SEMESTER 3

CIVIL ENGINEERING

SEMESTER S3

MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL SCIENCE – 3

(Common to Group B & C)

Course Code	**GYMAT301**	**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)	Basic knowledge in complex numbers.	**Course Type**	Theory

Course Objectives:

1. To introduce the concept and applications of Fourier transforms in various engineering fields.
2. To introduce the basic theory of functions of a complex variable, including residue integration and conformal transformation, and their applications

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fourier Integral, From Fourier series to Fourier Integral, Fourier Cosine and Sine integrals, Fourier Cosine and Sine Transform, Linearity, Transforms of Derivatives, Fourier Transform and its inverse, Linearity, Transforms of Derivative. **(Text 1: Relevant topics from sections 11.7, 11.8, 11.9)**	**9**
2	Complex Function, Limit, Continuity, Derivative, Analytic functions, Cauchy-Riemann Equations (without proof), Laplace's Equations, Harmonic functions, Finding harmonic conjugate, Conformal mapping, Mappings of $w= z^2$, $w=e^z$, $w=\frac{1}{z}$, $w= sinz$. **(Text 1: Relevant topics from sections 13.3, 13.4, 17.1, 17.2, 17.4)**	**9**
3	Complex Integration: Line integrals in the complex plane (Definition & Basic properties), First evaluation method, Second evaluation method, Cauchy's integral theorem (without proof) on simply connected domain,	**9**

	Independence of path, Cauchy integral theorem on multiply connected domain (without proof), Cauchy Integral formula (without proof). **(Text 1: Relevant topics from sections 14.1, 14.2, 14.3)**	
4	Taylor series and Maclaurin series, Laurent series (without proof), Singularities and Zeros – Isolated Singularity, Poles, Essential Singularities, Removable singularities, Zeros of Analytic functions – Poles and Zeros, Formulas for Residues, Residue theorem (without proof), Residue Integration- Integral of Rational Functions of $cos\theta$ and $sin\theta$. **(Text 1: Relevant topics from sections 15.4, 16.1, 16.2, 16.3, 16.4)**	**9**

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	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	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering.	**K3**
CO2	Understand the analyticity of complex functions and apply it in conformal mapping.	**K3**
CO3	Compute complex integrals using Cauchy's integral theorem and Cauchy's integral formula.	**K3**
CO4	Understand the series expansion of complex function about a singularity and apply residue theorem to compute real integrals.	**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	3	3	-	2	-	-	-	-	-	-	-	2
CO2	3	3	-	2	-	-	-	-	-	-	-	2
CO3	3	3	-	2	-	-	-	-	-	-	-	2
CO4	3	3	-	2	-	-	-	-	-	-	-	2

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons	10^{th} edition, 2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Complex Analysis	Dennis G. Zill, Patrick D. Shanahan	Jones & Bartlett	3rd edition, 2015
2	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39th edition, 2023
3	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th edition, 2018
4	Fast Fourier Transform - Algorithms and Applications	K.R. Rao, Do Nyeon Kim, Jae Jeong Hwang	Springer	1st edition, 2011

SEMESTER S3

FLUID MECHANICS

Course Code	PCCET302	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)	GCEST103/ Equivalent	Course Type	Theory

Course Objectives:

1. To familiarize the fundamental concepts of fluid mechanics and hydraulics in pipes and open channels, pressure measurement and flow measurement systems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fluid properties**, Newton's law of viscosity, types of fluids (description only) Fluid Statics: Fluid pressure, Pascal's Law, Hydrostatic law, Measurement of fluid pressure using manometers -Simple manometer (Piezo meter and U tube manometers) and Differential manometers (U tube differential manometer and inverted U tube differential manometer) (include numerical problems), Mechanical gauges (brief description only).	11
2	**Determination of total pressure and centre of pressure on surfaces** (include numerical problems)**:** Vertical plane surface, Horizontal plane surface, inclined plane surface, curved surfaces, **Buoyancy and Floatation:** Basic concepts**,** centre of buoyancy**,** meta-centre and meta-centric height of floating bodies, determination of meta -centric height using analytical and experimental method (include derivation and numerical problems), conditions for stability of floating and submerged bodies	11
3	**Fluid Kinematics**: Methods of describing fluid motion, Lagrangian and Eulerian methods.	11

	types of fluid flow, continuity equation in one, two and three dimensions (include derivation and numerical problems)-4 Determination of velocity and acceleration at a point in fluid flow (include numerical problems), Description of streamline, pathline and streakline, velocity potential, stream function and flow net **Fluid dynamics**: Forces in fluid motion, Derivation of Bernoulli's equation from Eulers's equation of motion with assumptions, Practical Applications of Bernoulli's equation- Venturimeter, orifice meter and Pitot tube (include numerical problems), Momentum equations and forces on Pipe bends	
4	**Flow through Orifices:** hydraulic coefficients and experimental determination of hydraulic coefficients (associated numerical problems) Discharge through large orifices- rectangular orifice (discharging freely, fully submerged and partially submerged), time of emptying of a rectangular tank through an orifice at its bottom (include numerical problems). **Pipe flow-** Computation of major losses in pipes (derivation of Darcy Weisbach equation) - Computation of minor losses in pipes (equations only) , hydraulic gradient line and total energy line, pipes in series and parallel - equivalent pipes (include numerical problems from all sections) **Flow in Open channel**: Comparison between pipe flow and open channel flow, classification of flow in open channels **Flow through Notches and weirs:** classification of notches and weirs, discharge over a rectangular notch/weir, discharge over a triangular notch/weir, discharge over a trapezoidal notch/weir, velocity of approach and end contraction (include numerical problems).	**11**

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	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 understand the basic properties of fluids	**K2**
CO2	To apply the fundamental principles of fluid statics and dynamics in the solution of practical problems in Hydraulics Engineering	**K3**
CO3	To evaluate the stability of floating and submerged bodies	**K3**
CO4	To estimate the forces in pipe bends	**K3**
CO5	To explain the fluid flow properties in pipes and 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,	22nd edition 2019
2	Flow in Open channels	Subramanya K	Tata McGraw-Hill	5th edition 2019
3	Open - Channel Flow	Hanif Chaudhary M	Springer	2nd edition 2007
4	Fluid Mechanics and Hydraulic Machines	R K Bansal	Laxmi Publications	10th edition 2020
5	Fluid Mechanics	John F Douglas, Janusz . Gasiorek, John A. Swaffield, Lynne B. Jack	Pearson Publications	6th edition 2011

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fluid Mechanics	Victor Streeter , E. Benjamin Wylie , K.W. Bedford	Mc Graw Hill Publishers.	9th edition 2017
2	Munson, Young and Okiishi's Fundamentals of Fluid Mechanics	Philip M. Gerhart John I. Hochstein, Andrew L. Gerhart	John Wiley & Sons Inc	9th edition 2020
3	Fundamentals Of Fluid Mechanics	Bruce R. Munson, Donald F. Young, Theodore H. Okiishi	John Wiley & Sons Inc	5th edition 2005
4	Introductory Fluid Mechanics	Joseph Katz	Cambridge University Press	2015
5	Fluid Mechanics, Hydraulics and Hydraulic Machines	Arora.K.R,	Standard Publishers	2005
6	A First Course in Fluid Mechanics	Narasimhan S.	University Press (India)	2006
7	Fluid Mechanics	Frank.M.White	Mc Graw Hill Publishers.	9th edition 2022
8	Fluid Mechanics	Mohanty.A.K.	Prentice Hall, New Delhi	2011
9	Principles of Fluid Mechanics and Fluid Machines	Narayana Pillai,N	University Press	2011
10	Fluid Mechanics and Fluid power Engineering	Kumar.D.N.	S.K.Kataria & sons	2013
11	Theory and Applications of Fluid Mechanics	Subramanya K	Tata McGraw-Hill	1993

Video Links (NPTEL, SWAYAM…)	
Sl No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_me31/preview https://www.youtube.com/playlist?list=PLPALMYFm0ysmjNIuw7eJ2ZGz_XSFkv6CI https://drive.google.com/drive/folders/1DcQjcxeUCHyOqJh5x4lSjwhUbbQn2UI?usp=sharing
2	https://nptel.ac.in/courses/105103095
3	https://nptel.ac.in/courses/105103095
4	https://nptel.ac.in/courses/105107059

SEMESTER S3

STRUCTURAL ANALYSIS - I

Course Code	**PCCET303**	**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)	PCCEL205/Equivalent	**Course Type**	Theory

Course Objectives:

1. To provide students with a thorough understanding of the fundamental theory of structural analysis
2. To develop the student's ability to both model and analyse statically determinate and indeterminate structures and to provide realistic applications encountered in professional practice

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Statically determinate trusses:** Analysis using method of joints and method of sections. **Cables and Suspension bridges:** Forces in loaded (concentrated and uniformly distributed) cables - length of cables – supports at same and different levels – maximum tension in the suspension cable and backstays, pressure on towers. Simple suspension bridges with three hinged stiffening girders - bending moments and shear force diagrams. **Deformation Response of Statically Determinate Beams:** **Moment area method**–Mohr's theorems, Applications to determinate deformations of cantilever and simply supported beams (prismatic and beams of varying cross section) subjected to concentrated and uniformly distributed loads.	**12**
2	**Deformation Response of Statically Determinate Beams:** **Conjugate beam method–** Real beam and conjugate beam, boundary conditions; Applications to determinate deformations of cantilever and	**11**

	simply supported beams (prismatic and beams of varying cross section subjected to concentrated and uniformly distributed loads. **Energy Principles and Energy Theorems:** Castigliano's theorem I, Principle of virtual work, Betti's theorem, Maxwell's law of reciprocal deflections. **Unit load method** for determination of deflection of statically determinate beams, frames and trusses.	
3	**Indeterminate Structures:** Introduction to force method of analysis. Static indeterminacy **Analysis of statically indeterminate structures** Castigliano's theorem II, Minimum strain energy method for analysing statically indeterminate structures (Illustration only) **Method of consistent deformations:** Analysis of beams, frames and trusses. (simple problems with one redundant, illustration only for two-redundant problems). Concepts of effect of pre-strain, lack of fit, temperature changes and support settlement. (Illustration only).	**10**
4	**Three Hinged Arches:** Action of an arch - Eddy's theorem – Three hinged, parabolic and circular arches (with supports at same level) - determination of horizontal thrust, bending moment, normal thrust and radial shear. **Moving Loads and influence lines** Introduction to moving loads - concept of influence lines - influence lines for reaction, shear force and bending moment in simply supported beams and over hanging beams – analysis for different types of moving loads (single concentrated load - several concentrated loads - uniformly distributed load shorter and longer than the span) conditions for maximum bending moment and shear force.	**11**

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	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 appropriate structural mechanics principles for estimation of force and deformation response of structural elements.	**K3**
CO2	Apply energy-based techniques for estimation of deformation response of structural elements and simple structural systems.	**K3**
CO3	Analyse statically indeterminate structures using force method.	**K3**
CO4	Analyse the effects of moving loads on structures using influence lines	**K3**

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

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

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

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mechanics of Structures Vol I & II	S.B. Junnarkar & H.J. Shah	Charotar Publishing House,	2015
2	Structural Analysis	Devdas Menon	Narosa Publishers, NewDelhi	3rd edition 2023
3	Structural Analysis	R.C. Hibbler	Pearson Education	10 th edn. 2022
4	Basic Structural Analysis,	C.S. Reddy	New Delhi: Tata McGrawHill, NewDelhi	3 rd Edn. ,2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Intermediate Structural Analysis,	C.K. Wang	Tata McGraw Hill Publishers	2017
2	Elementary Structural Analysis	J.B. Wilbur, C.H. Norris, and S. Utku	McGraw Hill, NewYork	2006
3	L.S. Negi and R.S. Jangid	Structural Analysis	Tata McGraw Hill	2006

Video Links (NPTEL, SWAYAM…)	
Sl.No.	**Link ID**
1	https://nptel.ac.in/courses/105105166
2	https://nptel.ac.in/courses/105105109

SEMESTER S3

SURVEYING & GEOMATICS

Course Code	**PBCET304**	**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)	GCEST104	**Course Type**	Theory

Course Objectives:

1. To impart awareness on the principles of surveying, various methods, errors associated with the field observations and advanced surveying techniques.
2. To impart practical knowledge on various surveying methods and enable students to utilize advanced surveying techniques in field surveying

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Surveying :** Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Local attraction, Declination, Methods of orientation (by compass and by back sighting). **Levelling** : Principles of levelling- Dumpy level, booking and reducing levels, Methods- simple, differential, reciprocal levelling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling	**9**
2	**Contouring** : Characteristics, methods, uses. **Areas and Volumes**: computation of area by offsets to base line, by dividing area into number of triangles; volume of level section by prismoidal and trapezoidal formulae. **Mass diagram** : Construction, Characteristics and uses **Triangulation**: Triangulation figures, Triangulation stations, Inter visibility of stations, Satellite Stations and reduction to centre.	**9**

3	**Theory of Errors** : Types, theory of least squares, Weighting of observations, Most probable value, Computation of indirectly observed quantities - method of normal equations. **Total Station** : Concept of EDM, principles and working, advantages and applications, Global Positioning Systems-Components and principles, satellite ranging-calculating position, signal structure, application of GPS, GPS Surveying methods-Static, Rapid static, Kinematic methods – DGPS, **Recent trends in Surveying** : GNSS, Smart Station and LIDAR	9
4	**Remote Sensing** : Definition- Electromagnetic spectrum-Energy interactions with atmosphere and earth surface features-spectral reflectance of vegetation, soil and water- Classification of sensors- Active and Passive, Resolution-spatial, spectral radiometric and Temporal resolution, Multi spectral scanning-Along track and across track scanning **Geographical Information System** : Components of GIS, GIS operations, Map projections- methods, Coordinate systems-Geographic and Projected coordinate systems, Data Types- Spatial and attribute data, Raster and vector data representation	9

Suggestion on Project Topics(8 hrs)

- On the first class before starting the first module, direct the students to select a land region with defined boundary. The faculty in charge should ensure that the selected region is appropriate for learning the concepts and methods through the project.
- The students should locate the geographic coordinate systems for the selected region using applications like Bhuvan.
- Conduct the land surveying using linear measurements (tape or distomat).
- Determine the errors in traverse and apply corrections.
- Prepare the survey sketch.
- Determine the reduced levels and prepare the contour maps using conventional (level or theodolite) methods.
- Conduct the total station survey of the same region and prepare the contour maps.
- Compare the results of the two methods.

- Determine the earthwork quantity – the faculty shall help the students by suggesting either a region to fill or cut to find the earthwork quantity estimation requirement.
- Application of advanced surveying techniques including LIDAR is advised but not mandatory.
- Prepare the survey report, print it and submit to the faculty.

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

<table>
<tr><th>Part A</th><th>Part B</th><th>Total</th></tr>
<tr><td>2 Questions from each module.
Total of 8 Questions, each carrying 2 marks
(8x2 =16 marks)</td><td>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)</td><td>40</td></tr>
</table>

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand and apply the principles and techniques of surveying	**K2, K3**
CO2	Apply the principles of surveying for triangulation, area and volume computation, contour maps preparation and in the construction of mass diagram	**K3**
CO3	Understand the concept of least squares, weight of observations and to identify the possible errors in the field observations	**K2 k3**
CO4	Understand different surveying techniques using advanced surveying equipments.	**K2**
CO5	Prepare a survey report incorporating various concepts of surveying.	**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	3	1	1								
CO2	3	3	1	1								
CO3	3	3							3	3		
CO4	3	3			3				3	3		
CO5	3	3	3	3	3	3			3	3		3

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Surveying Vol 1	Dr. B C Punmia,Ashok Kumar Jain & Arun Kumar Jain	Laxmi Publications (P) Ltd.	Seventeenth Edition Jan 2016
2	Surveying Vol II	Dr. B C Punmia,Ashok Kumar Jain & Arun Kumar Jain	Laxmi Publications (P) Ltd.	July 2018
3	Introduction to Geographic Information Systems	Kang-Tsung Chang	Mc Graw Hill Education	Indian Edition, July 2017
4	Fundamentals of Remote Sensing	George Joseph	Universities Press	2005

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Textbook of Surveying	C Venketaramaiah	Universities Press	2011
2	Surveying Vol I	S K Duggal	Mc Graw Hill	Fifth Edition,2019
3	Surveying Vol II	S K Duggal	Mc Graw Hill	Fifth Edition,2019
4	A textbook of Surveying and Levelling	R Agor	Khanna Publishers	2005
5	Textbook of Remote Sensing And Geographical Information Systems	Ms. Anji Reddy	B.S Publications	Fourth Edition,2012
6	Remote Sensing and Image Interpretation,7 Ed(An Indian Adaptation)	Thomas M Lillesand, Ralph W. Kiefer	Wiley	Seventh Edition,2000
7	Principles of Geographical Information Systems	Burrough P	Oxford University Press	1998

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://nptel.ac.in/courses/105107122 Surveying Nptel IIT Roorkee , J K Ghosh
2	https://nptel.ac.in/courses/105107122 Surveying Nptel IIT Roorkee , J K Ghosh
3	https://archive.nptel.ac.in/courses/105/104/105104100/ Nptel Modern Surveying Techniques,IIT Kanpur
4	https://onlinecourses.nptel.ac.in/noc22_ce84/preview Nptel Swayam Remote Sensing and GIS , Prof. Rishikesh Bharti ,IIT Guwahati

