, frequency and details, capacity, impact, prevention, mitigation.	4L	10
2.	Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial	8L	20

Module	Topics	42L	100%
	flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.		
3.	Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.	8L	20
4.	Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief, and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs, and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India, and the activities of the National Disaster Management Authority.	10L	24
5.	Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), sustainable and environmentally friendly recovery; reconstruction and development methods.	6L	13
6.	Accessibility in Disaster Contexts and Emergency Services for Differently Abled publics (Accessibility in Context of Disaster Preparedness, Response, Mitigation and reconstruction)	6L	13

7. References:

Text Book:

- Disaster Management, S.C. Sharma, Khanna Publishing House, 2022.
- Disaster Risk Reduction in South Asia, Pradeep Sahni, Prentice Hall, 2004.

Reference Books:

- Handbook of Disaster Management: Techniques & Guidelines, Singh B.K, Rajat Publication, 2008.
- http://ndma.gov.in/ (Home page of National Disaster Management Authority)
- http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).

8. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Classify different types of disasters and their causes	Classify	Understand
CO2	Identify the impacts of disasters on environmental, social, and economic systems.	Identify	Understand
CO3	Demonstrate disaster risk reduction strategies and policies, considering preparedness, mitigation, and response measures.	Demonstrate	Apply
CO4	Use scientific and engineering approaches to	Use	Apply

	disaster management, focusing on risk assessment and mitigation.		
CO5	Examine the role of environmental factors and sustainable development in disaster response and recovery.	Examine	Analyse
CO6	Appraise accessibility and emergency services for vulnerable populations in disaster management.	Appraise	Evaluate

9. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	3	-	-	-	-	-
3	-	3	-	-	-	-
4	-	-	3	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

10. Mapping of the Course outcomes to Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	2	3	2	2	-	2	3	-	-	-	-	2
CO3	-	2	3	2	2	2	3	-	2	2	2	2
CO4	3	2	2	3	3	2	2	-	-	-	2	3
CO5	2	2	2	-	-	3	3	-	-	-	-	2
CO6	-	-	2	-	-	2	2	2	2	2	-	2

11. Mapping to PSO

CO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-
CO2	3	2	-	-
CO3	3	2	2	2
CO4	3	3	2	2
CO5	3	3	2	-
CO6	2	2	-	-

Course Name: PAVEMENT MATERIALS LABORATORY
Course Code: CE-791
(Semester VII)
Category: Major
Course Broad Category: PROGRAM ELECTIVE COURSE

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Course Prerequisite:

Undergraduate level knowledge of Transportation Engineering, Basic Geotechnical Engineering Laboratory, Pavement Materials and Concrete Technology Laboratory.

1. **Course Learning Objectives:**
   By the end of the course, students will be able:

   i. To understand the characteristics and properties of various materials used in pavement construction.
   ii. To gain practical knowledge through testing of materials like aggregates, bitumen, soil, and other pavement components.
   iii. To interpret and analyze the test results for their suitability in pavement construction.
   iv. To develop skills in preparing material specifications and quality control tests.

2. **Teaching methodology and evaluation system for the course:**

   Teaching methodology – Hands-on Laboratory sessions, Lab-based experiment demonstrations, discussions on testing procedures, hands-on practice with testing equipment, Problem-solving sessions, Presentations, Lab Reports and Data Interpretation.

3. **Evaluation System –**
   Total Marks :100 [60(PCIA) + 40(PESE)]
   PCIA: 60 Marks (Includes practical performance, reports, and viva voce after each experiment.)
   PESE: 40 Marks (Final comprehensive practical examination covering the entire syllabus.)

