SEMESTER 5

CIVIL ENGINEERING

SEMESTER S5

HYDROLOGY AND WATER RESOURCES ENGINEERING

Course Code	**PCCET501**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**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	Hydrologic cycle-precipitation-mechanism, types, forms and measurement using rain gauges, Optimum number of rain gauges, representation of rainfall data-mass curve and hyetograph, computation of mean precipitation over a catchment, Design rainfall - probable maximum rainfall; IDF curves (conceptual idea only). Infiltration-measurement by double ring, infiltrometer, Horton's model, infiltration indices. Evaporation –measurement and control	**11**
2	Runoff-components of runoff- Hydrograph analysis-Hydrograph from isolated storm-Base flow, separation. Unit hydrograph – uses, assumptions and limitations of unit hydrograph theory. Computation of storm/flood hydrograph of different duration by method of superposition and by development of S– Hydrograph; Floods-methods of design flood estimation – Empirical methods; SPF and PMF, Return period (conceptual ideas only) Streamflow measurement-area velocity method of stream gauging, selection of site for stream gauging station, Stage-discharge curve, flow duration curve-uses and characteristics	**11**
3	Irrigation– Necessity, Benefits and ill effects. Types: flow and lift irrigation - perennial and inundation irrigation. Soil-water –plant relationships.	**11**

	Irrigation efficiencies, Computation o crop water requirement: depth and frequency of Irrigation. Duty and delta, duty-factors affecting and method of improving duty, Computation of crop water requirement by using the concept of duty and delta. Irrigation structures – storage structures – Reservoirs - types, zones, yield of reservoir; determination of storage capacity and yield by mass curve method; Reservoir sedimentation and control - trap efficiency- computation of life of reservoir – river training - diversion structures - layout	
4	Vertical distribution of ground water- classification of saturated formation (review) Aquifer properties, Darcy's law, Well hydraulics-Steady radial flow into a fully penetrating well in Confined and Unconfined aquifers; Types of wells, Types of tube wells; well losses; Yield of open wells- pumping test and recuperation test. Pollution of ground water- sources, distribution and evaluation of ground water pollution (Brief description only). Artificial recharge of ground water- different techniques.	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Describe and estimate the different components of hydrologic cycle by processing hydro-meteorological data	**K3**
CO2	Determine the crop water requirements for the design of irrigation canals by recollecting the principles of irrigation engineering	**K3**
CO3	Describe and apply the principles of reservoir engineering to estimate the capacity of reservoirs and their useful life	**K3**
CO4	Demonstrate the principles of groundwater engineering and apply them for computing the yield of aquifers and wells	**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	2					2					
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	Irrigation, Water Resources and Water Power Engineering,	Modi P N	S.B.H Publishers and Distributors, New Delhi	2009
2	Irrigation and Water Power Engineering,	Punmia B.C., Ashok K Jain, Arun K Jain, B. B. L Pande	Laxmi Publications (P) Ltd.	2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Hand book of Applied Hydrology,	Ven Te Chow	Tata McGraw Hill	1988
2	Ground Water Hydrology,	Todd D. K.	Wiley	2005
3	Groundwater	H. M Raghunath	New age International New Delhi	2007
4	Irrigation and Water Resources Engineering	G. L. Asawa.	New Age International New Delhi	2008
5	Hydrology and Water Resources Engineering,	Garg S. K.	Khanna Publishers New Delhi	2005
6	Irrigation Engineering and Hydraulic Structures	Garg S K	Khanna Publishers New Delhi	2006
7	Engineering Hydrology,	Subramanya K.	Tata McGraw Hill	2013
8	Hydrology: Principles, Analysis and Design.	Raghunath H.M.	New Age International New Delhi	2006

Video Links (NPTEL, SWAYAM…)	
Sl No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/104/105104103/
2	https://archive.nptel.ac.in/courses/105/105/105105110/
3	https://archive.nptel.ac.in/courses/105/105/105105042/

SEMESTER S5

TRANSPORTATION ENGINEERING

Course Code	PCCET502	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Design highway cross-section, alignments and pavements, and evaluate highway materials according to standard specifications.
2. Analyse traffic patterns for effective signal design and gain comprehensive knowledge of railway tracks, harbours, docks, tunnels, and airports to facilitate integrated infrastructure design.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction:** Classification of roads- based on material, function. Typical cross sections of roads in urban and rural area, Requirements and factors controlling alignment of roads. **Geometric design of highways:** Design controls and criteria, Design of highway cross section elements. Design of horizontal alignment - Stopping sight distance, Overtaking sight distance, super elevation, extra widening, transition curve, length and shift of transition curve, - worked out problems Design of vertical alignment - gradient - grade compensation – summit curves and valley curves	12
2	**Highway materials:** Desirable properties and testing of road aggregates, bituminous materials and sub grade soil **Introduction to Pavements and Pavement Design:** Flexible and rigid pavements, Functions of individual layers, Factors influencing pavement design	11

	Flexible pavements: Design of flexible pavements by CBR method and IRC 37: 2018* - worked out problems **Rigid pavements:** Types of stresses: wheel load stresses, temperature stresses, Critical combination of stresses - worked out problem, Functions of longitudinal, contraction and expansion joints (Design not expected)	
3	**Traffic engineering:** Road user, vehicle characteristics, Macroscopic (Volume, Density and speed) and Microscopic (time and space headway) characteristics of traffic stream- Fundamental diagrams of traffic flow- Greenshield's model (derivation not required), Capacity and Level of Service (Concept only). **Traffic Surveys:** Data collection and Analysis - Volume, speed, O&D, parking studies **Types of intersections** - At grade and grade separated intersections. **Traffic signal systems:** Types, Design of isolated signals by Webster's method- Warrants for traffic signal installation **Railway Engineering:** Component parts of a railway track - functions, concept of Gauges, sleeper density, coning of wheels, cant deficiency, compensation of gradients	**11**
4	**Introduction to Airport Engineering:** Components of airport, selection of site for airport. Runway orientation, basic runway length and corrections required, Design of taxiways. **Harbours:** classification, features, requirements. Break waters - necessity and functions, classification. **Docks** – Functions and types - dry docks, wet docks **Tunnel Engineering: Tunnel** – sections, tunnel surveying - alignment, transferring centre grade into tunnel.	**10**

**IRC: 37-2018, Guidelines for the Design of Flexible Pavements is permitted in the examination hall.*

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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(4x9 = 36 marks)**	**60**

**IRC: 37-2018, Guidelines for the Design of Flexible Pavements is permitted in the examination hall.*

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply design criteria to develop highway cross-sections and design horizontal and vertical alignments.	**K3**
CO2	Apply standard code specifications to evaluate the quality of highway materials and understand the principles of flexible and rigid pavement designs	**K3**
CO3	Analyse road traffic phenomena through data collection, analysis, and interpretation via surveys; design traffic signals; and understand railway track components and their functions.	**K3**
CO4	Understand railway systems, harbours, docks, and tunnels, and design airport elements.	**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						2
CO2	3	3				2		2				2
CO3	3	3				2						2
CO4	3	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	Highway Engineering	SK Khanna, CEO Justo, A. Veeraragavan	Nem Chand & Bros	R10th Edition - 2017
2	Principles and Practices of Highway Engineering	Kadiyali, L. R. and N.B Lal,	Khanna Publishers	7e, 2017
3	Principles of Transportation and Highway Engineering	Rao G. V.	Tata McGrawHill	1996
4	Railway Track Engineering	Mundrey J. S.	Tata McGraw Hill	4e
5	Railway Engineering	Rangawala, S.C.	Charotor Publishing House	27e, 2017
6	Harbour, Dock & Tunnel Engineering	Srinivasan,R.	Charotor Publishing House	30e, 2022
7	Airport Planning and Design	Khanna, S. K. and Arora. M. G., S. S. Jain	Nemchand& Bros	6e, 2019
8	IRC: 37-2018, Guidelines for the Design of Flexible Pavements		IRC, New Delhi	2018
9	IRC: 58 - 2015, Guidelines for the Design of Rigid Pavements		IRC, New Delhi	2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Planning and Design of Airports,	Horonjeff R. and McKelvy, F.	McGraw Hill	5e, 2010
2	Transport Planning and Traffic Engineering,	O' Flaherty, C.A (Ed.).	Elsevier	1997
3	Railway Engineering	Subhash C. Saxena	Dhanpat Rai & Sons	
4	Principles of Pavement Design	Yoder and W Nitezak,	John Wiley	1991
5	Design of Functional Pavements	Yang	McGraw Hill	
6	Airport Engineering	Rangwala, S. C.	Charotar Publishing Co.	16e, 2016
7	A course in Docks and Harbour Engineering	Bindra, S.P.	Dhanpat Rai& Sons	
8	Railway Engineering	Chandra, S., Agarwal, M.M.	Oxford University Press, New Delhi	2008
9	Railway Engineering	Saxena, S., Arora, S. P	Dhanpat Rai & Sons	7e, 2010
10	A Text Book of Railway Engineering	Subhash C Saxena, Satyapal Arora	Dhanpat Rai & Sons	
11	Design and Construction of Ports and Marine Structures	Quinn A.D.	McGraw Hill	
12	Railway Engineering	Agarwal. M.M.	Prabha & Co. New Delhi	1998

Video Links (NPTEL, SWAYAM…)	
Sl No.	**Link ID**
1	https://nptel.ac.in/courses/105105107
2	https://nptel.ac.in/courses/105107123
3	https://nptel.ac.in/courses/105107220

SEMESTER S5

ENVIRONMENTAL ENGINEERING

Course Code	PCCET503	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)	PCCET302	Course Type	Theory

Course Objectives:

1. To equip students with the skills to assess water quality and design appropriate treatment processes to ensure water meets health and safety standards.
2. To study with knowledge of various wastewater treatment processes, including primary, secondary, and tertiary treatments, as well as advanced treatment technologies.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to environmental engineering- Population forecast- water demand estimation-types of demand- demand fluctuation Systems of sewerage: separate and combined Layout plan of a conventional water treatment plant- site selection-Intakes-Screening-types of screens -aeration -aerator types Theory and principles of sedimentation-Stoke's Law-Types of settling - Design of plain sedimentation tanks Mechanisms of coagulation and flocculation, popular coagulants and feeding devices	9
2	Filtration of water-theory of filtration-types of filters - design of a slow sand and rapid sand filter. Disinfection of water - various methods - advantages and limitations. Lay out of water distribution network-types-methods of distribution. Network analysis –Hardy cross and equivalent pipe methods.	9
3	Layout plan of a conventional waste water treatment plant- site selection-concept of primary, secondary and tertiary treatment, equalization of flow.	9

	Secondary treatment methods-basic concepts of biological unit processes- aerobic and anaerobic- attached and suspended growth processes (Concepts only) Trickling filter (Concept only)- types- construction & operation-design of trickling filter. Activated sludge process- basic concepts-design of a conventional Activated Sludge Plant.	
4	Up flow Anaerobic Sludge Blanket (UASB) reactor (Concept only). Natural waste water treatment systems-Oxidation Ponds and Lagoons-Wetlands and Rootzone systems (Concepts only). Low-cost sanitation systems- Design of a septic tank and soak-pit. Sludge treatment (concepts only) -thickening- digestion- dewatering-drying- composting.	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Solve the water demand of a city by using various forecasting methods and treat water	**K2**
CO2	Design of slow sand and rapid sand filter and analyse the water distribution network	**K3**
CO3	Understanding wastewater treatment processes and design of trickling filter and activated sludge process	**K3**
CO4	Awareness about high-rate anaerobic process, oxidation ditches and natural wastewater treatment	**K2**
CO5	Design of septic tanks and understanding various sludge treatment processes	**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	3				2					
CO3	3	2					2					
CO4	3	2					2					
CO5	3	2	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	Waste Water engineering	Metcalf and Eddy	Tata McGraw Hill publishing Co Ltd	2003
2	Water supply engineering	S K Garg	Khanna Publishers	37e, 2024
3	Sewage and air pollution engineering	S K Garg	Khanna Publishers	43e, 2024

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Water supply engineering	B C Punmia, Arun Kumar Jain, Ashok Kumar Jain	Laxmi Publications	2e, 2016
2	Wastewater engineering, issues trends and solutions	Ashok Kumar Gupta, Vengatesh Uddameri, Abhradeep, Majumder, Shripad K. Nimbhorkar	CRC Press, Taylor and Francis Group	1e, 2023
3	Water supply and sanitary engineering	Rangwala	Charotar Publishing House Pvt ltd.	29e, 2022

Video Links (NPTEL, SWAYAM…)	
Sl No.	**Link ID**
1	https://nptel.ac.in/courses/103107084
2	https://archive.nptel.ac.in/courses/127/105/127105018/
3	https://archive.nptel.ac.in/courses/105/106/105106119/
4	https://archive.nptel.ac.in/courses/105/104/105104102/

SEMESTER S5

FOUNDATION ENGINEERING

Course Code	PBCET504	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Goal of this course is to expose the students to the fundamental concepts of foundation engineering.
2. After this course, students will be able to recognize practical problems of foundations in real-world situations and respond accordingly.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Earth pressure - At rest, active and passive earth pressures - Rankine's theory – Earth pressure and point of application for cohesionless and cohesive soils - Influence of surcharge and water table on earth pressure - Numerical problems - Earth pressure with layered backfill - Numerical problems - Coulomb's theory [concept only] Stability of finite slopes - Toe failure, base failure, slip failure - Swedish Circle Method (Procedure only) - Friction circle method (Procedure only) - Taylor's Stability number - Stability charts (Demo only)	11
2	General Considerations: Functions of foundations - definition of shallow and deep foundation Site investigation and soil exploration: objectives - planning - reconnaissance - Guidelines for choosing spacing and depth of borings [I.S. guidelines only]. Standard Penetration Test – Procedure and correlations - Corrections for SPT value – Numerical Problems - Boring log - Soil profile. Plate load test –	11

	Procedure, uses and limitations-Field test - Plate load test – Procedure, uses and limitations Failure mechanism (General, local and punching shear failure) – situations in which each of them can be expected. Terzaghi's bearing capacity theory for strip footing [no derivation required] – Assumptions -Gross and Net bearing pressure - Ultimate and Safe bearing capacity - -Allowable soil pressure -Bearing capacity factors- Numerical problems Terzaghi's formulae for circular and square footings - Numerical problems - Factors affecting bearing capacity - Effect of water table on bearing capacity - Numerical problems.	
3	Settlement analysis: Introduction- causes of settlement – estimation immediate settlement (I.S. Code) Numerical problems Design of Isolated Footing-Combined footings- Rectangular and Trapezoidal combined footings - Numerical problems Raft foundations: Types – Design Principles of raft foundation- Bearing capacity equations for raft on sand (Teng's equation based on SPT value) and for raft on clay (Skempton's formula) - Floating foundations	**11**
4	Pile foundations: Uses and classification of piles - Selection of type and length of piles - Bearing capacity of single pile in clay and sand [I.S. Static formulae] - Numerical problems - Dynamic formulae (Modified Hiley formulae only) – Numerical Problems - I.S. Pile load test [conventional] - Negative skin friction - Group action - Group efficiency - Capacity of Pile groups - Numerical problems	**11**

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	**30**	**12.5**	**12.5**	**60**

Guidelines for Project:

The project should be designed so that students should learn all the basic design steps in foundation design.