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 S3

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Course Code	**GNEST305**	**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. Demonstrate a solid understanding of advanced linear algebra concepts, machine learning algorithms and statistical analysis techniques relevant to engineering applications, principles and algorithms.
2. Apply theoretical concepts to solve practical engineering problems, analyze data to extract meaningful insights, and implement appropriate mathematical and computational techniques for AI and data science applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to AI and Machine Learning**: Basics of Machine Learning - types of Machine Learning systems-challenges in ML- Supervised learning model example- regression models- Classification model example- Logistic regression-unsupervised model example- K-means clustering. Artificial Neural Network- Perceptron- Universal Approximation Theorem (statement only)- Multi-Layer Perceptron- Deep Neural Network- demonstration of regression and classification problems using MLP.(Text-2)	**11**
2	**Mathematical Foundations of AI and Data science**: Role of linear algebra in Data representation and analysis – Matrix decomposition- Singular Value Decomposition (SVD)- Spectral decomposition-	**11**

	Dimensionality reduction technique-Principal Component Analysis (PCA). (Text-1)	
3	**Applied Probability and Statistics for AI and Data Science**: Basics of probability-random variables and statistical measures - rules in probability- Bayes theorem and its applications- statistical estimation-Maximum Likelihood Estimator (MLE) - statistical summaries-Correlation analysis- linear correlation (direct problems only)- regression analysis- linear regression (using least square method) (Text book 4)	**11**
4	**Basics of Data Science**: Benefits of data science-use of statistics and Machine Learning in Data Science- data science process - applications of Machine Learning in Data Science- modelling process- demonstration of ML applications in data science- Big Data and Data Science. (For visualization the software tools like Tableau, PowerBI, R or Python can be used. For Machine Learning implementation, Python, MATLAB or R can be used.)(Text book-5)	**11**

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	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 concept of machine learning algorithms including neural networks and supervised/unsupervised learning techniques for engineering applications.	**K3**
CO2	Apply advanced mathematical concepts such as matrix operations, singular values, and principal component analysis to analyze and solve engineering problems**.**	**K3**
CO3	Analyze and interpret data using statistical methods including descriptive statistics, correlation, and regression analysis to derive meaningful insights and make informed decisions.	**K3**
CO4	Integrate statistical approaches and machine learning techniques to ensure practically feasible solutions in engineering contexts.	**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	3	3	3	3								
CO2	3	3	3	3								
CO3	3	3	3	3								
CO4	3	3	3	3								
CO5	3	3	3	3								

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Linear Algebra	Gilbert Strang	Wellesley-Cambridge Press	6th edition, 2023
2	Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	O'Reilly Media, Inc.	2nd edition,2022
3	Mathematics for machine learning	Deisenroth, Marc Peter, A. Aldo Faisal, and Cheng Soon Ong	Cambridge University Press	1st edition. 2020
4	Fundamentals of mathematical statistics	Gupta, S. C., and V. K. Kapoor	Sultan Chand & Sons	9th edition, 2020
5	Introducing data science: big data, machine learning, and more, using Python tools	Cielen, Davy, and Arno Meysman	Simon and Schuster	1st edition, 2016

Reference Books				
1	Data science: concepts and practice	Kotu, Vijay, and Bala Deshpande	Morgan Kaufmann	2nd edition, 2018
2	Probability and Statistics for Data Science	Carlos Fernandez-Granda	Center for Data Science in NYU	1st edition, 2017
3	Foundations of Data Science	Avrim Blum, John Hopcroft, and Ravi Kannan	Cambridge University Press	1st edition, 2020
4	Statistics For Data Science	James D. Miller	Packt Publishing	1st edition, 2019
5	Probability and Statistics - The Science of Uncertainty	Michael J. Evans and Jeffrey S. Rosenthal	University of Toronto	1st edition, 2009
6	An Introduction to the Science of Statistics: From Theory to Implementation	Joseph C. Watkins	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.math.arizo	Preliminary Edition.

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/106/106106198/
2	https://archive.nptel.ac.in/courses/106/106/106106198/ https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/resources/lecture-29-singular-value-decomposition/
3	https://ocw.mit.edu/courses/18-650-statistics-for-applications-fall-2016/resources/lecture-19-video/
4	https://archive.nptel.ac.in/courses/106/106/106106198/

SEMESTER S3

ECONOMICS FOR ENGINEERS

(Common to All Branches)

Course Code	**UCHUT346**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understanding of finance and costing for engineering operation, budgetary planning and control
2. Provide fundamental concept of micro and macroeconomics related to engineering industry
3. Deliver the basic concepts of Value Engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Economics Concepts - Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Law of Demand - Law of supply – Elasticity - measurement of elasticity and its applications – Equilibrium- Changes in demand and supply and its effects Production function - Law of variable proportion – Economies of Scale – Internal and External Economies – Cobb-Douglas Production Function	**6**
2	Cost concepts – Social cost, private cost – Explicit and implicit cost – Sunk cost - Opportunity cost - short run cost curves - Revenue concepts Firms and their objectives – Types of firms – Markets - Perfect Competition – Monopoly - Monopolistic Competition - Oligopoly (features and equilibrium of a firm)	**6**

3	Monetary System – Money – Functions - Central Banking –Inflation - Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Deflation Taxation – Direct and Indirect taxes (merits and demerits) - GST National income – Concepts - Circular Flow – Methods of Estimation and Difficulties - Stock Market – Functions- Problems faced by the Indian stock market-Demat Account and Trading Account – Stock market Indicators- SENSEX and NIFTY	**6**
4	Value Analysis and value Engineering - Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure - Break-even Analysis - Cost-Benefit Analysis - Capital Budgeting - Process planning	**6**

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Case study/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
10	**15**	**12.5**	**12.5**	**50**

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
• Minimum 1 and Maximum 2 Questions from each module. • Total of 6 Questions, each carrying 3 marks **(6x3 =18marks)**	• 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 8 marks. **(4x8 = 32 marks)**	**50**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	**K2**
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	**K3**
CO3	Outline the macroeconomic principles of monetary and fiscal systems, national income and stock market.	**K2**
CO4	Make use of the possibilities of value analysis and engineering, and solve simple business problems using break even analysis, cost benefit analysis and capital budgeting techniques.	**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	-	-	-	-	-	1	-	-	-	-	1	-
CO2	-	-	-	-	-	1	1	-	-	-	1	-
CO3	-	-	-	-	1	-	-	-	-	-	2	-
CO4	-	-	-	-	1	1	-	-	-	-	2	-

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7^{TH} Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001

SEMESTER S3/S4

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	**UCHUT347**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals of ethics -** Personal vs. professional ethics, Civic Virtue, Respect for others, **Profession and Professionalism,** Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, **Technology and digital revolution-**Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, **High technologies: connecting people and places-**accessibility and social impacts, **Managing conflict**, Collective bargaining, **Confidentiality**, Role of confidentiality in moral integrity, **Codes of Ethics**. **Basic concepts in Gender Studies -** sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, **Gender disparity and discrimination in education**, employment and everyday life, History of women in Science & Technology, Gendered	**6**

	technologies & innovations**, Ethical values and practices in connection with gender** - equity, diversity & gender justice, **Gender policy and women/transgender empowerment initiatives.**	
2	**Introduction to Environmental Ethics:** Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). **Sustainable Engineering Principles:** Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. **Ecosystems and Biodiversity:** Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. **Landscape and Urban Ecology:** Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	**6**
3	**Hydrology and Water Management:** Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. **Zero Waste Concepts and Practices:** Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. **Circular Economy and Degrowth:** Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. **Mobility and Sustainable Transportation:** Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	**6**
4	**Renewable Energy and Sustainable Technologies:** Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. **Climate Change and Engineering Solutions:** Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. **Environmental Policies and Regulations:** Overview of key environmental policies and	**6**

	regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. **Case Studies and Future Directions:** Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	

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

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/ Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12

3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
		Total Marks		**50**

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis**: Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts**: Ability to apply course concepts to real-world problems and local contexts.
- **Creativity**: Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills**: Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

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

	Course Outcome	**Bloom's Knowledge Level (KL)**
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	**K3**
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	**K4**
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	**K5**
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	**K4**
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	**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						3	2	3	3	2		2
CO2		1				3	2	3	3	2		2
CO3						3	3	2	3	2		2
CO4		1				3	3	2	3	2		2
CO5						3	3	2	3	2		2

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessmen	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.

- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER S3

SURVEY LAB

Course Code	**PCCEL307**	**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)	GCESL106 /Equivalent	**Course Type**	Lab

Course Objectives:

1. Demonstrate proficiency in chain and compass surveying for practical applications.
2. Execute various levelling and theodolite surveying techniques effectively.
3. Utilize advanced surveying equipment such as total stations, levels, and GPS
4. Employ total station for field surveying, perform contouring, and set out curves.

Demonstrate the use of lidar and GNSS surveying

Expt. No.	Experiments
1	**Conventional surveying** a. Chain/ tape surveying b. Compass surveying
2	**Levelling** Differential levelling
3	Fly levelling
4	Profile Levelling and Cross sectioning
5	Distance between inaccessible points (horizontal angle)
6	Level difference between points (vertical angle)
7	Tangential tacheometry (vertical angle)
8	Traversing - Balancing the traverse using Bowditch's rule, Transit rule and graphical method
9	**Total station survey** Heights and distances
10	Area computation Contouring

11	Setting out of curve- simple curve
12	Setting out of curve - Compound curve using angular methods only
13	Study of instruments a. Automatic level b. Digital level c. Handled GPS
14	Lidar Surveying
15	GNSS Surveying
16	Distance between inaccessible points (horizontal angle)

*** A minimum of 12 experiments is 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	Demonstrate proficiency in conventional surveying for practical applications.	**K3**
CO2	Execute various levelling and theodolite surveying techniques effectively.	**K3**
CO3	Utilize advanced surveying equipment such as total stations, Lidar, GPS etc.	**K3**
CO4	Employ total station for field surveying, perform contouring, and set out curves.	**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			
CO2	3	2							2			
CO3	3	2			3				2			3
CO4	3	2			3				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	Surveying-Vol 1	B.C. Punmia, Ashok Kumar Jain & Arun Kumar Jain	Laxmi Publications	Seventh, 2016
2	Textbook of surveying	Venkataramaiah C.	University Press	Second, 2011
3	Surveying and Levelling	T.P.Kenetkar & S.V.Kulkarni	Pune Vidyarthi Griha Prakashan	Second, 2004
4	Advanced Surveying	Satheesh Gopi, R Santhikumar, N Madhu	Pearson Education	Second, 2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Surveying Vol. I	S. K. Duggal	Tata McGraw Hill Ltd	Reprint 2015
2	A Text book of Surveying and Levelling	R. Agor	Khanna Publishers	2005
3	GPS and GNSS for Land Surveyors	Jan Van Sickle	CRC Press	First, 2023
4	Topographic Laser Ranging and Scanning Principles and Processing	Charles K. Toth, Jie Shan	CRC Press	2009

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://sl-iitr.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 S3

FLUID MECHANICS LAB

Course Code	**PCCEL308**	**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 familiarize and understand the different flow measurement equipments, pumps and turbines and the laboratory procedures of experimentation with them.
2. To develop the necessary skills of experimentation techniques for the study of flow phenomena in channels/pipes

Expt. No.	Experiments
1	Study of taps, valves, pipe fittings, gauges, Pitot tubes, water meters and current meters
2	Calibration of Pressure gauges
3	Determination of metacentric height and radius of gyration of floating bodies.
4	Verification of Bernoulli's theorem
5	Hydraulic coefficients of orifices and mouth pieces under constant head method and time of emptying method.
6	Calibration of Venturi meter
7	Calibration of Orifice meter
8	Calibration of water meter..
9	Calibration of rectangular notch
10	Calibration of triangular notch
11	Determination of coefficient of discharge (Time of Emptying through orifice)
12	Plotting Specific Energy Curves in Open Channel flow
13	Study of Parameters of Hydraulic Jump in Open channel Flow
14	Determination of friction co-efficient in pipes
15	Determination of loss co-efficient for pipe fittings
16	Performance test on turbines (Impulse/Reaction turbines)
17	Performance test on pumps (positive displacement and rotodynamic pumps)

Note: A minimum of 12 Experiments 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 apply theoretical concepts in Fluid Mechanics to conduct laboratory experiments	**3**
CO2	To analyse experimental data and interpret the result	**3**
CO3	To document the experimentation in prescribed manner	**3**
CO4	To study the performance characteristics curve of turbines and pumps	**3**

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	3							3			
CO2	3	3							3			
CO3	1	2							2			
CO4	3	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	Hydraulics and Fluid Mechanics including Hydraulic machines,	Modi P. N. and S. M. Seth,	S.B.H Publishers, New Delhi,	22nd edition 2019
2	Flow in Open channels	Subramanya K	Tata McGraw-Hill	5th edition 2019
3	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	Fluid Mechanics	Victor Streeter , E. Benjamin Wylie , K.W. Bedford	Mc Graw Hill Publishers.	9th edition 2017
2	Munson, Young and Okiishi's Fundamentals of Fluid Mechanics	Philip M. Gerhart John I. Hochstein, Andrew L. Gerhart	John Wiley & Sons Inc	9th edition 2020
3	Fundamentals Of Fluid Mechanics	Bruce R. Munson, Donald F. Young, Theodore H. Okiishi	John Wiley & Sons Inc	5th edition 2005
4	Fluid Mechanics	Frank.M.White	Mc Graw Hill Publishers.	9th edition 2022

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://fm-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 4

CIVIL ENGINEERING

SEMESTER S4

MATHEMATICS FOR PHYSICAL SCIENCE – 4

(Group C)

Course Code	**GCMAT401**	**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)	Basic calculus.	**Course Type**	Theory

Course Objectives:

1. To familiarize students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.
2. To provide the students with the basics of various numerical methods to develop problem solving skills used in various engineering disciplines.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Random variables, Discrete random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Binomial distribution, Poisson distribution, Poisson distribution as a limit of the binomial distribution, Joint pmf of two discrete random variables, Marginal pmf, Independent random variables, Expected value of a function of two discrete variables. **[Text 1: Relevant topics from sections 3.1 to 3.4, 3.6, 5.1, 5.2]**	**9**
2	Continuous random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Uniform, Normal and Exponential distributions, Joint pdf of two Continuous random variables, Marginal pdf, Independent random variables, Expectation value of a function of two continuous variables. **[Text 1: Relevant topics from sections 3.1, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2]**	**9**

3	Confidence Intervals, Confidence Level, Confidence Intervals and One-side confidence intervals for a Population Mean for large and small samples (normal distribution and t-distribution), Hypotheses and Test Procedures, Type I and Type II error, z Tests for Hypotheses about a Population Mean (for large sample), t Test for Hypotheses about a Population Mean (for small sample), Tests concerning a population proportion for large and small samples. **[Text 1: Relevant topics from 7.1, 7.2, 7.3, 8.1, 8.2, 8.3, 8.4]**	**9**
4	Newton-Raphson Method, Gauss Elimination Method ,Gauss - Jordan Method, Numerical solution of ordinary differential equations-Euler's method, Modified Euler's method, Runge - Kutta method of 2^{nd} Order, Numerical solution of Laplace equation –Jacobi's Method, Curve Fitting by Method of Least Squares - Straight lines, Parabola. **(Text 2: Relevant topics from sections 2.5, 4.2, 7.5, 8.4, 8.5, 9.4)**	**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 concept, properties and important models of discrete random variables and to apply in suitable random phenomena.	**K3**
CO2	Understand the concept, properties and important models of continuous random variables and to apply in suitable random phenomena.	**K3**
CO3	Estimate population parameters, assess their certainty with confidence intervals, and test hypotheses about population means and proportions using z-tests and the one-sample t-test.	**K3**
CO4	Apply numerical methods to find solutions of linear system of equations, ordinary differential equations and Laplace equations.	**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	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO2	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO3	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Probability and Statistics for Engineering and the Sciences	Devore J. L	Cengage Learning	9th edition, 2016
2	Introductory Methods of Numerical Analysis	S S Sastry	PHI Learning Pvt Limited	5th edition, 2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Probability, Random Variables and Stochastic Processes,	Papoulis, A. & Pillai, S.U.,	McGraw Hill.	4th edition, 2002
2	Introduction to Probability and Statistics for Engineers and Scientists	Ross, S. M.	Academic Press	6th edition, 2020
3	Numerical methods for Engineers	Steven C. Chapra, Raymond P. Canale	McGraw Hill Education	8th edition, 2021

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/105/117105085/
2	https://archive.nptel.ac.in/courses/117/105/117105085/
3	https://archive.nptel.ac.in/courses/117/105/117105085/
4	https://archive.nptel.ac.in/courses/111/107/111107105/

SEMESTER S4

SOIL MECHANICS

(Common to Civil Engineering Branches)

Course Code	PCCET402	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)	PCCET205 or equivalent	Course Type	Theory

Course Objectives:

1. To understand the fundamental concepts of index and engineering properties of soil
2. To study laboratory methods to find soil characteristics
3. To study stress distribution in soil
4. To study shear, compaction and consolidation characteristic of soil

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Nature of soil and functional relationships** : Introduction to geotechnical engineering– Soil types – Major soil deposits of India - 3 phase system – Basic soil properties : Void ratio, porosity, degree of saturation, air content, water content, specific gravity, unit weight - Relationship between basic soil properties, Relative Density- Numerical problems. Determination of Water content by oven drying, Specific gravity using pycnometer & specific gravity bottle - Determination of Field density by sand replacement method and Core Cutter method - Numerical problems. Soil Structure and their effects on the basic soil properties –Basic structural units of clay minerals (introduction only)	**12**