4. **Course Content:**
   Course Name: Pavement Material Laboratory
   Course Code: CE-791
   Hours per Week: 0L:0T:2P
   Credits: 1

Module	Topics	14P
Experiment 1	**Grain Size Analysis – Sieve Analysis and Job Mix Calculation**	1P

Module	Topics	14P
Experiment 2	**Modified Proctor Compaction Test**	1P
Experiment 3	**California Bearing Ratio (CBR) Test on Stabilized Soil**	1P
Experiment 4	**Unconfined Compressive Strength (UCS) Test on Stabilized Soil**	1P
Experiment 5	**Impact Value Test on Aggregates and Shape Test**	1P
Experiment 6	**Los Angeles Abrasion Test**	1P
Experiment 7	**Water Absorption & Specific Gravity Test**	1P
Experiment 8	**Penetration Test and Softening Point Test on Bitumen**	1P
Experiment 9	**Ductility Test and Flash and Fire Point Test on Bitumen**	1P
Experiment 10	**Bitumen Content by Centrifuge Extractor**	1P
Experiment 11	**Design of RAP-Bituminous Mix and Marshall Stability Test**	1P
Experiment 12	**Modified Bitumen Performance Testing**	1P
Experiment 13	**Moisture Susceptibility Testing of Bituminous Mixes**	1P
Experiment 14	**Test on Concrete for Pavement**	1P

5. **References:**

IS 2386 (Part I to Part VIII) – Indian Standard Methods of Test for Aggregates

IS 1203 – Methods of Test for Bitumen

IS 2720 (Part 1 to Part 16) – Methods of Test for Soils

IS 6241 – Methods of Test for Bituminous Mixes

IRC 37 – Guidelines for the Design of Flexible Pavements

Text Book:

- Khanna, S. K., Justo, C. E. G., and Veeraraghavan, A., "Highway Engineering", Nem Chand & Bros
- Huang, Y. H., "Pavement Analysis and Design", Pearson Education, India
- Sustainable Highways, Pavements and Materials: An Introduction" by Kasthurirangan Gopalakrishnan, Createspace Independent Pub

Reference Books:

- "Life Cycle Cost Analysis in Pavement Design-Interim Technical Bulletin", Federal Highway Administration
- "Pavement Engineering: Principles and Practice" by Rajib B Mallick and Tahar El-Korchi, CRC Press

6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To Identify the properties and classification of aggregates and bitumen used in pavement construction.	Identify	Understand
CO2	To Use the aggregates and bituminous materials to determine their suitability in pavements through laboratory tests.	Use	Apply
CO3	To Use bituminous mixtures and evaluate their properties based on stability and performance requirements.	Use	Apply
CO4	To Execute soil and concrete testing for pavements and analyze their bearing capacity, strength, and suitability for construction.	Execute	Apply
CO5	To Implement the knowledge of compaction, CBR, and other soil tests to determine the suitability of subgrade materials.	Implement	Apply
CO6	To Relate the practical aspects of pavement materials testing and their impact on the design and durability of pavements.	Relate	Analyze

7. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	2	1	2	2
2	1	2	1	3	3	2
3	3	3	2	1	1	2
4	3	3	2	1	1	2
5	2	2	3	1	1	3
6	1	1	2	3	2	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	1	2	1	2	2	2	3
CO2	3	3	2	3	3	2	2	1	2	2	2	3
CO3	3	3	3	2	3	2	3	1	2	2	2	3
CO4	3	3	3	2	3	2	2	1	2	2	2	3
CO5	2	3	3	3	3	2	3	1	2	2	3	3
CO6	3	3	3	3	3	2	3	2	2	2	3	3

9. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	3	3	2	2

CO3	3	3	3	2
CO4	3	3	3	2
CO5	2	3	3	3
CO6	2	3	3	3

Course Name: Total Station and Gps Survey Laboratory
Course Code: CE-792
(Semester 7th)
Category: Major
Course Broad Category: PROGRAM ELECTIVE COURSE

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1. **Course Prerequisite:**
   - Basic Knowledge and understanding about surveying.
   - Fundamental knowledge of GPS.
2. **Course Learning Objectives:**

   By the end of the course, students will be able to:
   1. Perform advanced survey using a total station.
   2. Glide and control a drone for image capturing for surveying properly.
   3. Understand about GPS.

3. **Teaching methodology and evaluation system for the course:**

   Teaching methodology –: Lab-based experiments demonstrations, discussions on testing procedures, hands-on practice with testing equipment, and real-life case studies.

