

**SEMESTER 6**

**CIVIL ENGINEERING**

## SEMESTER S6

### QUANTITY SURVEYING AND VALUATION

<b>Course Code</b>	<b>PCCET601</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	PCCEL218	<b>Course Type</b>	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 equip 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

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	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.	<b>9</b>

2	<p>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).</p>	9
3	<p>Detailed Estimate- Preparation of detailed measurement using Centre line method &amp; 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.</p> <p>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.</p> <p>Road estimation-Estimation of earthwork from longitudinal section-metalead 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</p>	9
4	<p>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)</p>	9

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

**Continuous Internal Evaluation Marks (CIE):**

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

**End Semester Examination Marks (ESE)**

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions out of three questions from Module III and Module IV.*

Part A	Part B	Total
<ul style="list-style-type: none"> <li>2 Questions from each module I &amp; II</li> <li>Total of 4 Questions, each carrying 3 marks</li> </ul> <p style="text-align: center;"><b>(4 x 3 =12 marks)</b></p>	<ul style="list-style-type: none"> <li>Three questions will be given from <b>Module-III</b>, out of which 2 questions should be answered. (2 x 20=40 Marks)</li> <li>Three questions will be given from <b>Module-IV</b>, out of which 2 questions should be answered (2 x 4 =8 Marks)</li> </ul> <p style="text-align: center;"><b>(40+8 =48 Marks)</b></p>	<b>60</b>

### Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
<b>CO1</b>	Define basic terms related to estimation, quantity surveying and contract document	<b>K1</b>
<b>CO2</b>	Interpret the item of work from drawings and explain its general specification and unit of measurement.	<b>K2</b>
<b>CO3</b>	Make use of given data from CPWD DAR/DSR for calculating the unit rate of different items of work associated with building construction.	<b>K3</b>
<b>CO4</b>	Prepare detailed measurements (including BBS) and BoQ of various work like buildings, earthwork for road, sanitary and water supply work	<b>K3</b>
<b>CO5</b>	Explain various basic terms related to the valuation of land and building.	<b>K1</b>
<b>CO6</b>	Prepare valuation of buildings using different methods of valuation.	<b>K3</b>

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
<b>CO1</b>	2	-	-	-	-	-	-	-	-	-	-	-
<b>CO2</b>	2	-	-	-	-	-	-	-	-	-	-	-
<b>CO3</b>	3	2	-	-	-	-	-	-	-	-	-	-
<b>CO4</b>	3	2	-	-	-	-	-	-	-	-	2	-
<b>CO5</b>	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	28 <sup>th</sup> 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. Chakraborty	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 Voll & 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

<b>Course Code</b>	<b>PCCET602</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	PCCET501	<b>Course Type</b>	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

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	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.	<b>9</b>
<b>2</b>	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	<b>9</b>
<b>3</b>	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	<b>9</b>

	columns . Design of column bases - Slab base and Gusset base	
<b>4</b>	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	<b>9</b>

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

**Continuous Internal Evaluation Marks (CIE):**

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

**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*

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



### Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
<b>CO1</b>	Explain the behaviour and properties of structural steel members to resist various structural forces and actions and apply the relevant codes of practice	<b>K2</b>
<b>CO2</b>	Analyse the behaviour of structural steel members and undertake design at both serviceability and ultimate limit states	<b>K3</b>
<b>CO3</b>	Explain the theoretical and practical aspects of design of composite steel structure with design aspects	<b>K3</b>
<b>CO4</b>	Apply a diverse knowledge of design of steel engineering practices applied to real life problems.	<b>K3</b>
<b>CO5</b>	Demonstrate experience in the implementation of design of structures on engineering concepts which are applied in field of Structural Engineering	<b>K3</b>

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
<b>CO1</b>	3	-	-	-	-	-	-	-	-	-	-	-
<b>CO2</b>	2	3	2	-	-	-	-	-	-	-	-	-
<b>CO3</b>	2	3	2	-	-	-	-	-	-	-	-	-
<b>CO4</b>	2	3	3	-	-	-	-	-	-	-	-	-
<b>CO5</b>	2	3	3	-	-	-	-	-	-	-	-	-

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

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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

<b>Reference Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>Module No.</b>	<b>Link ID</b>
<b>1</b>	<a href="https://archive.nptel.ac.in/courses/105/105/105105162/">https://archive.nptel.ac.in/courses/105/105/105105162/</a>
<b>2</b>	<a href="https://archive.nptel.ac.in/courses/105/105/105105162/">https://archive.nptel.ac.in/courses/105/105/105105162/</a>
<b>3</b>	<a href="https://archive.nptel.ac.in/courses/105/105/105105162/">https://archive.nptel.ac.in/courses/105/105/105105162/</a>
<b>4</b>	<a href="https://archive.nptel.ac.in/courses/105/105/105105162/">https://archive.nptel.ac.in/courses/105/105/105105162/</a>