1. On the first class, while giving introduction to the subject, direct the students to form groups, if any student wish to work individually the faculty shall assess the student's capacity and take appropriate decision.
2. Guide the students to visit two site investigation projects (preferably one to design shallow foundation and other to design deep foundations)
3. Students can select any building for the study. The building which they have designed in the previous semester for PBCET404 can be used in this semester also.
4. The faculty in charge should provide two sets of soil investigation data for each group. Among them one should be of having adequate bearing capacity at shallow depth and the other with low bearing capacity at shallow depth. The group should calculate allowable bearing capacity and design one shallow and one deep foundation. The group should calculate allowable bearing capacity and design one shallow and one deep foundation.
5. For shallow foundation design students should first design the trench/ check the stability of trench. Find the possible unsupported cut. Further they have to find the stable slope in which the trench should be made.
6. The detailed design of shallow foundations with drawings should be prepared considering bearing capacity and settlement.
7. While using the second set of soil exploration data students should check the feasibility of both raft and pile foundations.
8. Design of pile foundation is expected with detailed drawings.
9. Prepare a detailed report with all the obtained results.

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
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the concept of lateral earth pressure and slope stability and apply it for the design of trenches.	**K3**
CO2	Calculate bearing capacity, pile capacity, and foundation settlement	**K3**
CO3	Develop soil investigation report	**K3**
CO4	Design appropriate foundation using the available soil exploration data and superstructure requirement.	**K6**

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

CO-PO Mapping Table:

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

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	Ranjan G. and A. S. R. Rao	New Age International	5e, 2024
2	Geotechnical Engineering	Arora K. R	Standard Publishers	2020
3	Foundation engineering	Varghese, P. C.	PHI Learning	2000

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of Geotechnical Engineering	Das B. M	Cengage India Pvt. Ltd	2010
2	Foundation Design: Principles and Practices	Donald Coduto, William Kitch, Man-chu Yeung	Pearson	3e, 2015
3	Soil Mechanics and Foundation Engineering	B.N.D. Narasinga Rao	Wiley	2019

Video Links (NPTEL, SWAYAM…)	
Sl No.	**Link ID**
1	https://nptel.ac.in/courses/105105176
2	https://nptel.ac.in/courses/105105207
3	https://nptel.ac.in/courses/105106144
4	https://nptel.ac.in/courses/105107120

PBL Course Elements

L: Lecture (3 Hrs.)	**R: Project (1 Hr.), 2 Faculty Members**		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**
   - Clarity and feasibility of the project plan
   - Research and background understanding
   - Defined objectives and methodology
2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**
   - Individual contribution to the presentation
   - Effectiveness in answering questions and handling feedback
3. **Involvement in the Project Work and Team Work (3 Marks)**
   - Active participation and individual contribution
   - Teamwork and collaboration
4. **Execution and Implementation (10 Marks)**
   - Adherence to the project timeline and milestones
   - Application of theoretical knowledge and problem-solving
   - Final Result
5. **Final Presentation (5 Marks)**
   - Quality and clarity of the overall presentation
   - Individual contribution to the presentation
   - Effectiveness in answering questions
6. **Project Quality, Innovation, and Creativity (3 Marks)**
   - Overall quality and technical excellence of the project
   - Innovation and originality in the project
   - Creativity in solutions and approaches

SEMESTER S5

ADVANCED STRUCTURAL ANALYSIS

Course Code	**PECET521**	**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)	PCCET303/ PCCET403	**Course Type**	Theory

Course Objectives:

1. This course provides the fundamental concepts of three hinged arches and matrix analysis of structures, specifically on direct stiffness method.
2. This course equips students with the concepts of finite element methods, which in turn is the basis of many structural analysis software, and a brief idea on the concept of structural dynamics.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Two hinged Arches:** Analysis of two hinged arches - Support reactions normal thrust and radial shear at any section of a parabolic arch due to simple cases of loading, influence line for horizontal thrust, bending moment, normal thrust, and radial shear. **Matrix Analysis of Structures:** Reviewing the definition of flexibility and stiffness influence coefficients, and concepts of physical approach	**9**
2	**Direct stiffness method:** Introduction to direct stiffness method-Rotation of axes in two dimensions, stiffness matrix of elements in global co- ordinates from element co-ordinates- assembly of load vector and stiffness matrix, solution of two span continuous beam-single bay single storey portal frame.	**9**
3	**Structural dynamics:** Introduction - degrees of freedom - equation of motion, D'Alembert's principle-damping- free response of damped and undamped systems- logarithmic decrement-- single degree of freedom systems subjected to harmonic load - transient and steady state responses, simple portal frame problems.	**9**

4	**Finite Element Methods:** Boundary value problems; Introduction to approximate numerical solutions for solving differential equations. Formulation techniques: Element equations using weighted residual approach - the axial element example.	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level
CO1	Apply suitable methods of analysis for arches.	**K3**
CO2	Apply the displacement methods to analyse framed structures.	**K3**
CO3	Remember basic dynamics, understand the basic principles of structural dynamics and apply the same to simple structures.	**K2**
CO4	Understand the basic features of boundary value problems, and 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**

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										
CO2	3	3	1									
CO3	3	3	1									
CO4	3	3	2	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	Comprehensive Structural Analysis Volume I & II	R.Vaidyanathan and P.Perumal	Laxmi Publications (P) Ltd	Fourth 2024
2	Elementary Finite Element Method	Desai, C.S.	Prentice Hall of India	1979
3	Structural Dynamics: Theory and Computation	Mario Paz, William Leigh	CBS Publishers, New Delhi, India	5th ed. 2004
4	Intermediate Structural Analysis,	Wang C.K.	**McGraw Hill Education**	2017
5	Matrix Analysis of Framed Structures	James M Gere & William Weaver	CBS Publishers	2nd edition 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Structural Analysis II	S.S. Bhavikatti	Vikas Publication Houses (P) Ltd	2016
2	Finite Element Procedures in Engineering Analysis	Bathe, K.J.	Prentice Hall of India	2006
3	Finite Element Analysis Theory and Programming,	Krishnamoorthy, C.S.	Tata McGraw Hill.	2nd edition 2017
4	Dynamics of Structures	Clough R. W. and J. Penzien	McGraw Hill	2nd edition 2015
5	Dynamics of Structures-Theory and application to Earthquake Engineering	Chopra A. K.	Pearson Education India	3rd edition 2008
6	Structural Analysis,	R.C. Hibbeler	Pearson	10th Edition 2022
7	Basic Structural Analysis	Reddy C. S.	Tata McGraw Hill	3rd edition 2017

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/105/105105109/
2	https://onlinecourses.nptel.ac.in/noc21_ce44/preview
3	https://archive.nptel.ac.in/courses/105/101/105101006/
4	https://archive.nptel.ac.in/courses/112/104/112104193/

SEMESTER S5

MODERN CONSTRUCTION TECHNOLOGY

Course Code	PECET522	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. Describe the various sustainable materials and smart materials suitable for Construction
2. Outline the various technologies and equipment used for smart & economic construction

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Sustainable Construction Materials**: Wood, bamboo, straw bales, earthen materials, recycled aggregates, recycled plastic products, sustainable concretes, bio composites **Smart & Intelligent materials**: Types - Neoprene, Bridge pads, thermocol - Smart and Intelligent Materials, Special features: - Shape Memory Alloys (SMAs), Magneto strictive materials, Piezoelectric materials, Electrochromic materials, Green materials including biomaterials, biopolymers, bioplastics – Case studies showing the applications of smart and intelligent materials.	9
2	**Equipment for Earth Work:** Fundamentals of earth work operations - earth moving operations - types of earth work equipment - tractors, motor graders, scrapers, front end waders – excavating and earth moving equipment- dozer, excavators, rippers, loaders - trucks and hauling equipment, compacting equipment, finishing equipment. **Erection Equipment**: Cranes, Derrick Cranes, Mobile cranes, Overhead cranes, Traveller cranes, Tower cranes	9
3	**Construction techniques**: Construction joints - movement and expansion joints –Vacuum Dewatering of Concrete Flooring – Techniques of construction for continuous concreting operation in Tall buildings – Slip Form techniques—Erection techniques of Tall structures, large Span Structures -	9

	Bridge Construction - Construction sequence and methods - Bow string bridges, cable stayed bridges - Launching techniques for heavy decks.	
4	**Cost-effective construction**: Rapid wall construction, soil-cement block masonry, voided slab, filler slab, rat-trap bond, cavity wall, ferrocement and ferro concrete constructions. **Prefabricated construction**: Advantages and disadvantages, prefabricated components. **Pre-Engineered Buildings**: Introduction – Advantages - Pre-Engineered Buildings Vs Conventional Steel Buildings – Applications Basic concept of **prestressing**: Fundamental understanding of pre-tensioned and post-tensioned construction. Construction **3D printing**.	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	To identify various sustainable and smart materials for structures	**K2**
CO2	To understand the equipment used in construction	**K2**
CO3	To outline the construction techniques for tall buildings and bridges	**K2**
CO4	To understand the advanced technologies for cost effective construction	**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					2
CO2	3					2	2					2
CO3	3					2	2					2
CO4	3					2	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	Materials for Civil and Construction Engineers	Michel S. Mamlouk, John P Zaniewski	Prentice Hall	2016
2	Smart Materials and Structures	Gandhi M. V. and B. S. Thompson	Chapmann & Hall, London	1993
3	Construction Planning, Equipment and Methods	Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C	McGraw Hill, Singapore	2006

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Methods of Construction and Innovative Materials	Arthur Lyons	Routledge Taylor & Francis Group	2024

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/106/105106053/
2	https://archive.nptel.ac.in/courses/105/103/105103206/

SEMESTER S5

OPEN CHANNEL HYDRAULICS

Course Code	PECET523	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 familiarize the concepts of different types of open channel flows hydraulics and apply for practical problems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Open channel flow, Uniform flow - Conveyance and section factor, Hydraulic exponents Computation of discharge through compound channels; Design of channels for uniform flow-Non erodible channel- Minimum permissible velocity-best hydraulic section. Erodible channels which scour but do not silt- Tractive force approach, stable hydraulic section. Velocity distribution in open channels, Pressure distribution in curvilinear flows- flows through spillway crest and spillway bucket.	9
2	Specific energy- specific energy diagram and discharge diagram, Critical flow and its computation. -Hydraulic exponents Application of Specific energy for channel transitions- hump and reduction in channel width	9
3	Gradually varied flow- Dynamic equation of gradually varied flow- different forms; Computation of length of water surface profiles - direct step method, Bresse's method; Standard step method. Rapidly varied flow-Hydraulic jump - sloping and exponential channels, types based on tail water conditions. Uses of hydraulic jumps for energy dissipation below spillways- jump height curve; tail water rating curve; Design features of USBR stilling basins, Standing wave flume, Parshall flume	9

4	Unsteady flow through open channels – Surges- positive surges (problems) and concept of negative surges; Spatially varied flow, dynamic equation of spatially varied flow, Analysis of spatially varied flow profile.	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Apply the principles of uniform flow computation in open channels	**K3**
CO2	Analyze the specific energy concepts for practical applications	**K3**
CO3	Analyze the flow through open channels for gradually varied flow cases	**K3**
CO4	Analyze the rapidly varied flow through open channels and describe its practical applications	**K3**
CO5	Analyze the unsteady flow and spatially varied flow cases through open channels	**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										
CO2	3	3										
CO3	3	3										
CO4	3	3										
CO5	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	Hydraulics and Fluid Mechanics including Hydraulic machines	Modi P. N. and S. M. Seth,	S.B.H Publishers, New Delhi,	22e, 2019
2	Flow in Open channels	SubramanyaK	TataMcGraw-Hill	5e, 2019
3	Open - Channel Flow	Hanif Chaudhary M	Springer	2e, 2007
4	Theory and Applications of Fluid Mechanics	Subramanya K	Tata McGraw-Hill	1993

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Flow through Open Channels	Chow VT	McGraw Hill, 1959	1959
2	Flow through Open Channels	Rangaraju K. G	Tata McGraw Hill	1994
3	Flow through Open Channels,	Srivastava R	Oxford Publishers	2012

SEMESTER S5

DISASTER MANAGEMENT

Course Code	PECET524	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. Objective of the course is to introduce the concept of disasters, their causes and their mitigation and management.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Hazards and disasters: Introduction to key concepts and terminology: hazard, disasters and types of classifications, vulnerability, exposure, risk, crisis, emergency, capacity, resilience, Carbon footprint. Effect of subsystems of earth. Extent and nature of natural hazards, implications of climate change: Earth quakes, Volcanoes, Floods. Coastal disasters- Storm surges, Tsunamis, mitigation methods.	9
2	Landslides, Causes and prediction, Soil and soil degradation, erosion and Desertification, Forest fires, their mitigation methods.	9
3	Impacts and assessment: Risk Management and Assessment and Disaster Management cycle. SWOT Analysis- basic concepts, uses, limitations and advantages. Disaster management plan and reports, participation of community in disaster management.	9
4	Hazard and disaster management plans for floods, storm surges, landslides, earthquakes, forest fires: pre-disaster phase, actual disaster phase, post-disaster phase	9

	Relief and Amenities, Relief camps, organization, individual and community participation, camp layout, food requirement, water needs, sanitation, security, information administration. Technology in disaster management.	