2	**Index properties**: Sieve analysis, Hydrometer analysis-strokes law, calibration of hydrometer, corrections to hydrometer readings, gradation of soil, combined sieve and hydrometer analysis, limitations, [no derivation required for percentage finer and diameter]. Consistency – Atterberg Limits and indices – Plasticity charts – activity of soil-laboratory tests for Liquid Limit (Casagrande's apparatus and cone penetrometer), Plastic Limit and Shrinkage Limit - Numerical problems IS classification of soil . **Permeability of soils** : Darcy's law – Factors affecting permeability – Laboratory tests: Constant head and variable head permeability tests - Average permeability of stratified deposits - Numerical problems	**12**
3	**Principle of effective stress -** Total, neutral and effective stress – Pressure diagrams in layered soil with water table, saturated by capillary action, subjected to surcharge load – Numerical problems- Quick sand condition – Critical hydraulic gradient **Stress distribution** : Introduction - Boussinesq's equations for vertical pressure due to point loads and line loads – Assumptions and Limitations - Numerical problems - Vertical pressure due to uniformly distributed loads beneath strip, circular [no derivation required] - Numerical problems. Vertical pressure due to loading on rectangular area and Fadum's chart (Brief description only) Approximate methods for vertical stress: Equivalent Point Load method & 2:1 Distribution Method - Numerical problems - Pressure Isobars - Pressure bulbs. distribution of contact pressure beneath footings : **Compaction Tests** – OMC and MDD, Zero Air voids line, IS Light & Heavy- Factors affecting compaction-Numerical problems - Field compaction methods-compaction control –Proctor needle.	**10**
4	**Consolidation -** Definition – Concepts of Coefficient of compressibility and volume compressibility - e-log p curve - Compression index, Recompression index and Pre-consolidation Pressure - Normally consolidated, over consolidated and under consolidated soils - Terzaghi's theory of one-dimensional consolidation with its assumptions (no derivation required) - average degree of consolidation – Time factor - Coefficient of consolidation - Numerical problems - Laboratory consolidation test – Determination of Coefficient of Consolidation - Difference between consolidation and compaction . **Shear strength of soils-** Practical Applications - Mohr-Coulomb failure criterion - Mohr circle method for determination of principal planes and	**10**

	stresses– relationship between shear parameters and principal stresses - Numerical problems - Brief discussion of Laboratory tests - Triaxial compression test - UU, CU and CD tests - Total and effective stress strength parameters - Unconfined compression test, Direct shear test and vane shear test	

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	Evaluate the basic soil properties based on tests and functional relationships	**K3**
CO2	Classify soils based on index properties	**K3**
CO3	Compute stresses developed in soil under different loading and hydraulic conditions	**K3**
CO4	Identify and explain various tests to assess the engineering properties of soil.	**K3**

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

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

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

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Soil Mechanics and Foundation Engineering	Dr. K. R. Arora	Standard Publishers and distributers	Seventh Edition, 2020
2	Basic and applied soil mechanics	Rangan G. and A.S.R. Rao	New Age International Private Limited	Fourth , 2022
3	Soil Mechanics and Foundations	Dr. B C Punmia, Er. Ashok Kumar, Dr. Arun Kumar Jain	Laxmi Publicationd (P) ltd	Eighteenth 2015
4	Principles of Geotechnical Engineering	Das B. M.	Cengage India Pvt. Ltd.	2010
5	Geotechnical Engineering	Venkatramaiah	Universities Press	2000

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Soil Mechanics and Foundation Engineering,	Purushothamaraj P.	Dorling Indersley (India) Pvt. Ltd.	2013
2	Numerical Problems, Examples and Objective questions in Geotechnical Engineering,	A V Narasimha Rao and C Venkatramaiah	Universities Press (India) Ltd.,	2000
3	Soil Mechanics in Engineering Practice	Terzaghi K. and R. B. Peck	John Wiley	1967
4	Fundamentals of Soil Mechanics	Taylor D.W.	Asia Publishing House	1948

Video Links (NPTEL, SWAYAM…)	
Sl.No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/101/105101201/ https://archive.nptel.ac.in/courses/105/105/105105168/

SEMESTER S4

STRUCTURAL ANALYSIS - II

(Common for Civil Engineering Branches)

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

Course Objectives:

1. To introduce classical and matrix methods of structural analysis and understand the behaviour of statically indeterminate structures.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Concept of displacement approach to structural analysis:** Introduction to displacement methods of analysis. Kinematic indeterminacy **Slope Deflection Method:** Introduction, sign convention, development of slope deflection equation; Analysis of continuous beams including settlement of supports; Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy up to 2 **Moment Distribution method:** Concept and derivation of basic equation, Analysis of beams and non-sway frames; analysis of sway frames (Illustration only)	**11**

2	**Approximate Methods of Analysis of Multi-storeyed Frames:** Analysis for vertical loads-substitute frames-loading condition for maximum hogging and sagging moments in beams and maximum bending moment in columns. Analysis for lateral loads – portal method, cantilever method. **Plastic Theory:** Introduction – plastic hinge concepts – plastic modulus – shape factor – redistribution of moments – collapse mechanisms – Plastic analysis of beams and portal frames by equilibrium and mechanism methods. (single storey and single bay frames only)	**11**
3	**Matrix analysis of structures:** **Flexibility method:** Definition of flexibility influence coefficients - Concepts of physical approach. Flexibility matrices for truss and frame elements-load transformation matrix- development of total flexibility matrix of the structure-analysis of simple structures (determinate & indeterminate)-plane truss and plane frame-nodal loads and element loads	**10**
4	**Stiffness method:** Definition of stiffness influence coefficients - Concepts of physical approach. Development of stiffness matrices by physical approach-stiffness matrices for truss and frame elements-displacement transformation matrix-analysis of simple indeterminate structures-plane truss and plane frame-nodal loads and element loads. Introduction to direct stiffness method- stiffness matrix of beam elements, assembly of load vector and stiffness matrix, solution of two span continuous beams.	**12**

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 displacement methods of analysis for indeterminate structures.	**K3**
CO2	Apply approximate methods for analysis of multi-storeyed framed structures	**K3**
CO3	Understand the principles of plastic theory and apply the same for limit analysis of steel structures.	**K3**
CO4	Apply the principles of matrix methods of structural analysis.	**K3**

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

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

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

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mechanics of Structures Vol I & II	S.B. Junnarkar & H.J. Shah	Charotar Publishing House,	2015
2	Structural Analysis	Devdas Menon	Narosa Publishers, NewDelhi	3rd edition 2023
3	Structural Analysis	R.C. Hibbler	Pearson Education	10 th edn. 2022

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Intermediate Structural Analysis,	C.K. Wang	Tata McGraw Hill Publishers	2017
2	Elementary Structural Analysis	J.B. Wilbur, C.H. Norris, and S. Utku	McGraw Hill, NewYork	2006
3	Matrix Analysis of Framed Structure	Weaver, W. Jr. and Gere, J.M	CBS Publishers, NewDelhi	2000
4	Matrix Methods of Structural Analysis	Praveen Nagarajan	CRC Press, Taylor & Francis	2019

Video Links (NPTEL, SWAYAM…)	
Sl. No	Link ID
1	https://nptel.ac.in/courses/105105166
2	https://nptel.ac.in/courses/105106050
3	https://nptel.ac.in/courses/105105109

SEMESTER S4

DESIGN OF CONCRETE STRUCTURES

Course Code	PBCET404	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)	(PCCEL208 and PCCET303) or equivalent	Course Type	Theory

Course Objectives:

1. Analyse reinforced concrete sections for the purpose of design
2. Design of structural members ensuring safety and serviceability
3. Prepare structural drawings of various elements of a framed structure
4. Analyse and design of a framed RCC structure using software
5. Solve a real field structural design problem

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Properties of Concrete and Steel, Philosophies of Design by Limit State Method, Introduction of IS 456:2000 design provisions Limit State of Collapse in Flexure - Singly Reinforced Rectangular Beams Computation of Parameters of Governing Equations Determination of Neutral Axis Depth and Computation of Moment of Resistance- Numerical Problems Limit State of Collapse in Shear - Numerical Problems Bond, Anchorage, Development Length and Splicing Torsion in Beams - Limit State of Collapse Numerical Problems on design and analysis of Singly Reinforced Rectangular Beams	9

2	Doubly Reinforced Beams - Theory and Problems Flanged Beams - Theory and IS Code provisions only One-way slabs - Basic Principles, Theory and design - Numerical Problems Design of Two-way Slabs - Numerical Problems	**9**
3	Limit State of Serviceability - Introduction to IS code provisions only Compression members - Definitions, Classifications, Guidelines and Assumptions - modes of failure. Analysis of Short Axially Loaded Compression Members under Axial Load with Uniaxial Bending & Biaxial bending - Numerical Problems Design of Short Columns under Axial Load with Uniaxial Bending & Biaxial bending - Numerical Problems.	**9**
4	Foundations - Shallow foundations- isolated foundations – Design of square and rectangular foundation.- Numerical Problems (Only axially loaded condition is expected) Modelling and design of a simple framed structure in any structural analysis and design software. (Example: A double storied structure with three rooms in GF and FF)	**9**

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	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 =16marks)**	• Each question carries 6 marks. • Two 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. **(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	Analyse reinforced concrete sections for the purpose of design	**K3**
CO2	Design of structural members ensuring safety and serviceability	**K3**
CO3	Analyse and design of a framed RCC structure using software	**K3**
CO4	Prepare structural drawings of various elements of a framed structure	**K4**
CO5	Solve a real field structural design problem	**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										
CO2	3	3						2				2
CO3	3	3			3			2				3
CO4	3	3	2		3			2	3	3		2
CO5	3	3	3	3	3	2		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	Limit Sate Design of Reinforced Concrete	B.C Punmia, Ashok Kumar Jain, Arun Kumar Jain	Laxmi Publications	10th Edition, 2015
2	Reinforced Concrete Design	Ravi Kumar Sharma, Rachit Sharma	BS Publications	2021
3	Design of Concrete Structures	J N Bandyopadhyay	PHI Learning Private Limited	2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Reinforced Concrete Design – Principles and Practice	N Krishna Raju, R N Pranesh	New Age International Publishers	2007
2	Design of Reinforced Concrete Structures	M L Gambhir	PHI Learning Private Limited	4th Edition, 2011
3	Limit State Design of Concrete Structures	Ramchandra, Virendra Gehlot	Scientific Publishers (India)	3rd Edition, 2018
4	Limit State Design of Reinforced Concrete	P C Varghese	PHI Learning Private Limited	2008
5	Limit State Design of Reinforced Concrete Structures	P Dayaratnam	CBS Publishers	2017
6	Design of concrete structures	Arthur H Nilson, David Darwin, Charles William Dolan	McGraw Hill	2010
7	Design of reinforced concrete structures	N. Subramanian	Oxford university press	2013
8	Relevant IS Codes: IS 456, IS 875, SP 16, SP34 etc. (Refer the latest updates and download from the official website of bureau of Indian standards)			

Video Links (NPTEL, SWAYAM…)	
Sl.No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/105/105105105/

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**

Project Assessment and Evaluation criteria (30 Marks)

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 S4

ADVANCED SOLID MECHANICS

(Common to Civil Engineering branches)

Course Code	**PECET411**	**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)	(PCCET205) or equivalent	**Course Type**	Theory

Course Objectives:

1. To explain three-dimensional state of stress, strain and strain energy stored in Elastic body
2. To explain behaviour of curved beams, thick cylinders and compound cylinders
3. To explain fracture mechanics and mechanics of composite materials.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Elementary concept of elasticity, stresses in three dimensions, Principal Stresses, Stress Invariants, Mohr's Circle for 3-D state of stress, Octahedral Stresses, State of pure shear, plane stress. Differential equations of equilibrium, plane stress problems and plane strain problems comparison.	**9**
2	Analysis of strain, State of strain at a point, Strain Invariant, Principal Strains, Plane state of strain, Strain measurements. Compatibility conditions. **Energy Methods:** Work done by forces and elastic strain energy stored. Reciprocal relations, Theorem of virtual work.	**9**
3	**Bending of beams:** Asymmetrical bending, Shear centre, Bending of curved beams, Stress distribution in beam with rectangular, circular and trapezoidal cross- section, Deflection of thick curved bars. **Axisymmetric problems:** Thick walled cylinder subjected to internal and external pressures, Compound cylinders, Shrink fit,	**9**

4	**Introduction to Mechanics of Composite Materials:** Lamina and Laminates, Micromechanics of FRP Composites. **Introduction to Fracture Mechanics:** Basic modes of fracture, Fracture toughness evaluation.	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 explain the three-dimensional state of stress in a body and methods to reduce computational effort.	**K3**
CO2	To explain the state of strain in a body and establish relation between elastic strain energy stored.	**K3**
CO3	To explain stress distribution in curved beams of various cross-sections and thick-walled cylinders subjected to internal and external pressure.	**K3**
CO4	To explain the mechanics of composite materials.	**K2**
CO5	To explain basic modes of fracture and fracture toughness	**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		
CO2	3	2								1		
CO3	3	1								1		
CO4	3	1								1		
CO5	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	Advanced Mechanics of Materials	Arthur P. Boresi, Richard J. Schmidt	John Wiley & Sons	6th, 2022
2	Advanced Mechanics of Solids	L. S. Srinath	McGraw Hill Education	3rd, 2017
3	Mechanics of Composite Material	Robert M. Jones	CRC Press	2nd, 1998
4	Fracture Mechanics: Fundamentals and Application	T. L. Anderson	CRC Press	4th, 2017
5	Computational elasticity	Mohammed Ameen	Narosa publishing house	2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Solid Mechanics: Fundamentals and Applications	A.R. Ragab, and S.E.Bayoumi	CRC Press,	1999
2	"Elasticity: Theory, Applications and Numerics",	M.H.Sadd	Academic Press	2006
3	Engineering Mechanics of Solids	Egor P Popov	Pearson Education India	2016

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/106/105106049/

SEMESTER S4

CONCRETE TECHNOLOGY

Course Code	**PECET412**	**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 characteristics of aggregates and additives, as well as various cement kinds according to their uses in various fields
2. To know the concrete tests conducted in the fresh and hardened stages, as well as the behavior of concrete structures
3. To comprehend the intended use and design economic conditions for concrete mix proportions.
4. To have knowledge on special concrete.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Cement -** chemical composition, Bogue’s compounds, hydration, hydrated structure, various types of cement, testing of cement as per Indian standard – standard consistency, setting times, fineness, specific gravity. **Aggregates -** Utility in concrete, fine and coarse aggregates, effect of geometry & texture, strength, mechanical properties, moisture content, water absorption, bulking of sand, deleterious substances, sieve analysis, aggregate grading and gradation curves - testing as per Indian Standards **Admixtures** - types, necessity and benefit . Mineral admixture - Fly ash, silica fume, blast furnace slag, and agro waste based pozzolans. Chemical admixtures - Accelerator, retarder, plasticizer and superplasticizer, their functions and dosage.	9

2	**Properties of fresh concrete**- factors affecting workability , slump test compacting factor test,Vee Bee consistometer test, flow test. **Properties of hardened concrete** – modulus of elasticity, compressive strength, split tensile strength, flexural strength. effect of water cement ratio on properties of concrete. Maturity of concrete (concept only). Creep - factors affecting creep - effect of creep Shrinkage- factors affecting and types. **Non-destructive testing of concrete**- surface hardness test- ultrasonic pulse velocity method, pull-out test- core test, measuring reinforcement cover.	**9**
3	Mix proportioning- Mix design ,nominal mix, design mix , concept of mix design, variables of proportioning - general considerations. Various methods of mix design - design of concrete mix as per IS 10262-2019 Statistical quality control of concrete, mean strength, standard deviation, coefficient of variation, sampling and testing, acceptance criteria. **Special concrete** - lightweight concrete, heavy weight concrete ,high strength concrete, high performance concrete, self compacting concrete, roller compacted concrete, fibre reinforced concrete - polymer concrete- pumped concrete - ready mix concrete -geopolymer/alkali activated concrete.	**9**
4	Durability of concrete, factors affecting durability, permeability, cracking, reinforcement corrosion, carbonation, chloride penetration, sulphate attack, acid attack, fire resistance, frost damage, alkali silica reaction. 3D concrete printing, underwater concrete, mass concrete; slip form construction, Sprayed Concrete.	**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	Learn how to apply engineering concepts to the application of concrete materials in the construction fields.	**K2**
CO2	Understand the behaviour of concrete and relevant tests, at its fresh and hardened state.	**K2**
CO3	Understand the factors influencing concrete mix & know the BIS method of mix design.	**K3**
CO4	Differentiate special concrete from conventional concrete along with their applications for practical purpose	**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											
CO2	3											3
CO3	3	2										3
CO4	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	Properties of Concrete	Neville A.M	Pearson Education India.	5e, 2012
2	Concrete Technology	R. Santhakumar	Oxford Universities Press,	2018
3	Concrete Technology	Shetty M. S.	S. Chand & Co.,	2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Concrete Technology	M.L. Gambhir. –	Tata Mc. Graw Hill Publishers, New Delhi	5e 2017
2	Concrete microstructure properties and materials	P. Kumar Mehta, Paulo J.M.Monteiro	Tata Mc. Graw Hill Publishers, New Delhi	4e 2017
3	IS 10262-2019 concrete mix proportioning -guidelines			