## SEMESTER S6

### ADVANCED DESIGN OF CONCRETE STRUCTURES

<b>Course Code</b>	<b>PECET631</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	PBCET404 ,PCCET602	<b>Course Type</b>	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

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	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	<b>9</b>
<b>2</b>	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	<b>9</b>
<b>3</b>	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.	<b>9</b>

	Flat slabs – Introduction–components–IS Code recommendations– IS code method of design of interior panel (with and without column drop).	
<b>4</b>	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	<b>9</b>

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

**Continuous Internal Evaluation Marks (CIE):**

<b>Attendance</b>	<b>Assignment/ Microproject</b>	<b>Internal Examination-1 (Written)</b>	<b>Internal Examination- 2 (Written)</b>	<b>Total</b>
<b>5</b>	<b>30</b>	<b>10</b>	<b>10</b>	<b>40</b>

**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*

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

**Course Outcomes (COs)**

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

Course Outcome		Bloom's Knowledge Level (KL)
<b>CO1</b>	Design and detail cantilever retaining wall and understand the design principles of Counter fort retaining wall. And Design and detail deep beams and corbels	<b>K2, K3</b>
<b>CO2</b>	Design and detail water tanks as per IS code provisions	<b>K3</b>
<b>CO3</b>	Explain Concept of yield line theory and design of different slab using yield line theory Design of Flat slabs using IS code provisions.	<b>K2, K3</b>
<b>CO4</b>	Analyse and design Cold form light gauge section.	<b>K3</b>
<b>CO5</b>	Use of latest industry standard formula, table, design aids used for design of beams and portal frames under pattern loading.	<b>K2, K3</b>

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
<b>CO1</b>	2	-	1	-	-	1	-	-	-	1	-	-
<b>CO2</b>	3	1	1	-	-	-	-	-	-	1	-	-
<b>CO3</b>	3	2	3	-	-	-	-	-	-	1	-	-
<b>CO4</b>	3	2	3	-	-	-	-	-	-	1	-	-
<b>CO5</b>	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.	10 <sup>th</sup> Ed 2015
2	Design of Steel Structures Vol. I	Ramchandra S and Virendra Gehlot	Standard Book House, 2007	12 <sup>th</sup> Ed 2018
3	Advanced Reinforced Concrete Design (IS: 456-2000)	N. Krishna Raju	CBS Publishers & Distributors	3 <sup>rd</sup> 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.	4 <sup>th</sup> Edition 2021
2	Advanced Reinforced Concrete Design	Varghese P.C	Prentice Hall of India Pvt Ltd	2 <sup>nd</sup> 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	2 <sup>nd</sup> Edition 2016

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	<a href="https://archive.nptel.ac.in/courses/">https://archive.nptel.ac.in/courses/</a>
2	<a href="https://archive.nptel.ac.in/courses/">https://archive.nptel.ac.in/courses/</a>
3	<a href="https://archive.nptel.ac.in/courses/">https://archive.nptel.ac.in/courses/</a>
4	<a href="https://archive.nptel.ac.in/courses/">https://archive.nptel.ac.in/courses/</a>

## SEMESTER S6

### IRRIGATION AND DRAINAGE ENGINEERING

<b>Course Code</b>	<b>PECET632</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	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

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	<p><b>Surface Irrigation methods:</b> 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.</p> <p><b>Crop Water Requirements :</b> 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</p> <p><b>Irrigation Water Distribution:</b> Canal network and canal regulation – Methods of distribution: supply based and demand based – Delivery of water</p>	<b>9</b>

	to farms –Measurement of water – Scheduling of irrigation – Criteria for scheduling, constraints – Frequency and interval of irrigation.	
2	<p><b>Irrigation System Performance Indicators:</b> Systems classification – Rehabilitation and modernization – Performance indicators – Improving system performance –constraints.</p> <p><b>Land Drainage systems:</b> necessity-types-surfaces and subsurface drainage-design considerations.</p> <p><b>SoilWater Zone:</b> 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.</p>	9
3	<p><b>Drainage studies</b>-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.</p> <p><b>Flow into open drains</b>-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.</p> <p><b>Unsteady state drainage equations</b>-Glover Dum equation, application, concept of Kraijenhoff Vande Leur Mass land equation, application- analysis for constant recharge, intermittent recharge cases.</p>	9
4	<p><b>Layout of open drainage systems:</b> 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</p> <p><b>Salinity and drainage</b>- cause of salinity, salt balance equation, leaching efficiency, salt equilibrium equation and leaching requirement – salt storage</p>	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. <b>Gravity outlet structures-</b> types, location.	
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**Course Assessment Method**  
(CIE: 40 marks, ESE: 60 marks)

