

SEMESTER 7

CIVIL ENGINEERING

SEMESTER S7

STRUCTURAL DYNAMICS

Course Code	PECET741	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCCET403	Course Type	Theory

Course Objectives:

1. To provide the basic concepts of structural dynamics and the theoretical background to perform dynamic analysis of structures.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	<p>Introduction – Classification of dynamic loads – essential characteristics of a dynamic problem – methods of discretization– single degree of freedom systems – basic components of a dynamic system.</p> <p>Formulation of equation of motion – Newton’s 2nd law and D’ Alembert’s principle; influence of gravitational forces – generalized SDOF systems.</p> <p>Solution of the equation of motion – undamped free vibration – damped free vibration- critically damped under damped and over damped SDOF systems, Logarithmic decrement.</p>	9
2	<p>Response to harmonic loading – steady state and transient states steady state amplitude, Dynamic magnification factor, force transmissibility and vibration isolation.</p> <p>Response to periodic loading – Fourier series representation of periodic loads in time domain. Response of SDOF systems.</p> <p>Response to impulse loading – half-sine, rectangular and triangular pulses;</p>	9

3	<p>Response to general loading – Duhamel Integral, damped and undamped systems.</p> <p>Multi degree of freedom systems – Lumped mass systems, shear building frame, Equation of motion.</p> <p><i>Free vibration analysis:</i> Natural frequencies and mode shapes, orthogonality of normal modes.</p>	9
4	<p>Approximate methods: Rayleigh's method Dunkarley's method, Stodola's method.</p> <p>Distributed mass (continuous) systems – differential equation of motion – Axial vibration of rods. Flexural vibration of beams, natural frequencies and mode shapes of simply supported beam. Evaluation of frequencies and mode shapes of cantilever beam and fixed beam (formulation only).</p>	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">2 Questions from each module.Total of 8 Questions, each carrying 3 marks <p>(8x3 =24marks)</p>	<ul style="list-style-type: none">Each question carries 9 marks.Two questions will be given from each module, out of which 1 question should be answered.Each question can have a maximum of 3 sub divisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Formulate appropriate SDOF models of simple structural systems under dynamic loads apply them to the solution of engineering problems.	K3
CO2	Analyze and interpret the dynamic response of SDOF systems for various dynamic inputs.	K3
CO3	Develop mathematical models for MDOF shear building models and estimate the natural frequencies and vibration modes for the same.	K3
CO4	Understand the dynamic behaviour of continuous parameter systems.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Dynamics of Structures	Anil K. Chopra	Pearson Education	2020
2	Structural Dynamics: Theory and Computation	Mario Paz	Springer	5 th Ed 2007
3	Structural Dynamics: Vibrations & Systems	Mukhopadhyay M.,	ANE Books	2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Dynamics of Structures	Clough R.W, J.Penzien	CBS	2 nd Ed 2015
2	Vibration of Structures	J.W. Smith	Chapman and Hall, London.	1988
3	Vibration Analysis and Structural Dynamics for Civil Engineers: Essentials and Group-Theoretic Formulations	Alphose Zingoni	CRC Press	2018

Video Links (NPTEL, SWAYAM...)	
Sl No.	Link ID
1	https://archive.nptel.ac.in/courses/105/106/105106151/
2	https://archive.nptel.ac.in/courses/105/101/105101006/
3	https://archive.nptel.ac.in/courses/105/101/105101209/

SEMESTER S7

FORMWORK ENGINEERING

Course Code	PECET742	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Understand the principles of formwork design and construction.
2. Learn about different formwork materials and systems.
3. Apply safety standards in formwork operations.
4. Develop skills in planning and managing formwork operations

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Formwork and Materials Introduction to Formwork Engineering, Definition and importance of formwork, Historical development of formwork systems, Formwork Materials : Timber, steel, aluminum, and plastic formwork, Properties and selection criteria, Advantages and disadvantages of different materials, Modern Formwork Systems, Modular, prefabricated, and reusable formwork, Advancements in formwork materials and technology, Environmental Considerations, Sustainable formwork practices, Reducing waste and recycling materials, Environmental impact assessment.	9
2	Design and Construction of Formwork Systems Basic Principles of Formwork Design, Load considerations and calculations Structural analysis of formwork systems, Formwork for Different Concrete Structures, Foundations, walls, columns, beams, and slabs,	9

	Special considerations for high-rise buildings and bridges, Formwork for architectural concrete, Assembling and Dismantling Formwork, Erection and alignment, Shoring and reshoring practices.	
3	Safety and Quality Control in Formwork Formwork Safety, Safety regulations and standards, Common hazards and risk management, Inspection and maintenance of formwork systems, Formwork Quality Control, Ensuring accuracy and quality in construction, Testing and inspection methods, Quality assurance protocols, Case Studies and Practical Applications, Analysis of real-world formwork projects Lessons learned from successful and failed systems, Guest lectures from industry professionals.	9
4	Project Planning, Management, and Special Conditions Project Planning and Management, Estimating formwork costs and labor, Scheduling and sequencing operations, Project management tools and techniques, Formwork in Special Conditions, Extreme weather conditions, Underwater formwork, Unusual shapes and complex geometries, Formwork for Repair and Rehabilitation, Techniques for concrete repair works, Strengthening and retrofitting existing structures, Case studies of rehabilitation projects	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">2 Questions from each module.Total of 8 Questions, each carrying 3 marks <p>(8x3 =24marks)</p>	<ul style="list-style-type: none">Each question carries 9 marks.Two questions will be given from each module, out of which 1 question should be answered.Each question can have a maximum of 3 sub divisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify appropriate materials for the form work construction	K3
CO2	Apply the principles of structural analysis and design in formwork design	K3
CO3	Demonstrate the safety and quality control requirements in formwork	K2
CO4	Organize form work construction considering the planning concepts	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Formwork for Concrete	M.K. Hurd	American concrete inst	1979
2	Concrete Formwork Systems	Awad S. Hanna	CRC Press	2019
3	Formwork for Concrete Structures	Garold D. Oberlender and Robert L. Peurifoy	McGraw Hill	4 th edition 2010

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Formwork A Practical Guide	Geoffrey Lee, Peter McAdam	CRC Press	2014

Video Links (NPTEL, SWAYAM...)	
Sl No.	Link ID
1	https://archive.nptel.ac.in/courses/105/104/105104030/

SEMESTER S7

ENVIRONMENTAL GEOTECHNOLOGY

Course Code	PECET743	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCCET402	Course Type	Theory

Course Objectives:

1. The provide information regarding soil -water- contaminant interaction process
2. To provide aspects of waste containment facilities design and remediation of contaminated sites

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Scope of geoenvironmental engineering - multiphase behaviour of soil – importance of soil physics, soil chemistry, hydrogeology, biological process-Geochemical Attenuation-Quantification of attenuation capacities-Laboratory evaluation, sequential batch-contact testing and Column percolation testing. Soil-water-contaminant interaction and concepts of double layer –Change in properties of soil due to change in environment;- Atterberg limits, shear strength, volume change, and permeability.	9
2	Contaminant transport in soil -Transport process- Advection, Diffusion, Dispersion and sorption-Fick's equation Characteristics of Municipal solid waste, Physical, Chemical and geotechnical characteristics-Identification of Hazardous and Non-Hazardous waste.- waste dump and its impact on environment-Regulatory requirement -Solid waste management rules (brief introduction only) –MOEF&CC Guidelines-duties of waste generator and local authority -Evolution of waste containment facilities and disposal practices – Site selection based on environmental impact assessment	9