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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Explain interaction between subsystems of earth that give rise to hazards and their potential for disasters	**K2**
CO2	Explain the evolving concepts and thoughts of management of hazards and disasters	**K2**
CO3	Apply the knowledge to find the causes behind natural disasters and evaluate their magnitude and impacts	**K3**
CO4	Develop management plans for hazards and disasters, and understand the roles of agencies involved	**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											1
CO2	3											2
CO3	3	3					2					2
CO4	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	Disaster Management	Mrinalini Pandey	Wiley	2e
2	Disaster Risk Reduction in South Asia	Ariyabandu, M. and Sahni P.	Prentice-Hall (India)	2003
3	Environmental Geology - Ecology, Resource and Hazard Management	Valdiya, K.S.	McGraw-Hill Education	2013
4	Disaster Management: Global Problems and Local Solutions	Shaw, R and Krishnamurthy, RR	Springer, Amsterdam	2010
5	Disaster Management - A Disaster Manager's Handbook	Nick Carter. W.,	Asian Development Bank, Philippines.	1991
6	Disaster management	Gupta, H.K.	Universities Press (India) Ltd.	2003
7	Natural and Anthropogenic Disasters- Vulnerability, Preparedness and Mitigation	Jha, M.K.	Springer, Amsterdam.	2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Geological Hazards: Their assessment, avoidance and mitigation	Bell, F.G.	E & FN SPON Routledge, London.	1999
2	Natural Disasters	Alexander, D.,	Research Press, New Delhi	1993
3	Handbook of Disaster and Emergency Management	Khorram-Manesh	Kompendiet (Gothenburg).	2017
4	Disaster Management in India Policies, Institutions, Practices	Rajendra Kumar Pandey	Routledge	2023

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://nptel.ac.in/courses/105104183
2	https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

SEMESTER S5

APPLIED HYDROLOGY AND CLIMATOLOGY

Course Code	PECET526	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 expose the students to the fundamental concepts of groundwater hydrology and its engineering applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction - weather and climate; hydrometeorology- variables affecting precipitation- humidity, vapor pressure, saturation vapor pressure–temperature relation (simple problems), perceptible water, forms and types of precipitation; cloud - types; Monsoon- characteristics of Indian summer monsoon rainfall- climate oscillations and Indian monsoon rainfall, Evapotranspiration - methods of estimation-Blaney Criddle method (problem)- penman method, Penmann-Montieth method	9
2	Causes and effects of climate change, modeling of hydrologic impact of climate change on water resources-typical framework, general circulation models and regional climate models; Downscaling-concept and types, Catchment characteristics, classification of streams - stream pattern and stream order;	9
3	Statistical methods in hydro-climatology: principal component analysis and its use in climate change studies, methods for change point analysis, methods for trend analysis-statistical and graphical methods, stationary and non-stationary series- determination of non-stationarity of hydro-climatic series (no problems)	9
4	Design flood and their Estimation - Different methods; Flood frequency studies -Gumbel's method; Flood Routing-Hydrologic and Hydraulic routing,	9

	Flood routing through reservoirs – concept only. Flood routing through channels - Muskingum method, determination of Muskingum parameters. Flood control methods - Flood forecasting and warning (Brief descriptions only)	

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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Estimate the different components of hydrologic cycle by processing hydro-meteorological data	K3
CO2	Describe the characteristics of hydrological extremes and climate change	K2
CO3	Apply statistical methods in modelling of hydro climatic extremes	K3
CO4	Describe the procedure of flood routing by considering the impact of climate change	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					2					
CO3	3	3					2					
CO4	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	Engineering Hydrology – IV th edition	Subramanya K.	Tata McGraw Hill	2013.
2	Hydrology: Principles, Analysis and Design- 3rd edition	Raghunath H.M.	New Age International New Delhi	2006
3	Statistical Methods in Hydrology and Hydro climatology	Rajib Maity	Springer	2018
4	A Text Book of Stochastic Hydrology	Jayarami Reddy	Laxmi Publications, New Delhi	2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Hand book of Applied Hydrology	Ven Te Chow.	Tata McGraw Hill	1988
2	Irrigation and Water Resources Engineering	G.L.Asawa	New Age International New Delhi	2008
3	Hydrology and Water Resources Engineering,	Garg S. K.	Khanna Publishers New Delhi	2005
4	Hydro climatology: Perspectives and Applications	M. L. Shelton	Cambridge University Press	2009

Video Links (NPTEL, SWAYAM…)	
Sl No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/104/105104029/
2	https://archive.nptel.ac.in/courses/105/101/105101002/

SEMESTER S5

TOWN PLANNING

Course Code	PECET527	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 have the knowledge on planning process and to introduce to the students about the regulations and laws related to Town Planning.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Definition of town planning, Evolution of towns, Objective of town planning, Economic Justification for town planning, Principles of town planning, Necessity of town planning, Origin, Growth and patterns of town development, distribution of land use, site for ideal town. Migration trends and impacts on urban and rural development, Problems of urban growth-beginning of town planning acts- concept of new towns - comprehensive planning of towns. Re- planning of existing towns	9
2	Surveys: Definition, Necessity, collection of data, Types of surveys, methods adopted to collect data, Drawings, reports. Zoning: Definition, Use of land, Objects of zoning, Principles of zoning, Aspects, Advantages & Importance zoning, Transition zone, Economy of zoning, Zoning powers, Maps for zoning	9
3	Housing: Classification of residential buildings- Agencies for housing- Housing finance agencies- problems of housing in India Slums: Causes, characteristics and effects of slums, Slum clearance. Industries: Classification of industry, Concentration of industry, requirements of the industry, Industrial townships. Public Buildings: Location, classification principle of design, town centre, grouping of public buildings.	9

4	Town Planning Legislations: Laws relating to land acquisition; urban land ceiling, UDPFI guidelines, disaster mitigation management; Environmental and Pollution Control Acts. Re-planning of existing towns: Objects of re-planning, defects of existing town, data required for re- planning, Urban Renewal projects, De-centralization and Re-centralized, Garden city concept overview.	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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 need of town planning	**K2**
CO2	Identify the data required for the town planning process and methods used to collect the data	**K2**
CO3	Apply the town planning strategies in the various levels of town planning	**K3**
CO4	Understand about the various rules and regulations in town planning	**K2**
CO5	Analyze the replanning concept of existing towns	**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											
CO2	3											
CO3	3	2										
CO4	3					3		3				2
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	Fundamentals of Town planning	Hiraskar G K	Dhanpat Rai publications	1993
2	Study of Town and Country planning in India	N.K Gandhi	Indian Town and Country Planning Association	1973
3	Town planning	Rangwala	Charotar publishing house	2015
4	Architecture & Town Planning	Satish chamdra Agarwala	DhanpatRai& Co (P) Ltd.	2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Traffic Engineering and Transport planning	Khadiyali L.R.	Khanna Tech Publishers	1999
2	Text book of Town Planning	Abir Bandyopadhyay	Books & Allied Ltd	2000
3	Town Planning the basics	Tony Hall	Taylor & Francis Ltd	2019

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://nptel.ac.in/courses/124107158
2	https://nptel.ac.in/courses/124105016
3	https://nptel.ac.in/courses/105107067

SEMESTER S5

OPTIMIZATION TECHNIQUES AND OPERATIONAL RESEARCH FOR CIVIL ENGINEERS

Course Code	**PECET528**	**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 principles of optimization.
2. Summarize the concepts of Linear and Non-linear Programming
3. Understand the concept of Dynamic programming

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Linear Programming: Introduction and formulation of models; Convexity; simplex method; Two phase method; Degeneracy, non - existent and unbounded solutions; Duality in L.P.P. Dual simplex method, Sensitivity analysis; Revised simplex method; transportation and assignment problems	**9**
2	Non-Linear Programming: Classical optimisation methods; Equality and inequality constraints; Lagrange multipliers; & KuhnTucker conditions; Quadratic forms; Quadratic programming.	**9**
3	Search Methods: One dimensional optimisation; Fibonacci search; multi-dimensional search methods; Univariate search; gradient methods; steepest descent/ascent methods; Conjugate Gradient method; Penalty function approach.	**9**
4	Dynamic Programming: Principle of optimality; Recursive relations; solution of L.P.Problem; simple examples. Integer Linear Programming: travelling salesman problem	**9**

**Formulation and solution of Civil Engineering optimization problems such as design of beams and frames, design of reservoirs, signal systems, etc. by different techniques are expected to be covered*

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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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 basic concepts of classical optimization techniques	**K2**
CO2	Analyse optimization algorithms	**K3**
CO3	Analyse linear and nonlinear programming problems and interpret the solutions	**K3**
CO4	Apply optimization methods to solve Civil Engineering Design Problems	**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		1							3
CO2	3	3	3		1							3
CO3	3	3	3		1							3
CO4	3	3	3		1							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	Optimisation Theory and Applications	S.S.Rao	Wiley Eastern Ltd., New Delhi	
2	Structural optimization using sequential linear programming	Bhavikatti S. S	Vikas publishing house	
3	Operation Research	Richard Bronson	Schaum's Outline Series	

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Optimisation	J.C.Pant	Jain Brothers; New Delhi	

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/108/105108127/
2	https://nptel.ac.in/courses/105103210

SEMESTER S5

DESIGN OF PRESTRESSED CONCRETE

Course Code	PECET525	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)	PBCET404	Course Type	Theory

Course Objectives:

1. This course will enable students to learn Design of Prestressed Concrete Elements.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction and Analysis of Members:** Concept of Prestressing - Types of Pre-stressing - Advantages - Limitations –Prestressing systems - Anchoring devices - Materials - Mechanical Properties of high strength concrete - high strength steel - Stress-Strain curve for High strength concrete **Losses in Prestress:** Loss of Pre stress due to Elastic shortening, Friction, Anchorage slip, Creep of concrete, Shrinkage of concrete and Relaxation of steel - Total Loss.	9
2	**Design of Sections for Flexure:** Analysis of members at ultimate strength - Preliminary Design - Final Design for Type 1members. Deflection due to gravity loads - Deflection due to prestressing force-Total deflection - Limits of deflection - Limits of span-to-effective depth ratio	9
3	**Design of Sections for Flexure:** Analysis of members at ultimate strength - Preliminary Design - Final Design for Type 1 members. **Design for Shear:** Analysis for shear - Components of shear resistance - Modes of Failure - Limit State of collapse for shear - Design of transverse reinforcement.	9
4	Different anchorage system and design of end block by latest IS codes. Conceptual design and detailing of Prestressed deck Prestressed beam – cast in situ slab composite Sections- Analysis	9

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Ex	Evaluate	Analyse	Total
5	15	10	10	40

Criteria for Evaluation (Evaluate and Analyse): 20 marks

Assignment

1. Structural design and detailing of composite prestressed beam- cast in situ slab from field- Load calculations has to taken from first principles

Criteria for evaluation:

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

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

Part A	Part B	Total
• 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 concept, principle, systems and typology of Prestressing	**K3**
CO2	Apply mechanical principles for analysis of prestress	**K3**
CO3	Evaluate the flexural, shear and torsional behaviour of prestressed sections	**K3**
CO4	Apply the principles of composite sections to prestressed members	**K3**

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

CO-PO Mapping Table (Mapping od 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

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	Prestressed Concrete	Krishna Raju.N	Tata McGraw Hill	6e, 2018
2	Prestressed Concrete Structures	P. Dayaratnam	Medtech	7e, 2017
3	Prestressed Concrete	N. Rajagopalan	Narosa Publishing House	2017
4	Prestressed Concrete Design	Praveen Nagarajan	Pearson	2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Limit State Design of Prestressed Concrete, - Vol - 1 & 2	Guyon .V	Applied Science Publishers, London	1995
2	Mechanics of Prestressed Concrete Design	Mallick and Rangaswamy	Khanna Publishers	2014
3	Prestressed Concrete	Pandit & Gupta	CBS Publishers	2019
4	Relevant latest IS codes			

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/106/105106118/

SEMESTER S5

GEOTECHNICAL ENGINEERING LAB

Course Code	PCCEL507	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCCET402	Course Type	Lab

Course Objectives:

1. This laboratory course aims to provide students with hands-on experience in testing and analysing soil properties.
2. Through a series of laboratory experiments, students will learn to evaluate the index properties and engineering properties of the soil.
3. By the end of the course, students will be equipped with the practical skills and knowledge necessary to conduct soil investigations and interpret geotechnical data.

Expt. No.	Experiments
1	Sieve Analysis
2	Determination of Specific Gravity-Pycnometer & Specific Gravity bottle
3	Determination of Water Content-Oven Drying Method
4	Swelling Test-Free Swell
5	Hydrometer analysis
6	Atterberg Limits - Liquid Limit, Plastic Limit, Shrinkage Limit
7	Field Density Test – (i) Core Cutter, (ii) Sand Replacement Method
8	Light Compaction Test (Standard Proctor Test)
9	Direct Shear Test
10	Unconfined Compression Test
11	Consolidation Test
12	Permeability Test- Constant Head Permeability, Variable Head Permeability
13	Triaxial Shear strength Test
14	Flexible wall Permeability Test
15	Determination of Relative Density of Cohesionless soil

Minimum of 12 experiments from among the 15 experiments listed, is to be completed.