**Continuous Internal Evaluation Marks (CIE):**

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

**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*

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

### Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
<b>CO1</b>	Design surface drainage systems for drainage of agricultural lands	<b>K3</b>
<b>CO2</b>	Understand the concepts of systems used for subsurface drainage of water-logged lands	<b>K2</b>
<b>CO3</b>	Assess the leaching requirement of salt affected soils	<b>K3</b>

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
<b>CO1</b>	3	3	-	-	-	-	-	-	-	-	-	-
<b>CO2</b>	3	2	-	-	-	-	-	-	-	-	-	-
<b>CO3</b>	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	<a href="https://archive.nptel.ac.in/courses/126/105/126105010/">https://archive.nptel.ac.in/courses/126/105/126105010/</a>
2	<a href="https://archive.nptel.ac.in/courses/126/105/126105010/">https://archive.nptel.ac.in/courses/126/105/126105010/</a>
3	<a href="https://archive.nptel.ac.in/courses/126/105/126105010/">https://archive.nptel.ac.in/courses/126/105/126105010/</a>
4	<a href="https://archive.nptel.ac.in/courses/126/105/126105010/">https://archive.nptel.ac.in/courses/126/105/126105010/</a>

## SEMESTER S6

### GROUND IMPROVEMENT TECHNIQUES

<b>Course Code</b>	<b>PECET633</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	PBCET 504	<b>Course Type</b>	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

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	<b>Introduction</b> 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 <b>Drainage and dewatering:</b> - well point system, shallow & deep well system, vacuum method, electro osmosis method. Comparison between methods	<b>9</b>
<b>2</b>	<b>Compaction</b> -Introduction, compaction mechanics, Field procedure, surface compaction, Dynamic Compaction, selection of field compaction procedures, compaction quality control. <b>Drainage Methods-</b> 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. <b>Pre-compression and Vertical Drains:</b> Importance, Vertical drains, Sand drains, Drainage of slopes, Electro kinetic dewatering, Preloading.	<b>9</b>

3	<p><b>Chemical Modification-</b> 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.</p> <p>Lime stabilization – suitability, process, criteria for lime stabilization. Bitumen, tar or asphalt in stabilization.</p> <p><b>Vibration Methods:</b> Introduction, Vibro compaction – blasting, vibratory probe, Vibro displacement compaction – displacement piles, vibro flotation, sand compaction piles, stone columns, heavy tamping</p>	9
4	<p><b>Grouting And Injection:</b> Introduction, Effect of grouting. Chemicals and materials used. Types of grouting. Grouting procedure, Applications of grouting.</p> <p><b>Reinforced earth:</b> - 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.</p> <p>Soil nailing &amp; Micro pile-basic concept-construction sequence-areas of application-design considerations-merit and demerit</p> <p>Earth Reinforcement-Reinforcement materials-reinforced earth wall-design considerations-construction procedure</p>	9

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

**Continuous Internal Evaluation Marks (CIE):**

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

### End Semester Examination Marks (ESE)

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

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

### 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

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
1	Ground Improvement Techniques	P. Purushothama Raj	Laxmi Publications (P) Ltd.	1 <sup>st</sup> & 1999
2	Engineering Principles of Ground Modification	Manfred. R. Hausmann	McGraw Hill	1 <sup>st</sup> & 1989
3	Reinforced soil and its engineering applications	Swami Saran	I. K. International Pvt Ltd	1 <sup>st</sup> & 2010

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

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>Module No.</b>	<b>Link ID</b>
<b>1</b>	<a href="https://onlinecourses.nptel.ac.in/noc23_ce78/preview">https://onlinecourses.nptel.ac.in/noc23_ce78/preview</a>
<b>2</b>	<a href="https://onlinecourses.nptel.ac.in/noc23_ce78/preview">https://onlinecourses.nptel.ac.in/noc23_ce78/preview</a>
<b>3</b>	<a href="https://onlinecourses.nptel.ac.in/noc23_ce78/preview">https://onlinecourses.nptel.ac.in/noc23_ce78/preview</a>
<b>4</b>	<a href="https://onlinecourses.nptel.ac.in/noc23_ce78/preview">https://onlinecourses.nptel.ac.in/noc23_ce78/preview</a>

## SEMESTER S6

### REPAIR AND REHABILITATION OF STRUCTURES

<b>Course Code</b>	<b>PECET634</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	PBCET404	<b>Course Type</b>	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

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



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

	Epoxy injection, Shoring, Underpinning. <b>Demolition Techniques</b> - 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.	
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**Course Assessment Method**  
**(CIE: 40 marks, ESE: 60 marks)**