   Evaluation System –

   Total Marks: 100 [60(PCIA) + 40(PESE)]
   Passing criteria: 50% and above
   Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks
   Section 2: Practical End Semester Examination (PESE) - 40 Marks

4. **Course Content:**

   Course Name: Total Station and GPS Survey Laboratory
   Course Code: CE-792
   Hours per Week: 0L:0T:2P
   Credits: 1

Module	Topics	14P
Experiment 1	Introduction to Total Station & GPS: Understanding instrument components, functions and set up procedures.	1P
Experiment 2	Coordinate Systems & Transformations: Practical demonstration of different coordinate systems and their transformations.	1P
Experiment 3	Determine of area using Total Station.	1P
Experiment 4	Determining Easting, Northing and Height using Total Station	1P
Experiment 5	Contouring using Total Station	1P
Experiment 6	Determination of Remote height using Total Station	1P
Experiment 7	Stake out using Total Station	1P

Module	Topics	14P
Experiment 8	Electronic Distance & Gradient measurement with a total station.	1P
Experiment 9	Curve Setting Using Total Station	1P
Experiment 10	Drone surveying with GPS	1P
Experiment 11	Using a stereoscope to view aerial photos	1P
Experiment 12	Conducting surveys for area calculations using GPS techniques.	1P
Experiment 13	Post Processing of GPS Data: Processing field data using software tools for accuracy enhancement.	1P
Experiment 14	Hydrographic & Route Surveying: Conducting river surveys, route alignments for highways and railway applications.	1P

6. References:

Text Book:

- Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin
- R. Subramanian, Surveying and Levelling, Oxford University Press
- Alfred Leick, GPS satellite surveying, John Wiley & Sons
- Basak, N. N.: Surveying and Levelling, Tata McGraw-Hill Education, Delhi

Reference Books:

- Satheesh, G., Sathikumar, R. and Madhu, N. (2007): Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education, Delhi
- "Textbook of Surveying" by C. Venkatramaiah, University Press Publishers

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	To Explain the principles, components, and setup procedures of Total Station and GPS for surveying applications.	Explain	Understand
CO2	To Use coordinate systems and transformation techniques for accurate geospatial data representation.	Use	Apply
CO3	To Execute terrain mapping and area calculations using Total Station and GPS, including contouring, remote height determination, and stake-out procedures.	Execute	Apply
CO4	To Operate Total Station for precise distance, gradient measurements, and curve setting in surveying applications.	Operate	Apply
CO5	To Implement drone-based surveying and aerial photogrammetry techniques for geospatial analysis.	Implement	Apply
CO6	To Examine hydrographic and route surveys for infrastructure projects, including data post-processing for accuracy enhancement.	Examine	Analyze

8. **Mapping of course outcomes to module/course content**

Experiments	CO1	CO2	CO3	CO4	CO5	CO6
Experiment 1.	3	2	2	2	1	1
Experiment 2.	3	3	2	2	1	1
Experiment 3.	2	2	3	2	1	1
Experiment 4.	2	2	3	2	1	1
Experiment 5.	1	1	3	2	1	1
Experiment 6.	1	1	3	2	1	1
Experiment 7.	1	1	2	2	1	1
Experiment 8.	1	1	1	3	1	1
Experiment 9.	1	1	1	3	1	1
Experiment 10.	1	1	1	1	3	2
Experiment 11.	1	1	2	1	3	2
Experiment 12.	1	2	3	2	2	2
Experiment 13.	1	2	2	2	2	3
Experiment 14.	1	1	2	1	1	3

9. **Mapping of the Course outcomes to Program Outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	1	1	1	1	2	2	3
CO2	3	3	2	2	3	1	2	1	2	2	2	3
CO3	3	3	3	2	3	1	2	1	2	2	2	3
CO4	2	3	3	3	3	2	3	1	2	2	2	3
CO5	2	2	2	2	2	2	2	2	2	2	2	2
CO6	2	2	3	3	3	3	3	2	2	2	3	3

10. **Mapping to PSO**

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	2	3	2	2
CO3	2	3	3	2
CO4	2	3	3	2
CO5	1	3	3	2
CO6	2	2	3	3