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Determine experimentally the index properties of soil	**K3**
CO2	Evaluate experimentally the engineering properties of soil	**K3**
CO3	Analyse the experimental data and document the results	**K4**

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

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	Ranjan G. and A. S. R. Rao,	New Age International Pvt Ltd.	4e, 2022
2	Soil Mechanics & Foundation Engineering	K.R. Arora	Standard Publisher	2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Soil Mechanics in Engineering Practice	Terzaghi K. and R. B. Peck	John Wiley	1967
2	Relevant latest BIS standards		BIS, New Delhi	

Video Links (NPTEL, SWAYAM…)	
Sl No.	**Link ID**
1	https://smfe-iiith.vlabs.ac.in/
2	https://nptel.ac.in/courses/105101084

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**
    - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
    - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.
2. **Conduct of Experiments (7 Marks)**
    - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
    - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
    - Teamwork: Collaboration and participation in group experiments.
3. **Lab Reports and Record Keeping (6 Marks)**
    - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
    - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.
4. **Viva Voce (5 Marks)**
    - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
    - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
    - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**
    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.
3. **Result with Valid Inference/Quality of Output (10 Marks)**
    - Accuracy of Results: Precision and correctness of the obtained results.
    - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.
4. **Viva Voce (10 Marks)**
    - Ability to explain the experiment, procedure results and answer related questions
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.
5. **Record (5 Marks)**
    - Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S5

CONCRETE LAB (MT-2)

Course Code	PCCEL508	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. To enable experimental evaluation of properties of the materials used for concrete
2. To obtain the characteristics of the materials.

Expt. No.	Experiments
1	Test on Cement: Fineness, normal consistency, initial & final setting time.
2	Test on Cement: Specific gravity and compressive strength
3	Study on soundness of cement.
4	Test on Coarse and Fine Aggregate: Sieve analysis.
5	Test on Coarse and Fine Aggregate: Water absorption, bulk density, void ratio, porosity and specific gravity.
6	Test on bulking of sand.
7	Test on coarse aggregate crushing value
8	Tests on fresh concrete: Measurement of workability of concrete by slump cone test and compacting factor test.
9	Study on workability of concrete by Vee-Bee test and flow test.
10	Concrete mix design by IS code method and casting of cubes, cylinders with designed concrete mixes.
11	Tests on hardened properties of concrete: Compressive, split and flexural strength.
12	Tests on hardened properties of concrete: Modulus of elasticity of concrete
13	Tests on brick, floor and roof tiles as per IS code provision.
14	Study on Non-destructive tests on hardened concrete (Rebound hammer, ultrasonic pulse velocity and Rebar locator).
15	Study on concrete core cutter, concrete penetrometer and crack detection microscope.

Minimum of 12 experiments from among the 15 experiments listed, is to be completed.

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To describe the basic properties of cement	**K3**
CO2	To characterize the physical and mechanical properties of various aggregates.	**K3**
CO3	To experimentally evaluate the fresh and hardened properties of concrete	**K3**
CO4	To interpret the quality of various construction materials as per IS Code provisions.	**K3**

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

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	Concrete Technology, Theory and Practice	M. S. Shetty, A.K Jain	S.Chand & Company	2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Concrete Manual	M. L. Gambhir	Dhanpat Rai & Sons, Delhi.	2004
2	Properties of Concrete	A. M. Neville	Pitman	2011
3	IS codes on cement: IS 1489(Part 1& 2):2015, IS 269:2015, IS 8112: 2013, IS 4031 (Part 1):1996, IS 4031 (Part 3):1988, IS 4031 (Part 4): 1988, IS 4031 (Part 5): 1988, IS 4031 (Part 6): 1988, IS 4031 (Part 11): 1988, IS 5513: 1996			
4	IS codes on aggregate: IS 2386(Part 1):1963, IS 2386(Part 3):1963, IS 2386 (Part 4): 1963, IS 383:2016			
5	IS codes on fresh and hardened concrete: IS 1199(Part1 to 7): 2018, IS 10262:2019, IS 516 Part 1 Sec 1: 2021, IS 516 Part 5 (Sec 1 to 4), IS 516 Part 8 Sec 1: 2020, IS 14858: 2000, IS 13311 (Part 2):1992			
6	IS codes on brick and tiles: IS 3495 (Part 1 to 6): 2019, IS 1077:1992, IS 654:2023, IS 1237: 2012, IS 13630 (Part 1): 2019, IS 13630 (Part 2): 2019, IS 13630 (Part 6): 2019, IS 13630 (Part 15): 2019, IS 5454: 2024			
7	Other relevant latest BIS standards			

Video Links (NPTEL, SWAYAM…)	
Sl No.	**Link ID**
1	https://cs-iitd.vlabs.ac.in/
2	https://ms-nitk.vlabs.ac.in/exp/concrete-mix-design/simulation.html
3	http://digimat.in/nptel/courses/video/105104030/L34.html
4	http://acl.digimat.in/nptel/courses/video/105102012/L17.html

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**
    - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
    - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.
2. **Conduct of Experiments (7 Marks)**
    - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
    - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
    - Teamwork: Collaboration and participation in group experiments.
3. **Lab Reports and Record Keeping (6 Marks)**
    - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
    - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.
4. **Viva Voce (5 Marks)**
    - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
    - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
    - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**
    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.
3. **Result with Valid Inference/Quality of Output (10 Marks)**
    - Accuracy of Results: Precision and correctness of the obtained results.
    - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.
4. **Viva Voce (10 Marks)**
    - Ability to explain the experiment, procedure results and answer related questions
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.
5. **Record (5 Marks)**
    - Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 6

CIVIL ENGINEERING

SEMESTER S6

QUANTITY SURVEYING AND VALUATION

Course Code	PCCET601	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)	PCCEL218	Course Type	Theory

Course Objectives:

1. To provide a structured and comprehensive framework for the study of two interconnected areas of expertise, Estimation and valuation.
2. To equips students to analyse the rate of various items of work with reference to the standard data and schedule of rate.
3. This course develops the capability of students to prepare detailed estimates of various items of work related to civil engineering construction and also preparation of the valuation of land and buildings.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction- Quantity Surveying- Basic principles, Role/responsibility of Quantity surveyor at various stages of construction Estimate-Details required, Type of estimate, purposes. Contingencies, Work-charge establishment, Tools and Plant, centage charge, Day work, Prime cost, Provisional sum & provisional Quantity, Overhead charges, Cost index, Contract documents (Brief description only) Bill of Quantity -Typical format-use Item of works- Identify various item of work from the drawings-units of measurement of various materials and works (focus may give to RCC residential building) General rule & method of measurement with reference to Indian Standard Specifications-IS1200.	9

2	Introduction to the use of CPWD schedule of rates as per latest DSR and Analysis of rate as per latest DAR Specifications-General specification of all items of a residential building. Detailed specifications (CPWD specifications) of major item of work like Earth work excavation in foundation, masonry, Reinforced cement concrete, finishing of building work Analysis of rates for Earth work in excavation for foundation, mortars, reinforced cement concrete Works, finishing work, masonry work, stone works, flooring with reference to latest DSR and latest DAR (Data should be given).	**9**
3	Detailed Estimate- Preparation of detailed measurement using Centre line method & Short wall long wall (separate wall) method for RCC single-storied building (Flat roof) including stair cabin- Residential/office/school building. BOQ preparation of a single-storied RCC building work. Material quantity calculation of the items of work (Rubble, Brick work, Concrete work, Plastering) in detailed estimate prepared for building work. (Data for unit quantity should be provided from DAR) Bar Bending Schedule- Preparation of BBS of RCC beams, slabs, Column footings, Retaining wall. Road estimation-Estimation of earthwork from longitudinal section-metaled road. Estimation of sanitary and water supply work -Water tank, Septic tank, Manhole (No Detailed estimate needed- concept of item of work, its general specification and unit of measurement). Introduction to software tools for quantity surveying	**9**
4	Valuation – purpose, factor affecting, introduction to terms-Value, Cost, Price, kinds of values Income- Gross income, net income, outgoings, annuity, sinking fund, Year's purchase, Depreciation, obsolescence -Free hold and leasehold properties. Methods of calculating depreciation – straight line method – constant percentage method, sinking fund method and quantity survey method. Methods of valuation– rental method, direct comparison of capital cost, valuation based on profit, depreciation method. Valuation of land (Brief description 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 out of three questions from Module III and Module IV.

Part A	Part B	Total
• 2 Questions from each module I & II • Total of 4 Questions, each carrying 3 marks **(4 x 3 =12 marks)**	• Three questions will be given from **Module-III**, out of which 2 questions should be answered. (2 x 20=40 Marks) • Three questions will be given from **Module-IV**, out of which 2 questions should be answered (2 x 4 =8 Marks) **(40+8 =48 Marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Define basic terms related to estimation, quantity surveying and contract document	**K1**
CO2	Interpret the item of work from drawings and explain its general specification and unit of measurement.	**K2**
CO3	Make use of given data from CPWD DAR/DSR for calculating the unit rate of different items of work associated with building construction.	**K3**
CO4	Prepare detailed measurements (including BBS) and BoQ of various work like buildings, earthwork for road, sanitary and water supply work	**K3**
CO5	Explain various basic terms related to the valuation of land and building.	**K1**
CO6	Prepare valuation of buildings using different methods of valuation.	**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	-	-	-	-	-	-	-	-	-	-	**-**
CO2	2	-	-	-	-	-	-	-	-	-	-	**-**
CO3	3	2	-	-	-	-	-	-	-	-	-	**-**
CO4	3	2	-	-	-	-	-	-	-	-	2	**-**
CO5	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	Estimation and costing in civil engineering	B. N. Dutta	UBS publishers	28th Revised Edition, 2020
2	Estimation Costing and Valuation	Rangwala	Charotar publishing house Pvt. Ltd	2017
3	Estimation and quantity surveying,	Dr. S. Seetha Raman & M. Chinna swami,	Anuradha publications Chennai.	2015
4	Estimating, Costing, Specification and valuation	M. Chakraborthy	By Author	2006

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Civil Engineering Estimation and Costing	V N Vazirani& S P Chandola	Khanna Publishers	1968
2	Methods of measurement of building & civil engineering works	IS 1200-1968	Bureau of Indian Standards, New Delhi	1968
3	CPWD DAR and DSR		CPWD	2018
4	CPWD Specifications Vol1 & 2		CPWD	2019

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	Building cost estimation simplified - Course (swayam2.ac.in)

SEMESTER S6

DESIGN OF STEEL STRUCTURES

Course Code	PCCET602	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. The course covers the basic ideas needed to design structural steel members. The students are exposed to many areas related to steel structural design and they learn how to identify and address real-world practical issues.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to steel and steel structures, properties of steel, structural steel sections. Introduction to design loads and load combinations, limit state design concepts. Type of Fasteners- Bolts and welds. Types of simple bolted and welded connections-Relative advantages and disadvantages-Modes of failure of bolted connection-Design of bearing type connection and friction connection–Prying forces- Design of bracket connection.	9
2	Welds-specifications and effective area of welds-Fillet and butt connections-Axially loaded connections for plate and angle truss members- Design of bracket connections. Tension Members - Types of sections -Modes of failure-Slenderness ratio- Net area- Concepts of Shear Lag- Design of tension Members-Connections in tension members - Use of lug angles	9
3	Types of compression members and sections–Behaviour and types of failures-Effective Length-Slenderness ratio–Column formula and column curves- Design of solid and built-up columns - Design of Built up laced and battened type	9

	columns . Design of column bases - Slab base and Gusset base	
4	Types of beam sections- Flexural strength and lateral stability of beams- Design of laterally supported and laterally unsupported beams. Design of roof trusses-types-Design loads and load combination- Assessment of wind loads- Design of I section purlin	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Explain the behaviour and properties of structural steel members to resist various structural forces and actions and apply the relevant codes of practice	**K2**
CO2	Analyse the behaviour of structural steel members and undertake design at both serviceability and ultimate limit states	**K3**
CO3	Explain the theoretical and practical aspects of design of composite steel structure with design aspects	**K3**
CO4	Apply a diverse knowledge of design of steel engineering practices applied to real life problems.	**K3**
CO5	Demonstrate experience in the implementation of design of structures on engineering concepts which are applied in field of Structural Engineering	**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	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	2	-	-	-	-	-	-	-	-	-
CO3	2	3	2	-	-	-	-	-	-	-	-	-
CO4	2	3	3	-	-	-	-	-	-	-	-	-
CO5	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	Steel structures: Design and Practice	N Subramanian	Oxford Publication	2010
2	Design of Steel structures	Duggal S.K.	Tata McGraw-Hill	2017
3	Design of Steel structures	A. S. Arya, J.L. Ajmani and Awadesh Kumar	Nem Chand and Bros	2014

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Design of Steel Structures	P. Dayaratnam	Wheeler Publishing	1998
2	Steel design	William T Segui	Cenage Learning	2017
3	Design of Steel Structures- Vol I and Vol II	Ramachandra S. and Virendra Gehlot	Standard Book House	2011
4	IS 800-2007, Code of practice for structural steel design		BIS	2007

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/105/105105162/
2	https://archive.nptel.ac.in/courses/105/105/105105162/
3	https://archive.nptel.ac.in/courses/105/105/105105162/
4	https://archive.nptel.ac.in/courses/105/105/105105162/

SEMESTER S6

ADVANCED DESIGN OF CONCRETE STRUCTURES

Course Code	PECET631	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)	PBCET404 ,PCCET602	Course Type	Theory

Course Objectives:

1. Intends to brush-up the fundamentals of design of reinforced concrete and steel structures by limit state design and review the usage of relevant codes
2. Make students competent by covering contemporary engineering practices in the structural design
3. Develop the mixed qualities to students in structural engineering point of view - independently handling the design problems and to work in a group for team works