**Continuous Internal Evaluation Marks (CIE):**

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

**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*

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

### Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
<b>CO1</b>	Understand the various distress and damages to concrete and masonry structures	<b>K2</b>
<b>CO2</b>	Examine the damages of the structure using required tests with required surface preparations.	<b>K3</b>
<b>CO3</b>	Understand the types and properties of repair materials and apply various techniques for repairing damaged and corroded structures.	<b>K3</b>
<b>CO4</b>	Proposing wholesome solutions for maintenance /rehabilitation and applying methodologies for repairing and demolishing structures.	<b>K3</b>

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
<b>CO1</b>	2	1	-	-	-	-	-	-	-	-	-	-
<b>CO2</b>	2	2	1	-	-	-	-	-	-	-	-	-
<b>CO3</b>	2	2	1	1	-	-	-	-	-	-	-	-
<b>CO4</b>	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	<a href="https://youtu.be/NdLwHk-A0hc">https://youtu.be/NdLwHk-A0hc</a>
2	<a href="https://youtu.be/sjyYppF-uKQ">https://youtu.be/sjyYppF-uKQ</a>
3	<a href="https://youtu.be/P-PFYAIg-3E">https://youtu.be/P-PFYAIg-3E</a>
4	<a href="https://youtu.be/geYZYg8csYQ">https://youtu.be/geYZYg8csYQ</a>

## SEMESTER S6

### SOLID AND HAZARDOUS WASTE MANAGEMENT

<b>Course Code</b>	<b>PECET636</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	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

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	<b>Introduction</b> 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	<b>9</b>
<b>2</b>	<b>Functional Elements</b> 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.	<b>9</b>
<b>3</b>	<b>Disposal Of Solid Waste</b> 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	<b>9</b>

	Thermo chemical methods -incineration, gasification and pyrolysis, types of incinerators -parts of an incinerator-incinerator effluent gas and composition, advantages and disadvantages	
<b>4</b>	<b>Hazardous Waste</b> Hazardous waste –Definition and Identification, Classification, Handling and Storage, Collection, Transportation Treatment and remedial actions, Stabilization and Solidification, Thermal methods, Secure Landfill	<b>9</b>

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

**Continuous Internal Evaluation Marks (CIE):**

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

**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*

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

### Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
<b>CO1</b>	Classify the various categories of solid waste generated from diverse sources and to outline the issues and scopes associated with each type.	<b>K2</b>
<b>CO2</b>	Illustrate the various aspects of waste management for solid waste.	<b>K2</b>
<b>CO3</b>	Analyse the various options of waste disposal based on the nature of waste, required end product.	<b>K3</b>
<b>CO4</b>	Illustrate the classification, handling and storage, collection, transportation, treatment for hazardous waste.	<b>K2</b>

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
<b>CO1</b>	3	2	1	2	1	3	3	3	1	2	3	2
<b>CO2</b>	3	2	1	2	1	3	3	3	1	2	3	2
<b>CO3</b>	3	3	2	2	2	3	3	3	1	2	3	2
<b>CO4</b>	3	2	1	2	1	3	3	3	1	2	3	2

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

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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

<b>Reference Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>Module No.</b>	<b>Link ID</b>
<b>1</b>	<a href="https://nptel.ac.in/courses/105103205">https://nptel.ac.in/courses/105103205</a>
<b>2</b>	<a href="https://nptel.ac.in/courses/105103205">https://nptel.ac.in/courses/105103205</a>
<b>3</b>	<a href="https://nptel.ac.in/courses/105103205">https://nptel.ac.in/courses/105103205</a>
<b>4</b>	<a href="https://nptel.ac.in/courses/105106056">https://nptel.ac.in/courses/105106056</a>



## SEMESTER S6

### TRAFFIC ENGINEERING AND MANAGEMENT

<b>Course Code</b>	<b>PECET637</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	PCCET502	<b>Course Type</b>	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

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	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.	<b>9</b>
<b>2</b>	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	<b>9</b>

	Control Measures - Traffic Signs, Road Markings, Traffic control aids. General awareness only.	
<b>3</b>	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.	<b>9</b>
<b>4</b>	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)	<b>9</b>

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

**Continuous Internal Evaluation Marks (CIE):**

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

### End Semester Examination Marks (ESE)

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

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

### 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

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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	10 <sup>th</sup> , 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	4 <sup>th</sup> , 2010

<b>Reference Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>Module No</b>	<b>Link ID</b>
<b>1</b>	<a href="https://archive.nptel.ac.in/courses/105/105/105105215/">https://archive.nptel.ac.in/courses/105/105/105105215/</a>
<b>2</b>	<a href="https://archive.nptel.ac.in/courses/105/105/105105215/">https://archive.nptel.ac.in/courses/105/105/105105215/</a>
<b>3</b>	<a href="https://archive.nptel.ac.in/courses/105/105/105105215/">https://archive.nptel.ac.in/courses/105/105/105105215/</a>
<b>4</b>	<a href="https://archive.nptel.ac.in/courses/105/105/105105215/">https://archive.nptel.ac.in/courses/105/105/105105215/</a>

