DEPARTMENT OF
CIVIL ENGINEERING

PERIYAR
MANIAMMAI
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University)
Established Under Sec. 3 of UGC Act, 1956 • NAAC Accredited
think • innovate • transform

CURRICULUM & SYLLABUS

(Based on Outcome Based Education)

For

B.Tech – CIVIL ENGINEERING

(Part Time –3 1/2Years)

REGULATION 2021

PERIYAR MANIAMMAI INSTITUTE OF SCIENCE AND TECHNOLOGY

Vision	To be a University of global dynamism with excellence in knowledge and innovation ensuring social responsibility for creating an egalitarian society.	
Mission	**UM1**	Offering well balanced programmes with scholarly faculty and state-of-art facilities to impart high level of knowledge.
	UM2	Providing student - centered education and foster their growth in critical thinking, creativity, entrepreneurship, problem solving and collaborative work.
	UM3	Involving progressive and meaningful research with concern for sustainable development.
	UM4	Enabling the students to acquire the skills for global competencies.
	UM5	Inculcating Universal values, Self respect, Gender equality, Dignity and Ethics.

Core Values

- Student – centric vocation
- Academic excellence
- Social Justice, equity, equality, diversity, empowerment, sustainability
- Skills and use of technology for global competency.
- Continual improvement
- Leadership qualities.
- Societal needs
- Learning, a life – long process
- Team work
- Entrepreneurship for men and women
- Rural development
- Basic, Societal, and applied research on Energy, Environment, and Empowerment.

DEPARTMENT OF CIVIL ENGINEERING

Vision		To create technocrats in the discipline of Civil Engineering through research integrated academic programme of UG, PG and Ph.D. of global standards and in turn contribute to the socio-economic development of the nation through research and consultancy.
Mission	**DM1**	To create, disseminate and integrate knowledge of science , engineering and technology through innovative teaching learning process that expands Civil Engineering Knowledge base and enhance the betterment of industry and human society
	DM2	To develop , perform forward looking research by integrating proper blend of applied and theoretical knowledge with a positive impact for the society
	DM3	To educate , inspire and create competent civil engineering professionals who possess the knowledge and skills required by industries for careers or to become an entrepreneur
	DM4	To serve as a reliable , highly capable resource for society , the profession and the university through activities in the professional organization , committees , consultancy and continuing education

Table: 1 Mapping of University Mission (UM) and Department Mission (DM)

	UM 1	**UM 2**	**UM 3**	**UM 4**	**UM 5**
DM 1	2	3	2	1	3
DM 2	1	2	2	1	2
DM 3	2	3	3	2	2
DM 4	3	2	2	2	3
	8	**10**	**9**	**6**	**10**

1-Low 2- Medium 3 – High

PROGRAMME EDUCATIONAL OBJECTIVES

Based on the mission of the department, the programme educational objectives is formulated as

PEO1	Graduates will successfully apply the engineering concepts to the formulation and provide solution to the emerging technical problems in industry, government or other organizations towards implementing efficient civil engineering practices.
PEO2	Graduates will have the ability to use their education to be lifelong learners and in turn utilize intellectual curiosity in enhancing technical, personal and professional growth.
PEO3	Graduates will become entrepreneurs (professional engineers) in starting-up and growing their own new firms in the domain of civil engineering and also exhibit leadership role of highest standards of professional endeavors in their chosen profession and in other activities.
PEO4	Graduates will be aware of ethical, social and cultural issues within a global context and their importance in the exercise of professional skills and responsibilities.

Table: 2 Mapping of Program Educational Objectives (PEOs) with Department Mission (DM)

	DM 1	**DM 2**	**DM3**	**DM 4**
PEO 1	3	2	1	1
PEO 2	2	3	2	1
PEO 3	1	1	3	2
PEO 4	2	1	1	3
	8	**7**	**7**	**7**

1- Low 2 – Medium 3-High

GRADUATE ATTRIBUTES

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling to complex engineering activities, with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM OUTCOMES

PO 1 Apply the knowledge of mathematics, science, Engineering fundamentals and Civil Engineering principles to the solution of complex problems in Civil Engineering.

PO 2 Identify, formulate, research literature and analysis complex civil engineering problems reaching substantiated conclusions using first principles of mathematics and Engineering Sciences.

PO 3 Design solutions for complex civil engineering problems and design system components or processes that meet the specified needs with appropriate considerations for the public health and safety and the cultural, societal and environmental conservations

PO 4 An ability to plan, draw and design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

PO 5 An ability to work effectively as an individual and a team.

PO 6 An ability to identify, formulate, and solve engineering problems.

PO 7 An understanding of professional and ethical responsibility in a global context

PO 8 An ability to articulate and communicate ideas persuasively and effectively both in written and oral.

PO 9 A recognition of the need for, and an ability to engage in lifelong learning

PO 10 A knowledge of contemporary issues relevant to engineering practice

PO 11 An ability to understand the critical issues of professional practice such as the procurement of work, financial management and the interaction with contractors during the construction phase of a project.

PO 12 An ability to use the techniques, skills, and modern engineering tools necessary for Engineering practice

PROGRAM SPECIFIC OUTCOME

PSO 1 Capably plan, analyse and design the civil engineering structures.

PSO 2 Apply knowledge of three technical areas appropriate to Civil Engineering such as Geotechnical, Environmental and water resources engineering etc.