3	Landfill Types-Landfill layout and capacity, Planning of landfills-Liner and Cover system, its components and its functions-natural clay liner- compacted clay liner selection of soil for barrier layer- Methods to find permeability of clay barrier layer -Primary and secondary leachate collection and removal systems - Gas Management, Gas extraction systems-passive and active system Closure and post closure monitoring system (brief introduction)	9
4	Application of geosynthetics in landfills-Geotextile, geomembrane, geosynthetic clay liners, Geocomposites. methodology of construction, testing and design aspects Contaminated site- Soil exploration at contaminated site (brief introduction)-risk assessment of contaminated site - remediation methods for soil and groundwater –selection and planning of remediation methods–in-situ/exitu remediation, bioremediation, thermal remediation, pump and treat method, phyto remediation and electrokinetic remediation Stability of landfill (brief introduction)	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> 2 Questions from each module. Total of 8 Questions, each carrying 3 marks <p>(8x3 =24marks)</p>	<ul style="list-style-type: none"> Each question carries 9 marks. Two questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand Soil -water- contaminant interaction process and	K1
CO2	Study Contaminant transport in soil	K2
CO3	Design aspects of waste containment facilities	K3
CO4	Plan Remediation of contaminated sites	K1

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Soil engineering in relation to environment	Ayyar TSR	LBS centre for Science and Technology, Trivandrum	2000
2	Solid waste Management and Engineered Landfills	Dr. G V Rao and Dr. R S Sasidhar	Saimaster Geoenvironmental Services Pvt. Ltd. Publication	2009
3	Geotechnical Practice for Waste Disposal.	Daniel, D.E.).	Chapman, and Hall, London.	1993
4	Geoenvironmental Engineering	Hari D. Sharma, Krishna R. Reddy	Publisher: John Wiley & Sons Inc.	2004
5	Designing with Geosynthetics.	Koerner, R.M.	Fifth Edition. Prentice Hall, New Jersey	2005.

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Geoenvironmental Engineering: Principles and Applications,	Reddi L.N and Inyang HI	Marcel Dekker Inc Publication	2000
2	Waste Disposal in Engineering landfills,	Manoj Datta	Narosa Publishing House, NewDelhi	1997
3	Geoenvironmental Engineering: Contaminated Soils, Pollutant Fate, Mitigation	R. N. Yong	Lewis Publication.	2000

Video Links (NPTEL, SWAYAM...)	
Sl No.	Link ID
1	https://archive.nptel.ac.in/courses/105/101/105101196/

SEMESTER S7

AIRPORT PLANNING AND DESIGN

Course Code	PECET744	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:3:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCCET502	Course Type	Theory

Course Objectives:

1. To impart knowledge about planning different components of airport.
2. To enable the students to understand the factors affecting the design of airports.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	General - History, development, policy of air transport, aircrafts, aerodromes, air transport authorities, air transport activities, air craft characteristics, airport classifications as per ICAO. Regional planning -concepts and advantages, location and planning of airport as per ICAO and F.A.A. recommendations, airport Elements -airfield, terminal area, obstructions, approach zone, zoning laws, airport capacity, size and site selection, estimation of future air traffic, development of new airport, requirements of an ideal airport layout.	9
2	Runway 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 configurations. threshold limits cross section of runway. Taxiway design - Controlling factors, layout, exit taxiway, location and geometrics, holding apron, turn around facility. 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.	9
3	Landside Planning: Terminal area elements and requirements, Terminal concepts & types, Passenger requirements at terminal building, space requirements-design peak hour demand, standards, location planning	9

	concepts of other landside elements. Airport Geometrics: Runway and taxiway geometric elements: Length, width, Safety Area, Grade & grade changes, Sight distance, Turning radius. Grading and Drainage: Airport grading-importance - operations, airport drainage aims, functions, special characteristics, basic requirements, surface and subsurface drainage systems.	
4	Visual Aids: Objectives, Runway Marking, Taxiway Marking, Shoulder marking, Apron marking. Airport Lighting: Beacon, Obstruction lighting, Approach lighting, Runway lighting. Taxiway Lighting, Airfield Signage system: Runway and taxiway signages, Signing standards. Air traffic control: Air traffic control-objectives, rules, control system, control network-visual aids-landing information system. Air Travel demand forecast: Macro & Micro Analysis (Intro only), Air field capacity: factors, (Intro only).	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the different components of airport and aircrafts.	K1
CO2	Apply principles of airport planning in design of Runways and Taxiways.	K3
CO3	Apply the principles in planning the landside features of an airport.	K2
CO4	Apply the standards for geometric design of runways and taxiways.	K3
CO5	Describe the various visual aids applied on airports.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Airport Planning and Design	Khanna S K, Arora M G and Jain S S	Nemchand and Brothers	6 th Edition, 2012
2	Airport Engineering	Rangwala S., C., and Dalal K., B	Charotar Publishing House Pvt. Ltd.	16 th Edition, 2016
3	Planning and Design of Airports	Horonjeff, R. , McKelvey, F. X., Sproule, W. J., and Young S. B.	McGraw-Hill Professional	5 th Edition, 2010

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Airport Systems: Planning, Design, and Management	Richard de Neufville	McGraw-Hill Professional	2 nd Edition, 2013
2	Transportation Engineering: Railways, Airports, Docks & Harbours	Srinivasa Kumar R	Universities Press	2014
3	Planning, Design and Development of 21st Century Airports	Norman J. Ashford, Saleh Mumayiz and Paul H. Wright	John Wiley & Sons	4 th Edition, 2011
4	Airport planning and management	Young, S.B. and Wells, A.T.	McGraw-Hill Education	6th ed., 2011

Video Links (NPTEL, SWAYAM...)	
Sl No.	Link ID
1	https://archive.nptel.ac.in/courses/105/107/105107123/

SEMESTER S7

HIGHWAY MATERIALS AND DESIGN

Course Code	PECET746	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:3:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCCET502	Course Type	Theory

Course Objectives:

1. Understand the characteristics of various highway materials, tests on highway materials, and design of bituminous mixes,
2. Analyse the stresses on pavements and to design major types of pavements using different approaches so that it has better performance and longer service life

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Pavements and materials: Desirable properties and testing of materials: Introduction to highway pavements-Flexible and rigid pavements-component parts - Functions and significance of layers. Pavement Materials – Desirable properties, principle and procedure of tests for assessment of subgrade soil, road aggregates and bitumen.	9
2	Bituminous mixes requirements and design: Materials for durable pavements- Artificial aggregates, types of binders, -emulsions, cut backs and modified binders-grading, characteristics and uses. Aging of bitumen and aging tests. Requirements of bituminous mixes, Specifications for bituminous pavement layers. Grading of aggregates, design of bituminous mixes using Marshall Method.	9
3	Design of flexible pavements: Introduction to analysis and design of flexible pavements: Factors affecting design and performance of pavements, ESWL of multiple wheels, Repeated loads and EWL factors, stresses and	9

	deflections in homogeneous masses and layered system. Design of flexible pavements: Empirical, semi - empirical and theoretical approaches for flexible pavement design- Design of pavement using CBR method, Triaxial method, Burmister's two-layer theory and IRC method.	
4	Design of rigid pavements: Introduction to analysis and design of rigid pavements: Types of stresses -wheel load stress, warping stress, frictional stress and critical combination of stresses, Westergaard's Analysis. Joints in cement concrete pavements: Types of joints and functions, Joint spacings, design of tie bar and dowel bar using IRC method. Design of slab thickness- IRC methods of design of cement concrete slab.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify suitable materials for different types of pavements and Interpret material test results with respect to field conditions and standards.	K3
CO2	Apply the pavement material properties to analysis of pavements and Evaluate material properties in design of pavement mixes.	K3
CO3	Determine the stresses and design flexible pavements with better performance and longer service life	K3
CO4	Determine the stresses and design rigid pavements with better performance and longer service life and Design the reinforcements in cement concrete pavements	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Highway Engineering	SK Khanna , CEO Justo, A. Veeraragavan	Nem Chand & Bros	Revised 10th Edition - 2017
2	Principles and Practices of Highway Engineering	Kadiyali, L. R. and N.B Lal,	Khanna Publishers, 2013	Seventh edition, 2017
3	Principles of Transportation and Highway Engineering	Rao G. V.	Tata McGrawHill	1996
4	Principles of Pavement Design	Yoder E J and Witezak M W	John Wiley and sons	2nd Edition 2011
5	IRC: 37-2018, Guidelines for the Design of Flexible Pavements			
6	IRC: 58 - 2015, Guidelines for the Design of Rigid Pavements			
7	MoRTH specifications			