## SEMESTER S6

### ADVANCED FOUNDATION ENGINEERING

<b>Course Code</b>	<b>PECET635</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	5/3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	PCCET402 PBCET504	<b>Course Type</b>	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

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	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.	<b>9</b>
<b>2</b>	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.	<b>9</b>
<b>3</b>	Under reamed piles-ultimate load carrying capacity in sand and clay-design considerations as per IS. IS formula-single and double bulb -Numerical	<b>9</b>

	<p>problems. Drilled piers (straight shafted and belled) in clay- Design Considerations- Load Transfer Mechanism. Vertical Bearing Capacity and uplift capacity of belled pier -</p> <p>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</p>	
4	<p>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</p> <p>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.</p>	9

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

**Continuous Internal Evaluation Marks (CIE):**

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

**Criteria for Evaluation (Evaluate and Analyse): 20 marks**

**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
<ul style="list-style-type: none"><li>2 Questions from each module.</li><li>Total of 8 Questions, each carrying 3 marks (8x3 =24marks)</li></ul>	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)
<b>CO1</b>	Explain allowable soil pressure and safe bearing capacity, evaluate safe bearing capacity of shallow foundations by IS formula.	<b>K3</b>
<b>CO2</b>	Proportion and design pile foundations, evaluate settlement of pile groups, uplift capacity of single and group of piles in clay	<b>K4</b>
<b>CO3</b>	Apply the procedure for the deflection and ultimate lateral load capacity of vertical piles.	<b>K3</b>
<b>CO4</b>	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,	<b>K4</b>
<b>CO5</b>	Evaluate the load carrying capacity of under reamed piles and load capacity and uplift resistance of belled piers.	<b>K5</b>

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
<b>CO1</b>	3	-	-	-	-	-	-	-	-	-	-	-
<b>CO2</b>	3	3	-	-	-	-	-	-	-	-	-	-
<b>CO3</b>	3	3	-	2	-	-	-	-	-	-	-	-
<b>CO4</b>	3	3	2	-	-	-	-	-	-	-	-	-
<b>CO5</b>	3	3	3	-	-	-	-	-	-	2	2	-

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



<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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

<b>Reference Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>Sl. No.</b>	<b>Link ID</b>
1	<a href="https://archive.nptel.ac.in/courses/105/105/105105207/">https://archive.nptel.ac.in/courses/105/105/105105207/</a>

## SEMESTER S6

### CONSTRUCTION PROJECT MANAGEMENT

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

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	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.	<b>9</b>

	Precedence Diagramming Method – types of relationships – concept of lead and lag. Concept only	
<b>2</b>	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.	<b>9</b>
<b>3</b>	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.	<b>9</b>
<b>4</b>	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.	<b>9</b>

### **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
<ul style="list-style-type: none"> <li>2 Questions from each module.</li> <li>Total of 8 Questions, each carrying 2 marks (8x2 =16 marks)</li> </ul>	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)	<b>40</b>

**Course Outcomes (COs)**

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

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

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
<b>CO1</b>	2	-	-	-	-	-	-	-	-	-	1	-
<b>CO2</b>	3	3	-	-	2	-	-	1	-	-	2	-
<b>CO3</b>	3	3	-	-	3	-	-	1	-	-	2	-
<b>CO4</b>	3	3	-	-	3	-	-	1	-	-	3	-
<b>CO5</b>	3	3	-	-	3	-	-	1	-	-	-	-

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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

<b>Reference Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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	<a href="https://archive.nptel.ac.in/courses/105/104/105104161/">archive.nptel.ac.in/courses/105/104/105104161/</a>
2	<a href="https://archive.nptel.ac.in/courses/105/103/105103093/">archive.nptel.ac.in/courses/105/103/105103093/</a>

### 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**

<b>Sl. No</b>	<b>Evaluation for</b>	<b>Allotted Marks</b>
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
<b>Total</b>		<b>30</b>

#### **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

<b>Course Code</b>	<b>OECET611</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	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

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	<b>Construction Materials</b> 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)	<b>9</b>
<b>2</b>	<b>Concrete Technology</b> Process of manufacturing concrete – batching, mixing, transportation, placing, compacting, finishing, curing Properties of fresh concrete: Workability, factors affecting workability, test on	<b>9</b>