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://nptel.ac.in/courses/105102012
2	https://nptel.ac.in/courses/105104030
3	https://nptel.ac.in/courses/105106225
4	https://nptel.ac.in/courses/105106176

SEMESTER S4

MECHANICS OF FLUID FLOW

(Common for Civil Engineering Branches)

Course Code	**PECET413**	**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)	PCCET 302	**Course Type**	Theory

Course Objectives:

1. To understand the basic principles of Fluid Mechanics and will be able to apply the basic principles to analyze fluid mechanical systems.
2. To understand the basic fundamentals of boundary layer theory, turbulent flow and dimensional analysis

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Concepts and Fundamentals: Fluid statics, Cartesian Tensors, Fluid Kinematics, and Description of fluid motion –Types of motion of fluid elements, Vorticity and circulation– Concept of rotational and irrotational flows. Equation of motion of forced and free vortex flow. Stream function and its relation with velocity field. ˋ+ – Relation between stream function and velocity potential for a 2-D irrotational and incompressible flow.	**9**
2	Pipe Flow: Viscous flow: Reynolds experiment to classify laminar and turbulent flows, significance of Reynolds number, critical Reynolds number, shear stress and velocity distribution in a pipe, Hagen Poiseuille equation. Turbulent flow:, Chezy's equation Moody's chart, siphon, transmission of power through pipes, efficiency of transmission, Water hammer, real life problems causing water hammer, Cavitation.on	**9**
3	Concept of Boundary Layer : Growth of boundary layer over a flat plate and definition of boundary layer thickness, displacement thickness, momentum thickness and energy thickness, laminar and turbulent boundary layers,	**9**

	laminar sub layer, velocity profile, Von- Karman momentum integral equations for the boundary layers, calculation of drag, separation of boundary and methods of control.	
4	Dimensional Analysis and Hydraulic similitude: Dimensional analysis, Buckingham's theorem, important dimensional numbers and their significance, geometric, Kinematic and dynamic similarity, model studies. Froude, Reynold, Weber, Cauchy and Mach laws- Applications and limitations of model testing, simple problems 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	Describe the concept of potential flow theory	**K2**
CO2	Demonstrate the concept of viscosity on flow characteristics in diverse fluid flow problems	**K2**
CO3	Use dimensional analysis to design physical or numerical experiments and to apply dynamic similarity	**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											
CO2	3	1	1									
CO3	3	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	A Text Book of Fluid Mechanics and Machines	Bansal R. K	Laxmi Publications	2010
2	Fluid Mechanics	Cengel	McGraw Hill Education India	2014
3	Fluid Mechanics	Douglas J. F	Pearson Education	2005
4	Mechanics of Fluids,	Shames I. H	McGraw Hill	1992

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Boundary Layer Theory	Schlichting H., K. Gersten ,	Springer	2000.
2	Fluid Mechanics	Streeter V. L., E. B. Wylie and K. W. Bedford,	Tata McGraw Hill, Delhi	2010

SEMESTER S4

CARTOGRAPHY AND GIS

(Common to Civil Engineering Branches)

Course Code	**PECET414**	**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)	PBCET304	**Course Type**	Theory

Course Objectives:

1. Develop a comprehensive understanding of maps, map scales, projections, and GIS principles.
2. Gain practical skills in map interpretation, design, and production using modern cartographic methods.
3. Acquire skills in acquiring, managing, and analysing spatial data using GIS software and spatial databases.
4. Explore applications of geospatial technologies in revisualization, multimedia cartography, and location-based services.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Maps and Scale: Map - types of maps - interpreting maps - map scale: plain linear, statement, diagonal and comparative, representative fraction. Map Projections: General principles of map projections – classification – cylindrical, conical, and zenithally projections – coordinate systems - UTM – choice of projections.	**9**
2	Map Layout and Map Production: Data acquisition –Spatial and Non-Spatial Data -Mechanics of map construction -Map design and layout - map reproduction methods: tradition and modern - Cartographic Publication	**9**

	Modern Cartography: Theories - Geodata Infrastructures - Geovisualization – Visual Data Analytics - Location based services - Multimedia Cartography - Georelief – Mobile Cartography	
3	Introduction: Nature of GIS – Real world and representations: Modelling, Maps, Databases and Spatial Databases - Geographic phenomena: fields, objects and boundaries - Data types: nominal, ordinal, interval and ratio - Attribute data. Data Representation: Tessellations and vector approaches - Topology and spatial relationships - Scale and resolution - Representations of geographic fields and objects - Temporal dimension.	**10**
4	Data Management: GIS software - Spatial Data Infrastructure - Spatial data handling - Database management systems – GIS and spatial databases - Data Input: Spatial data input –Data quality - Data preparation – Point data transformation	**8**

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

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 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 and interpret different types of maps effectively and choose appropriate map projections for different mapping needs	**K2**
CO2	Apply techniques and tools in map design to produce, and publish visually effective maps using both traditional and contemporary methods.	**K3**
CO3	Understand modern cartography theories and geovisualization techniques to represent spatial data.	**K2**
CO4	Understand the principles, data handling, and spatial analysis techniques to effectively apply GIS in various real-world scenarios.	**K2**
CO5	Understand techniques to acquire, store, and manage spatial data using GIS software and database systems, ensuring data quality and optimizing data handling processes for various applications	**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		
CO2	3	2	2		2					3		
CO3	3	2			2					2		3
CO4	3	2		3	3					2		3
CO5	3	2	2	3	3					2		3

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Elements of Cartography	Robinson, A.H. et al.	John Wiley & Sons, U.S.A.	1995
2	Fundamentals of Cartography	Misra, R.P. and Ramesh, A.	Concept Publishing Company	1986
3	Cartography: A Compendium of Design Thinking for Mapmakers	Kenneth Field	ESRI Press	2018
4	Concept and Techniques of geographic Information System	Albert K.W Yeung	PHI Learning private limited New Delhi	Second Edition 2012
5	Introduction to Geographic Information Systems.	Chang, K. T	Tata McGrawHill	2006

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Thematic Cartography and Geovisualization	Terry A. Slocum, Robert B. McMaster, Fritz C. Kessler, and Hugh H. Howard	CRC Press, London	Fourth Edition 2022
2	GIS: Fundamentals Applications and Implementations	Elangovan K	New India Publishing Agency	2020
3	GIS and Cartographic Modeling	C. Dana Tomlin	ESRI Press	2012
4	Web Cartography: Map Design for Interactive and Mobile Devices	Ian Muehlenhaus	CRC Press, London	2014

Useful Links	
Sl. No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/107/105107206/
2	www.esri.com
3	www.natmo.gov.in
4	www.surveyofindia.gov.in
5	www.gsi.gov.in
6	www. nbsslup.icar.gov.in

SEMESTER S4

ENGINEERING GEOLOGY

Course Code	PECET416	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To give the basics knowledge of Geology that is required for constructing various Civil Engineering Structures - surface changes, earth materials etc.,
2. To focus on the core activities of engineering geologists –geologic hazard identification and mitigation, ground water problems, geological structures. Planning and construction of major Civil Engineering projects.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Relevance of Geology in Civil Engineering, Branches of Geology. **Surface Processes of the earth-**Weathering -Types of weathering, Products of weathering. Geological processes by rivers. Geological work by Sea waves and currents and coastal protection measures. Landslides-types, causes and controlling measures. **Internal Processes of the earth-** Earthquakes- Causes and effects, Seismic waves, concept of intensity and magnitude of earthquake, Seismic zones of India. Basics of seismic safety factor.	11
2	**Mineralogy-**Physical properties of minerals, physical properties and chemical composition of minerals like quartz, orthoclase, plagioclase, biotite, muscovite, hornblende, augite, hypersthene, calcite, gypsum. **Petrology-** Igneous rocks - Chemical and mineralogical classification, structures & textures. Sedimentary rocks-types based on mode of formation and structures. Metamorphic rocks-structures only. Megascopic study of granite, dolerite, basalt, sandstone, limestone, shale, gneiss, marble and charnockite, Rock types of Kerala.	11

3	**Hydrogeology-** Origin & Occurrence of groundwater, vertical distribution of groundwater. Aquifers and types of aquifers. Porosity and Permeability/hydraulic conductivity, Darcy's Law. Electrical resistivity survey for groundwater exploration. Seawater intrusion in Coastal area, Ghyben-Herzberg relation. Problems created by groundwater to civil engineering structures, Methods to control groundwater problems.	**9**
4	**Structural Geology–** Attitude of rocks – Dip and Strike. Terminology, brief classification and engineering significance of folds, faults and joints. **Engineering Geology** -Significance of geological Investigations for civil engineering projects. Geological part of site investigation for the construction of dams & reservoirs, tunnels and highways.	**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 understand the dynamic nature of earth, the associated surface and subsurface processes	**K2**
CO2	To understand basic knowledge about different minerals, various rocks and their classification & identification and their significance in civil engineering.	**K2**
CO3	To apply basic knowledge about ground water and identify the problems created by ground water for civil engineering projects.	**K3**
CO4	To analyse the process involved in rock deformation and formation of various geological structures such as folds, faults, joints unconformities and their critical aspects in stability of civil engineering structures.	**K4**
CO5	To evaluate geological knowledge in planning, designing and construction of various civil projects	**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	2											
CO2	3											
CO3	3	3					3					
CO4	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	Engineering Geology	S.K. Duggal, H.K. Pandey, & N. Rawat	McGraw Hill Education (India) Private Limited.	1st Edition - 2016
2	Engineering Geology	D. Venkat Reddy	Vikas Publishing House Pvt. Ltd.	2nd Edition – 2016
3	Textbook of Engineering Geology	N. Chenna Kesavulu	Macmillan India Limited	2nd Edition -2009
4	Engineering Geology	B.S. Sathya Narayanaswami	Dhanpat Rai & Co.	1st Edition - 2000
5	Engineering and General Geology	Parbin Singh	S. K. Kataria & Sons	8th Edition - 2008
6	Principles of Engineering Geology	K.V.G.K. Gokhale	BSP Books	1st Edition - 2019
7	Engineering Geology	Subinoy Gangopadhyay	Oxford University Press	1st Edition - 2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles Of Physical Geology	Arthur Homes	Springer	4th Edition – 1993
2	Dana's Textbook Of Mineralogy	William E. Ford	CBS	4th Edition - 2006
3	Rutley's Elements Of Mineralogy	C.D. Gribble	CBS	27th Edition - 2005
4	The Principles Of Petrology	Tyrrell G.W.	Springer Science & Business Media	2012
5	Petrology: The Study of Igneous, Sedimentary and Metamorphic Rocks	Loren A. Raymond	Waveland Pr Inc	2nd Edition - 2007
6	Groundwater Hydrology	David Keith Todd & Larry W. Mays	Wiley India Pvt Ltd	3rd Edition - 2011
7	Structural Geology	Marland P. Billings	Pearson Education	3rd Edition- 2016

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/105/105105106/

SEMESTER S4

NUMERICAL METHODS FOR ENGINEERS

(Programme Elective for Civil Engineering Branches)

Course Code	**PECET417**	**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 apply numerical methods to solve Civil Engineering problems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to numerical methods - Errors in numerical computation System of linear algebraic equations –Ill-conditioned systems – Symmetric and Banded systems. Elimination methods –Gauss Elimination (review), Gauss Seidel iteration, Factorization method-Choleski's method. System of non-linear equations – Newton-Raphson method. Eigen value problems - largest and smallest Eigen values- Power method, Jacobi's transformation	9
2	Approximation - Lagrangian and Hermite interpolation, Spline interpolation - Quadratic and Cubic splines (example of equal intervals). Data smoothing by least squares criterion- non-polynomial models like exponential model and power equation, Multiple linear regression. Numerical integration - Newton–Cotes open quadrature formulae, Trapezoidal rule, Simpson's rules (Review).	9
3	Solution of first-order ordinary differential equations - stability of solution, Use of Taylor series, Euler's method, Modified Euler's method, Fourth order Runge-Kutta method. Higher order equations of initial value type by Runge-Kutta method. Ordinary differential equations of the boundary value type – Finite difference solution.	9

4	Partial differential equations in two-dimension - types, Laplace Equation and Poisson's equation. Parabolic equations – Explicit finite difference method – Bender-Schmidt method. Crank-Nicholson implicit method. Elliptic equations - Finite difference method. Weighted residual methods for initial value problems and boundary value problems – Collocation method, Method of least squares, Galerkin's method.	**9**

Applications of the methods shall be based on Civil Engineering problems such as Structural analysis problems to determine member forces, traffic simulations, weather prediction, water flow estimation, fluid dynamics simulations, and geotechnical modelling of groundwater movement.

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 apply basic numerical methods to obtain approximate solutions of mathematical problems.	**K3**
CO2	Obtain numerical solution of linear and nonlinear algebraic equations.	**K3**
CO3	Perform numerical integration for Civil Engineering problems	**K3**
CO4	Apply numerical solutions of differential equations to Civil Engineering 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	2	2			3							1
CO2	2	2			3							1
CO3	2	2			3							1
CO4	2	2			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	Numerical Methods for Engineering Problems	N Krishna Raju, K U Muthu	Macmillan Publishers India Limited	2000
2	Numerical Methods for Engineers & Scientists	Grewal B. S	Khanna Publishers	
3	Numerical Methods in Science and Engineering	Rajasekharan S	S Chand & Company	2003
4	Numerical methods	Babu Ram	Pearson	2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Numerical Methods for Engineers	Chapra S. C. and R. P. Canale,	McGraw Hill,	2006
2	Numerical solutions for Differential Equations	Smith G. D.	McGraw Hill.	
3	Modern Methods for Engineering Computations	Ketter and Prawel,	McGraw Hill	
4	Numerical Methods for Initial and Boundary value problems	Rajasekharan S.	Khanna Publishers	1989

SEMESTER S4

ENVIRONMENTAL LAW AND POLICY

(Common for Civil Engineering Branches)

Course Code	**PECET418**	**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; Biological Diversity Act, 2002; Forest Rights Act, 2006. Strategies for conservation–Project Tiger, Elephant, Rhino, Modulew leopard.	**9**

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	2	1		1		2
CO2	2	2				2	2	1		1		2
CO3	3	3				2	2	1		2		2
CO4	2	3				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	2022
2	Environmental Law in India	Leelakrishnan P	Lexis Nexis, India. .	6TH ed.2022
3	International Law and the Environment	Birnie P	Oxford.	3rd ed. 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…)	
Sl No.	**Link ID**
1	https://onlinecourses.swayam2.ac.in/cec20_ge12/preview#:~:text=The%20course%20covers%20the%20following,responsibilities)%20Human%20rights%20to%20environment

SEMESTER S4

ARCHITECTURAL ENGINEERING

Course Code	PECET415	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)	PBCET304, PCCEL218 (or equivalent)	Course Type	Theory

Course Objectives:

1. To enable students to develop creative and sustainable building design and management solutions based on sound engineering principles and ethics.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Definition of architecture –Historical development of architecture. Principles of architectural composition – Unity/ harmony – character– balance – proportion – scale –rhythm — Accentuation and contrast. Organising principles in architecture – Symmetry – hierarchy – axis – linear – concentric, radial – and asymmetric grouping – primary and secondary masses. Form and Space in architecture – Positive and negative space – Defining space with horizontal and vertical elements -qualities of architectural space Architecture Design Process: The 7 phases : The pre-design phase: The schematic design phase: The design development phase: The construction documents phase: The building permit phase: The bidding and negotiation phase: The construction administration phase.	9
2	Acoustics, fundamentals: Intensity of sound- Watts/m2- Bel- Decibel scales-dBA-Phon. Addition of sound levels. Acoustical Defects- Echoes, Reverberation, Foci and Dead Spots, Loudness, Noise Acoustics, applications: Recommended sound levels for interiors - Air and structure born noises-Measures of noise control- Source-path and receiving end. TL value and computation of TL value, Flanking paths. Sound absorption-materials and fixings. Reverberation-Sabines formula-Eyrings modification.	9

	Natural lighting: Visual task requirements, Units of Light, Light, Vision and Buildings, Standards of Lighting and Visual comfort-The sky as a source of light, Daylight factor, Recommended daylight factors for interiors. Design of side-lit windows using Daylight factor graphs Artificial lighting: Artificial lighting- illumination requirements-lux meter – lamps and luminaries – polar distribution curves Design of artificial lighting – lumen method – point by point method.	
3	Thermal comfort: Factors affecting thermal comfort- effective Temperature Thermal comfort indices-ET-CET Charts- Bioclimatic chart- Psychrometry and Psycrometric chart. Earth-Sun relationship: Sun's apparent movement with respect to the earth. Solar angles Computation of solar radiation on different surfaces-solar path diagram-shadow-throw concept and design of shading devices Thermal design of buildings: Thermo physical properties of building materials and thermal control-. Concept for electrical load calculation of structures Basic concept of HVAC load calculation Functional protection: Causes of fire, Mechanism of fire spread in buildings, classification of fire-High temperature effects and combustibility of building materials and structure- Fire alarm system, and means of escape. Firefighting installations	**9**
4	Architecture Design aspect: basic anthropometrics- human functions and their implications for space requirements- movement and circulation diagrams-special interpretations- various activities and their relationship with spaces Perspective views of form: 2-point perspective and 3-point perspective Climate responsive architecture Traditional Architecture of Kerala- Scope of Vastuvidya Dimensional system in Vastuvidya – concept of selection of perimeter - proportions Energy efficiency in buildings – Energy assessment in buildings – Green building rating guidelines – case studies.	**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

Students should Identify a real word requirement for a residential building. Develop detailed architectural drawing of it incorporating details, selecting a suitable site, using the concepts learned in the course. Finally, a complete file with documents ready to submit to the authorities and a drawing set which will give the client a 3D concept of the structure should be submitted.