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Pavement Analysis and Design	Yang H. Huang	Prentice Hall	2004
2	Pavement Engineering – Principles and Practice	Rajib B. Mallick and Tahar El-Korchi	CRC Press (Taylor and Francis Group)	

Video Links (NPTEL, SWAYAM...)	
SL. No.	Link ID
1	https://nptel.ac.in/courses/105106221
2	https://nptel.ac.in/courses/105104098

SEMESTER S7

RIVER ENGINEERING

Course Code	PECET747	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCCET501	Course Type	Theory

Course Objectives:

1. To understand river morphology, classification systems, channel behaviour, and sediment transport processes.
2. To understand the critical aspects in the design of river engineering structures
3. To understand river mechanics to facilitate mathematical/ hydraulic modelling.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction – river morphology- classification of rivers - systems of stream classification. Behaviour of rivers, channel geometry, effects of long contraction. Super critical flow, Stream profiles and bed material bank erosion, degradation, aggradation. River basin management plans, inter basin river water transfers and river water disputes.	9
2	River training works – classification of river training works-objectives - methods – planning – design parameters-embankment as river training works- design of guide banks- artificial cut off– pitched island – river diversions - examples of river training works.	9
3	Properties of the sediment settling velocity, - incipient motion critical tractive force, empirical equations- scour criteria, Shield's analysis –White's analysis Regimes of flow and resistance; Bed form mechanics design of stable channels – Garret's method Bed load transport and its estimation.	9

4	Suspended load transport, Diffusion in turbulent flow, differential equation for suspension of sediment, estimation of suspended load, Sediment samplers – bed load samplers – suspended load samplers.	9
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To understand river morphology, classification, channel behaviour, and sediment transport processes.	K2
CO2	To understand the critical aspects in the design of river engineering structures	K3
CO3	To understand river mechanics to facilitate mathematical/ hydraulic modelling.	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mechanics of Sediment Transportation and Alluvial Stream Problems	R. J. Garde, K. G. Ranga Raju	New Age International	3 rd Ed, 2000
2	Flow in Open Channels	Subramanya K	Tata McGraw Hill	4, 2015
3	Hydraulics of Sediment Transport	Walter Hans Graf	Water Resources Pubns	1987
4	River Engineering	Margaret S. Peterson,	Prentice Hall	1986

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fluvial Processes in River Engineering	Howard Chang	John Wiley & Sons	1988
2	An introduction to fluvial hydraulics	Serge Leliavsky	Dover Publications	1966

Video Links (NPTEL, SWAYAM...)	
Sl. No.	Link ID
1	https://archive.nptel.ac.in/courses/105/103/105103204/

SEMESTER S7

PAVEMENT DESIGN AND CONSTRUCTION

Course Code	PECET745	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCCET502 and PCCEL607	Course Type	Theory

Course Objectives:

1. This course introduces students to the fundamental concepts of Pavements, materials used for pavement construction, and types.
2. Students will learn to analyse and design a pavement and also to evaluate the condition of a pavement.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Pavement: Functions and characteristics- types of pavement: flexible pavement, rigid pavement, comparison - Different layers of flexible and rigid pavement, functions and characteristics of layers. Pavement materials: Properties of aggregates, bitumen and subgrade soil. Requirements and tests on aggregates, bitumen and subgrade soil (CBR value). Types of bitumen and uses, bituminous emulsion and cutback. Methods of grading of bitumen.	9
2	Bituminous pavement types: Penetration layer system and premixed system- Types and specification of materials used. Special types of bituminous layers (stone mastic asphalt and mastic asphalt). Mix design: physical and volumetric properties of bituminous mix, Marshall method of mix design, Super pave mix design.	9

3	<p>Construction of Flexible Pavement- Construction steps, equipment used and quality control checks of subgrade, granular sub base (GSB),WBM, WMM, Bituminous Macadam and Bituminous Concrete layers of flexible pavement.</p> <p>Construction of Cement concrete pavement: material characterization, preparation of subgrade and base, presetting reinforcement in joints and PCC slab construction. Methods of construction of concrete pavements.</p>	9
4	<p>Introduction to Pavement Evaluation- Structural and functional requirements of pavements. Functional evaluation of pavements- pavement condition survey, pavement distress rating indices,</p> <p>Structural evaluation of flexible pavements by Benkelman Beam Deflection technique.</p>	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

<i>Attendance</i>	<i>Internal Ex</i>	<i>Evaluate</i>	<i>Analyse</i>	<i>Total</i>
5	15	10	10	40

Criteria for Evaluation(Evaluate and Analyse): 20 marks

Assignment

Find a real-world pavement requirement. Collect and analyse required data and design the pavement.

1. *Defining objectives (K4 - 4 points).*
2. *Laboratory experiments or field data collection (K4 - 4 points)*
3. *Analysis of data (K5 - 4 points)*
4. *Verification with standard specification or rating (K5 - 4 points)*
5. *Conclusions (K4- 2 points, K5 – 2 points)*
 - a. *Summarizes findings and insights. (K4)*
 - b. *Reflects critical thinking and informed decision-making. (K5)*

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">• 2 Questions from each module.• Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. Each question carries 9 marks. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the different types of pavements and the materials used.	K3
CO2	Design a typical bituminous pavement using standard methods.	K3
CO3	Apply on field the basic construction practises of flexible and rigid pavements.	K3
CO4	Understand the concept of pavement evaluation as per standard procedures.	K3
CO5	Analyse & evaluate the design procedure, construction and conduct a structural & functional evaluation of a typical pavement.	K4, K5

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Highway Engineering	Khanna, S.K, Justo E.G, .A Veeraragavan	Khanna Publishers	10th Edition, 2018
2	Principles of Highway Engineering	Kadiyali, L. R	Khanna Publishers	2001
3	Pavement Engineering	Rajib B. Mallick and TaharEl-Korchi	CRC press	2009
4	Principles of Transportation and Highway Engineering	Rao G. V	Tata McGrawHill	1996
5	Bituminous Road Construction in India	Prithvi Singh Khandhal	PHI Learning	2019

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Pavement Management for Airports, Roads and Parking lots	Shahin M.Y	Chapman & Hall,	2005
2	MoRTH 2001, Manual for construction and supervision of Bituminous works			
3	IRC: 37-2018: Guidelines for the Design of Flexible Pavements			

Video Links (NPTEL, SWAYAM...)	
Sl.No.	Link ID
1	https://nptel.ac.in/courses/105104098
2	https://www.civil.iitb.ac.in/~vmtom/nptel/401_InTse/web/web.html
3	https://archive.nptel.ac.in/courses/105/107/105107219/
4	https://nptelvideos.com/video.php?id=2058

SEMESTER S7

GROUND WATER ENGINEERING

Course Code	PECET751	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCCET501, PCCET402	Course Type	Theory

Course Objectives:

1. To expose the students to the fundamental concepts of groundwater hydrology and its engineering applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Vertical distribution of groundwater- Types of geologic formations, aquifer and their types, Properties of aquifer related to storage and transmissivity of water, Darcy's law (Review) Steady unidirectional flow- steady flow in a homogenous aquifer- aquifer with recharge- flow into infiltration galleries. (Problems from unidirectional flow) Evaluation of aquifer parameters by Theis, Jacob's and Chow's method. (Problems from evaluation of aquifer parameters)	9
2	Modelling of ground water flow- governing equations of ground water flow and boundary conditions (basic ideas only), solution of partial differential equation of ground water flow for 1D steady ground water flow in homogenous aquifers (confined and unconfined) using finite difference method (uniform mesh interval only) Partial differential equation governing unsteady groundwater flow- unsteady radial flow towards well.	9
3	Well hydraulics -Well flow near aquifer boundaries- Image well system. Method of images- Practical cases (Problems from method of images). Method of constructing shallow wells- Method of constructing shallow wells	9

	-cable tool method, rotary method and reverse rotary method-well completion-design of gravel packed well-well development-different methods, well rehabilitation.	
4	Surface investigation of groundwater- different methods-electrical resistivity method, seismic refraction method- determination of aquifer thickness of horizontal aquifers (Problems from resistivity method, seismic refraction) Groundwater Contamination, Quality of Ground Water- Graphical Representations. Reducing Groundwater Contamination. Sea water intrusion- Ghyben-Herzberg equation, sea water-fresh water interface, length of intrusion, upconing, preventive measures.(Problems from sea water intrusion)	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> 2 Questions from each module. Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> Each question carries 9 marks. Two questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Determine the aquifer parameters using different methods.	K3
CO2	Perform numerical modelling of ground water system.	K3
CO3	Describe the procedure of well construction and estimate the well draw down curve.	K3
CO4	Determine aquifer thickness using different geophysical methods	K3
CO5	Estimate the extent of ground water pollution and assess the quality	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Ground Water Hydrology	D.K. Todd	Wiley International	1995
2	Groundwater.	H.M. Raghunath	New Age International	2007
3	Numerical Ground Water Hydrology	A.K. Rastogi	Penram International	2007

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Ground Water Assessment, Development and Management	K. Karanth	Tata McGraw Hill	2017
2	Ground Water Manual : A Water Resources Technical Publication	USDI, Bureau of Reclamation	Scientific Publishers - USDI	2017
3	Ground Water and tube wells	S.P Garg	Oxford & IBH Publishing Company	1993
4	Ground Water Hydrology	Herman Bouwer	MC Graw Hill Kogakusha Ltd	2000

Video Links (NPTEL, SWAYAM...)	
Sl No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc24_ce83/preview
2	https://nptel.ac.in/courses/105103026

SEMESTER S7

SUSTAINABLE CONSTRUCTION PRACTICES

Course Code	PECET752	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To know the importance of sustainable use of natural resources and energy.
2. To understand the principles of effective energy and resources management in buildings.
3. To bring awareness of the basic criteria in the green building rating systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to sustainable practices: Building life cycle, resource use in the built environment, major environmental issues, three dimensions of sustainability, environment, economy and social aspects, construction ecology and principles of green engineering. Indoor Environmental Quality: Day lighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics. Codes related to green buildings: NBC, ECBC, ASHRAE, UPC, etc.	9
2	Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy. Methods to reduce operational energy: Energy efficient building envelopes, Solar Heat Gain Coefficient, U-Values for facade materials, efficient lighting technologies, energy efficient and BEE rated appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of NET ZERO buildings.	9

3	<p>Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.</p> <p>Waste Management: Handling of construction & demolition waste materials, separation of household waste, handling e-waste, on-site and off-site organic waste management</p>	9
4	<p>Introduction to Green Buildings: Definition of green buildings, definition of sustainability, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems, Case studies.</p>	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">2 Questions from each module.Total of 8 Questions, each carrying 3 marks <p>(8x3 =24marks)</p>	<ul style="list-style-type: none">Each question carries 9 marks.Two questions will be given from each module, out of which 1 question should be answered.Each question can have a maximum of 3 sub divisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the methodologies for sustainability and maintain indoor environmental quality	K3
CO2	Describe energy efficiency methods used in green building practices.	K3
CO3	Adopt various water efficiency criteria and waste management methods	K3
CO4	Understand the principles and practices of green buildings	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Non-Conventional Energy Resource	G. D. Rai	Khanna Publishers	1988
2	Sustainable Construction and Design	Regina Leffers	Pearson / Prentice Hall, USA	2009
3	Sustainable Construction Practices	Er. Chirag K Baxi and Dr. Snehal Abhyankar	Nexus stories publication	2023

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Green Building Fundamentals: Practical Guide to Understanding and Applying Fundamental Sustainable Construction Practices and the Leed System	Mike Montoya	Pearson	2 nd Ed 2010
2	Sustainable Practices in the Built Environment	Craig Langston	CRC Press	2008
3	Sustainable Building Design Manual, Vol.1 and 2, TERI, 2004			
4	GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment			

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	http://acl.digimat.in/nptel/courses/video/105102195/105102195.html

SEMESTER S7

ADVANCED GEOTECHNICAL INVESTIGATION

Course Code	PECET753	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Geotechnical Engineering -1 (PCCET402)	Course Type	Theory

Course Objectives:

1. To impart in-depth knowledge about the various methods of geotechnical investigation and the field tests to be conducted in different situations
2. To give the students a clear idea about how a geotechnical investigation programme is to be planned and executed
3. To help the students to take proper engineering decisions in practical situations
4. To understand the functions and applications of geosynthetics

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Planning an Investigation Programme Geotechnical Investigation – Necessity, Scope and Objectives Planning of a sub-surface exploration program -Factors to be considered Reconnaissance, preliminary and detailed investigation. I.S guidelines for deciding the number, size, spacing and depth of boreholes Exploration techniques Methods of exploration- open pits, trenches, shafts, boreholes. Methods of boring – Auger boring, wash boring, percussion drilling, rotary drilling Sampling Soil Sampling- disturbed and undisturbed soil samples- representative and non-representative samples , chunk and tube samples,	9

2	<p>Sounding Methods</p> <p>Standard Penetration Test- procedure, Factors influencing the SPT results and precautions to obtain reliable results– corrections to be applied to observed N values– correlations of N value with various engineering and index properties of soils-Field study from sites-Field visit and analysis of data</p> <p>Static cone penetration test-procedure-merits/drawbacks. Correlation of static CPT results with properties</p> <p>Dynamic Cone penetration test-Procedure-merits/drawbacks-Critical comparison of SPT, Static CPT and dynamic CPT</p> <p>Plate load test –Procedure, uses, limitations-Design of foundation from the analysis of data</p>	9
3	<p>Field Tests</p> <p>Geophysical methods -Seismic refraction method- procedure, use, limitations. Electrical resistivity method-Electrical profiling and electrical sounding-procedure, uses, limitations</p> <p>Field tests – Pressure meter Test procedure, uses -limitations, correlations.</p> <p>Pile load tests- Procedure- analysis of results of data</p>	9
4	<p>Sampling, Report & Geosynthetics</p> <p>Soil Sampling- disturbed and undisturbed soil samples- representative and non-representative samples, chunk and tube samples, Area ratio clearance, outside clearance-recovery ratio, Handling and transportation of sample, Types of samplers-Thin walled sampler, Piston sampler-Split spoon sampler. Methods for collection of sand samples from beneath the water table</p> <p>Soil Investigation report</p> <p>Presentation of soil exploration data – Bore log and soil profile.</p> <p>Geosynthetics</p> <p>Geosynthetics- Functions and applications from case studies – any field visit - Pavements, Embankments, Railways, Erosion control from Kerala state.</p>	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	The students will be able to understand the procedure, applicability and limitations of various methods of geotechnical investigation	K2
CO2	The students will be able to make judgements and take appropriate decisions related to geotechnical investigations	K4
CO3	The students will be able to understand the procedure and applications of penetration tests and geophysical tests for the exploration of the soil profile	K3
CO4	The students will be able to choose the right soil sampling technique, analyse the dependability of samples collected and understand the soil investigation report	K4
CO5	The students will be able to understand the functions and field applications of Geosynthetics from case studies from Kerala State	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Basic and applied soil mechanics	Gopal Ranjan and Rao A.S.R	New Age International (P) Limited, New Delhi	5 th edition 2024
2	Geotechnical Engineering	Venkataramaih	Universities Press (India) Limited, Hyderabad	6 th edition 2018
3	Geotechnical Ground Investigation	Myint Win Bo	World Scientific Publishing Company	2022