	<p>workability (slump test), segregation and bleeding (brief discussion)</p> <p>Properties of hardened concrete: Strength, factors affecting strength, tests for strength of concrete in compression, tension and flexure</p> <p>Concrete quality control – statistical analysis of results – standard deviation – acceptance criteria – mix proportioning (B.I.S method) – nominal mixes.</p>	
<b>3</b>	<p><b>Building Construction</b></p> <p>Preliminary considerations for shallow and deep foundations</p> <p>Masonry – Types of stone masonry</p> <p>Lintels and arches – types and construction details.</p> <p>Tall Buildings – Framed building – steel and concrete frame – structural systems –erection of steel work–concrete framed construction– formwork – construction and expansion. joints</p> <p>Introduction to prefabricated construction – slip form construction</p>	<b>9</b>
<b>4</b>	<p><b>Construction Technology</b></p> <p>Cost-effective construction – rapid wall construction, soil-cement block masonry, voided slab technology, filler slab technology</p> <p>Basic concept of prestressing – fundamental understanding of pre-tensioned and post-tensioned construction</p> <p>Construction 3D printing (brief discussion only)</p> <p>Building failures – General reasons – classification – Causes of failures in RCC and Steel structures, Failure due to Fire, Wind and Earthquakes.</p> <p>Foundation failure – failures by alteration, improper maintenance, overloading.</p> <p>Retrofitting of structural components - beams, columns and slabs</p>	<b>9</b>

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

**Continuous Internal Evaluation Marks (CIE):**

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

### End Semester Examination Marks (ESE)

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

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

### 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

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
1	Advanced Construction Technology	Roy Chudley, Roger Greeno	Prentice Hall	4 <sup>th</sup> 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

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

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>Module No.</b>	<b>Link ID</b>
<b>1</b>	<a href="https://nptel.ac.in/courses/105102088">https://nptel.ac.in/courses/105102088</a>
<b>2</b>	<a href="https://archive.nptel.ac.in/courses/105/102/105102012/">https://archive.nptel.ac.in/courses/105/102/105102012/</a>

## SEMESTER S6

### ENVIRONMENTAL LAWS AND POLICY

<b>Course Code</b>	<b>OECET612</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	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

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	<b>Basic Concepts in Environmental Law</b> 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	<b>9</b>
<b>2</b>	<b>Forest, Wildlife and Biodiversity related laws</b> 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;	<b>9</b>

	Biological Diversity Act, 2002; Forest Rights Act, 2006. Strategies for conservation–Project Tiger, Elephant, Rhino, Modulew leopard.	
<b>3</b>	<b>Air, Water and Marine Laws</b> 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	<b>9</b>
<b>4</b>	<b>Hazardous Substances and Activities Legal framework</b> EPA and rules made thereunder; PLI Act, 199 Principles of strict and absolute liability; <b>International Environmental law</b> 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.	<b>9</b>

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

**Continuous Internal Evaluation Marks (CIE):**

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

### End Semester Examination Marks (ESE)

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

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

### 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

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
1	Environmental Law and Policy in India	Divan S. and Rosencranz A.	Oxford, New Delhi	3 <sup>rd</sup> , 2022
2	Environmental Law in India	Leelakrishnan P.	Lexis Nexis, India	6 <sup>th</sup> , 2022
3	International Law and the Environment	Birnie P.	Oxford	3 <sup>rd</sup> , 2009

<b>Reference Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>Module No.</b>	<b>Link ID</b>
<b>1</b>	<a href="https://onlinecourses.swayam2.ac.in/cec20_ge12/preview">https://onlinecourses.swayam2.ac.in/cec20_ge12/preview</a>



**SEMESTER S6**  
**DISASTER MANAGEMENT**

<b>Course Code</b>	<b>OE CET613</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	Theory

**Course Objectives:**

1. To introduce the concept of disasters, their causes and their mitigation and management

**SYLLABUS**

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	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.	<b>9</b>
<b>2</b>	Landslides, Causes and prediction, Soil and soil degradation, erosion and Desertification, Forest fires, their mitigation methods.	<b>9</b>
<b>3</b>	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.	<b>9</b>
<b>4</b>	Hazard and disaster management plans for floods, storm surges, landslides, earthquakes, forest fires: pre-disaster phase, actual disaster phase, post-disaster phase	<b>9</b>

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

**(CIE: 40 marks, ESE: 60 marks)**

#### Continuous Internal Evaluation Marks (CIE):

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

#### End Semester Examination Marks (ESE)

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

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

### Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
<b>CO1</b>	Explain interaction between subsystems of earth that give rise to hazards and their potential for disasters	<b>K2</b>
<b>CO2</b>	Explain the evolving concepts and thoughts of management of hazards and disasters	<b>K2</b>
<b>CO3</b>	Apply the knowledge to find the causes behind natural disasters and evaluate their magnitude and impacts	<b>K3</b>
<b>CO4</b>	Develop management plans for hazards and disasters, and understand the roles of agencies involved	<b>K3</b>

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
<b>CO1</b>	3	-	-	-	-	-	-	-	-	-	-	1
<b>CO2</b>	3	-	-	-	-	-	-	-	-	-	-	2
<b>CO3</b>	3	3	-	-	-	-	2	-	-	-	-	2
<b>CO4</b>	3	-	3	-	-	-	-	-	-	-	-	1