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 creating drawings for technical requirements including approval.
   b. Demonstrates proficiency in creating visually impressive presentation drawings for the clients

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	Use principles of architectural composition and organization for development of building form and planning of functional spaces in buildings.	**K3**
CO2	Show good understanding of the comprehensive architectural design process, from the pre-design stage to construction management.	**K3**
CO3	Adopt principles of acoustics, lighting and thermal comfort for efficient functional design of buildings.	**K3**
CO4	Show good understanding of basic service load calculations and fire protection methods for efficient and safe function of buildings.	**K3**
CO5	Apply traditional, passive, climate conscious architectural principles for creating energy efficient buildings.	**K5/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	2	1										2
CO2	2	1										2
CO3	2	1					2					2
CO4	2	1										2
CO5	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	A global history of architecture	Francis D. K. Ching , Mark M. Jarzombek , Vikramaditya Prakash	Wiley	3rd edition 2017
2	Architecture: Form, Space, and Order	Francis D. K. Ching	Wiley	5th edition 2023
3	Architecture And Town Planning	Satish Chandra Agarwala	Dhanpath Rai &Co	2018
4	Architectural Engineering Design: Mechanical Systems	Robert Butler Brown	Mc Graw Hill	1st edition
5	Building Services Engineering	David Chadderton	T&F India	6th Edition 2017
6	Architectural Acoustics	Marshall Long	Academic Press	2014
7	Lighting	Pritchard, D.C	Longman Scientific & Technical, Harlow	1995
8	Daylight in Architecture	Benjamin Evans	McGraw - Hill Book Company	1981
9	Building Environment	AjithaSimha.D	Tata McGraw Hill Publishing Co	1985
10	Design and Installation of Services in Building complexes &High Rise Buildings	Jain. V.K.,	Khanna Tech. Publishers	1986
11	A text book of Vastuvidya	A. Achyuthan, Balagopal. T.S. Prabhu	Vastuvidyaparatishthanam	1996
12	Manual of tropical Housing and Building Part I – Climatic design	Koenigseberger	Orient Longman	2011

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Architecture: From Prehistory to Climate Emergency	Barnabas Calder	Pelican	2021
2	Building construction illustrated	Francis D. K. Ching	**Wiley**	6th edition 2017
3	Architectural Engineering Design: Mechanical Systems	Robert Butler Brown	Mc Graw Hill	1st edition
4	Acoustical Design in Architecture	Knudsen V.O. and Harris C.M	John Wiley	1980
5	Energy Efficient Buildings: Architecture, Engineering, and Environment	Wayne Forster and Dean Hawkes	W.W. Norton Company Inc	2002
6	Bureau of Indian standards, Handbook on Functional Requirement of Buildings – SP:41(S and T)-1987			
7	National Building Code of India (latest revisions to be refered)			
8	Bureau of Energy Efficiency, India. Design Guidelines for Energy Efficient Multi-Storey Buildings,2014.			

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/124/107/124107005/ https://nptel.ac.in/courses/124107012
2	https://archive.nptel.ac.in/courses/105/102/105102175/
3	https://archive.nptel.ac.in/courses/105/107/105107156/
4	https://nptel.ac.in/courses/101104065 https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ar03/

SEMESTER S4

ECONOMICS FOR ENGINEERS

(Common to All Branches)

Course Code	**UCHUT346**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 min,
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understanding of finance and costing for engineering operation, budgetary planning and control
2. Provide fundamental concept of micro and macroeconomics related to engineering industry
3. Deliver the basic concepts of Value Engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Economics Concepts - Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Law of Demand - Law of supply – Elasticity - measurement of elasticity and its applications – Equilibrium- Changes in demand and supply and its effects Production function - Law of variable proportion – Economies of Scale – Internal and External Economies – Cobb-Douglas Production Function	**6**

2	Cost concepts – Social cost, private cost – Explicit and implicit cost – Sunk cost - Opportunity cost - short run cost curves - Revenue concepts Firms and their objectives – Types of firms – Markets - Perfect Competition – Monopoly - Monopolistic Competition - Oligopoly (features and equilibrium of a firm)	**6**
3	Monetary System – Money – Functions - Central Banking –Inflation - Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Deflation Taxation – Direct and Indirect taxes (merits and demerits) - GST National income – Concepts - Circular Flow – Methods of Estimation and Difficulties - Stock Market – Functions- Problems faced by the Indian stock market-Demat Account and Trading Account – Stock market Indicators- SENSEX and NIFTY	**6**
4	Value Analysis and value Engineering - Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure - Break-even Analysis - Cost-Benefit Analysis - Capital Budgeting - Process planning	**6**

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Case study/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
10	15	12.5	12.5	50

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
● Minimum 1 and Maximum 2 Questions from each module. ● Total of 6 Questions, each carrying 3 marks **(6x3 =18marks)**	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 8 marks. **(4x8 = 32 marks)**	**50**

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	**K2**
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	**K3**
CO3	Outline the macroeconomic principles of monetary and fiscal systems, national income and stock market.	**K2**
CO4	Make use of the possibilities of value analysis and engineering, and solve simple business problems using break even analysis, cost benefit analysis and capital budgeting techniques.	**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	-	-	-	-	-	1	-	-	-	-	1	-
CO2	-	-	-	-	-	1	1	-	-	-	1	-
CO3	-	-	-	-	1	-	-	-	-	-	2	-
CO4	-	-	-	-	1	1	-	-	-	-	2	-

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7TH Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001

SEMESTER S3/S4

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	**UCHUT347**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals of ethics -** Personal vs. professional ethics, Civic Virtue, Respect for others, **Profession and Professionalism,** Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, **Technology and digital revolution**-Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, **High technologies: connecting people and places**-accessibility and social impacts, **Managing conflict**, Collective bargaining, **Confidentiality**, Role of confidentiality in moral integrity, **Codes of Ethics**. **Basic concepts in Gender Studies** - sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, **Gender disparity and discrimination in education**, employment and everyday life, History of women in Science &	**6**

	Technology, Gendered technologies & innovations**, Ethical values and practices in connection with gender** - equity, diversity & gender justice, **Gender policy and women/transgender empowerment initiatives.**	
2	**Introduction to Environmental Ethics:** Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). **Sustainable Engineering Principles:** Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. **Ecosystems and Biodiversity:** Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. **Landscape and Urban Ecology:** Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	**6**
3	**Hydrology and Water Management:** Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. **Zero Waste Concepts and Practices:** Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. **Circular Economy and Degrowth:** Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. **Mobility and Sustainable Transportation:** Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	**6**
4	**Renewable Energy and Sustainable Technologies:** Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. **Climate Change and Engineering Solutions:** Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate	**6**

	crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. **Environmental Policies and Regulations:** Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. **Case Studies and Future Directions:** Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	

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

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/ Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12

3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
		Total Marks		**50**

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis**: Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts**: Ability to apply course concepts to real-world problems and local contexts.
- **Creativity**: Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills**: Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	**K3**
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	**K4**
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	**K5**
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	**K4**
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	**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						3	2	3	3	2		2
CO2		1				3	2	3	3	2		2
CO3						3	3	2	3	2		2
CO4		1				3	3	2	3	2		2
CO5						3	3	2	3	2		2

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessmen	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?

- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER S4

MATERIALS TESTING LAB (GROUP C)

Course Code	PCCEL407	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)	PCCET205/ Equivalent	Course Type	Lab

Course Objectives:

1. To provide hands-on experience for the students to determine the material properties
2. To impart the knowledge of material properties to identify and make use of it in various fields of engineering

Expt. No.	Experiments
1	Test on stress-strain characteristics of mild steel and Tor Steel by conducting uniaxial tension test on rod specimens
2	Shear test on mild steel rod (Compression Testing Machine and Shear Shackle)
3	Flexural behaviour of steel by conducting a bending test on Rolled steel sections (I cross section)
4	Torsional behaviour and estimation of modulus of rigidity of steel by conducting torsion test on rod specimens
5	Estimation of modulus of rigidity of steel and brass / copper materials utilizing the principles of torsional vibrations – Torsion Pendulum.
6	Estimation of toughness of steel specimens by conducting (a) Izod & (b) Charpy impact tests.
7	Estimation of hardness properties of engineering materials such as brass, aluminium, copper, steel etc.by performing Brinell hardness test
8	Estimation of Hardness properties of engineering materials such as brass, aluminium, copper, steel etc.by performing (a) Rockwell hardness test (b) Vicker's hardness test
9	Estimation of modulus of rigidity of steel by performing tension and compression tests on spring specimens.

10	Flexural behaviour of timber material by performing bending tests on beam specimens.
11	Estimation of compressive strength of timber specimen.
12	Experiment on verification of Maxwell's reciprocal theorem
13	Demonstration of Fatigue Test
14	Study/demonstration of Strain Gauges and load cells
15	Bend & Rebend test on M S Rods
16	Tensile behaviour of polymeric membranes, textiles, fibres etc.
17	Digital Image Correlation Techniques for the study of material behaviour under various loading conditions

* A minimum of 12 experiments 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	Identify the behaviour of engineering materials under various forms and stages of loading	**K3**
CO2	Characterize the elastic properties of various materials.	**K3**
CO3	Evaluate the strength and stiffness properties of engineering materials under various loading conditions	**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

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	History of Strength of Materials	S.P. Timoshenko	Dover publications	2003
2	Engineering Mechanics of Solids	Egor P. Popov	Pearson	2015

References	
SL No	**Title Edition and Year**
1	IS 1608 : Part 1 : 2022 Metallic materials - Tensile testing - Part 1 : Method of test at room temperature
2	IS 1598 (1977): Method for Izod Impact test of Metals, (Reaffirmed 2020)
3	IS 1757 Part:1(2020) : Metallic materials – Charpy Pendulum Impact test Method
4	IS 5242 (1979) Method of Test for determining Shear Strength of Metals, (Reaffirmed 2022)
5	IS 1500 Part:1 (2019): Metallic materials – Brinnel Hardness test Part 1 Test method
6	IS 1500 Part:4 (2019): Metallic materials – Brinnel Hardness test Part 4 table of hardness values
7	IS 1501 Part 1 (2020) : Metallic materials – Vickers Hardness test Part 1 Test method
8	IS 1501 Part 4 (2020) : Metallic materials – Vickers Hardness test Part 4 table of hardness values
9	IS 1586 Part 1 (2018) : Metallic materials – Rockwell Hardness test Part 1 Test method
10	IS 1586 Part 3 (2018) : Metallic materials – Rockwell Hardness test Part 3 Calibration of reference blocks (Scale A, B, C, D, E, F, G, H, K, N, T)
11	IS 1717 (2018): Metallic Materials – Wire – Simple Torsion Test
12	IS 883 (2016): Design of Structural Timber in Building- Code of Practice. (Reaffirmed 2021)
13	IS 13325 (1992) Determination of Tensile Properties of Extruded Polymer Geogrids Using the Wide Strip - Test Method (Reaffirmed Year : 2019)
14	IS17415(2023) Metallic Materials torsion test at room temperature.

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	www.sm-nitk.vlab.ac.in
2	www.eerc01-iiith.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 S4

CIVIL ENGINEERING MODELLING LAB

(Common to C Group)

Course Code	**PCCEL408**	**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)	PCCEL208 / Equivalent	**Course Type**	Lab

Course Objectives:

1. The course is designed to introduce the fundamentals of Civil Engineering Drawing and understand the principles of planning.
2. The students will be able to learn the drafting of buildings manually and using drafting software such as AutoCAD.

Expt. No.	Experiments
1	Review of drafting software: Plan a single storeyed residential building with flat roof for given requirements and draw the site plan, plan, section and elevation.
2	Plan a double storeyed residential building with sloped roof for a set of given requirements for a given plot and draw the site plan, plan, section and elevation. Prepare a file with hardcopies of drawings ready to submit for approval from the authorities.
3, 4	Plan a public building–office complex, public health centre, commercial, educational, post office, bank and draw the plan, section and elevation: Any two.
5	Plan and prepare plumbing and sanitary drawings of a building.
6	Plan and prepare electrical drawings of a building.
7	Introduction to BIM Software: Draw plan, section & elevation of a single storied residential building (Expt 1or 2)
8	Introduction to Project Planning Software: Schedule the construction sequence of a single storied residential building
9	Preparation of a contour map of a site from the provided total station survey data
10	Earthwork estimation from the provided total station survey data
11	Simulation of a small water supply pipe network using EPANET
12	Land use data preparation using GIS

- Do a minimum of 10 experiments. All experiments are expected to be completed with the help of computers.

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	Illustrate the ability to organize civil engineering drawings systematically and professionally.	**K3**
CO2	Apply the building bye-laws and principles of planning for residential and public building design.	**K3**
CO3	Apply the learned skills to Plan and prepare drawings of building services like plumbing, wiring etc.	**K3**
CO4	Utilize computer aided techniques for civil engineering applications including survey, pipe network simulations, planning etc.	**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	3	3					3		2		2
CO3	3	3	3					2		2		2
CO4	3	3	3		3					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	Building Drawing and Detailing	Dr. Balagopal T.S. Prabhu	Spades Publishers, Calicut	Revised Edition 2022
2	Building Drawing With An Integrated Approach to Built Environment	Shah, M.G., Kale, C. M. and Patki, S.Y.	Tata McGraw Hill Publishing Company Limited, New Delhi	5th edition 2017
3	Building Planning and Drawing	M.V. Chitawadagi S.S. Bhavikatti	Dreamtech Press	2019

Sl. No	References
1	National Building Code of India (refer the latest updates)
2	Kerala panchayat building rules (refer the latest updates)
3	Kerala Municipality building rules (refer the latest updates)

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 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.	1^{st} & 1999
2	Engineering Principles of Ground Modification	Manfred. R. Hausmann	McGraw Hill	1^{st} & 1989
3	Reinforced soil and its engineering applications	Swami Saran	I. K. International Pvt Ltd	1^{st} & 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	1^{st} & 1984
2	Ground Improvement Techniques	Nihar Ranjan Patra	Vikas Publishing house	1^{st} & 2012
3	Current Practices in Geotechnical Engineering Vol.-I	Alam Singh and Joshi	International Book Traders	1^{st} & 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	4^{th} 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	7^{th}, 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)

- 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 7

CIVIL ENGINEERING

SEMESTER S7

STRUCTURAL DYNAMICS

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

Course Objectives:

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

SYLLABUS

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

3	**Response to general loading** – Duhamel Integral, damped and undamped systems. **Multi degree of freedom systems** – Lumped mass systems, shear building frame, Equation of motion. ***Free vibration analysis:*** Natural frequencies and mode shapes, orthogonality of normal modes.	**9**
4	**Approximate methods**: Rayleigh's method Dunkarley's method, Stodola's method. **Distributed mass (continuous) systems** – differential equation of motion – Axial vibration of rods. Flexural vibration of beams, natural frequencies and mode shapes of simply supported beam. Evaluation of frequencies and mode shapes of cantilever beam and fixed beam (formulation only).	**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	Formulate appropriate SDOF models of simple structural systems under dynamic loads apply them to the solution of engineering problems.	**K3**
CO2	Analyze and interpret the dynamic response of SDOF systems for various dynamic inputs.	**K3**
CO3	Develop mathematical models for MDOF shear building models and estimate the natural frequencies and vibration modes for the same.	**K3**
CO4	Understand the dynamic behaviour of continuous parameter systems.	**K3**

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

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

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

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

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

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

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

SEMESTER S7

FORMWORK ENGINEERING

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

Course Objectives:

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

SYLLABUS

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

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

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

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 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 appropriate materials for the form work construction	**K3**
CO2	Apply the principles of structural analysis and design in formwork design	**K3**
CO3	Demonstrate the safety and quality control requirements in formwork	**K2**
CO4	Organize from work construction considering the planning concepts	**K3**

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

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

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

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

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

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

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

SEMESTER S7

ENVIRONMENTAL GEOTECHNOLOGY

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

Course Objectives:

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

SYLLABUS

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

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

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 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 Soil -water- contaminant interaction process and	**K1**
CO2	Study Contaminant transport in soil	**K2**
CO3	Design aspects of waste containment facilities	**K3**
CO4	Plan Remediation of contaminated sites	**K1**

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

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

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

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

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

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

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

SEMESTER S7

AIRPORT PLANNING AND DESIGN

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

Course Objectives:

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

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**General** - History, development, policy of air transport, aircrafts, aerodromes, air transport authorities, air transport activities, air craft characteristics, airport classifications as per ICAO. **Regional planning**-concepts and advantages, location and planning of airport as per ICAO and F.A.A. recommendations, airport Elements -airfield, terminal area, obstructions, approach zone, zoning laws, airport capacity, size and site selection, estimation of future air traffic, development of new airport, requirements of an ideal airport layout.	9
2	**Runway design**- Wind rose and orientation of runway, wind coverage and crosswind component, factors affecting runway length, basic runway length, and corrections to runway length, runway configurations. threshold limits cross section of runway. **Taxiway design** - Controlling factors, layout, exit taxiway, location and geometrics, holding apron, turn around facility. Aprons -locations, size, gate positions, aircraft parking configurations and parking systems, hanger-site selection, planning and design considerations, Fuel storage area, blast pads. wind direction indicator.	9
3	**Landside Planning**: Terminal area elements and requirements, Termina concepts & types, Passenger requirements at terminal building, space requirements-design peak hour demand, standards, location planning	9