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Geotechnical Engineering Investigation Handbook	Hunt R.E. (2005)	, Mc GrawHill, New York	Second Edition 2005
2	Principles of Geotechnical Engineering, Seventh Edition, Cengage Learning Inc, Stamford, USA	Braja M Das (2010)	Cengage Learning Inc, Stamford, USA	Seventh Edition (2010)
3	Soil Mechanics & Foundation Engineering	Purushothama Raj P	Pearson Education India.	(2008)

Video Links (NPTEL, SWAYAM...)	
	Link ID
1	https://nptel.ac.in/courses/105105039
2	https://nptel.ac.in/courses/105103182

SEMESTER S7

RAILWAY, PORT AND HARBOR ENGINEERING

Course Code	PECET754	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCCET502	Course Type	Theory

Course Objectives:

1. To understand the components and geometric design of railway tracks, construction of railway track, operational and control systems in functioning of the entire rail system.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Role of Railways in the development of a Nation- Development of railways in India- Track Alignment - Basic requirements- Factors in selection of suitable alignment-Surveys for track alignment- Permanent way and Railway track components - Functions of various components- Rails, Sleepers, Ballast, - Rails - types of rails, rail sections- defects in rails, creep of rails, theories- Measurement of creep- Prevention of creep. Rail fixtures and fastenings, rail joints and welding of rails, Sleepers – types, spacing and density, Ballast – types, advantages and disadvantages, Subgrade – Functions- Material and its improvement (brief description only)- Concept of Gauges -Selection of Gauge-Uniformity of gauge. Coning of wheels -Theory of coning- advantages and disadvantages.	9
2	Geometric design of track : gradients, grade compensation, speed of trains on curves, super elevation, cant deficiency, negative super elevation, curves, types (brief description), necessity of providing transition curve, length of transition curve, widening on curves. Points and crossings -Necessity – Turnout- components- Crossings- Components- Design features of turnout- Types of Track Junctions - Construction of Railway Track - Earthwork and consolidation- Plate laying- Laying of ballast.	9

3	Water Transportation: Advantages and disadvantages. Harbours- Classification, requirements and characteristics of good harbour, and principles of harbour planning, site selection- Layout of harbour-Shape of harbour, harbour depth, Ship characteristics. Effects of natural phenomena on marine structures- Tides, Wind, Water waves Littoral drift. Marine Structure- General design aspects, Breakwaters - function, types, general design principles, construction methods, Wharves, Quays, Jetties, Piers, Pier heads, Dolphin, Fenders, Mooring Accessories.	9
4	Navigational Aids- Necessity, Types of navigation aids, Requirement of signals, Fixed and floating navigation aid- Docking and Repair Facilities- wet dock, classification-different types-design considerations- operation of lock gates and passage- Dry dock- Graving dry dock- design aspects- floating dry dock- design aspects- Port Facilities- Port building facilities, Transit sheds, Warehouses, Cargo handling facility, Services for shipping terminals, Inland port facilities planning.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">2 Questions from each module.Total of 8 Questions, each carrying 3 marks <p>(8x3 =24marks)</p>	<ul style="list-style-type: none">Each question carries 9 marks.Two questions will be given from each module, out of which 1 question should be answered.Each question can have a maximum of 3 sub divisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify factors affecting alignment of railway track for a given terrain and to explain the component parts of railway tracks, its functions, and materials of making	K3
CO2	Carry out geometric design of railway track and to explain the construction procedure of railway tracks	K3
CO3	Explain the basic principles, site selection characteristics and lay out of ports and harbours and the basics of docks.	K2
CO4	Understand the concepts of various structures on harbours and navigational aids for communication.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Railway Track Engineering,	Mundrey J. S,	Tata McGraw Hill	5th edition 2017
2	Harbour. Dock & Tunnel Engineering,	Srinivasan,R.,	Charotar Publishing House,	28e, 2016
3	Railway Engineering.	Rangawala, S.C.	Charotor Publishing House	27th edition 2017
4	A course in Docks and Harbour Engineering,	Bindra. S.P.,	Dhanpat Rai& Sons	January 2012

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Railway Engineering	Chandra, S. and Agarwal, M.M.	Oxford University Press, New Delhi	Second edition 2013
2	Railway Engineering.	Saxena, S. C and Arora, S. P,	Dhanpat Rai & Sons,	7e, 2015
3	Dock and Harbour Engineering	H P Oza and G H Oza,	Charotar Publishing House	8th Edition 2017

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	http://acl.digimat.in/nptel/courses/video/105107123/105107123.html
2	http://acl.digimat.in/nptel/courses/video/105107123/105107123.html
3	http://www.digimat.in/nptel/courses/video/114106025/114106025.html
4	http://www.digimat.in/nptel/courses/video/114106025/114106025.html

SEMESTER S7

AIR AND NOISE POLLUTION CONTROL ENGINEERING

Course Code	PECET756	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:3:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand the various air pollutants, its sources, monitoring methods, control methods and regulations
2. To familiarise the concept of noise pollution and its control

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Air pollutants, Sources, classification, Combustion Processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects, Smoke, smog and ozone layer disturbance, Greenhouse effect.	7
2	Air sampling and pollution measurement methods, principles and instruments, ambient air quality and emission standards, Air pollution indices, Air Act, legislation and regulations	9
3	Control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods. Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods like absorption, adsorption, precipitation etc. Biological air pollution control technologies, Indoor air quality	9
4	Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes; special	11

	noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Noise control methods	
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand sources of air pollution , air pollution problems, and Demonstrate a detailed knowledge of study the effect of meteorological parameters in the dispersion of air pollutants	K3
CO2	Analyze Environment legislation and regulations for air and noise pollution	K3
CO3	Evaluate efficiency of various air pollution control devices used for particulate removal	K3
CO4	Design, operate and control the devices used for noise emission control	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Environmental Pollution Control Engineering	C. S. Rao	Wiley Eastern Limited	2000
2	Air pollution	M. N. Rao, H. V. N. Rao	Tata McGraw Hill Pvt. Ltd, New Delhi	1993
3	Noise Pollution	G.K. Nagi, M.K. Dhillon, G.S. Dhaliwa	Commonwealth Publishers,	1999

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Sewage Disposal and Air Pollution Engineering	S.K. Garg	Khanna publishers	2024
2	Environmental pollution analysis	S.M. Khopkar	New Age International Publications	2020

Video Links (NPTEL, SWAYAM...)	
Sl.No.	Link ID
1	https://archive.nptel.ac.in/courses/105/107/105107213/
2	https://onlinecourses.nptel.ac.in/noc22_me52/preview

SEMESTER S7

FINITE ELEMENT METHOD

Course Code	PECET757	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCCET403	Course Type	Theory

Course Objectives:

1. This course provides the fundamental concepts of finite element method and its applications in structural engineering. As a natural development from the matrix analysis of structures, the student is encouraged to appreciate the versatility of this method across various domains, and also as the basis of many structural analysis software. This course introduces the basic mathematical concepts of the method and its application to simple analysis problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	General Introduction –introduction to boundary value problems – approximate numerical solutions for solving differential equations – least square method – collocation method – Galerkin method – introduction to finite element method- advantages and disadvantages.	9
2	Brief review of matrix methods – Direct stiffness method – truss and beam element – Coordinate transformation –global assembly –Estimation of element forces. Interpolation and shape functions- polynomial approximations for 1D and 2D elements using Lagrange polynomials – CST, LST and bilinear rectangular elements	9
3	Formulation techniques – Variational approach and weighted residual approach – formulation of element equations for 1D bar element, 1D beam element and CST element. Isoparametric, sub-parametric and super-parametric elements	9
4	Development of stiffness matrix for bar element and beam element -	

	Introduction to higher order elements – introduction to axisymmetric elements – Numerical Integration – Gauss quadrature. Discussion of modelling and analysis using recent commercial finite element software packages	9
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Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the basic features of boundary value problems and methods to solve them	K2
CO2	Get familiar with the basic element types and shape functions so as to identify and choose suitable elements to solve a particular problem.	K3
CO3	Understand the fundamental concept of the finite element method and develop the ability to generate the governing FE equations for systems governed by partial differential equations	K3
CO4	Understand the concepts of isoparametric elements and apply it for problems in structural engineering	K3
CO5	Apply numerical integration procedures as a tool to solve mathematical models in FEM	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Elementary Finite element method	Desai C.S.	Prentice Hall of India	1979
2	Introduction to Finite Elements in Engineering	Chandrupatla T.R. and Belegundu A.D.	Cambridge University Press	5 th Ed 2021
3	Concepts and Applications of Finite Element Analysis	Cook R.D.	John Wiley	2001

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Finite Element Procedures in Engineering Analysis	Bathe K.J.	Prentice Hall of India	1995
2	Finite Element Analysis in Engineering Design	Rajasekaran S	Wheeler Pub.	2006
3	Finite Element Analysis Theory and programming	Krishnamoorthy C.S.	Tata McGraw Hill	2017
4	Fundamental Finite Element Analysis and Applications with Mathematics and Matlab computations	Bhatti, Asghar	Wiley	2012
5	Finite element method	Zienkiewicz O C and Taylor R W	Elsevier Butterworth-Heinemann, UK	2007

Video Links (NPTEL, SWAYAM...)	
Sl. No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc22_me43/preview
2	https://archive.nptel.ac.in/courses/105/106/105106051/

SEMESTER S7

DESIGN OF HYDRAULIC STRUCTURES

Course Code	PECET755	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. This course introduces the fundamental hydraulic design concepts of different hydraulic structures
2. This course equips the students to perform the hydraulic design of minor irrigation structures such as cross drainage works; canal falls and regulators.
3. This course enables the student to develop/prepare the drawings of minor irrigation structures.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Diversion head works- layout and functions of components, Weir and barrage- Causes of failure of weirs on permeable soils - Bligh's theory and Khosla's theory. Design of vertical drop weir. Design of impervious floor of hydraulic structures by Khosla's theory Cross drainage works-Types, selection of suitable type, Type of aqueducts. Regulation Works - Canal falls-necessity, classification. Canal regulators- Regulator cum road bridge- Head regulators and cross regulators.	9
2	Hydraulic design and Drawing of the following hydraulic structures: 1. Tank sluice 2. Canal Fall (Trapezoidal Notch type) 3. Syphon Aqueduct (Type III) 4. Syphon Well Drop5. Canal Regulator (Using Khosla's Theory	9
3	Dams-Types, Gravity dam – selection of site- forces acting - stability analysis and modes of failure – Principal and shear stresses Problems - Elementary profile –limiting height of gravity dams high and low dams- Practical profiles, Functions of various components shafts, keys, water stops,	9

	and different types of galleries, Grouting. Instrumentation in dams (Concept only)	
4	Earth dams-types, causes of failure and design criteria, Arch dams- thin cylinder theory; Spillways-types-Ogee spillway profile; Energy dissipation-stilling basins-Indian standard Type I and Type II (description only) Arch dams-types, methods for design (list only)-Thin cylinder theory	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

<i>Attendance</i>	<i>Internal Ex</i>	<i>Evaluate</i>	<i>Analyse</i>	<i>Total</i>
5	15	10	10	40

Criteria for Evaluation(Evaluate and Analyse): 20 marks

Assignment

1. Preparation of spread sheet for the design of of hydraulic structures mentioned in the second module
2. Prepare the design and drawings hydraulic structures mentioned in the second module in A2 Sheet.
3. Identify any practical requirement for a hydraulic structure and complete its design.

Criteria for evaluation:

1. *Defining objectives (K4 - 4 points).*
2. *field data collection (K4 - 4 points)*
3. *Analysis of data (K5 - 4 points)*
4. *Verification with standard specification or rating (K5 - 4 points)*
5. *Final design (K4- 2 points, K5 – 2 points)*
 - a. *Summarizes findings and insights. (K4)*
 - b. *Reflects critical thinking and informed decision-making. (K5)*

Scoring:

1. *Accomplished (4 points): Exceptional analysis, clear implementation, and depth of understanding.*
2. *Competent (3 points): Solid performance with minor areas for improvement.*
3. *Developing (2 points): Adequate effort but lacks depth or clarity.*
4. *Minimal (1 point): Incomplete or significantly flawed.*

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions. (Detailed drawings not expected and regular answer book will be provided)

Part A	Part B	Total
<ul style="list-style-type: none">• 2 Questions from each module.• Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. Each question carries 9 marks. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Elucidate the causes of failure, principles of design of different components of hydraulic structures	K3
CO2	Perform the hydraulic design of existing minor irrigation structures such as cross drainage works, canal falls, cross regulator by group activity	K3
CO3	Prepare the scaled drawings of different minor irrigation structures	K3
CO4	Analyse the designs principles and features of dams and perform the stability analysis of gravity dams	K4/K5
CO5	Apply the design criteria of earthen dam and arch dams	K4, K5

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Irrigation Engineering and Hydraulic Structures	Garg S.K	Khanna Publishers	2023 (38th R edition)
2	Irrigation, Water Resources and Water Power Engineering	Modi. P. N	Standard Book House	2020
3	Irrigation and Water Power Engineering.	Punmia B.C, B. B. Pande Lal	Laxmi Publications (P) Ltd.	2010(12th edition)
4	Water Resources Engineering- Principles and Practice	Sathyanarayana M. C.	New Age International Publishers	2020 (2nd Revised edition)
5	Irrigation, Water Resources and Water Power Engineering	K R Arora	S.B.H Publishers and Distributors, New Delhi.	2010

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Theory & Design of Irrigation Structures -Vol III	Varshney, R.S	Nem Chand & Bros., Roorkee	2001(5 th edition)
2	Irrigation and Water Resources Engineering	Asawa. G.L	New Age International Publishers	2008
3	Irrigation Engineering & Hydraulic Structures	Sahasrabudhe S.R.,	S.K. Kataria & Sons	2013

SEMESTER S7

INTELLIGENT TRANSPORTATION SYSTEMS

Course Code	OECET721	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Understand the need of the ITS and ITS System requirements
2. List the various ITS user services and identify their major components
3. Suggest the appropriate tools and components in various functional areas of transportation for field conditions.
4. Identify the importance of automated highway systems and new technology applications in autonomous vehicles

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Intelligent Transportation Systems: <i>Basics of ITS:</i> History of ITS, Urbanisation and motorisation, Transport system characteristics and problems. ITS- components, importance, need, challenges. ITS initiatives in India <i>Understanding ITS:</i> Functionalities required for user service, ITS architecture, ITS technology building blocks (introduction only)	9
2	<i>Traffic management and ITS:</i> Traffic management – objectives, measures, application of ITS for traffic management <i>ITS user services and applications: (introduction only)</i> ATIS advanced traveller information system- Introduction, Functional areas, components. AVCS-advanced vehicle control system, APTS- advanced public transportation system, CVOS-commercial vehicle operation system <i>Application of ITS-</i> Emergency management- objectives, components, benefits	9