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Design of continuous beams– Redistribution of moments- Detailing Reinforced concrete portal frames: Introduction - Analysis and design of rectangular portal frames for vertical loading Approximate methods for structural Analysis and design for vertical loads, Pattern loading, lateral loads	9
2	Retaining Structures- Introduction- Functions and types of retaining walls- Structural analysis and design of RCC cantilever type of retaining wall for various types of backfill conditions. Counterfort retaining wall- design principles of components and detailing (design not required) Introduction to Strut and Tie Method; Design of Deep beams, Corbels and Pile cap	9
3	Introduction to design of water tanks-design philosophy and requirements-joints- IS code recommendations- Design of rectangular circular water tanks using IS code coefficients (IS 3370- 2009). Yield line method of analysis of slabs – Characteristic features of yield lines– analysis by virtual work method – Yield line analysis by equilibrium method.	9

	Flat slabs – Introduction–components–IS Code recommendations– IS code method of design of interior panel (with and without column drop).	
4	Review of the codes –IS 811(1987), IS 801(1975), SP 6-5(1980) Light gauge sections – Types of cross sections – Local buckling and post buckling – Design of compression and Tension members – Design of flexural member - Types of connections and their design	**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	**30**	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Design and detail cantilever retaining wall and understand the design principles of Counter fort retaining wall. And Design and detail deep beams and corbels	**K2, K3**
CO2	Design and detail water tanks as per IS code provisions	**K3**
CO3	Explain Concept of yield line theory and design of different slab using yield line theory Design of Flat slabs using IS code provisions.	**K2, K3**
CO4	Analyse and design Cold form light gauge section.	**K3**
CO5	Use of latest industry standard formula, table, design aids used for design of beams and portal frames under pattern loading.	**K2, 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	-	-	1	-	-	-	1	-	-
CO2	3	1	1	-	-	-	-	-	-	1	-	-
CO3	3	2	3	-	-	-	-	-	-	1	-	-
CO4	3	2	3	-	-	-	-	-	-	1	-	-
CO5	1	3	2	-	-	-	-	2	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	RCC Designs	Punmia, B. C. and Jain A.K	Laxmi Publications Ltd.	10th Ed 2015
2	Design of Steel Structures Vol. I	Ramchandra S and Virendra Gehlot	Standard Book House, 2007	12th Ed 2018
3	Advanced Reinforced Concrete Design (IS: 456-2000)	N. Krishna Raju	CBS Publishers & Distributors	3rd Ed 2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Reinforced Concrete Design	Pillai S.U & Menon D	Tata McGraw Hill Book Co.	4th Edition 2021
2	Advanced Reinforced Concrete Design	Varghese P.C	Prentice Hall of India Pvt Ltd	2nd Revised Edition 2010
3	Relevant IS codes (IS 456, IS 875, IS 1893, IS 13920, SP 16, SP 34, IS 801)			
4	Design of Steel Structures	N. Subramanian	Oxford University Press	2nd Edition 2016

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/
2	https://archive.nptel.ac.in/courses/
3	https://archive.nptel.ac.in/courses/
4	https://archive.nptel.ac.in/courses/

SEMESTER S6

IRRIGATION AND DRAINAGE ENGINEERING

Course Code	PECET632	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 understand the concepts of irrigation water scheduling, distribution and system performance.
2. To familiarize the concepts of surface and sub-surface systems for drainage of irrigation lands.
3. To study the principles behind the reclamation of saline soils

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Surface Irrigation methods**: Classification – Border irrigation: design parameters, evaluation and ideal wetting pattern – Furrow irrigation: design parameters, types of furrows, evaluation, ideal wetting pattern – Basin irrigation: types of basins, ideal wetting pattern, shapes and size – Efficiency of surface irrigation methods. **Crop Water Requirements** : Infiltration and movement of water in soil– Soil-water-plant relationship –Water requirement of crops – Evapo transpiration (ET) and consumptive use - Effective rainfall – Irrigation requirement, Soil water balance, Yield response to water,Production functions . **Irrigation Water Distribution**: Canal network and canal regulation – Methods of distribution: supply based and demand based – Delivery of water	9

	to farms –Measurement of water – Scheduling of irrigation – Criteria for scheduling, constraints – Frequency and interval of irrigation.	
2	**Irrigation System Performance Indicators**: Systems classification – Rehabilitation and modernization – Performance indicators – Improving system performance –constraints. **Land Drainage systems**: necessity-types-surfaces and subsurface drainage-design considerations. **SoilWater Zone**: Description, Flow through soil water zone-Physical properties of soil-hydraulic conductivity-saturated thickness-drainable pore space-storativity, hydraulic resistance, leakage factor-Ground water data-concepts of ground water hydrograph, ground water maps, Isobath map, water table fluctuation maps etc.	**9**
3	**Drainage studies**-continuity equation, Laplace equation, relaxation method of solution-Typical boundary conditions like impervious layer, plane of symmetry, free water surface, water at rest or slowly moving water, seepage surface- Dupit Forchheimer Theory steady low above an impervious horizontal boundary-Dupits equation-water table subject to recharge. **Flow into open drains**-steady state equations-Hooghoudt equation, Principles, applications for design use of nomographs for homogeneous and layered soils– Earnst equation, concept of horizontal vertical and radial flow, application to layered soils. **Unsteady state drainage equations**-Glover Dum equation, application, concept of Kraijenhoff Vande Leur Mass land equation, application- analysis for constant recharge, intermittent recharge cases.	**9**
4	**Layout of open drainage systems**: types-Field drains, design considerations of ditch drains- Mole drains, design considerations, suitability- Sub-surface drainage systems- Pipe drainage systems design for uniform and non-uniform flow conditions-transport and dewatering situations. Patterns of drainage system- Drainage criteria formulation for off season drainage, crop season drainage, salt drainage- use of steady state and unsteady state approaches in formulation. - criteria for irrigated area. –incorporation of intentional and unavoidable losses **Salinity and drainage**- cause of salinity, salt balance equation, leaching efficiency, salt equilibrium equation and leaching requirement – salt storage	**9**

	equation – expressing equations in electrical conductivity terms-Design of a drainage system for an irrigated area based on crop water requirement and leaching requirement- Dynamic equilibrium concept. **Gravity outlet structures**- types, location.	

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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Design surface drainage systems for drainage of agricultural lands	**K3**
CO2	Understand the concepts of systems used for subsurface drainage of water-logged lands	**K2**
CO3	Assess the leaching requirement of salt affected soils	**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	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	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	Irrigation Theory and Practice	Michel A M	Vikas Publishing House	2008
2	Irrigation Water Management Principles and Practices	Majumdar D P	Prentice Hall of India	2000

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Drainage Principles and Applications, Volumes I to IV	H. P. Ritzema	International Institute for Land Reclamation and Improvement (ILRI)	1979
2	Land Drainage Principles: Methods and Applications	Bhattacharya A K and Michael A M	Konark Publishers Pvt. Ltd.	2003

Video Links (NPTEL, SWAYAM…)	
Module	**Link ID**
1	https://archive.nptel.ac.in/courses/126/105/126105010/
2	https://archive.nptel.ac.in/courses/126/105/126105010/
3	https://archive.nptel.ac.in/courses/126/105/126105010/
4	https://archive.nptel.ac.in/courses/126/105/126105010/

SEMESTER S6

GROUND IMPROVEMENT TECHNIQUES

Course Code	PECET633	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)	PBCET 504	Course Type	Theory

Course Objectives:

1. To introduce engineering properties of soft, weak and compressible deposits, principles of treatment for granular and cohesive soils and various stabilization techniques.
2. To understand the need of ground improvement techniques

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction** Need for engineered ground improvement, classification of ground modification techniques; suitability, feasibility and desirability of ground improvement technique; objectives of improving soil. Emerging trends in ground improvement-Different materials used for ground improvement and its property **Drainage and dewatering**: - well point system, shallow & deep well system, vacuum method, electro osmosis method. Comparison between methods	9
2	**Compaction-**Introduction, compaction mechanics, Field procedure, surface compaction, Dynamic Compaction, selection of field compaction procedures, compaction quality control. **Drainage Methods-** Introduction, Seepage, filter requirements, ground water and seepage control, methods of dewatering systems, Design of dewatering system including pipe line effects of dewatering. Drains, different types of drains. **Pre-compression and Vertical Drains:** Importance, Vertical drains, Sand drains, Drainage of slopes, Electro kinetic dewatering, Preloading.	9

3	**Chemical Modification-** Definition, cement stabilization, sandwich technique, admixtures. Hydration – effect of cement stabilization on permeability, Swelling and shrinkage and strength and deformation characteristics. Criteria for cement stabilization. Stabilization using Fly ash. Lime stabilization – suitability, process, criteria for lime stabilization. Bitumen, tar or asphalt in stabilization. **Vibration Methods:** Introduction, Vibro compaction – blasting, vibratory probe, Vibro displacement compaction – displacement piles, vibro flotation, sand compaction piles, stone columns, heavy tamping	**9**
4	**Grouting And Injection:** Introduction, Effect of grouting. Chemicals and materials used. Types of grouting. Grouting procedure, Applications of grouting. **Reinforced earth**: - mechanism- types of reinforcing elements-reinforcement-soil interaction – applications- reinforced soil structures with vertical faces Geosynthetics – types of geosynthetics – functions of geosynthetics – properties of geosynthetics. Soil nailing & Micro pile-basic concept-construction sequence-areas of application-design considerations-merit and demerit Earth Reinforcement-Reinforcement materials-reinforced earth wall-design considerations-construction procedure	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Classify the different ground improvement techniques	**K1, K2**
CO2	Outline the basic concept/ design aspects of various ground improvement methods	**K2, K3**
CO3	Understand the methods of stabilisation	**K2, K3**
CO4	Choose different application of geosynthetics and soil stabilisation in Ground improvement	**K3**
CO5	Understand the methods and properties of reinforced soil	**K2, 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**	-	-	-	-	-	-	-	-	-	-	-
CO2	**2**	-	-	-	-	-	-	-	-	-	-	-
CO3	**2**	**2**	-	-	-	-	-	-	-	-	-	-
CO4	**3**	**2**	-	-	-	-	-	-	-	-	-	-
CO5	**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	Ground Improvement Techniques	P. Purushothama Raj	Laxmi Publications (P) Ltd.	1st & 1999
2	Engineering Principles of Ground Modification	Manfred. R. Hausmann	McGraw Hill	1st & 1989
3	Reinforced soil and its engineering applications	Swami Saran	I. K. International Pvt Ltd	1st & 2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Construction and Geotechnical Method in Foundation Engineering	Robert M. Koerner	McGraw Hill	1st & 1984
2	Ground Improvement Techniques	Nihar Ranjan Patra	Vikas Publishing house	1st & 2012
3	Current Practices in Geotechnical Engineering Vol.-I	Alam Singh and Joshi	International Book Traders	1st & 1985

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc23_ce78/preview
2	https://onlinecourses.nptel.ac.in/noc23_ce78/preview
3	https://onlinecourses.nptel.ac.in/noc23_ce78/preview
4	https://onlinecourses.nptel.ac.in/noc23_ce78/preview

SEMESTER S6

REPAIR AND REHABILITATION OF STRUCTURES

Course Code	PECET634	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)	PBCET404	Course Type	Theory

Course Objectives:

1. To understand the basic idea about the need of maintenance, repair, rehabilitation and strengthening measures of building structures
2. To identify various deterioration mechanisms or damage mechanisms in buildings
3. To study various non-destructive techniques and semi destructive techniques for the damage diagnosis and assessment of a structure at the site
4. To be aware of several practices for maintenance and rehabilitation like surface repair, corrosion protection, structural strengthening etc.
5. To suggest evaluation and repair/maintenance methods for extending the service life of buildings
6. To recognize various demolition methods

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction** – Maintenance, importance of maintenance, routine and preventive maintenance, rehabilitation, repair, retrofit and strengthening, need for rehabilitation of structures. **Cracks in R.C. buildings** - Various cracks in R.C. structures, causes and effects. **Damages to masonry structures** - Various damages to masonry structures and causes.	9

	Damage diagnosis and assessment - Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, Visual inspection	
2	**Non-Destructive Testing of structures:** Rebound hammer, Ultra sonic pulse velocity. **Semi destructive testing of structures**: Probe test, Pull out test, Chloride penetration test, Carbonation, Carbonation depth testing, Corrosion activity measurement, Core test. **Strength and Durability of Concrete structures** - Quality assurance for concrete – Strength, Durability and Thermal properties of concrete. Effects due to climate, temperature, Sustained elevated temperature, Corrosion - effects of cover thickness. **Substrate preparation** - Importance of substrate/ surface preparation, General surface preparation methods and procedure, reinforcing steel cleaning.	**9**
3	**Repair materials** -Various repair materials, Criteria for material selection, Methodology of Selection. Health and safety precautions for handling and applications of repair materials. **Special mortars and concretes-** Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Self-healing concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes, Polymer Concrete and Mortar, Quick setting compounds, Gunite and Shot Crete, Expansive cement, Ferro cement, Concrete chemicals. **Grouting materials** - Gas forming grouts, Salfoaluminate grouts, Polymer grouts, Acrylate and Urethane grouts. Protective coatings - Protective coatings for Concrete and Steel. FRP sheets	**9**
4	**Crack repair** - Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Overlays, Repair to active cracks, Repair to dormant cracks. **Corrosion of embedded steel in concrete** – Corrosion of embedded steel in concrete, Mechanism, Stages of corrosion damage. Repair of various corrosion damages of structural elements by Cathodic protection. **Jacketing** - Column jacketing, Beam jacketing, Beam-Column joint jacketing, Reinforced concrete jacketing, Steel jacketing, FRP jacketing. **Strengthening of Structural elements** due to fire, Leakage, earthquake-	**9**

	Epoxy injection, Shoring, Underpinning. **Demolition Techniques** - Non-explosive and Explosive demolition, Engineered demolition techniques for dilapidated structures - Wrecking Ball Method, Concrete Sawing Method, Top down method, Hydraulic crusher, Implosion by delayed detonation technique.	