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

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 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 different components of airport and aircrafts.	**K1**
CO2	Apply principles of airport planning in design of Runways and Taxiways.	**K3**
CO3	Apply the principles in planning the landside features of an airport.	**K2**
CO4	Apply the standards for geometric design of runways and taxiways.	**K3**
CO5	Describe the various visual aids applied on airports.	**K2**

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

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

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

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

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

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

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

SEMESTER S7

HIGHWAY MATERIALS AND DESIGN

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

Course Objectives:

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

SYLLABUS

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

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

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 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 suitable materials for different types of pavements and Interpret material test results with respect to field conditions and standards.	**K3**
CO2	Apply the pavement material properties to analysis of pavements and Evaluate material properties in design of pavement mixes.	**K3**
CO3	Determine the stresses and design flexible pavements with better performance and longer service life	**K3**
CO4	Determine the stresses and design rigid pavements with better performance and longer service life and Design the reinforcements in cement concrete pavements	**K3**

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

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

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

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

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

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

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

SEMESTER S7

RIVER ENGINEERING

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

Course Objectives:

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

SYLLABUS

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

4	Suspended load transport, Diffusion in turbulent flow, differential equation for suspension of sediment, estimation of suspended load, Sediment samplers – bed load samplers – suspended load samplers.	**9**

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 understand river morphology, classification, channel behaviour, and sediment transport processes.	**K2**
CO2	To understand the critical aspects in the design of river engineering structures	**K3**
CO3	To understand river mechanics to facilitate mathematical/ hydraulic modelling.	**K4**

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

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

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

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

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

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

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

SEMESTER S7

PAVEMENT DESIGN AND CONSTRUCTION

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

Course Objectives:

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

SYLLABUS

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

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

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

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

End Semester Examination Marks (ESE):

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

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. Each question carries 9 marks. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

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

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

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

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

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

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

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

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

SEMESTER S7

GROUND WATER ENGINEERING

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

Course Objectives:

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

SYLLABUS

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

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

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 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	Determine the aquifer parameters using different methods.	**K3**
CO2	Perform numerical modelling of ground water system.	**K3**
CO3	Describe the procedure of well construction and estimate the well draw down curve.	**K3**
CO4	Determine aquifer thickness using different geophysical methods	**K3**
CO5	Estimate the extent of ground water pollution and assess the quality	**K3**

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

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

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

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

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

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

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

SEMESTER S7

SUSTAINABLE CONSTRUCTION PRACTICES

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

Course Objectives:

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

SYLLABUS

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

3	**Water conservation and efficiency**: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems. **Waste Management**: Handling of construction & demolition waste materials, separation of household waste, handling e-waste, on-site and off-site organic waste management	9
4	**Introduction to Green Buildings**: Definition of green buildings, definition of sustainability, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems, Case studies.	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 methodologies for sustainability and maintain indoor environmental quality	**K3**
CO2	Describe energy efficiency methods used in green building practices.	**K3**
CO3	Adopt various water efficiency criteria and waste management methods	**K3**
CO4	Understand the principles and practices of green buildings	**K2**

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

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

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

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

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

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

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

SEMESTER S7

ADVANCED GEOTECHNICAL INVESTIGATION

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

Course Objectives:

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

SYLLABUS

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

2	**Sounding Methods** Standard Penetration Test- procedure, Factors influencing the SPT results and precautions to obtain reliable results– corrections to be applied to observed N values– correlations of N value with various engineering and index properties of soils-Field study from sites-Field visit and analysis of data Static cone penetration test-procedure-merits/drawbacks. Correlation of static CPT results with properties Dynamic Cone penetration test-Procedure-merits/drawbacks-Critical comparison of SPT, Static CPT and dynamic CPT Plate load test –Procedure, uses, limitations-Design of foundation from the analysis of data		**9**
3	**Field Tests** Geophysical methods -Seismic refraction method- procedure, use, limitations. Electrical resistivity method-Electrical profiling and electrical sounding-procedure, uses, limitations Field tests – Pressure meter Test procedure, uses -limitations, correlations. Pile load tests- Procedure- analysis of results of data		**9**
4	**Sampling, Report & Geosynthetics** Soil Sampling- disturbed and undisturbed soil samples- representative and non-representative samples, chunk and tube samples, Area ratio clearance, outside clearance-recovery ratio, Handling and transportation of sample, Types of samplers-Thin walled sampler, Piston sampler-Split spoon sampler. Methods for collection of sand samples from beneath the water table **Soil Investigation report** Presentation of soil exploration data – Bore log and soil profile. **Geosynthetics** Geosynthetics- Functions and applications from case studies – any field visit - Pavements, Embankments, Railways, Erosion control from Kerala state.		**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	The students will be able to understand the procedure, applicability and limitations of various methods of geotechnical investigation	**K2**
CO2	The students will be able to make judgements and take appropriate decisions related to geotechnical investigations	**K4**
CO3	The students will be able to understand the procedure and applications of penetration tests and geophysical tests for the exploration of the soil profile	**K3**
CO4	The students will be able to choose the right soil sampling technique, analyse the dependability of samples collected and understand the soil investigation report	**K4**
CO5	The students will be able to understand the functions and field applications of Geosynthetics from case studies from Kerala State	**K3**

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

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

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

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

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

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

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

SEMESTER S7

RAILWAY, PORT AND HARBOR ENGINEERING

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

Course Objectives:

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

SYLLABUS

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

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

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

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 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 factors affecting alignment of railway track for a given terrain and to explain the component parts of railway tracks, its functions, and materials of making	**K3**
CO2	Carry out geometric design of railway track and to explain the construction procedure of railway tracks	**K3**
CO3	Explain the basic principles, site selection characteristics and lay out of ports and harbours and the basics of docks.	**K2**
CO4	Understand the concepts of various structures on harbours and navigational aids for communication.	**K2**

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

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

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

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

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

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

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

SEMESTER S7

AIR AND NOISE POLLUTION CONTROL ENGINEERING

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

Course Objectives:

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

SYLLABUS

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

	noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Noise control methods	

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 sources of air pollution , air pollution problems, and Demonstrate a detailed knowledge of study the effect of meteorological parameters in the dispersion of air pollutants	**K3**
CO2	Analyze Environment legislation and regulations for air and noise pollution	**K3**
CO3	Evaluate efficiency of various air pollution control devices used for particulate removal	**K3**
CO4	Design, operate and control the devices used for noise emission control	**K3**

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

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

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

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

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

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

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

SEMESTER S7

FINITE ELEMENT METHOD

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

Course Objectives:

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

SYLLABUS

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

	Introduction to higher order elements – introduction to axisymmetric elements – Numerical Integration – Gauss quadrature. Discussion of modelling and analysis using recent commercial finite element software packages	**9**

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

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

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

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

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

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

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

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

SEMESTER S7

DESIGN OF HYDRAULIC STRUCTURES

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

Course Objectives:

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

SYLLABUS

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

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

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

Criteria for Evaluation(Evaluate and Analyse): 20 marks

Assignment

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

Criteria for evaluation:

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

Scoring:

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

End Semester Examination Marks (ESE):

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

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. Each question carries 9 marks. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

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

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

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

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

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

Text Books

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

Reference Books

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

SEMESTER S7

INTELLIGENT TRANSPORTATION SYSTEMS

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

Course Objectives:

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

SYLLABUS

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

	Electronic toll collection- objectives, components. Fleet management and operations	
3	***Transport Demand management and ITS***: Introduction, Application of ITS for TDM- Promotion of Public transport, Road pricing, parking management, High occupancy lanes, Bicycle rentals, carpooling, integrated fare, traffic rule enforcement, Incentive schemes. ***Use of GPS and GIS in ITS***: Introduction to GPS and GIS, Automatic vehicle location and identification, real time passenger information, GSM Technologies.	**9**
4	**Automated Highway systems**: ***AHS:*** Introduction, Concepts and technologies of AHS, Connected vehicle system, Vehicle automation, Benefits, goals, challenges with AHS. ***Sensing Technologies***: In vehicle- categories, examples, Issues, In road- intrusive, non-intrusive, application, uses. ***Smart Roads***: concepts and technologies, smart street lights, smart intersection ***Self driving car***: Technology, examples ***ITS case studies***: world examples, Indian examples.	**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 the ITS and ITS System requirements	**K2**
CO2	List the various ITS user services and identify their major components	**K2**
CO3	Suggest the appropriate tools and components in various functional areas of transportation for field conditions.	**K2**
CO4	Identify the importance of automated highway systems and new technology applications in autonomous vehicles	**K2**

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

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

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

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

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

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

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

SEMESTER S7

ENVIRONMENTAL HEALTH AND SAFETY

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

Course Objectives:

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

SYLLABUS

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

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

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 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 Toxicology and Occupational Health associated with industries.	**K2**
CO2	Identify chemical and microbial agents that originate in the environment and can impact human health.	**K2**
CO3	Describe various measures to ensure safety in Construction industry.	**K2**
CO4	Describe the safety measures against various environmental hazards.	**K2**

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

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

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

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

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

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

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

SEMESTER S7

WATERSHED CONSERVATION AND MANGEMENT

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

Course Objectives:

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

SYLLABUS

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

	Role of Vegetation in Watershed Management: Importance of vegetation in soil and water conservation - Types of vegetation and their roles in watershed health - Afforestation and reforestation practices **Drought management-** Drought assessment, Drought analysis- Drought mitigation	
3	**Watershed Management Planning and Implementation:** Steps in watershed management planning - Community involvement in watershed management - Case studies of successful watershed management projects **Environmental and Socio-Economic Considerations:** Environmental impact assessment of watershed projects - Social and economic benefits of watershed management - Policy and legal frameworks for watershed management - Watershed management for conservation of resources and enhancing productivity in problem lands	9
4	**Watershed Modeling and Geographic Information Systems (GIS):** Introduction to watershed modelling- Use of GIS in watershed management - Applications of remote sensing in watershed analysis Delineation and Prioritization-Concept of Topographic or Contour Map, Boundary Delineation, GIS for Delineation, Accuracy in Delineation, Concept of Priority, Factors, Basics & Methods, Purpose & Benefits Land Management: Land use and Land capability classification, management of forest, agricultural, grassland and wild land. Reclamation of saline and alkaline soils Integrated watershed modelling – basic concepts	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 understand the concepts and importance of watershed management.	**K1**
CO2	To learn the techniques for soil and water conservation.	**K3**
CO3	To develop skills for designing and implementing watershed management plans.	**K3**
CO4	To assess the environmental, social, and economic impacts of watershed projects.	**K3**

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

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

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

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

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

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

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

SEMESTER S7

FORENSIC ENGINEERING

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

Course Objectives:

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

SYLLABUS

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

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

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 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 fundamental aspects of forensic Engineering	**K2**
CO2	Apply forensic Engineering in Practical work flow and Investigation	**K3**
CO3	Apply methods and analysis in Forensic Investigation	**K4**
CO4	Develop practical strategies and standards of Investigation	**K4**
CO5	Create an awareness in criminal cases and create Engineering expertise in court room on forensic Engineering	**K4**

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

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

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

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

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

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

SEMESTER S7

FINANCE FOR ENGINEERING

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

Course Objectives:

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

SYLLABUS

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

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

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 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 principles and process of accounting.	**K2**
CO2	Apply basic analysis tools like rate of return, benefit cost, and breakeven analysis in economic decision making.	**K3**
CO3	Prepare financial statements and apply revenue recognition methods.	**K3**
CO4	Explain the basics of financial management and sources of finance for a project.	**K3**

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

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

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

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

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

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

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

SEMESTER 8

CIVIL ENGINEERING

SEMESTER S8

WATER AND AIR QUALITY MANAGEMENT

Course Code	**PECET861**	**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 provide knowledge of aquatic ecology, water pollution, water quality standards, water quality assessment and its management
2. Students would get an insight into the dispersion of air pollution in the atmosphere, its sources, sampling techniques and control measures.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Water quality: impurities (pollutants and contaminants) in water, their significance and estimation techniques; water borne diseases; standards of potable water. Impact of water pollutants on environment; self-purification of waste in streams; zones of purification; eutrophication; disposal standards	**7**
2	Water treatment:Aeration and types of aerators; purpose and mechanism of flocculation; coagulants used in water treatment; factors influencing coagulation; estimation of coagulant dose; types of flash mixers and flocculators; sedimentation; analysis of discrete and flocculent settling; sedimentation tanks; Filtration: types and design of filters, Disinfection: chemical and non-chemical methods	**9**
3	Water resources and quality management in India : Water availability; water stress index; status and trend of surface and groundwater; issues and policy	**9**

	interventions; pollution of rivers, lakes and ground water; GAP and National River Action Programme; role of national and international agencies in water health and sanitation.	
4	Air Pollution: Types, Sources, Effects on human health, vegetation, materials, global environmental issues.Air sampling and pollution measurement methods, principles and instruments, ambient air quality and emission standards, Air pollution indices, Air Act, legislation and regulations Control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods. Particulate emission control	**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	Gain insight into key concepts of water quality, water quality and health, impairment of natural water bodies	**K2**
CO2	Comprehend components of water treatment and schemes based on source of water, select suitable unit process and unit operation at conceptual, theoretical, methodical level	**K3**
CO3	Develop an integrated perspective on water resource and water quality management	**K3**
CO4	Design, operate and control the devices used for air quality management	**K3**

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					2	2					
CO2	3					2	2					
CO3	3					2	1					
CO4	3					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	Water Supply and Sanitary Engineering	Birde G.S. and Birde J.S	7th ed., New Delhi, Dhanpat Rai Publishing	2004
2	Air pollution	M. N. Rao, H. V. N. Rao	Tata McGraw Hill Pvt. Ltd, New Delhi	1993
3	Basic Environmental Technology: Water Supply, Waste Management and Pollution Control	Nathanson J.A.	4th ed., New Delhi, PHI Learning	2009

Reference Texts				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Handbook Of Environment And Waste Management: Air And Water Pollution Control	Lawrence K Wang, Nazih K Shammas, Yung-tse Hung	World Scientific Publishing Company	2012
2	Water and Air Effluents Treatment Handbook	NPCS Board of consultants and Engineers	ASIA PACIFIC BUSINESS PRESS Inc.	2009

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_ag06/preview
2	https://archive.nptel.ac.in/courses/105/107/105107213/

SEMESTER S8

VALUATION OF REAL PROPERTIES

Course Code	**PECET862**	**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)	PCCET601	**Course Type**	Theory

Course Objectives:

1. This course introduces the principles and methodologies involved in the valuation of real properties. It covers fundamental concepts in real estate appraisal, exploring various approaches to property valuation, market analysis, and regulatory considerations. Through theoretical discussions, case studies, and practical exercises, students will gain the skills and knowledge necessary to assess the value of different types of real estate.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Role of valuer-Classification-Valuers' Functions & Responsibilities. Purpose-doctrine of estate-different form of value-factors affecting, aspects, characteristics. Supply and demand forces, factors affecting demand and supply-Cost, Price & Value Type of interest (right) in land-Free hold-Lease hold, Forms of lease, Mortgage Income, Outgoings-Type, sinking fund, Year's Purchase Numerical examples. Valuation table-use	**8**
2	Investment-Type-characteristics of ideal investment Appraisal technique – Net present value (NPV) by discounted cash flow method (DCF), Internal rate of return (IRR)-Numerical Example. Life of various types of buildings - Depreciation- Obsolescence-Functional & Economical -difference between depreciation and obsolescence Method of estimating cost depreciation-Numerical examples	**8**

3	Building FSI – Plot coverage – Types of structure Method of Valuation for open land- Comparative method, Abstractive method, Belting method- Numerical examples Method of valuation of land with buildings- Rental method, direct comparison of the capital, Valuation based on profit- Numerical examples Valuation of apartment-FSI – Super built-up area, Undivided share of land Valuation for bank-Purposes – Security, Primary and collateral Report writing for various purposes of valuation-Sale, Purchase, Mortgage, Taxation, Insurance, Liquidation etc	**10**
4	Environment & Valuation- Environmental factors affecting valuation Professional ethics- Model Code of Conduct as notified by MCA under the Companies (Registered valuers and valuation) Rules 2017 - Ethical considerations under terms of engagements Salient features of Real estate (regulation & development) Act 2016, Transfer of property Act, Land acquisition, Indian easement Act, Estate Duty Act of 1953, Wealth Tax Act of 1957, Gift Tax Act of 1958, Income Tax Act of 1964, Rating Laws of 1866 (brief description only) Important case laws-Case study based on case laws CPWD Rates, Cost Index, Cost Inflation Index Valuation for Capital Gain Tax-Numerical examples	**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	Define the technical terms involved in valuation of Real properties	**K2**
CO2	Identify the return on investment on real properties	**K3**
CO3	Prepare valuation of land and buildings	**K3**
CO4	Recall the important aspects of Acts related to valuation	**K1**