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

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
1	Disaster Management	Mrinalini Pandey	Wiley	2 <sup>nd</sup> 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

<b>Reference Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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	Kompndiet (Gothenburg).	2017
4	Disaster Management in India Policies, Institutions, Practices	Rajendra Kumar Pandey	Routledge	2023

<b>Video Links (NPTEL, SWAYAM...)</b>	
	<b>Link ID</b>
<b>1</b>	<a href="https://nptel.ac.in/courses/105104183">https://nptel.ac.in/courses/105104183</a>
<b>2</b>	<a href="https://onlinecourses.swayam2.ac.in/cec19_hs20/preview">https://onlinecourses.swayam2.ac.in/cec19_hs20/preview</a>

## SEMESTER S6

### ENVIRONMENTAL IMPACT ASSESSMENT

<b>Course Code</b>	<b>OE CET614</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	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

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	<b>Introduction</b> 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	<b>9</b>
<b>2</b>	Impact analysis- Adhoc, checklists, matrix methods, overlay analysis, Fault Tree Analysis method & Event Tree Analysis method EIA case studies <b>Water Pollution</b> 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)	<b>9</b>
<b>3</b>	<b>Solid Waste</b> Classification and sources of Solid Waste, Characteristics of Solid Waste, E-waste, & Radioactive wastes - Types, management/disposal	<b>9</b>

	Hazardous waste -waste identification process and characteristics Solid Waste Management Rules 2016 <b>Land/Soil Pollution</b> Effects of urbanization on land degradation, Impact of Modern Agriculture on Soil, pesticide pollution, Effect on Environment	
<b>4</b>	<b>Air Pollution</b> 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 <b>Noise Pollution</b> Sources of Noise, Effects of Noise, measurement of noise, Equivalent sound pressure level, Control measures –Noise pollution (Regulation and control) Rule 2000	<b>9</b>

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

**Continuous Internal Evaluation Marks (CIE):**

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

**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*

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

### Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
<b>CO1</b>	Demonstrate the process, need and significance of EIA	<b>K2</b>
<b>CO2</b>	Predict and analyse the possible environmental impact assessment on various projects	<b>K3</b>
<b>CO3</b>	Apply assessment methodologies for evaluating environmental impact assessment	<b>K3</b>
<b>CO4</b>	Identify the significant sources of pollution from any upcoming or existing project and their impacts on biotic and abiotic elements in the environment	<b>K3</b>

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
<b>CO1</b>	3	2	1	2	1	3	3	3	1	2	3	2
<b>CO2</b>	3	3	2	2	2	3	3	3	1	2	3	2
<b>CO3</b>	3	3	2	2	2	3	3	3	1	2	3	2
<b>CO4</b>	3	3	2	2	2	3	3	3	1	2	3	2

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



<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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	15 <sup>th</sup> , 2008

<b>Reference Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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. Tchobanaglou	Mc Graw Hill Education	1985
4	Standard Handbook of Environmental Engineering	Robert A Corbett	McGraw Hill	1999

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>Module No.</b>	<b>Link ID</b>
<b>1</b>	<a href="https://nptel.ac.in/courses/124107160">https://nptel.ac.in/courses/124107160</a>
<b>2</b>	<a href="https://nptel.ac.in/courses/124107160">https://nptel.ac.in/courses/124107160</a>
<b>3</b>	<a href="https://nptel.ac.in/courses/124107160">https://nptel.ac.in/courses/124107160</a>
<b>4</b>	<a href="https://nptel.ac.in/courses/124107160">https://nptel.ac.in/courses/124107160</a>

**SEMESTER S6**

**STRUCTURAL GEOLOGY**

<b>Course Code</b>	<b>OECET 615</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	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**

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	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.	<b>9</b>
<b>2</b>	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.	<b>9</b>
<b>3</b>	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	<b>9</b>
<b>4</b>	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.	<b>9</b>

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

**Continuous Internal Evaluation Marks (CIE):**

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

**End Semester Examination Marks (ESE)**

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

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

**Course Outcomes (COs)**

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand 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
<b>CO1</b>	3	3	1	2	1	-	-	-	-	-	-	3
<b>CO2</b>	3	3	-	2	-	1	-	-	1	-	-	3
<b>CO3</b>	3	3	1	2	1		1	1	1	-	-	3
<b>CO4</b>	3	3		2	-	-	-	-	-	-	-	3
<b>CO5</b>	3	3	1	2	1	1	-	1	1	-	-	3

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

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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

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

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>Module No.</b>	<b>Link ID</b>
<b>1</b>	<a href="https://onlinecourses.nptel.ac.in/noc19_ce47/preview">https://onlinecourses.nptel.ac.in/noc19_ce47/preview</a>