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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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 various distress and damages to concrete and masonry structures	**K2**
CO2	Examine the damages of the structure using required tests with required surface preparations.	**K3**
CO3	Understand the types and properties of repair materials and apply various techniques for repairing damaged and corroded structures.	**K3**
CO4	Proposing wholesome solutions for maintenance /rehabilitation and applying methodologies for repairing and demolishing structures.	**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	2	2	1	-	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-
CO4	2	2	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	Concrete repair and maintenance	Peter. H. Emmons	Galgotia publications Pvt. Ltd.	2001
2	Repair and protection of concrete structures	Noel P. Mailvaganam	CRC Press.	1991
3	Earthquake resistant design of structures	Pankaj Agarwal, Manish Shrikande	PHI	2006
4	Concrete Structures, Materials, Maintenance and Repair	Denison Campbell, Allen and Harold Roper	Longman Scientific and Technical	1991

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Failures and repair of concrete structures	S.Champion,	John Wiley and Sons	1961
2	Diagnosis and treatment of structures in distress	R.N.Raikar .	R & D Centre of Structural Designers and Consultants Pvt.Ltd, Mumbai	1994
3	Handbook on repair and rehabilitation of RCC buildings	CPWD	Government of India	2011
4	Handbook on seismic retrofit of buildings	A. Chakrabarti et.al.	Narosa Publishing House	2010

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtu.be/NdLwHk-A0hc
2	https://youtu.be/sjyYppF-uKQ
3	https://youtu.be/P-PFYAIg-3E
4	https://youtu.be/geYZYg8csYQ

SEMESTER S6

SOLID AND HAZARDOUS WASTE MANAGEMENT

Course Code	PECET636	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 create an awareness on different types of solid waste generated, methods of collection, processing and disposal.
2. To study about classification, handling and storage, collection, transportation, treatment of hazardous waste

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction** Wastes-Sources and characteristics - Categories of wastes- Municipal, Industrial, Bio-medical, Universal, Construction and demolition, Radioactive, e wastes, Agricultural waste. Functional elements of solid waste management	9
2	**Functional Elements** Characteristics of solid waste, Proximate and ultimate analysis, Generation and factors, Storage of solid waste- factors to be considered Collection systems, Routing, Need for transfer operation. Processing techniques- Mechanical volume and size reduction, chemical volume reduction, component separation Resource conservation and recovery.	9
3	**Disposal Of Solid Waste** Biochemical methods – Sanitary landfills, composting, anaerobic digesters Sanitary landfills- parts and their functions, design considerations, methods of landfilling advantages and disadvantages, Composting- Stages in aerobic composting, types of composting-Indore and Bangalore process Anaerobic digesters – Stages in anaerobic digestion, Parts of a digester	9

	Thermo chemical methods -incineration, gasification and pyrolysis, types of incinerators -parts of an incinerator-incinerator effluent gas and composition, advantages and disadvantages	
4	**Hazardous Waste** Hazardous waste –Definition and Identification, Classification, Handling and Storage, Collection, Transportation Treatment and remedial actions, Stabilization and Solidification, Thermal methods, Secure Landfill	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Classify the various categories of solid waste generated from diverse sources and to outline the issues and scopes associated which each type.	**K2**
CO2	Illustrate the various aspects of waste management for solid waste.	**K2**
CO3	Analyse the various options of waste disposal based on the nature of waste, required end product.	**K3**
CO4	Illustrate the classification, handling and storage, collection, transportation, treatment for hazardous waste.	**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	1	2	1	3	3	3	1	2	3	2
CO2	3	2	1	2	1	3	3	3	1	2	3	2
CO3	3	3	2	2	2	3	3	3	1	2	3	2
CO4	3	2	1	2	1	3	3	3	1	2	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	Hand book of solid waste management	George Tchobanoglous, Frank Kreith	Mc Graw hill publications, New York.	2002
2	Solid Waste Engineering	William A Worrell, Aarne Vesilind,	Cengage learning	2016
3	Environmental Engineering	Howard S Peavy, Donald R Rowe, George Tchobanoglous	Mc Graw hill Education	Edition 7, 1985

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Waste management Practices	John Pichtel	Taylor& Francis publishers	2015
2	Introduction to Environmental Engineering	David A. Cornwell and Mackenzie L. Davis	Mc Graw Hill International Edition	Edition 4, 2013
3	Environmental Science (Earth as a living plant)	Daniel B. Botkin and Edward A. Keller	John Wiley & Sons Inc.	IV Edition, 2003
4	Hand Book of Environmental Engineering	Robert A. Corbitt	Mc Graw hill publishing Company	1990

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/105103205
2	https://nptel.ac.in/courses/105103205
3	https://nptel.ac.in/courses/105103205
4	https://nptel.ac.in/courses/105106056

SEMESTER S6

TRAFFIC ENGINEERING AND MANAGEMENT

Course Code	PECET637	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. Impart in-depth knowledge pertinent to traffic flow theory, traffic management measures, capacity analysis and road safety
2. Enable designing of road intersections and traffic signals

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamental parameters- speed, density, volume, travel time, headway, spacing, time-space diagram, time mean speed, space mean speed and their relation. Fundamental diagrams of traffic flow. Single Regime models - Greenshields model, Greenberg logarithmic model. Multi-Regime models – Two and three regime linear models. Need and scope of traffic regulations- Motor Vehicle Act – Regulation of speed- Regulation of vehicles – Regulations concerning driver- General rules concerning traffic- parking regulations- Enforcement of regulations.	9
2	Scope of traffic management measures – restrictions to turning movements – one-way streets – tidal flow operations-Closing side streets –Exclusive bus lanes. Intersections: At-grade intersections- basic forms- conflict points -visibility triangle- design principles- Channelization. Grade separated intersection: Grade separated intersections without interchange, and with interchange- Three leg interchange, Four leg interchange and multileg interchange. Traffic	9

	Control Measures - Traffic Signs, Road Markings, Traffic control aids. General awareness only.	
3	Capacity and Level of service (LOS): Concept- Base capacity, Adjusted capacity, LOS definition, Factors Affecting Capacity and LOS, Homogeneous and heterogeneous traffic conditions- vehicle types - Concept of PCU. Capacity and LOS analysis –Single lane, Intermediate lane and two lane interurban roads- Base capacity and adjustment factors- Indo HCM (2017) Approach. Capacity and LOS analysis of Urban roads - Base conditions - Adjustment factors- Indo HCM (2017) approach. Roundabouts- Geometric layout, types- design elements.	**9**
4	Traffic Signals - Warrants- pre-timed and traffic actuated. Design of signal timing at isolated intersections- Phase design- optimum cycle time (Webster's approach), green splitting-pedestrian phase -phase diagrams, timing diagram. Traffic Safety: Road Safety Situation in India, Causes of road accidents – influence of road, vehicle, driver and environmental factors - Pedestrian Safety, Collection and statistical analysis of accident data, Collision and condition diagram. Road safety audit- concept and need- organizations involved-stages of road safety audit (brief description 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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Identify the relationship among various traffic stream variables.	**K2, K3**
CO2	Apply traffic management measures and regulations so as to solve issues related to traffic flow in road network.	**K2, K3**
CO3	Identify the need for intersection control and design of various types.	**K2, K3**
CO4	Explain the concept of capacity and LOS and its estimation for various traffic facilities.	**K2, K3**
CO5	Analyse causes of road accidents and suggest preventive measures.	**K2, 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**	-	-	-	-	-	-
CO3	**3**	**2**	-	**2**	-	**2**	-	-	-	-	-	**2**
CO4	**3**	**2**	**3**	**2**	-	**2**	**3**	-	-	-	-	**2**
CO5	**3**	**2**	**2**	**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	Traffic Engineering and Transport planning	Kadiyali L.R.	Khanna Publishers	2011
2	Highway Engineering	Khanna S.K, Justo C.E.G. and A. Veeraragavan	Nem Chand & Bro	10th, 2018
3	Transport planning and Traffic Engineering,	CAO Flaherty	Elsevier	2006
4	Traffic Engineering	Roess, R. R., McShane W R & Prassas E S	Prentice Hall of India	4th, 2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Traffic Engineering	Pignataro L. J	Prentice Hall of India	1973
2	Transportation Engineering: An Introduction	C. J. Khisty and B. K. Lall	Prentice Hall of India	2002
3	Principles of Transportation Engineering	Chakroborty P. and Das A.	Prentice Hall of India	2003
4	Traffic Flow Fundamentals	A. D. May	Prentice Hall of India	1990
5	Highway Capacity Manual	-	Transportation Research Board, USA	2010
6	Indian Highway Capacity Manual (Indo-HCM)	-	CSIR, New Delhi	2017

Video Links (NPTEL, SWAYAM…)	
Module No	**Link ID**
1	https://archive.nptel.ac.in/courses/105/105/105105215/
2	https://archive.nptel.ac.in/courses/105/105/105105215/
3	https://archive.nptel.ac.in/courses/105/105/105105215/
4	https://archive.nptel.ac.in/courses/105/105/105105215/

SEMESTER S6

ADVANCED FOUNDATION ENGINEERING

Course Code	PECET635	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)	PCCET402 PBCET504	Course Type	Theory

Course Objectives:

1. To impart the students a comprehensive understanding of foundation design concept
2. To enable students to acquire proper knowledge for performing the design and analysis of foundation in real life situation

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Bearing capacity of shallow foundations-Review of technology-IS code formula for safe bearing capacity of shallow foundation. Numerical problems. Footings subjected to moments-effective width concept-Numerical problems. Allowable bearing pressure from N Value-Teng's equations for safe bearing capacity of strip, square and circular footings, Safe bearing pressure for a permissible settlement. Numerical problem- Footings on layered soil concept with Explanation.	9
2	Deep foundations- Geotechnical Design of Piles from SPT and CPT -values-number and spacing-Numerical Problems-Settlement of pile groups in clay-equivalent raft concept-Numerical problem. Settlement of pile groups in sand-Skempton's method-Meyerhof's Method-Numerical problem. Uplift capacity of single piles and group of piles in clay -Numerical problems.	9
3	Under reamed piles-ultimate load carrying capacity in sand and clay-design considerations as per IS. IS formula-single and double bulb -Numerical	9

	problems. Drilled piers (straight shafted and belled) in clay- Design Considerations- Load Transfer Mechanism. Vertical Bearing Capacity and uplift capacity of belled pier - Numerical problems. Types of Sheet Pile Walls-Cantilever Sheet Pile Walls - Cantilever sheet pile walls with cohesion less backfill-deflection diagram-depth of embedment. Cantilever sheet pile walls with cohesive backfill-depth of embedment. Numerical problem- Anchored sheet pile walls-free earth support and fixed earth support analysis (concept only)-Rowe moment reduction factor	
4	Behavior of vertical piles under lateral loading – Failure mechanisms of short piles in cohesive and granular soils for restrained and unrestrained conditions, given by (Broms). Failure mechanisms of long piles in sand and clay both free headed and fixed headed given by Broms-Empirical Methods to Determine Lateral Strength of Piles-IS 2911 and Brom's method. IS2911 method-concept and assumptions made- Criteria for classification of piles into short rigid piles or long elastic piles*:* Lateral load test on vertical piles. Details of Broms Method- Chart for estimating the resistance of short and long piles in clayey soils. Chart for estimating the lateral deflection at ground level for piles in Clayey soils under working loads given by Broms. Chart for estimating the ultimate lateral resistance of short and long piles in sandy soils and Chart for estimating the lateral deflection at ground level for piles in Clayey soils under working loads given by Broms. Numerical problems using Brom's charts alone.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	*Internal Ex*	*Evaluate*	*Analyse*	*Total*
5	**15**	**10**	**10**	**40**

Criteria for Evaluation (Evaluate and Analyse): 20 marks

Criteria for Evaluation(Evaluate and Analyse): 20 marks

Assignment

Students should Identify a real word requirement for a special foundation. Design and develop detailed drawing of it. Finally, a complete file with documents including basic requirements, soil exploration data, design specification, design procedure, drawings and concluding remarks.

Criteria for evaluation:

1. **Problem Definition (K4 - 4 points)**
   a. Clearly defines the requirements and constrains.
2. **Problem Analysis (K4 - 4 points)**
   a. Compare and justify the proposed schemes with evidence and logical reasoning.
3. **Evaluate (K5 - 4 points)**
   a. Thoroughly evaluate the proposed solutions.
   b. Compares trade-offs, advantages, and disadvantages.
   c. Considers feasibility, scalability, and practical implications.
4. **Design and drawing (K6 - 8 points)**
   a. Demonstrates proficiency in design.
   b. Demonstrates proficiency in creating drawings for technical requirements including approval.