	Electronic toll collection- objectives, components. Fleet management and operations	
3	<p><i>Transport Demand management and ITS:</i> Introduction, Application of ITS for TDM- Promotion of Public transport, Road pricing, parking management, High occupancy lanes, Bicycle rentals, carpooling, integrated fare, traffic rule enforcement, Incentive schemes.</p> <p><i>Use of GPS and GIS in ITS:</i> Introduction to GPS and GIS, Automatic vehicle location and identification, real time passenger information, GSM Technologies.</p>	9
4	<p>Automated Highway systems:</p> <p><i>AHS:</i> Introduction, Concepts and technologies of AHS, Connected vehicle system, Vehicle automation, Benefits, goals, challenges with AHS.</p> <p><i>Sensing Technologies:</i> In vehicle- categories, examples, Issues, In road-intrusive, non-intrusive, application, uses.</p> <p><i>Smart Roads:</i> concepts and technologies, smart street lights, smart intersection</p> <p><i>Self driving car:</i> Technology, examples</p> <p><i>ITS case studies:</i> world examples, Indian examples.</p>	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">2 Questions from each module.Total of 8 Questions, each carrying 3 marks <p>(8x3 =24marks)</p>	<ul style="list-style-type: none">Each question carries 9 marks.Two questions will be given from each module, out of which 1 question should be answered.Each question can have a maximum of 3 sub divisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the need of the ITS and ITS System requirements	K2
CO2	List the various ITS user services and identify their major components	K2
CO3	Suggest the appropriate tools and components in various functional areas of transportation for field conditions.	K2
CO4	Identify the importance of automated highway systems and new technology applications in autonomous vehicles	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Intelligent transport systems	Pradip Kumar Sarkar and Amit Kumar Jain	PHI Learning Private Limited	2018
2	Fundamentals of Intelligent Transportation Systems Planning	M.A. Chowdhury and A. Sadek	Artech House,	2010, First Edition
3	Automated Highway Systems,	Petros A. Ioannou,	Springer Science & Business Media	2013
4	Intelligent Transport Systems Standards,	Bob Williams,	Artech House Publishers,	2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Transportation Engineering: An Introduction, ,	C. J. Khisty and B. K. Lall	Prentice- Hall India	2002
2	ITS Hand Book 2000: Recommendations for World Road Association (PIARC)	PIARC Committee on Intelligent Transport	Artech House	2000
3	Systems Engineering for Intelligent Transportation Systems-an introduction to transportation professionals,	FHWA, Department of Transportation,	Federal Highway Administration	January 2007

Video Links (NPTEL, SWAYAM...)	
Sl No.	Link ID
1	https://archive.nptel.ac.in/courses/105/101/105101008/

SEMESTER S7

ENVIRONMENTAL HEALTH AND SAFETY

Course Code	OECET722	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To build environmental health literacy among students and encourage them to take safety measures against various environmental hazards.
2. To motivate the students in maintaining and improving the quality of the environment and empower learners to take appropriate actions to reduce the environment pollution.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Occupational Health And Toxicology: Safety at work – Socio – Economic reasons. Introduction to health and safety at various industries. occupational related diseases-Musculoskeletal disorders, hearing impairment, carcinogens, silicosis, asbestosis, pneumoconiosis – Toxic materials and substances used in work, exposure limits, toxicological investigation, Industrial Hygiene, Arrangements by organisations to protect the workers.	7
2	Chemical hazards- Dust, fumes, vapour, fog, gases; Methods of Control. Biological hazards- Classification of Biohazardous agents– bacterial agents, viral agents, fungal, parasitic agents, infectious diseases, control of biological agents at workplaces. Noise, noise exposure regulation and control. Radiation Hazards, Types and effects of radiation on human body, disposal of radioactive waste.	9
3	Safety in Construction industry - Scaffolding and Working platform, Welding and Cutting, Excavation Work, Concreting, control measures to	9

	reduce the risk. Electrical Hazards, Protection against voltage fluctuations, Effects of shock on human body.	
4	Safe working environment - The basic purpose and benefits of safety inspection, First-aid appliances, shelters, rest rooms and lunch rooms, use of personal protective equipment, Role of an individual in conservation of natural resources, Methods for controlling water pollution, role of individual in prevention of pollution.	11

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the Toxicology and Occupational Health associated with industries.	K2
CO2	Identify chemical and microbial agents that originate in the environment and can impact human health.	K2
CO3	Describe various measures to ensure safety in Construction industry.	K2
CO4	Describe the safety measures against various environmental hazards.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Environmental and Health and Safety Management	By Nicholas P. Cheremisinoff and Madelyn L. Graffia	University College London Press Limited William Andrew Inc. NY	1995
2	Effective Environmental, Health, and Safety Management Using the Team Approach	Bill Taylor	Culinary and Hospitality Industry Publications Services	2005

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Handbook of Occupational Safety and Health	Slote. L	JohnWileyand Sons, NewYork	2019
2	Industrial Accident Prevention	Heinrich H.W	McGrawHill Company,NewYork	1980
3	Pollution control in process industries	S.P.Mahajan	Tata McGraw Hill Publishing Company, New Delhi	1993

Video Links (NPTEL, SWAYAM...)	
Sl. No.	Link ID
1	https://archive.nptel.ac.in/courses/114/106/114106017/

SEMESTER S7

WATERSHED CONSERVATION AND MANGEMENT

Course Code	OECET723	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:3:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To develop watershed management program, making proper use of all available resources.
2. To obtain optimum output from watershed with minimum hazards to natural resources.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Watershed Management: Definition and importance of watersheds - Watershed functions and processes -Watershed management objectives and principles- Integrated and multidisciplinary approach for watershed management. Hydrological Cycle and Watershed Characteristics: Components of the hydrological cycle - Watershed characteristics (size, shape, slope, drainage pattern -Hydrological processes in watersheds (precipitation, infiltration, runoff) Importance of Watershed Properties: Effect of Physical Properties, Effect of Geomorphologic Factors & Associated Processes	9
2	Soil and Water Conservation Techniques: Soil erosion- types, causes, and effects, Soil conservation methods (contour plowing, terracing, strip cropping), Water conservation techniques (rainwater harvesting, check dams, recharge pits)	9

	<p>Role of Vegetation in Watershed Management: Importance of vegetation in soil and water conservation - Types of vegetation and their roles in watershed health - Afforestation and reforestation practices</p> <p>Drought management- Drought assessment, Drought analysis- Drought mitigation</p>	
3	<p>Watershed Management Planning and Implementation: Steps in watershed management planning - Community involvement in watershed management - Case studies of successful watershed management projects</p> <p>Environmental and Socio-Economic Considerations: Environmental impact assessment of watershed projects - Social and economic benefits of watershed management - Policy and legal frameworks for watershed management - Watershed management for conservation of resources and enhancing productivity in problem lands</p>	9
4	<p>Watershed Modeling and Geographic Information Systems (GIS): Introduction to watershed modelling- Use of GIS in watershed management - Applications of remote sensing in watershed analysis</p> <p>Delineation and Prioritization-Concept of Topographic or Contour Map, Boundary Delineation, GIS for Delineation, Accuracy in Delineation, Concept of Priority, Factors, Basics & Methods, Purpose & Benefits</p> <p>Land Management: Land use and Land capability classification, management of forest, agricultural, grassland and wild land. Reclamation of saline and alkaline soils</p> <p>Integrated watershed modelling – basic concepts</p>	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">2 Questions from each module.Total of 8 Questions, each carrying 3 marks <p>(8x3 =24marks)</p>	<ul style="list-style-type: none">Each question carries 9 marks.Two questions will be given from each module, out of which 1 question should be answered.Each question can have a maximum of 3 sub divisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To understand the concepts and importance of watershed management.	K1
CO2	To learn the techniques for soil and water conservation.	K3
CO3	To develop skills for designing and implementing watershed management plans.	K3
CO4	To assess the environmental, social, and economic impacts of watershed projects.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Watershed Management	JVS Murthy	New Age International	revised edition -1998
2	Land and Water Management	VVN Murthy	Kalyani Publication	2015
3	Irrigation and Water Management	D K Majumdar	Prentice Hall of India	revised edition -2001
4	Hydrology and Watershed Management	Vijay P. Singh and Ram Narayan Yadava	Allied Publishers	2003
5	Soil and Water Conservation Engineering	R. Suresh	Standard Publishers Distributors	2 nd edition 2005