**SEMESTER S6**

**APPLIED EARTH SYSTEMS**

<b>Course Code</b>	<b>OECET616</b>	<b>CIE Marks</b>	40
<b>Teaching Hours/Week (L: T:P: R)</b>	3:0:0:0	<b>ESE Marks</b>	60
<b>Credits</b>	3	<b>Exam Hours</b>	2 Hrs. 30 Min.
<b>Prerequisites (if any)</b>	None	<b>Course Type</b>	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**

<b>Module No.</b>	<b>Syllabus Description</b>	<b>Contact Hours</b>
<b>1</b>	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.	<b>9</b>
<b>2</b>	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.	<b>9</b>
<b>3</b>	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)	<b>9</b>

<b>4</b>	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	<b>9</b>
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**Course Assessment Method**  
**(CIE: 40 marks, ESE: 60 marks)**

**Continuous Internal Evaluation Marks (CIE):**

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

**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*

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

### Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
<b>CO1</b>	Explain the concept of earth as a system of interrelated components and associated exogenic/endogenic processes.	<b>K2</b>
<b>CO2</b>	Appraise geological agents and their respective erosion, transportation and deposition regimes and landforms formed.	<b>K5</b>
<b>CO3</b>	Evaluate/investigate the significance of Plate tectonics theory to explain the geodynamic features and processes of earth's surface.	<b>K5</b>
<b>CO4</b>	Develop an understanding of oceanographic and atmospheric regimes and their sway on other subsystems and process thereof.	<b>K6</b>
<b>CO5</b>	Understand implications of human interaction with the Earth system.	<b>K2</b>

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
<b>CO1</b>	3	2	-	2	-	3	3	2	-	-	-	3
<b>CO2</b>	3	3	-	3	-	3	3	-	1	-	-	3
<b>CO3</b>	3	3	-	3	-	3	3	-	-	-	-	3
<b>CO4</b>	3	3	2	3	-	3	3	-	-	-	-	3
<b>CO5</b>	3	3	-	3	-	3	3	3	-	-	-	3

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

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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

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

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>Module No.</b>	<b>Link ID</b>
<b>1</b>	<a href="https://onlinecourses.nptel.ac.in/noc20_ce33/preview">https://onlinecourses.nptel.ac.in/noc20_ce33/preview</a>
<b>2</b>	<a href="https://onlinecourses.nptel.ac.in/noc20_ce33/preview">https://onlinecourses.nptel.ac.in/noc20_ce33/preview</a>
<b>3</b>	<a href="https://onlinecourses.nptel.ac.in/noc20_ce33/preview">https://onlinecourses.nptel.ac.in/noc20_ce33/preview</a>
<b>4</b>	<a href="https://onlinecourses.nptel.ac.in/noc20_ce33/preview">https://onlinecourses.nptel.ac.in/noc20_ce33/preview</a>



## SEMESTER S6

### TRANSPORTATION ENGINEERING LAB

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

<b>Expt. No.</b>	<b>Experiments</b>
<b>Test on Soil</b>	
1	California Bearing Ratio Test
<b>Test on Coarse Aggregate</b>	
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.
<b>Test on Bitumen</b>	
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
<b>Design of Bituminous Mix</b>	
13	Design of bituminous mix by Marshall method of mix design
<b>Functional Evaluation of Pavement</b>	
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):**

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

**End Semester Examination Marks (ESE):**

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

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

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
<b>CO1</b>	3	-	2	-	-	2	-	-	2	2	1	-
<b>CO2</b>	3	-	2	-	-	2	-	-	2	2	1	-
<b>CO3</b>	3	-	2	-	-	2	-	-	2	2	1	-
<b>CO4</b>	3		2	-	-	2	-	-	2	2	1	-
<b>CO5</b>	3	3	2	1	-	2	-	-	2	2	1	-

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

<b>Text Books</b>				
<b>Sl. No</b>	<b>Title of the Book</b>	<b>Name of the Author/s</b>	<b>Name of the Publisher</b>	<b>Edition and Year</b>
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

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

<b>Video Links (NPTEL, SWAYAM...)</b>	
<b>No.</b>	<b>Link ID</b>
1	<a href="https://ts-nitk.vlabs.ac.in/">https://ts-nitk.vlabs.ac.in/</a>

## **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

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

#### Course Objectives:

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

<b>Expt. No.</b>	<b>Experiments</b>
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):**

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

**End Semester Examination Marks (ESE):**

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

- *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:

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

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	<a href="https://ee1-nitk.vlabs.ac.in/List%20of%20experiments.html">https://ee1-nitk.vlabs.ac.in/List%20of%20experiments.html</a>
2	<a href="https://ee2-nitk.vlabs.ac.in/List%20of%20experiments.html">https://ee2-nitk.vlabs.ac.in/List%20of%20experiments.html</a>

### Continuous Assessment (25 Marks)

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## **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.***

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- Creativity and logic in algorithm or experimental design.

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**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