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

Part A	Part B	Total
• 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	Explain allowable soil pressure and safe bearing capacity, evaluate safe bearing capacity of shallow foundations by IS formula.	**K3**
CO2	Proportion and design pile foundations, evaluate settlement of pile groups, uplift capacity of single and group of piles in clay	**K4**
CO3	Apply the procedure for the deflection and ultimate lateral load capacity of vertical piles.	**K3**
CO4	Analyse the load carrying capacity of under reamed piles and load capacity and uplift resistance of belled piers. Analyse the depth of embedment for cantilever sheet pile walls in clay and sand,	**K4**
CO5	Evaluate the load carrying capacity of under reamed piles and load capacity and uplift resistance of belled piers.	**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	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	2	-	-	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-
CO5	3	3	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	Analysis and design of substructures	Swami Saran	Oxford & IBH publishing Co. Pvt. Ltd.	2013
2	Foundation Engineering	P.C. Varghese	PHI Learning Private Limited	2012
3	Principles of Geotechnical Engineering	Das B. M.	Cengage India Pvt. Ltd.	2010
4	Basic and Applied Soil Mechanics	Ranjan G. and A. S. R. Rao.	New Age International	2002

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Geotechnical Engineering,	Arora K. R.	Standard Publishers.	2006.
2	Soil Mechanics and Foundation Engineering	Purushothamaraj P.	Dorling Inversely (India) Pvt. Ltd.	2013
3	Geotechnical Engineering: Principles and practices of Soil Mechanics and Foundation Engineering	Murthy V.N.S	New York: Marcel Dekker	2003
4	Geotechnical Engineering	Arora K. R.	Standard Publishers	2006

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/105/105105207/

SEMESTER S6

CONSTRUCTION PROJECT MANAGEMENT

Course Code	PBCET604	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	4	ESE Marks	40
Credits	3:0:0:1	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	-	Course Type	Theory

Course Objectives:

1. Introduce students to the fundamentals of construction project management and planning.
2. Covers techniques for planning and scheduling construction projects, as well as methods for monitoring and controlling them.
3. Provides insights into the applications of Building Information Modelling (BIM) in construction.
4. Ensure that students become proficient in construction project planning and management by combining theoretical concepts with practical exercises using various software tool.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Construction projects, life cycle of a project – phases in a project. Tendering: types of tenders, stages in tendering. Process of development of plans and schedules – work break-down structure, estimating durations. Types of Schedules – Construction schedule, Material schedule, labour schedule, equipment schedule, financial schedule. Techniques of planning – Bar charts, Mile Stone Charts. Network representation – Activity on Arrow (AoA) or Activity on Node (AoN) Diagram. Network analysis – Critical Path Method (CPM), Programme Evaluation and Review Technique (PERT) – concepts and problems.	9

	Precedence Diagramming Method – types of relationships – concept of lead and lag. Concept only	
2	Handling resources on projects, resource constraints and conflicts, resource allocation and resource levelling. Concept only Time-Cost trade-off on construction projects – Classification of costs, compression of networks, cost optimization through the crashing of a network.	**9**
3	Updating project schedules. Project control, Schedule/time/progress control, periodic progress reports. Concept of Time-cost monitoring and control using S-curve, Earned value analysis – measures of performance.	**9**
4	Introduction to BIM Technology: Define BIM and BIM model, describe workflow in using BIM in the building lifecycle, Model-Based cost estimating, Perform Simulations, Apply BIM to reduce error and change orders in projects, Evaluate and communicate ideas related to the use of BIM in the building life cycle, BIM Benefits: Case Studies, Organizational Maturity and Dimensions, Construction Management and Planning using BIM.	**9**

Suggestion on Project Topics:

Project based learning (8 hrs)

Steps of Detailed Project Planning:

1. Develop basic drawings of a construction project (Preferably Residential/ small commercial building; G+1 building maximum)-Use drafting software for developing plan
2. Approximate estimation of quantities and rates, development of BOQ for the project -Use spread sheet or similar software
3. Develop a Gantt chart/ Precedence Network of the project and identify the critical path and floats. (use suitable planning software)
4. Develop a resource schedule for the selected project
5. Submit the completed files as project planning report

Course Assessment Method

(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

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
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the procedure for planning and executing public works.	**K1**
CO2	Apply scheduling techniques in construction project planning	**K3**
CO3	Optimize resource requirements in construction projects.	**K3**
CO4	Apply earned value analysis for monitoring the schedule and cost performance of construction projects.	**K3**
CO5	Demonstrate the application of BIM in construction management and planning.	**K3**

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

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Construction Project Management Theory & Practice	Jha K. N	Pearson India Education Services Pvt. Ltd.	2nd edition, 2015
2	Construction Management and Planning	Sengupta B. and Guha H.,	McGraw Hill	1995
3	BIM and Construction Management: Proven Tools, Methods and Workflows.	Hardin B. and McCool D	John Wiley and Sons Inc.,	2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Construction Management	Harris F., McCaffer R., Baldwin A. and Edum-Fotwe F.,	Wiley-Blackwell	8th Edition, 2021
2	Construction Engineering and Management	Sharma S. C. and Deodhar S. V.	Khanna Publishing	2019
3	Construction Project Management: Planning, Scheduling and Controlling,	Chitkara, K. K.	Tata McGraw-Hill Education	3rd Edition, 2014

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	archive.nptel.ac.in/courses/105/104/105104161/
2	archive.nptel.ac.in/courses/105/103/105103093/

PBL Course Elements

L: Lecture (3 Hrs.)	**R: Project (1 Hr.), 2 Faculty Members**		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**

    - Clarity and feasibility of the project plan
    - Research and background understanding
    - Defined objectives and methodology

2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**

    - Individual contribution to the presentation
    - Effectiveness in answering questions and handling feedback

3. **Involvement in the Project Work and Team Work (3 Marks)**

    - Active participation and individual contribution
    - Teamwork and collaboration

4. **Execution and Implementation (10 Marks)**

    - Adherence to the project timeline and milestones
    - Application of theoretical knowledge and problem-solving
    - Final Result

5. **Final Presentation (5 Marks)**

    - Quality and clarity of the overall presentation
    - Individual contribution to the presentation
    - Effectiveness in answering questions

6. **Project Quality, Innovation, and Creativity (3 Marks)**

    - Overall quality and technical excellence of the project
    - Innovation and originality in the project
    - Creativity in solutions and approaches

SEMESTER S6

INTRODUCTION TO CONSTRUCTION ENGINEERING

Course Code	OECET611	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. Identify the properties and applications of different construction materials
2. Understand the principles of concrete mix design and production
3. Learn various building systems and components
4. Comprehend the role of emerging trends and technology innovations in construction

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Construction Materials** Mortar – Types – properties – uses. Timber products – properties & uses of plywood, fibre board, particle board. Cement - Manufacturing, chemical composition, Tests on cement – specific gravity, standard consistency, initial and final setting time, fineness, soundness, compressive strength, IS specifications Aggregates – types, Gradation, importance of gradation, bulking of fine aggregate Iron and Steel –Reinforcing steel – types – specifications. Structural steel – specifications Admixtures, uses – mineral admixtures – fly ash and ground granulated blast furnace slag and chemical admixtures – plasticizers, super plasticizers, accelerators, retarders (brief discussion only)	9
2	**Concrete Technology** Process of manufacturing concrete – batching, mixing, transportation, placing, compacting, finishing, curing Properties of fresh concrete: Workability, factors affecting workability, test on	9

	workability (slump test), segregation and bleeding (brief discussion) Properties of hardened concrete: Strength, factors affecting strength, tests for strength of concrete in compression, tension and flexure Concrete quality control – statistical analysis of results – standard deviation – acceptance criteria – mix proportioning (B.I.S method) – nominal mixes.	
3	**Building Construction** Preliminary considerations for shallow and deep foundations Masonry – Types of stone masonry Lintels and arches – types and construction details. Tall Buildings – Framed building – steel and concrete frame – structural systems –erection of steel work–concrete framed construction– formwork – construction and expansion. joints Introduction to prefabricated construction – slip form construction	**9**
4	**Construction Technology** Cost-effective construction – rapid wall construction, soil-cement block masonry, voided slab technology, filler slab technology Basic concept of prestressing – fundamental understanding of pre-tensioned and post-tensioned construction Construction 3D printing (brief discussion only) Building failures – General reasons – classification – Causes of failures in RCC and Steel structures, Failure due to Fire, Wind and Earthquakes. Foundation failure – failures by alteration, improper maintenance, overloading. Retrofitting of structural components - beams, columns and slabs	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Describe the characteristics and uses of common construction materials	**K2**
CO2	Design and specify concrete mixes for different applications	**K3**
CO3	Identify and explain various building systems and components	**K2**
CO4	Describe the impact of emerging trends and innovations on construction	**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	-	-	-	-	1	2	-	-	-	-	3
CO2	3	-	-	-	-	1	2	-	-	-	-	3
CO3	3	-	-	-	-	1	2	-	-	-	-	3
CO4	3	-	-	-	1	1	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	Advanced Construction Technology	Roy Chudley, Roger Greeno	Prentice Hall	4th Ed, 2006
2	Architectural Design with SketchUp	Alexander C. Schreyer	John Wiley & Sons	3rd Ed, 2023
3	Building materials & construction	Anil Kumar Mishra	S. Chand Publishers	1st Ed, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Building Construction: Materials and Methods	Edward Allen, Joseph Iano	Wiley Publishers	7th, 2019

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/105102088
2	https://archive.nptel.ac.in/courses/105/102/105102012/

SEMESTER S6

ENVIRONMENTAL LAWS AND POLICY

Course Code	OECET612	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 explain the role of law, policy and institutions in the conservation and management of natural resources as well as pollution control
2. To introduce the laws and policies both at the national and international level relating to environment
3. To equip the students with the skills needed for interpreting laws, policies and judicial decisions
4. To familiarise students in the concept of international environmental law

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Basic Concepts in Environmental Law** An introduction to the legal system; Constitution, Acts, Rules, Regulations; Indian Judiciary, Doctrine of precedents, judicial review, Writ petitions, PIL– liberalization of the rule of locus standi, Judicial activism. Introduction to environmental laws in India; Constitutional provisions, Stockholm conference; Bhopal gas tragedy; Rio conference. General principles in Environmental law: Precautionary principle; Polluter pays principle; Sustainable development; Public trust doctrine. Overview of legislations and basic concepts	9
2	**Forest, Wildlife and Biodiversity related laws** Evolution and Jurisprudence of Forest and Wildlife laws; Colonial forest policies; Forest policies after independence 2 Statutory framework on Forests, Wildlife and Biodiversity: IFA, 1927; WLPA, 1972; FCA, 1980;	9

	Biological Diversity Act, 2002; Forest Rights Act, 2006. Strategies for conservation–Project Tiger, Elephant, Rhino, Modulew leopard.	
3	**Air, Water and Marine Laws** National Water Policy and some state policies Laws relating to prevention of pollution, access and management of water and institutional mechanism: Water Act, 1974; Water Cess Act, 1977, EPA, 1986. Pollution Control Boards Ground water and law Judicial remedies and procedures Marine laws of India; Coastal zone regulations. Legal framework on Air pollution: Air Act,1981; EPA, 1986	**9**
4	**Hazardous Substances and Activities Legal framework** EPA and rules made thereunder; PLI Act, 199 Principles of strict and absolute liability; **International Environmental law** An introduction to international law; sources of international law; law of treaties; signature, ratification Evolution of international environmental law: Customary principles; Common but differentiated responsibility, Polluter pays.	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Familiar with the laws, policies and institutions in the field of environment	**K1**
CO2	Acquire the skills needed for interpreting laws, policies and judicial decisions in a holistic perspective	**K2**
CO3	Acquire the ability to evaluate the role of law and policy in conservation and management of natural resources and prevention of pollution	**K2**
CO4	Familiar with the concept of international environmental law	**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	**2**	-	-	-	-	**2**	**2**	**1**	-	**1**	-	**2**
CO2	**2**	-	-	-	-	**2**	**2**	**1**	-	**1**	-	**2**
CO3	**3**	-	-	-	-	**2**	**2**	**1**	-	**2**	-	**2**
CO4	**2**	-	-	-	-	**2**	**2**	**1**	-	**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	Environmental Law and Policy in India	Divan S. and Rosencranz A.	Oxford, New Delhi	3rd, 2022
2	Environmental Law in India	Leelakrishnan P.	Lexis Nexis, India	6th, 2022
3	International Law and the Environment	Birnie P.	Oxford	3rd, 2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Hand Book on Environmental Law- Forest Laws, Wildlife Laws and the Environment; Vols. I, II and III	Upadhyay S. and Upadhyay V	Lexis Nexis-Butterworths-India, New Delhi.	2002
2	Principles of International Environmental Law,	Sands P	Cambridge	2003

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.swayam2.ac.in/cec20_ge12/preview

SEMESTER S6

DISASTER MANAGEMENT

Course Code	OECET613	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 introduce the concept of disasters, their causes and their mitigation and management

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Hazards and disasters: Introduction to key concepts and terminology: hazard, disasters and types of classifications, vulnerability, exposure, risk, crisis, emergency, capacity, resilience, Carbon footprint. Effect of subsystems of earth. Extent and nature of natural hazards, implications of climate change: Earth quakes, Volcanoes, Floods. Coastal disasters- Storm surges, Tsunamis, mitigation methods.	9
2	Landslides, Causes and prediction, Soil and soil degradation, erosion and Desertification, Forest fires, their mitigation methods.	9
3	Impacts and assessment: Risk Management and Assessment and Disaster Management cycle. SWOT Analysis- basic concepts, uses, limitations and advantages. Disaster management plan and reports, participation of community in disaster management.	9
4	Hazard and disaster management plans for floods, storm surges, landslides, earthquakes, forest fires: pre-disaster phase, actual disaster phase, post-disaster phase	9

	Relief and Amenities, Relief camps, organization, individual and community participation, camp layout, food requirement, water needs, sanitation, security, information administration. Technology in disaster management.	

