# 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.<br>• Total of 8 Questions, each carrying 3 marks<br>**(8x3 =24marks)** | • Each question carries 9 marks.<br>• Two questions will be given from each module, out of which 1 question should be answered.<br>• Each question can have a maximum of 3 sub divisions.<br>**(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.<br>**Geometric design of highways:** Design controls and criteria, Design of highway cross section elements.<br>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<br>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<br>**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<br>**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).<br>**Traffic Surveys:** Data collection and Analysis - Volume, speed, O&D, parking studies<br>**Types of intersections** - At grade and grade separated intersections.<br>**Traffic signal systems:** Types, Design of isolated signals by Webster's method- Warrants for traffic signal installation<br>**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.<br>**Harbours:** classification, features, requirements. Break waters - necessity and functions, classification.<br>**Docks** – Functions and types - dry docks, wet docks<br>**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.<br>• Total of 8 Questions, each carrying 3 marks<br>**(8x3 =24marks)** | • Each question carries 9 marks.<br>• Two questions will be given from each module, out of which 1 question should be answered.<br>• Each question can have a maximum of 3 sub divisions.<br>**(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<br>Systems of sewerage: separate and combined<br>Layout plan of a conventional water treatment plant- site selection-Intakes-Screening-types of screens -aeration -aerator types<br>Theory and principles of sedimentation-Stoke's Law-Types of settling - Design of plain sedimentation tanks<br>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.<br>Disinfection of water - various methods - advantages and limitations.<br>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)<br>Trickling filter (Concept only)- types- construction & operation-design of trickling filter.<br>Activated sludge process- basic concepts-design of a conventional Activated Sludge Plant. | |
| **4** | Up flow Anaerobic Sludge Blanket (UASB) reactor (Concept only).<br>Natural waste water treatment systems-Oxidation Ponds and Lagoons-Wetlands and Rootzone systems (Concepts only).<br>Low-cost sanitation systems- Design of a septic tank and soak-pit.<br>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.<br>• Total of 8 Questions, each carrying 3 marks<br>**(8x3 =24marks)** | • Each question carries 9 marks.<br>• Two questions will be given from each module, out of which 1 question should be answered.<br>• Each question can have a maximum of 3 sub divisions.<br>**(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]<br>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<br>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<br>Failure mechanism (General, local and punching shear failure) – situations in which each of them can be expected.<br>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<br>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<br>Design of Isolated Footing-Combined footings- Rectangular and Trapezoidal combined footings - Numerical problems<br>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.<br>• Total of 8 Questions, each carrying 2 marks<br>**(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.<br>**(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.<br>**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.<br>• Total of 8 Questions, each carrying 3 marks<br>**(8x3 =24marks)** | • Each question carries 9 marks.<br>• Two questions will be given from each module, out of which 1 question should be answered.<br>• Each question can have a maximum of 3 sub divisions.<br>**(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<br>**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.<br>**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.<br>**Prefabricated construction**: Advantages and disadvantages, prefabricated components.<br>**Pre-Engineered Buildings**: Introduction – Advantages - Pre-Engineered Buildings Vs Conventional Steel Buildings – Applications<br>Basic concept of **prestressing**: Fundamental understanding of pre-tensioned and post-tensioned construction.<br>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.<br>• Total of 8 Questions, each carrying 3 marks<br>**(8x3 =24marks)** | • Each question carries 9 marks.<br>• Two questions will be given from each module, out of which 1 question should be answered.<br>• Each question can have a maximum of 3 sub divisions.<br>**(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.<br>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.<br>• Total of 8 Questions, each carrying 3 marks<br>**(8x3 =24marks)** | • Each question carries 9 marks.<br>• Two questions will be given from each module, out of which 1 question should be answered.<br>• Each question can have a maximum of 3 sub divisions.<br>**(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.<br>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,<br>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.<br>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.<br>• Total of 8 Questions, each carrying 3 marks<br>**(8x3 =24marks)** | • Each question carries 9 marks.<br>• Two questions will be given from each module, out of which 1 question should be answered.<br>• Each question can have a maximum of 3 sub divisions.<br>**(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.<br>• Total of 8 Questions, each carrying 3 marks<br>**(8x3 =24marks)** | • Each question carries 9 marks.<br>• Two questions will be given from each module, out of which 1 question should be answered.<br>• Each question can have a maximum of 3 sub divisions.<br>**(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.<br>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.<br>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<br>Slums: Causes, characteristics and effects of slums, Slum clearance.<br>Industries: Classification of industry, Concentration of industry, requirements of the industry, Industrial townships.<br>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.<br>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.<br>• Total of 8 Questions, each carrying 3 marks<br>**(8x3 =24marks)** | • Each question carries 9 marks.<br>• Two questions will be given from each module, out of which 1 question should be answered.<br>• Each question can have a maximum of 3 sub divisions.<br>**(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.<br>• Total of 8 Questions, each carrying 3 marks<br>**(8x3 =24marks)** | • Each question carries 9 marks.<br>• Two questions will be given from each module, out of which 1 question should be answered.<br>• Each question can have a maximum of 3 sub divisions.<br>**(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<br>**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.<br>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.<br>**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.<br>Conceptual design and detailing of Prestressed deck<br>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.<br>• Total of 8 Questions, each carrying 3 marks<br>**(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.<br>**(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