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**											
CO2	**3**											
CO3	**3**	**2**								**2**		
CO4								**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	Valuation of real properties	Rangwala	Charotar Publishing House Pvt. Ltd.	2020
2	Basics in real estate valuation	P.T. Hardikar	P.T. Hardikar	2022
3	Estimation and costing in civil engineering	B. N. Dutta	UBS publishers	28th Rev. Edition, 2020

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Real estate principles : A value approach	David Ling and Wayne Archer	McGraw-Hill Education	Fifth Edition, 2018
2	Fundamentals of real estate appraisal	R. Martha Williams & L. William Ventolo	Real Estate Education Co.	1998
3	Latest CPWD DAR and DSR			

Video Links	
Module No.	**Link ID**
2	www.onlinecourses.swayam2.ac.in/imb22_mg06/preview

SEMESTER S8

CONTRACTS MANAGEMENT

Course Code	**PECET863**	**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)	PCCET601	**Course Type**	Theory

Course Objectives:

1. To provide students with a comprehensive understanding of the basic principles of contract law and their application in construction projects.
2. To ensure students can identify the essential elements required for the formation of a valid contract.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to contract management-Definition & importance, Type of contracts (Lump sum, item rate, EPC, BOT etc..), Agreement and contract Indian Contract Act 1872 – Layout and Salient Features - Performance and Non-performance of Contract - Breach of Contract - Consequences and Remedies - Liquidated Damages, Extension of Time	9
2	Contract Documentation-Form of Agreement & Hierarchy of Terms and Conditions- Typical structure of contract- Preamble, Scope and Specifications- Preliminaries and General - Insurance policies, Bonds and Guarantees, Terms of Payment- Price adjustment- Assignments and Subcontracting	9

	Tendering and Bidding process-Prequalification, Invitation of tender, Bid preparation and submission, Evaluation of bid and award of contract, Negotiation.	
3	Standard Forms of Contracts - FIDIC form of Contract. Performance Bond - Programme of Work – Submissions and approvals - Progress Review Meetings - Certification and Interim Payments - Quality and Safety - Variation clauses and changes to the scope of work - Claims - Delay and disruption - Force majeure and Exceptional events - Suspension & Termination - Taking over and Substantial completion - Release of Performance Bond/Security - Defect Liability and Release of Retention Money - Contract closure and Final	**10**
4	Conflicts, Disputes, and their causes - Conflict avoidance and tiered dispute resolution clauses - Alternative Dispute Resolution Methods & Litigation - Best practices in dispute resolution and management - General Provisions - Arbitration Agreement, Composition of Arbitral Tribunal	**8**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 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 basic elements of conditions of contract.	**K2**
CO2	Recall provisions of Indian contract law & FIDIC	**K1**
CO3	Explain the various steps involved in the contract documentation	**K3**
CO4	Explain the process of dispute resolution in contracts	**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**								**3**	
CO2			**2**								**3**	
CO3			**2**							**3**		
CO4			**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	Law of contract and specific relief	A. Md. Samiulla	Asia Law House	2016
2	Construction project management	K.K.Chitkara	McGraw Hill Education	2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Indian Contract Act (1872)			
2	FIDIC Contracts: Law and Practice	Ellis Baker, Ben Mellors , Scott Chalmers , Anthony Lavers	Informa Law from Routledge	2009
3	Construction contract: Law and Management	John Murdoch , Ronan Champion , Will Hughes	Routledge	5th edition , 2015

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1, 2	NPTEL :: Law - NOC:Advanced Contracts, Tendering and Public Procurement

SEMESTER S8

ADVANCED DESIGN OF STEEL STRUCTURES

Course Code	**PECET864**	**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)	PCCET602	**Course Type**	Theory

Course Objectives:

1. The proposed course is expected to enhance and strengthen the knowledge on detailed design methods for steel structures, in compliance with Indian codes

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Types of bolts−Bearing and High strength bolts−Prying Force−Beam to Column connections−Design of seat angle−Unstiffened−Design of seat angle−Stiffened web angle & end plate connections, Beam and column bolted splices−Design of framed beam connection−continuous beam to beam connection	9
2	Structure and properties of weld metal. Beam to-column connections−Stiffened beam seat connection−Web angle and end plate connections− -Tubular Connections−Parameters of an in-plane joint - Welds in tubular joints−curved weld length at intersection of tubes	9
3	Design of plate girders subjected to uniformly distributed loads – design of stiffeners	9

	Design of gantry girders–Introduction–Loading consideration–Selection of gantry girder–Position of moving load for maximum effects, profile of gantry girder, limitation on vertical deflection–Design of gantry girders.	
4	Design of Light Gauge Structures: Design of light gauge steel structures: Introduction–Types of cross sections–Materials-Local and post buckling of thin elements–Stiffened and multiple stiffened compression elements–Tension members– Beams and deflection of beams–Combined stresses and connections	**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, K4**
CO2	Analyse the behaviour of structural steel members and undertake design at both serviceability and ultimate limit states	**K3, K4**
CO3	Apply a diverse knowledge of design of steel engineering practices applied to real life problems.	**K2, K3**
CO4	Analyse and design cold formed steel members	**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	
2	Design of Steel structures	Duggal S.K.	Tata McGraw-Hill	
3	Design of Steel structures	A. S. Arya, J.L. Ajmani and Awadesh Kumar	Nem Chand and Bros	
4	Cold-Formed Steel Structures	Wie-Wen Yu	McGraw Hill Book Company	

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

Sl. No.	Link ID
1	https://archive.nptel.ac.in/courses/114/106/114106047/
2	https://archive.nptel.ac.in/courses/105/105/105105162/

SEMESTER S8

URBAN TRANSPORTATION PLANNING

Course Code	PECET866	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	**Course Type**	Theory

Course Objectives:

1. The course aims to introduce to the students the concept of transportation planning and impart in-depth knowledge on the four stage planning process and to highlight the need for sustainable transportation

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Need for transportation planning-** Characteristics of urban travel, Transportation issues and challenges, Detrimental effects of traffic on environment. **Urban Structure-** types and properties -centripetal, grid, linear, directional, Movement and Accessibility – Hierarchy of transportation facilities. **Demand analysis in transportation planning**, Modelling based on consumer behavior of travel choices, Basic principles of travel demand analysis and assumptions.	**9**
2	**Transportation planning process -**Systems approach, Elements/stages of transportation planning process - Goal, objectives and constraints, Trip-based and Activity-based approaches for transportation planning. **Data collection** – Definition of study area, zoning- selection of cordon, Sampling techniques and sample size, Sources of data and types of surveys for planning, **Trip Generation-**	**9**

	Factors influencing grip generation, methods of forecasting trip generation rates- expansion factor, linear regression, category analysis.	
3	**Trip Distribution-** Growth factor methods, Synthetic methods- Gravity models,opportunity model. **Modal Split-** Factors influencing modal split, Types of mode split models – trip end,trip interchange, logit model. **Traffic assignment-** Purpose, Elements of transportation networks- Nodes and links,Methods for traffic assignment	**9**
4	**Transportation and land use -** Role of urban activity analysis in transportationplanning, Transportation impacts on activity system, Land use transportation interaction. **Land use models-** Selection of land use model, Lowry model-Structure, features, Model equation system. **Sustainable transportation-** features, facilities, Transit oriented development, Non transport solutions to transport problems, Transportation demand management, Quickresponse techniques for demand estimation. **Comprehensive Mobility Plan-** objectives and activities involved, Application ofGIS in transport planning	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 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 need for transportation planning, the issues and challenges related totransportation and its interaction with urban structure and land use	**K3**
CO2	Apply the concept of travel demand and analyse its role in transportation planning and to apply the concept in systems approach to transportation planning process.	**K3, K4**
CO3	Apply the concept of delineation of study area, sampling of data, and data collection techniques for the four stage planning process and to analyse the techniques for predicting trip generation.	**K3, K4**
CO4	Apply and analyse the methods for predicting trip distribution, mode split and traffic assignment	**K3, K4**
CO5	Apply the land use transport models and to analyse the sustainable approaches to transportation planning and preparation of comprehensive mobility plan with application of GIS	**K3, K4**

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1	2	1		3	3	3				2
CO2		1	2	2		2		1				2
CO3	2	2	2	3	2	2		1				2
CO4	3	3	3	3	3	2		1				2
CO5	2	1	3	3	3	3	3	3		2	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	Introduction to Transportation Planning	Bruton,M.J	Hutchinson of London	2021
2	Principles of Transportation Engineering	Chakraborthy,P and Das,A	PHI Learning	2nd Ed
3	Traffic Engineering and Transport Planning	Kadiyali, L.R	Khanna Publishers	8th Ed
4	Highway Engineering,	Rogers M	Blackwell Science	

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of Urban Transport Planning	chinson, B G	Tata McGrawHill	1974
2	Metropolitan Transportation Planning	Dickey, J. W	Tata McGrawHill	1975
3	Urban Transportation Planning a Decision Oriented Approach	Mayer, M.D and Miller, E. J ,	Tata McGrawHill	2nd Ed
4	Transportation Engineering and Planning	Papacostas, C. S. and Prevedouros, P.D	Prentice Hall of India Pvt. Ltd.	2012, 3rd Ed

Video Links (NPTEL, SWAYAM…)	
SL.No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/105/105105208/

SEMESTER S8

RURAL WATER SUPPLY AND ONSITE SANITATION SYSTEMS

Course Code	PECET867	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)	PCCET503	Course Type	Theory

Course Objectives:

1. Understand key concepts and the importance of rural water supply and on-site sanitation systems
2. Explore the design, implementation, and sustainability of water supply systems in rural areas
3. Study various on-site sanitation technologies and their applications in rural settings.
4. Develop skills for planning, managing, and evaluating rural water and sanitation projects, considering socio-economic, cultural, and environmental factors.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Rural Water Supply and Sanitation** Overview of Global Water and Sanitation Challenges, Global water crisis: statistics and trends, Importance of water and sanitation in rural development, Sustainable Development Goals (SDGs) related to water and sanitation. Principles of Rural Water Supply, Basic water supply concepts: sources, availability, and quality, Water demand estimation in rural communities, Water supply systems: gravity-fed, pumped, and rainwater harvesting	9

2	**Design and Implementation of Rural Water Supply Systems** Water Source Development, Identifying and protecting water sources: surface water, groundwater, and rainwater, Water source contamination and protection strategies. Water Treatment and Distribution, Water treatment methods: filtration, disinfection, and safe storage, Distribution systems: pipelines, storage tanks, and standpipes, Operation and Maintenance strategies for rural water supply systems, Monitoring and evaluation of water supply services	11
3	**Introduction to On-Site Sanitation** Concepts of on-site sanitation: Importance of sanitation for public health and environment. Design and construction of basic on-site sanitation systems: pit latrines, septic tanks, and composting toilets. Advanced sanitation technologies: biogas digesters, eco-san toilets. Selecting appropriate sanitation systems based on local conditions. Waste Management and Resource Recovery: Faecal sludge management: collection, treatment, and disposal. Resource recovery from sanitation: composting and biogas generation.	9
4	**Planning and Management of Rural Water Supply and Sanitation Projects** Planning water supply and sanitation projects: needs for assessment and feasibility studies. Funding and financing options for rural water and sanitation projects. Stakeholder engagement and community participation. National and international policies on water and sanitation. Regulatory frameworks and standards for rural water and sanitation. Role of government, NGOs, and private sector in rural water and sanitation. Sustainability and Innovation in Water and Sanitation technology in rural areas.	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 global water and sanitation challenges, importance and principles of rural water supply systems	**K2**
CO2	learn to identify, protect, and treat water sources, manage distribution systems, and oversee the operation and maintenance of rural water supply services.	**K3**
CO3	design on-site sanitation systems, select appropriate technologies, and manage waste and resource recovery processes.	**K3**
CO4	plan and assess rural water and sanitation projects, explore funding, engage stakeholders, and apply policies and innovations for sustainable implementation.	**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	2	2	-		2	2					
CO2	3	3	2			2	2				1	
CO3	3	2	3			2	3				1	
CO4	3	3	2			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	Rural water supply and sanitation	Sanjay Gupta	Vayu Education of India	First Edition 2012
2	Rural water supply and sanitation	Sharma J K	Ardent Publications	First Edition 2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Wastewater Engineering, Treatment and Reuse	Metcaff and Eddy	Tata McGrawhill publications	4 th Edition 2017
2	Sewage disposal and air pollution Engineering	S K Garg	Khanna publishers	43 rd edition
3	Manual of water supply and treatment, 3rd edition, CPHEEO, GOI, New delhi			

SEMESTER S8

DESIGN OF EARTHQUAKE RESISTANT STRUCTURES

Course Code	PECET865	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)	PCCET303/ Equivalent	Course Type	Theory

Course Objectives:

1. Apply the basic seismic concepts and building code provisions to the seismic design of structures

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction** – Classification of dynamic loads – essential characteristics of a dynamic problem – methods of discretization– single degree of freedom systems – basic components of a dynamic system. **Formulation of equation of motion** – Newton's 2nd law and D' Alembert's principle generalized SDOF systems. **Solution of the equation of motion** – undamped free vibration – damped free vibration- critically damped under damped and over damped SDOF systems, Logarithmic decrement. (Numerical examples expected, but not derivations) **Response to harmonic loading** – steady state and transient states steady sate amplitude, Dynamic magnification factor. (Numerical examples expected, but not derivations)	9
2	**Base excited SDOF system -** formulation of equation of motion – Response of SDOF base excited systems;	9

	Response spectrum: Concept of pseudo acceleration, velocity. Response spectra, Four-way logarithmic plot – DVA spectrum (concept only). **Multi degree of freedom systems** – 2 DOF systems- Equation of motion- Normal modes of vibrations and natural frequencies, MDOF systems: shear building idealization and equation of motion - Natural frequencies and mode shapes, orthogonality of normal modes. **Forced vibration analysis of MDOF Systems** – Modal expansion of response, Mode superposition method. (concept only)	
3	**Elements of Earthquake Engineering:** Plate tectonics – faults, Earthquake magnitude and intensity, Focus and Epicentre, Energy release and seismic waves. Characteristics of Earthquake, Measurement of ground motion- Seismographs, Seismic zone mapping. **Structural Systems for Seismic Resistance:** Lateral load resisting systems in RC and steel structures. **Building Irregularities:** in elevation – plan – influence of structural classification- Concepts of seismic design- Centre of mass, centre of rigidity, torsional eccentricity **Estimation of Seismic Demand on buildings:** **Seismic coefficient method -** Estimation of base shear and its distribution along height based on Equivalent static method using IS 1893 for multi storied buildings.	**9**
4	**Response spectrum method(RSM):** concept, (Numerical problems in RSM not expected in exams) **Ductility considerations in earthquake resistant design of buildings:** Ductility of R.C structures- significance. Factors influencing ductility. Ductile detailing provisions as per IS-13920 (2016)- for beams, columns, beam-column joints and shear walls. Evaluation of Earthquake proneness of building by preliminary inspection - Rapid Visual Screening Technique	**9**

	NB: Assessment of RSM through submission of course project alone, which involves computer modelling of building, seismic analysis and design and submission of design drawings including ductile detailing provisions.	

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. Identify any requirement for an earthquake resistant structure and complete its design.