Course Name: Basic AIR AND NOISE POLLUTION CONTROL LABORATORY

Course Code: CE-793

(Semester VII)

Category: Major

Course Broad Category: PROGRAM ELECTIVE COURSE- 5 (PE)

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1. **Course Prerequisite:**
   Biology and Environmental Science; Undergraduate level knowledge of Statistics and Environmental Engineering and Air and Noise Pollution Control
2. **Course Learning Objectives:**
   i. Understand Soil Properties and Classification
   ii. Perform Soil Sampling and Preparation
   iii. Conduct Standard Laboratory Tests
   iv. Analyze Soil Strength and Compressibility
   v. Evaluate Soil Permeability and Seepage
   vi. Interpret and Report Laboratory Data
   vii. Develop Problem-Solving Skills
   viii. Collaborate in a Team Environment
3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Hands-on Laboratory Sessions**,** Pre-lab Theoretical Lectures and Discussions, Problem-solving Sessions, Group Projects and Presentations and Lab Reports and Data Interpretation.
   Evaluation System –
   Total Marks: 100 [60(PCIA) + 40(PESE)]
   Section 1: Practical Continuous Internal Assessment (PCIA) - 60 Marks
   Section 2: Practical End Semester Examination (PESE) - 40 Marks
4. **Course Content:**
   Course Name: Air and Noise Pollution Control Laboratory
   Course Code: CE-793
   Hours per Week: 2P
   Credits: 1

Experiment 1	Sampling of PM10 in Ambient Air and Determination of its Concentration
Experiment 2	Sampling of PM2.5 in Ambient Air and Determination of its Concentration
Experiment 3	Measurement of Sulphur Dioxide (SO_2) Concentration in Ambient Air
Experiment 4	Measurement of Nitrogen Dioxide (NO_2) Concentration in Ambient Air
Experiment 5	Measurement of Carbon Monoxide (CO) Concentration in Ambient Air (if applicable in the manual)
Experiment 6	Measurement of Hydrocarbons in Ambient Air (if applicable in the manual)
Experiment 7	Noise Level Measurement and Ambient Noise Monitoring
Experiment 8	Traffic Noise Monitoring

6. References:

1. IS 5182 (Part 23): 2006
2. CPCB Guidelines Volume-I
3. IS 5182 (Part 2): 2001

7. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Explain the fundamental concepts of air pollution and noise pollution measurement techniques.	Explain	Understand
CO2	Execute sampling and measurement of PM10 and PM2.5 concentrations in ambient air using appropriate methods.	Execute	Apply
CO3	Measure the concentration of gaseous pollutants like SO_2, NO_2, CO, and hydrocarbons in ambient air.	Measure	Understand
CO4	Analyse air pollutant data to assess environmental air quality based on standard regulations.	Analyse	Analyze
CO5	Conduct noise level measurement in ambient and traffic conditions to evaluate noise pollution.	Conduct	Apply
CO6	Develop strategies for air and noise pollution control based on experimental data and regulatory standards.	Develop	Create

8. Mapping of course outcomes to module / course content

	CO1	CO2	CO3	CO4	CO5	CO6
Experiment 1	2	3	-	-	-	-
Experiment 2	2	3	-	-	-	-
Experiment 3	-	-	3	-	-	-
Experiment 4	-	-	3	-	-	-
Experiment 5	-	-	3	-	-	-
Experiment 6	-	-	-	3	-	-
Experiment 7	-	-	-	-	3	-
Experiment 8	-	-	-	-	3	3

9. Mapping of the Course outcomes to Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	2	-	1	-	3	2	-	1
CO2	3	3	1	3	-	-	1	-	3	2	-	1
CO3	3	3	1	3	2	-	1	-	3	2	-	1
CO4	3	3	1	3	-	-	1	-	3	2	-	1
CO5	3	3	1	3	2	-	1	-	3	2	-	1
CO6	3	3	2	3	2	-	1	-	3	2	-	1

10. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	-
CO2	3	3	1	-
CO3	3	3	1	-
CO4	3	3	1	-
CO5	3	3	1	-
CO6	3	3	1	-