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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Explain interaction between subsystems of earth that give rise to hazards and their potential for disasters	**K2**
CO2	Explain the evolving concepts and thoughts of management of hazards and disasters	**K2**
CO3	Apply the knowledge to find the causes behind natural disasters and evaluate their magnitude and impacts	**K3**
CO4	Develop management plans for hazards and disasters, and understand the roles of agencies involved	**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	-	-	-	-	-	-	-	-	-	-	1
CO2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	-	-	-	-	2	-	-	-	-	2
CO4	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	Disaster Management	Mrinalini Pandey	Wiley	2nd edition
2	Disaster Risk Reduction in South Asia	Ariyabandu, M. and Sahni P.	Prentice-Hall (India)	2003
3	Environmental Geology - Ecology, Resource and Hazard Management	Valdiya, K.S.	McGraw-Hill Education	2013
4	Disaster Management: Global Problems and Local Solutions	Shaw, R and Krishnamurthy, RR	Springer, Amsterdam	2010
5	Disaster Management - A Disaster Manager's Handbook	Nick Carter. W.,	Asian Development Bank, Philippines.	1991
6	Disaster management	Gupta, H.K.	Universities Press (India) Ltd.	2003
7	Natural and Anthropogenic Disasters- Vulnerability, Preparedness and Mitigation	Jha, M.K.	Springer, Amsterdam.	2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Geological Hazards: Their assessment, avoidance and mitigation	Bell, F.G.	E & FN SPON Routledge, London.	1999
2	Natural Disasters	Alexander, D.,	Research Press, New Delhi	1993
3	Handbook of Disaster and Emergency Management	Khorram-Manesh	Kompendiet (Gothenburg).	2017
4	Disaster Management in India Policies, Institutions, Practices	Rajendra Kumar Pandey	Routledge	2023

Video Links (NPTEL, SWAYAM…)	
	Link ID
1	https://nptel.ac.in/courses/105104183
2	https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

SEMESTER S6

ENVIRONMENTAL IMPACT ASSESSMENT

Course Code	OECET614	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 study the various types of environmental pollution and their impacts.
2. To study the process of environmental impact assessment and impact analysis methodologies.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction** Pollution and pollutants - general aspects, scale of impact-Global, local pollutants History of EIA - Global and Indian scenario, Need for EIA, EIA 2006 key features, General overview of Draft EIA 2020 EIA procedure in India, Public participation – Significance & steps Environment management plan Role of an Environmental Engineer	9
2	Impact analysis- Adhoc, checklists, matrix methods, overlay analysis, Fault Tree Analysis method & Event Tree Analysis method EIA case studies **Water Pollution** Point and Non-point Source of Pollution, Major Pollutants of Water, Physical, chemical and biological characteristics of water, Water borne diseases, Water Quality standards (IS 10500-2012)	9
3	**Solid Waste** Classification and sources of Solid Waste, Characteristics of Solid Waste, E-waste, & Radioactive wastes - Types, management/disposal	9

	Hazardous waste -waste identification process and characteristics Solid Waste Management Rules 2016 **Land/Soil Pollution** Effects of urbanization on land degradation, Impact of Modern Agriculture on Soil, pesticide pollution, Effect on Environment	
4	**Air Pollution** Classification of Pollution and Pollutants, Primary and Secondary Pollutants, Criteria Pollutants and their impacts on environment, human health, National Ambient Air Quality Standards by CPCB **Noise Pollution** Sources of Noise, Effects of Noise, measurement of noise, Equivalent sound pressure level, Control measures –Noise pollution (Regulation and control) Rule 2000	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Demonstrate the process, need and significance of EIA	**K2**
CO2	Predict and analyse the possible environmental impact assessment on various projects	**K3**
CO3	Apply assessment methodologies for evaluating environmental impact assessment	**K3**
CO4	Identify the significant sources of pollution from any upcoming or existing project and their impacts on biotic and abiotic elements in the environment	**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	1	2	1	3	3	3	1	2	3	2
CO2	3	3	2	2	2	3	3	3	1	2	3	2
CO3	3	3	2	2	2	3	3	3	1	2	3	2
CO4	3	3	2	2	2	3	3	3	1	2	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	Introduction to EIA	John Glasson, Riki Therivel & S Andrew Chadwick	University College London Press Limited	2005
2	Environmental Impact Assessment	Larry W Canter	McGraw Hill Inc., New York	1996
3	Waste Water Engineering	B.C. Punmia	Laxmi Publications Pvt. Ltd	1998
4	Sewage Treatment & Disposal and Waste water Engineering	P.N. Modi	Standard Book House	15th , 2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	EIA Analysis Hand Book	Rau G J and Wooten C. D.	McGraw Hill	1979
2	Introduction to Environmental Engineering	Mackenzie L Davis	McGraw hill Education	2013
3	Environmental Engineering	Peavy H S, Rowe, D.R. Tchobanaglous	Mc Graw Hill Education	1985
4	Standard Handbook of Environmental Engineering	Robert A Corbett	McGraw Hill	1999

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/124107160
2	https://nptel.ac.in/courses/124107160
3	https://nptel.ac.in/courses/124107160
4	https://nptel.ac.in/courses/124107160

SEMESTER S6

STRUCTURAL GEOLOGY

Course Code	OECET 615	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 evolution of earth from the deformed rocks and structures.
2. Identify areas of mineral, oil and gas deposits.
3. Get an idea about the structural instabilities which can lead to natural hazards

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Structural Geology; Forces causing deformation in Earth's lithosphere; Concept of rock deformation: Stress and Strain in rocks; Strain ellipses of different types and their geological significance; Rheology of rocks; Concept of dip and strike; Outcrop patterns.	9
2	Foliation and lineation- Description and origin of foliations, axial plane cleavage and its tectonic significance; Description and origin of lineation and relationship with the major structures; Neotectonics-Introduction; Neo tectonic activity in Kerala.	9
3	Folds- Fold morphology; Geometric and genetic classification of folds; Introduction to the mechanics of folding: Buckling, Bending, Flexural slip and flow folding; Importance of structures in mineral, oil and gas deposits	9
4	Fractures and faults: Geometric and genetic classification of fractures and faults; Effects of faulting on the outcrops; Geologic/geomorphic criteria for recognition of faults and fault plane solutions; Lineaments- Introduction; Major lineaments in Kerala and its possible implications.	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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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 about stress, strain and the deformation of rocks and the causes of deformation of rocks	**K2**
CO2	Evaluate the basic concepts in tectonics with respect to the geology of Kerala	**K5**
CO3	Identify the structures with probable mineral, oil and gas deposits	**K1**
CO4	Acquire the ability to describe and classify brittle and ductile structures, including faults and folds	**K4**
CO5	Anticipate the possibility of natural hazards	**K6**

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	2	1	-	-	-	-	-	-	3
CO2	3	3	-	2	-	1	-	-	1	-	-	3
CO3	3	3	1	2	1		1	1	1	-	-	3
CO4	3	3		2	-	-	-	-	-	-	-	3
CO5	3	3	1	2	1	1	-	1	1	-	-	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	Structural Geology	Marland P Billings	Pearson education	2016
2	Geology of Kerala	K Soman	Geological Society of India	2023
3	An Introduction to Structural Geology	A.K. Jain	Geological Society of India	2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Structural Geology of Rocks and Regions	George H. Davis, Stephen J. Reynolds, Charles F. Kluth	Wiley	3rd, 2011

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc19_ce47/preview

SEMESTER S6

APPLIED EARTH SYSTEMS

Course Code	OECET616	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. Appreciation of earth as a system of interrelated components
2. Understanding mechanisms that give rise to oceanographic and atmospheric phenomena
3. Comprehension of processes that result in characteristic land features in different climatic regimes

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamental concepts of equilibrium. Geomorphic agents and processes. Basic concept of Earth as a system and its component sub systems. Climate Change vis-a-vis the interrelationships of the subsystems- Green House Effect and Global warming, basic ideas about their causes and effects.	9
2	Weathering- relevance, influence of and on earth systems, types and controlling factors. Soil- formation and controls, soil profile, soil erosion and conservation methods. Fluvial processes-hydrological cycle, fluvial erosion, transportation and deposition, fluvial landforms. Stages of stream development; Drainage patterns.	9
3	Wagner's ideas of continental drift, Plate Tectonics- seafloor spreading. Plate boundaries and their features, mechanisms of plate movements Basics of oceanography: coastal upwelling and downwelling. Outlines of ocean floor topography, basic outlines of origin and circulation of deep sea surface currents (Atlantic and Pacific Oceans)	9

4	Basics of atmosphere and atmospheric processes: Structure and composition of the atmosphere. Heat budget, factors affecting solar radiation. Fundamental concepts of precipitation, global wind patterns. General weather systems of India, - Monsoon system, cyclone and jet stream	**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
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 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. **(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	Explain the concept of earth as a system of interrelated components and associated exogenic/endogenic processes.	**K2**
CO2	Appraise geological agents and their respective erosion, transportation and deposition regimes and landforms formed.	**K5**
CO3	Evaluate/investigate the significance of Plate tectonics theory to explain the geodynamic features and processes of earth's surface.	**K5**
CO4	Develop an understanding of oceanographic and atmospheric regimes and their sway on other subsystems and process thereof.	**K6**
CO5	Understand implications of human interaction with the Earth system.	**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**	-	**3**	**3**	**2**	-	-	-	**3**
CO2	**3**	**3**	-	**3**	-	**3**	**3**	-	**1**	-	-	**3**
CO3	**3**	**3**	-	**3**	-	**3**	**3**	-	-	-	-	**3**
CO4	**3**	**3**	**2**	**3**	-	**3**	**3**	-	-	-	-	**3**
CO5	**3**	**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	General Climatology	Critchfield H. J.	Prentice Hall, New Delhi	1983
2	Applied Hydrogeology	Fetter C. W.	CBS New Delhi	1990
3	Physical geology: Earth Revealed	Carlson D.H., Plummer C. C. and Mc Greary D.	McGraw Hill, New York,	2006
4	Oceanography–An Introduction to the Planet Oceanus	Pinet P R	West Publishing Co.,	1992
5	Environmental Geology: Ecology, Resource and Hazard Management	Valdiya K. S.	McGraw-Hill Education (India) Private Limited, New Delhi	2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Climatology and oceanography	D. S. Lal	Allahabad Sharda Pustak Bhawan	2001

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc20_ce33/preview
2	https://onlinecourses.nptel.ac.in/noc20_ce33/preview
3	https://onlinecourses.nptel.ac.in/noc20_ce33/preview
4	https://onlinecourses.nptel.ac.in/noc20_ce33/preview

SEMESTER S6

TRANSPORTATION ENGINEERING LAB

Course Code	**PCCEL607**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PECET637	**Course Type**	Lab

Course Objectives:

1. To enable students to assess the quality of various pavement materials and their suitability in highway construction
2. To make student familiar with mix design and do functional evaluation of pavements

Expt. No.	**Experiments**
	Test on Soil
1	California Bearing Ratio Test
	Test on Coarse Aggregate
2	Specific Gravity and Water Absorption Test
3	Aggregate Impact Test
4	Los Angeles Abrasion Test
5	Aggregate Crushing Value Test
6	Shape Test: Angularity number
7	Combined flakiness and elongation index
8	Stripping value of road aggregates.
	Test on Bitumen
9	Determination of grade of bitumen based on viscosity
10	Softening point
11	Ductility of bitumen (Demonstration using Aged bitumen)
12	Flash and fire point of bitumen
	Design of Bituminous Mix
13	Design of bituminous mix by Marshall method of mix design
	Functional Evaluation of Pavement
14	Use of MERLIN apparatus to determine road roughness

Any 12 experiments mandatory

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Determine CBR value of the given sample of soil. Comment on its suitability as a subgrade material	**K3**
CO2	Assess the suitability of aggregates as a pavement construction material based on specifications given relevant codes/guidelines	**K3**
CO3	Assess the suitability of bitumen as a pavement construction material based on specifications given relevant codes/guidelines	**K3**
CO4	Determine optimum binder content of the given bituminous mix by Marshall method of mix design	**K3**
CO5	Comment on the condition of road surface by determining the IRI value of the given road surface using MERLIN and comparing with standard values.	**K3**

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

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 Materials and Pavement Testing	Khanna, S.K., Justo, C.E.G. and Veeraragavan, A	Nem Chand & Bros., Roorkee	2013
2	Highway Material Testing and Quality Control	Venkatappa Rao, K. Ramachandra Rao, Kausik Pahari and D.V. Bhavanna Rao	I.K. International.	2019
3	Principles and Practices of Highway Engineering	Kadiyali, L. R. and Lal, N.B.	Khanna Publishers.	2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of Highway Engineering and Traffic Analysis, 7th Edition	Fred L. Mannering and Scott S. Washburn	Wiley	2019

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://ts-nitk.vlabs.ac.in/

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. **Conduct of Experiments (7 Marks)**

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (6 Marks)**

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. **Viva Voce (10 Marks)**

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. **Record (5 Marks)**

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S6

ENVIRONMENTAL ENGINEERING LAB

Course Code	PCCEL609	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. Perform the experiments to determine water and waste water quality
2. Understand the quality of water, waste water, Industrial water

Expt. No.	Experiments
1	Determination of pH and Turbidity
2	Determination of Conductivity and Total dissolved solids
3	Determination of Alkalinity & Acidity
4	Determination of Chlorides
5	Determination and Estimation of total solids, organic solids and inorganic solids
6	Determination of iron
7	Determination of Dissolved Oxygen
8	Determination of Nitrogen
9	Determination of total Phosphorous
10	Determination of B.O.D
11	Determination of C.O.D
12	Determination of Optimum coagulant dose
13	Determination of Chlorine demand
14	Determination of Sulphate
15	Determination of Hardness
16	Presumptive coli form test

Any 12 experiments mandatory

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the equipment used to test water quality	**K3**
CO2	Perform the experiments for water quality & estimate the quality	**K3**
CO3	Compare the water quality standards with prescribed standards set by the local governments	**K3**

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

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	Standard Methods for Analysis of water and Waste Water	E.W. Rice, R.B. Baird, A.D. Eaton	APHA	2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Chemistry for Environmental Engineering	Sawyer and Mc. Carty	McGraw Hill	2017

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://ee1-nitk.vlabs.ac.in/List%20of%20experiments.html
2	https://ee2-nitk.vlabs.ac.in/List%20of%20experiments.html

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

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   - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - Teamwork: Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (6 Marks)**

   - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

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   - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
   - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**

   - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**

    - Accuracy of Results: Precision and correctness of the obtained results.
    - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. **Viva Voce (10 Marks)**

    - Ability to explain the experiment, procedure results and answer related questions
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. **Record (5 Marks)**

    - Completeness, clarity, and accuracy of the lab record submitted