Criteria for evaluation:

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

Scoring:

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

4. *Minimal (1 point): Incomplete or significantly flawed.*

End Semester Examination Marks (ESE):

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

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	Apply structural dynamics principles for seismic analysis of structures.	**K3**
CO2	Understand the principles of various lateral load resisting systems for building structures and apply the same to seismic design of structures.	**K3**
CO3	Estimate the seismic demand over structures	**K3**
CO4	Apply the principles of ductile detailing.	**K3**

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

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

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

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Dynamics of Structures- Theory and applications to earthquake engineering	Anil K. Chopra	Prentice Hall	2020
2	Earthquake resistant design of structures	Pankaj Agarwal and Manish Shrikhande	PHI New-Delhi	2017
3	Structural Dynamics	Mario Paz	CBS publishers	2004

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Dynamics of Structures	Clough R.W, J.Penzien	MC GrawHill International	
2	Seismic Design of RC and Masonry Buildings	T Paulay and M J N Priestley	Wiley Inter Seience, 1	1992
3	IS 1893 (2016): Criteria for Earthquake Resistant Design of Structures - Part 1 : General Provisions and Buildings			
4	IS 13920 (2016) Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice			

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://archive.nptel.ac.in/courses/105/101/105101004/

SEMESTER S8

WASTE MANAGEMENT

Course Code	OECET831	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 learn broader understandings on various aspects of solid waste management practiced in industries.
2. To learn recovery of products from solid waste to compost and biogas, incineration and energy recovery, hazardous waste management and treatment, and integrated waste management.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**INTRODUCTION TO SOLID WASTE MANAGEMENT:** Classification of solid wastes (source and type based), solid waste management (SWM), elements of SWM, ESSWM (environmentally sound solid waste management) and EST (environmentally sound technologies), factors affecting SWM, Indian scenario, progress in MSW (municipal solid waste) management in India. Indian and global scenario of e-waste	9
2	**WASTE GENERATION ASPECTS:** Waste stream assessment (WSA), waste generation and composition, waste characteristics (physical and chemical), health and environmental effects (public health and environmental) **COLLECTION, STORAGE, TRANSPORT AND DISPOSAL OF WASTES:** Waste Collection, Storage and Transport: Collection components, storage-containers/collection vehicles, collection operation, transfer station,	9

	waste collection system design, record keeping, control, inventory and monitoring, implementing collection and transfer system.	
3	**WASTE DISPOSAL:** key issues in waste disposal, disposal options and selection criteria, sanitary landfill, landfill gas emission, leachate formation, environmental effects of landfill, landfill operation issues, a case study. **HAZARDOUS WASTE MANAGEMENT AND TREATMENT:** Identification and classification of hazardous waste, hazardous waste treatment, pollution prevention and waste minimization, hazardous wastes management in India.	**9**
4	**WASTE PROCESSING TECHNIQUES & SOURCE REDUCTION, PRODUCT RECOVERY & RECYCLING:** Purpose of processing, mechanical volume and size reduction, component separation, drying and dewatering. Source Reduction, Product Recovery and Recycling: basics, purpose, implementation monitoring and evaluation of source reduction, significance of recycling, planning of a recycling programme, recycling programme elements, commonly recycled materials and processes, E-waste recycling,a case study.	**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 basics of solid waste management towards sustainable development	**K2**
CO2	Undestand technologies to process waste and dispose the same.	**K2**
CO3	Design working models to convert waste to energy	**K3**
CO4	Identify and classify hazardous waste and manage the hazard	**K2**

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					3	3					2
CO2	3					3	3					2
CO3	3					3	3					2
CO4	3					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	Integrated Solid Waste Management, Engineering Principles and Management Issues	Tchobaanoglous, G., Theisen, H., and Samuel A Vigil,	McGraw-Hill Publishers	2014
2	Waste Management	Bilitewski B., Hard He G., Marek K., Weissbach A., and Boeddicker H	Springer	1994
3	Waste Management Practices: Municipal, Hazardous and Industrial,	John Pichtel	CRC Press	2014, 2nd Edition
4	Solid Waste Engineering	Vesilind PA, Worrell W and Reinhart D	Brooks/Cole Thomson Learning Inc	2010, 2nd Edition
5	Thermo-chemical Processing of Biomass: Conversion into Fuels, Chemicals and Power	Robert C. Brown	John Wiley and Sons, USA	2019

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Integrated solid waste management: a life cycle inventory	White, F. R., Franke P. R., & Hindle M.	McDougall,P. John Wiley & Sons.	2001
2	Handbook of solid waste management and waste minimization technologies	Nicholas, P., & Cheremisinoff, P. D.	Imprint of Elsevier Science	2005
3	Environmental Engineering	Peavy, H.S, Rowe, D.R., and G. Tchobanoglous	,McGraw Hill Education	2017, 1st Indian Edition
4	Waste Management Practices,	John Pichtel	CRC Press, Taylor and Francis Group	2005.
5	Hazardous Waste Management	LaGrega, M.D.Buckingham,P.L. and Evans, J.C.	McGraw Hill International Editions, New York	2010
6	Solid Waste Management - Present and Future Challenges,	Jagbir Singh, Ramanathan, AL.	I.K. International publishing House Pvt.Ltd., India.	2019
7	Manual on Municipal Solid Waste Management	CPHEEO	Ministry of Urban Development, India	2016

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	http://cpheeo.gov.in/cms/manual-on-municipal-solid-waste-management-2016.php
2	https://nptel.ac.in/courses/105/103/105103205/
3	https://nptel.ac.in/courses/120/108/120108005/
4	https://nptel.ac.in/courses/105/106/105106056/
5	https://nptel.ac.in/courses/105/105/105105160
6	https://nptel.ac.in/courses/103/107/103107125/
7	https://nptel.ac.in/courses/105103205
8	https://www.youtube.com/watch?v=k0ktJRoRcOA
9	https://nptel.ac.in/courses/103/107/103107125/
10	https://onlinecourses.nptel.ac.in/noc22_ce76/preview
11	https://onlinecourses.swayam2.ac.in/cec20_ge13/preview

SEMESTER S8

RAINWATER HARVESTING

Course Code	OECET832	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 students with the important aspects of Rain water harvesting system.
2. To impart the knowledge about the various hydrologic phenomena and their relevance in the field of water conservation.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction: Hydrologic cycle, Advantages of Rainwater, Factors affecting run off from catchment, Important points relating to water storage and recharging, Rainwater harvesting, Components of rain water harvesting, Catchment area, harvesting structures, soil moisture conservation, check dams, artificial recharge, farm ponds, percolation tanks.	9
2	Water harvesting: Principles, importance and issues, Water harvesting techniques – classification based on source, storage and use. Rain water harvesting methods, storing rain water for direct use, Recharging ground water aquifers from roof top runoff, Recharging ground water aquifers with runoff from ground areas, Modular Rain Water Harvesting System- Coarse mesh/leaf screen Gutter - Down spout/Conduit - First flushing device Filter- Sand Filter- Charcoal Water Filter	9
3	Recharging subsurface Aquifers: Methods of recharging subsurface aquifers- through recharge pit - recharge through abandoned hand pump - recharge through abandoned dug well/ open well - through recharge trench - recharge through shafts - recharge trench with bore	9

4	Artificial Recharge - Concept of artificial recharge of groundwater, recharge methods – basin - stream - channel, ditch and furrow, flooding and recharge well methods, recharge mounds and induced recharge. Concepts of Watershed - need for watershed development in India, Planning of watershed management – Drainage - ,watershed management for rainwater harvesting,	**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 different components of Rain water harvesting system	**K1**
CO2	Describe the concept of Artificial Recharge and methods for groundwater storage	**K3**
CO3	To study the watershed development and management with reference to Rain water harvesting system	**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	1			1		
CO2	3					1	2			1		
CO3	3	1	2		1	2	1		1	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	Groundwater Hydrology	Larry W. Mays, David Keith Todd	John Wiley & Sons,	2004
2	Groundwater and Wells	Edward E. Johnson S.I	Johnson Screens	2007

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Traditional Rainwater Harvesting Structures	Joji V.S., Reshma Susan Jacob	Springer Nature Switzerland,	2023
2	Designing Rainwater Harvesting Systems Integrating Rainwater Into Building Systems	Celeste Allen Novak, Eddie Van Giesen, Kathy M. DeBusk	Wiley	2014
2	Rainwater Harvesting Techniques to augment Groundwater: Ministry of Water Resources			

SEMESTER S8

PUBLIC TRANSPORTATION SYSTEMS

Course Code	OECET833	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To comprehend the Fundamental Concepts of Public Transit Systems
2. To Develop and Evaluate Transit Service and Operational Plans
3. To Plan and Analyze Transit Lines and Networks
4. To analyze performance and economic aspects of Transit Systems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Operating Elements of Public Transit, public transport travel characteristics, Transit travel characteristics: factors, spatial distribution, temporal variations, Passenger volume analysis and service capacity determination, Introduction to transit service planning, Operational planning process, Service and evaluation standards, Data requirements and collection, Frequency and Headway distributions, Scheduling of service and timetabling.	9
2	Transit Line Capacity: Elements and Computation, Systems approach to transit line capacity, Capacities of different modes, Level Service measures, Speed of Transit Service, Passenger demand: factors and elasticity. Stops and stopping regimes: Definitions and relationships, Practical and optimal values	9

	of stop spacing, Comparison of all-stop, skip-stop, zonal and express/local operations	
3	Transit Lines and Networks: Planning objectives, principles and considerations, Geometry of transit lines, Types of transit lines and their characteristics, Transfers in transit networks, Analysis of metro network geometric forms, Transit System Statistics, Route choice and assignment	**9**
4	Introduction to Network design and service design, Performance and Economic Measures: Revenues, costs and operating ratio, Transit Fares: Fare structure and Collection, Costing and cost allocation methods, Modern Approaches in Transit planning: Information System for Passengers, Application of ITS.	**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	Comprehend the Fundamental Concepts of Public Transit Systems	**K2**
CO2	Develop and Evaluate Transit Service and Operational Plans	**K3**
CO3	Plan and Analyze Transit Lines and Networks	**K3**
CO4	Measure and analyze performance and economic aspects of Transit Systems	**K3**

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

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

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

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Public Transit Planning and Operation: Theory, Modelling and Practise,	Ceder, Avishai	Elsevier, Oxford, UK	2007
2	Public Transport: Its Planning, Management and Operation	White, Peter	Taylor & Francis, London.	2008
3	Urban Transit: Operations, Planning and Economics	Vuchic, Vukan R.	Wiley, New Jersy.	2005

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Transportation Engineering– An Introduction	Khisty, C J.	Prentice-Hall, New Jersy	2002
2	Transit Capacity and Quality of Service Manual	Transit Cooperative Research Program	Transportation Research Board, Washington,D.C	2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_ce70

SEMESTER S8

FUNDAMENTALS OF BUILDING PLANNING

Course Code	**OECET834**	**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 enable students to develop creative and sustainable building design

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Definition of architecture –Historical development of architecture. Principles of architectural composition – Unity/ harmony – character– balance – proportion – scale –rhythm — Accentuation and contrast. Organising principles in architecture – Symmetry – hierarchy – axis – linear – concentric, radial – and asymmetric grouping – primary and secondary masses. Form and Space in architecture – Positive and negative space – Defining space with horizontal and vertical elements -qualities of architectural space Architecture Design Process: The 7 phases : The pre-design phase: The schematic design phase: The design development phase: The construction documents phase: The building permit phase: The bidding and negotiation phase: The construction administration phase.	
2	Acoustics, fundamentals: Intensity of sound- Watts/m2- Bel- Decibel scales- dBA-Phon. Addition of sound levels. Acoustical Defects- Echoes, Reverberation, Foci and Dead Spots, Loudness, Noise	

	Sound absorption-materials and fixings. Natural lighting: Visual task requirements, Units of Light, Light, Vision and Buildings, Standards of Lighting and Visual comfort-The sky as a source of light, Daylight factor, Recommended daylight factors for interiors.	
3	Thermal comfort: Factors affecting thermal comfort- effective Temperature Thermal comfort indices-ET-CET Charts- Bioclimatic chart- Psychrometry and Psycrometric chart. Earth-Sun relationship: Sun's apparent movement with respect to the earth. Solar angles Thermal design of buildings: Thermo physical properties of building materials and thermal control-. Functional protection: Causes of fire, Mechanism of fire spread in buildings, classification of fire-High temperature effects and combustibility of building materials and structure	
4	Architecture Design aspect: basic anthropometrics- human functions and their implications for space requirements- movement and circulation diagrams-special interpretations- various activities and their relationship with spaces Energy efficiency in buildings – Energy assessment in buildings – Green building rating guidelines	

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	Use principles of architectural composition and organization for development of building form and planning of functional spaces in buildings.	**K3**
CO2	Show good understanding of the comprehensive architectural design process, from the pre-design stage to construction management.	**K3**
CO3	Adopt principles of acoustics and lighting for efficient functional design of buildings.	**K3**
CO4	Show good understanding of fire protection methods for efficient and safe function of buildings.	**K3**
CO5	Apply climate conscious architectural principles for creating energy efficient buildings.	**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										2
CO2	2	1										2
CO3	2	1					2					2
CO4	2	1										2
CO5	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	A global history of architecture	Francis D. K. Ching , Mark M. Jarzombek , Vikramaditya Prakash	Wiley	3rd edition 2017
2	Architecture: Form, Space, and Order	Francis D. K. Ching	Wiley	5th edition 2023
3	Architecture And Town Planning	Satish Chandra Agarwala	Dhanpath Rai &Co	2018
4	Architectural Engineering Design: Mechanical Systems	Robert Butler Brown	Mc Graw Hill	1st edition
5	Building Services Engineering	David Chadderton	T&F India	6th Edition 2017
6	Architectural Acoustics	Marshall Long	Academic Press	2014
7	Lighting	Pritchard, D.C	Longman Scientific & Technical, Harlow	1995
8	Daylight in Architecture	Benjamin Evans	McGraw - Hill Book Company	1981
9	Building Environment	AjithaSimha.D	Tata McGraw Hill Publishing Co	1985

10	Design and Installation of Services in Building complexes &High Rise Buildings	Jain. V.K.,	Khanna Tech. Publishers	1986
11	A text book of Vastuvidya	A. Achyuthan, Balagopal. T.S. Prabhu	Vastuvidyaparatishthanam	1996
12	Manual of tropical Housing and Building Part I – Climatic design	Koenigseberger	Orient Longman	2011

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Architecture: From Prehistory to Climate Emergency	Barnabas Calder	Pelican	2021
2	Building construction illustrated	Francis D. K. Ching	**Wiley**	6th edition 2017
3	Architectural Engineering Design: Mechanical Systems	Robert Butler Brown	Mc Graw Hill	1st edition
4	Acoustical Design in Architecture	Knudsen V.O. and Harris C.M	John Wiley	1980
5	Energy Efficient Buildings: Architecture, Engineering, and Environment	Wayne Forster and Dean Hawkes	W.W. Norton Company Inc	2002
6	Bureau of Indian standards, Handbook on Functional Requirement of Buildings – SP:41(S and T)-1987			
7	National Building Code of India (latest revisions to be refered)			
8	Bureau of Energy Efficiency, India. Design Guidelines for Energy Efficient Multi-Storey Buildings,2014.			

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/124/107/124107005/ https://nptel.ac.in/courses/124107012
2	https://archive.nptel.ac.in/courses/105/102/105102175/
3	https://archive.nptel.ac.in/courses/105/107/105107156/
4	https://nptel.ac.in/courses/101104065 https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ar03/

SEMESTER S8

HYDROGEOLOGY

Course Code	OECET835	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)	PECET416	Course Type	Theory

Course Objectives:

1. Understand Groundwater Origin and Occurrence: Gain foundational knowledge necessary for advanced hydrogeological studies.
2. Identify Geologic Structures Favourable to Groundwater Movement: Learn to describe and assess structures that influence groundwater availability and flow.
3. Apply Groundwater Exploration Principles: Develop practical skills for locating water resources and evaluating groundwater quality.
4. Analyse Groundwater Conditions Across Different Terrains: Formulate strategies for managing and protecting groundwater resources.
5. Overview of Groundwater Impacts on Civil Engineering Structures: Understand how groundwater affects civil engineering projects and structures.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Groundwater- origin and occurrence. Hydrological cycle. Geologic structures favouring groundwater occurrence and movement. Vertical distribution of groundwater. Water table. Groundwater reservoirs – aquifer, aquiclude, aquifuge and aquitard. Types of aquifers– unconfined, confined, leaky and bounded aquifers – artesian aquifers; springs and their types. Hydrological	9

	characteristics of aquifers and aquifer properties: Porosity, Permeability, Void Ratio, Specific Yield and Specific Retention – Aquifer parameters– Hydraulic conductivity, Transmissivity and Storativity. Hydraulic Conductivity determination – Lab tests – Permeameter methods and Field tests – Auger Hole test, Tracer test and Pump test	
2	Groundwater exploration- Remote sensing and GIS applications. Geophysical methods of groundwater exploration: Principles of electrical resistivity method- Wenner and Schlumberger methods. Subsurface investigations- test drilling, resistivity logging, SP logging, radiation logging- brief description. Groundwater movement – Water table and Piezometric level (surface) – Theory of groundwater flow – Darcy's law and its experimental verification – differential equation governing groundwater flow. Groundwater level fluctuations	**9**
3	Well design criteria. Water wells– types of wells. Methods for drilling deep wells. Quality of groundwater-domestic, irrigation and industrial & construction purpose. Chemical characteristics of groundwater – Graphical representation of water quality data: Interpretation of hydrochemical analysis data: Hill-Piper Trilinear diagram, Durov's diagram and U. S. Salinity diagram – Sodium Adsorption Ratio (SAR). WHO, BIS and ISI water quality standards. Biological health of groundwater	**9**
4	Saline water intrusion in coastal and other aquifers and its prevention. Ghyben-Herzberg relationship– methods and need for artificial recharge to aquifers. Groundwater management. Groundwater development– safe yield and optimal mining policy. Relation between geomorphology of a terrain and its hydrogeological condition. Problems created by groundwater in the construction phase of mega civil engineering projects. Groundwater provinces of India. Groundwater conditions in Kerala	**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	A comprehensive understanding of the origin, occurrence and storage of groundwater	**K2**
CO2	Identify and describe geologic structures that favour groundwater occurrence and movement, including the vertical distribution of groundwater and water table dynamics	**K2**
CO3	Apply the principles of geospatial and geophysical methods for ground water exploration	**K3**
CO4	Evaluate the quality of groundwater for human consumption, irrigation and industrial & construction purpose.	**K3**
CO5	Evaluate the groundwater conditions across various terrains and assess the level of groundwater contamination for formulating approaches for groundwater conservation	**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	2										2
CO3	3	2	2									1
CO4	3					2	2					1
CO5	3	2				2	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	Groundwater Hydrology	Bouwer,	McGraw-Hill	1978.
2	Hydrogeology	Davis, S.N. and Dewiest, R.J.N.	John Wiley and Sons Inc. New York,	1966.
3	Hydrogeology, Principle and Practice	Kevin M. Hiscock, Victor F. Bense	Wiley	2021
4	Groundwater geophysics,	Krisch R	Springer - Verlag	2008
5	Groundwater	Reghunath,	Wiley Eastern Limited.	3rd Edn. 2007

Reference Texts				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Hydrogeology: Groundwater Science and Engineering	Alain Dassargues	**CRC Press**	2018
2	Introduction to Hydrogeology Unesco-IHE Delft Lecture Note Series	J.C. Nonner, Johannes Nonner	CRC Press	2010