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Integrated Watershed Management: Principles and Practice	Isobel W. Heathcote	Wiley	2 nd edition 2009
2	Water Resource Engineering	R. Awurbs and WP James	Prentice Hall	revised edition 2001

Video Links (NPTEL, SWAYAM...)	
Sl. No.	Link ID
1	https://archive.nptel.ac.in/courses/105/101/105101010/

SEMESTER S7

FORENSIC ENGINEERING

Course Code	OECET724	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. This course explores various aspects of Forensic Engineering and different methods, tools and procedures used by Engineers to investigate and analyze .
2. The students will learn to develop their awareness in Forensic Engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Forensic Engineering - Forensic Engineering – Definition, Investigation Pyramid, Eyewitness Information, Role in Legal system , Scientific Method – Applying scientific method in forensic engineering – engineer as expert witness – scientific methods and legal system, Qualification of forensic engineer – Technical knowledge – oral and written communication – other skills – personality characteristics, Ethics and professional responsibilities	9
2	Forensic Engineering Workflow and Investigation Methods - Forensic Engineering Workflow-Team & planning-preliminary onsite investigation. Sampling-selection of sample-collection- packing-sealing of samples, Source and type of evidence - Paper documentation- digital documentation- electronic data. Physical Evidence-Collection of photograph-cataloguing - Recognizing the Evidence-organizing Evidence Analysis –Reporting, Investigation Methods- Cause and Causal mechanism analysis-Time and event sequence-STEP method. Human Factors, Human errors - Analysis of	9

	Operative Instruction and working Procedures	
3	Physical Product Failure & Analytical Methods - Introduction to typical Forensic Engineering Tool box-NDT, Crack detection and human eye - Hardness testing- and Destructive testing Methods with case studies, Indirect stress strain Analysis-Brittle lacquer technique, Contact Radiography-Metallography-EDAX method , Forensic Optical Microscopy-Examination-Magnification-USB Microscopy -Wifi Enabled microscopy -Reflected microscopy, Novel Tools and System -Contour Method-Flash Thermography, Thermographic signal reconstruction (TSR)-Electromagnetically induced acoustic Emission (EMAE)-Pulsed Eddy Current (PEA)-Theory only	9
4	Engineer in the Court room & Criminal Cases - Role of an Engineering Expert-Report-pre trial meetings-Alternative dispute resolution-Single joint expert. Engineer in the court room, Criminal Cases-Introduction-Counterfeit coins-fraudulent road accidents-Fraudulent Insurance claims, Cyber Crimes and Cases- SIM Swapping -ATM Cloning-Microsoft Internal Spam-Intellectual property cases.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">2 Questions from each module.Total of 8 Questions, each carrying 3 marks <p>(8x3 =24marks)</p>	<ul style="list-style-type: none">Each question carries 9 marks.Two questions will be given from each module, out of which 1 question should be answered.Each question can have a maximum of 3 sub divisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify the fundamental aspects of forensic Engineering	K2
CO2	Apply forensic Engineering in Practical work flow and Investigation	K3
CO3	Apply methods and analysis in Forensic Investigation	K4
CO4	Develop practical strategies and standards of Investigation	K4
CO5	Create an awareness in criminal cases and create Engineering expertise in court room on forensic Engineering	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Forensic Engineering The Art & Craft of a failure detective	Colin R Gagg,	Taylor & Francis Publishing	2020
2	Principles of Forensic Engineering Applied to Industrial Accidents	Luca Fiorentini ,Luca Marmo	Wiley	2019
3	Forensic Engineering Fundamentals	Harold Franck, Darren Franck	Taylor & Francis	2013
4	Forensic Engineering Investigation	Randall K Noon	CRC press	2001
5	Guidelines for forensic Engineering practice	Joshua B Kardon	ASCE	2012

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering standards for forensic Applications	Richard W. Mclay and Robert N. Anderson	Academic Press	1 st edition, 2018
2	Forensic Engineering (Advanced forensic Science)	Max M Houck	Academic Press	1 st edition, 2017
3	Practical Cyber Forensics. An Incident-based Approach to Forensic Investigations	Niranjan Reddy	Apress	2019
4	Forensic Materials Engineering Case Studies	Peter Rhys Lewis, Ken Reynolds, Colin Gagg	CRC Press	2003
5	Forensic Engineering: Damage assessment for residential and commercial structures	Stephen E Petty	CRC press	2 nd edition, 2017

SEMESTER S7

FINANCE FOR ENGINEERING

Course Code	OECET725	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. The course details the fundamental concepts of engineering economics, construction accounting, financial management and basic tools used in the economic decision making of construction projects. The course helps the students acquire knowledge on basic financial management aspects and economics to facilitate the process of economic decision making effectively.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Book keeping and Accounting — Accounting Process – Purpose of accounting – Classification of accounting – Generally Accepted Accounting Principles – Conventions and Concepts – Double entry system of accounting – Preparation of Journal, Ledger and Trial Balance. (Illustrative problem) Introduction to financial statements – Preparation of Profit & Loss Account and Balance Sheet. (Simple problems)	10
2	Rate of Return method – Minimum attractive rate of return (MARR), Internal Rate of Return (IRR) – Economic Decision Making using Incremental Rate of Return (IRoR) Analysis of public projects – Benefit cost analysis – applications. Breakeven analysis – Fixed and variable cost – Total cost – Breakeven point and breakeven chart– Interpretation, limitations.	10

3	Working capital – Operating cycle – Working capital management – Sources of finance - long term and short term financing. Financing of PPP projects – Sources of project finance – Providers of finance – Financial structure – Financial indicators – Special nature of infrastructure financing need.	8
4	Construction Economics – Definition and scope. Time value of money – Simple and Compound interest – Time value equivalence –Cash flow diagrams – Interest calculations – Compound interest factors – Interest tables. Evaluating alternatives by equivalence – Present worth comparison – Future worth comparison – Annual cost and worth comparison.	8

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks <p>(8x3 =24marks)</p>	<ul style="list-style-type: none"> • Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the principles and process of accounting.	K2
CO2	Apply basic analysis tools like rate of return, benefit cost, and breakeven analysis in economic decision making.	K3
CO3	Prepare financial statements and apply revenue recognition methods.	K3
CO4	Explain the basics of financial management and sources of finance for a project.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Construction Project Management	Kumar Neeraj Jha	Dorling Kindersley (India) Pvt. Ltd	2nd ed. Pearson, 2015
2	Engineering Economy	Leland Blank, and Anthony Tarquin	McGraw Hill	Seventh Edition, 2012

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Accounting Made Easy	Agrawal R and Srinivasan, R	Tata McGraw-Hill	2005
2	Engineering Economy	Theusen G.J. and Fabrycky W.J.	Prentice-Hall, Inc.	9th Edition, 2001
3	Finance for Engineers- Evaluation and Funding of Capital Projects	Crundwell F.K.	Springer, London (ISBN 978-1-84800-032-2)	2008

NPTEL - Link ID
NPTEL :: Civil Engineering - NOC: Introduction to Accounting and Finance for Civil Engineers