Table 3 Mapping of Program Educational Objectives (PEOs) with Program Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
PEO 1	3	2	2	1	1	2	-	-	-	1	2	-	3	-
PEO 2	1	3	2	3	2	1	1	-	-	2	1	1	-	2
PEO 3	-	1	3	2	3	-	2	1	1	2	1	2	1	1
PEO 4	-	1	2	2	-	1	3	1	1	1	1	1	-	1
	4	**7**	**9**	**8**	**6**	**4**	**6**	**2**	**2**	**6**	**5**	**4**	**4**	**4**

1 - Low 2 – Medium 3 - High

CURRICULUM REGULATION – 2021

(Applicable to the students admitted from the Academic year 2021– 2022 onwards)

Bachelor of Technology in Civil Engineering (Part Time)

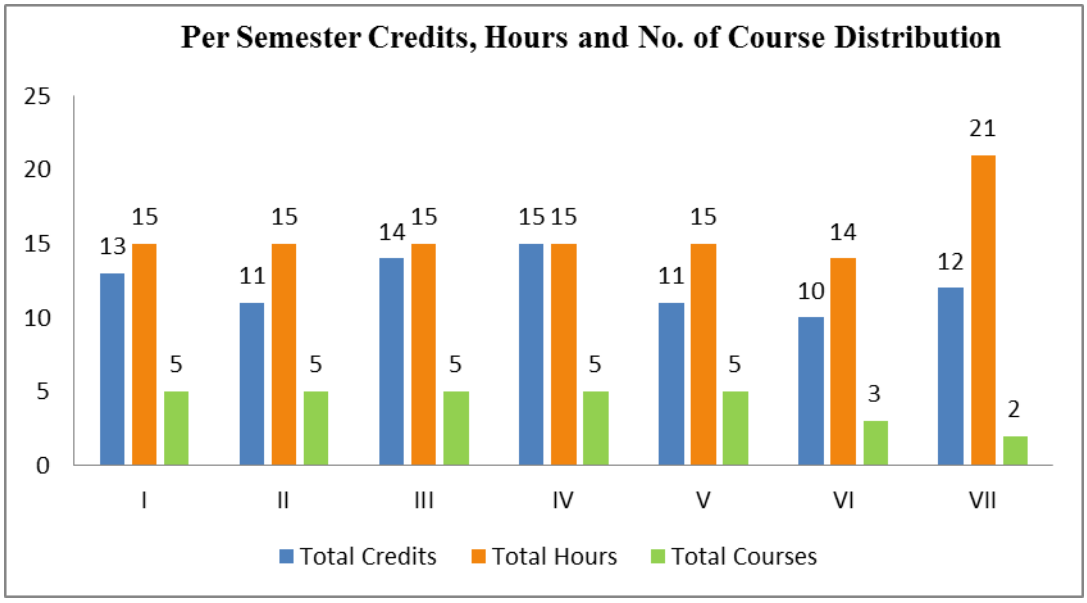
S.No	Description		Courses	Credits				Hours			
				L	T	P	TO	L	T	P	TO
SEMESTER I											
1.	MA-I	PCE101	Probability and statistics	3	0	0	3	3	0	0	3
2.	PCC T	PCE102	Mechanics of Solids-I	2	1	0	3	2	2	0	4
3.	PCC-T	PCE103	Fluid Mechanics and Machinery	2	1	0	3	2	2	0	4
4.	PCC-L	PCE104	Strength of Materials Lab	0	0	2	2	0	0	2	2
5.	PCC-L	PCE105	Fluid Mechanics and Machinery Lab	0	0	2	2	0	0	2	2
			Total				**13**				**15**
SEMESTER II											
1.	PCC T	PCE201	Mechanics of Solids-II	2	1	0	3	2	2	0	4
2.	PCC-T	PCE202	Geotechnical Engineering - I	2	1	0	3	2	2	0	4
3.	PCC-T	PCE203	Concrete Technology	3	0	0	3	3	0	0	3
4.	UMAN-I	P**204	Disaster Management	0	0	0	0	2	0	0	2
5.	PCC-L	PCE205	Geotechnical Engineering Lab	0	0	2	2	0	0	2	2
			Total				**11**				**15**
Semester III											
1.	PCC T	PCE301	Structural Analysis	3	1	0	4	3	2	0	5
2.	PCC-T	PCE302	Transportation Engineering	3	0	0	3	3	0	0	3
3.	PCC-T	PCE303	Environmental Engineering	3	0	0	3	3	0	0	3
4.	PCC-L	PCE304	Environmental Engineering Lab	0	0	2	2	0	0	2	2
5.	PCC-L	PCE305	Concrete & Highway Lab	0	0	2	2	0	0	2	2
			Total				**14**				**15**

S.No	Description		Courses	Credits				Hours			
				L	T	P	TO	L	T	P	TO
Semester IV											
1.	PCC -T	PCE401	Design of RCC Structures	3	1	0	4	3	1	0	4
2.	PCC-T	PCE402	Geotechnical Engineering - II	2	1	0	3	2	1	0	3
3.	PCC-T	PCE403	Construction Engineering and Management	3	0	0	3	3	0	0	3
4.	PEC-I	PCEE**	Professional Elective -I	3	0	0	3	3	0	0	3
5.	PCC-L	PCE405	Construction Management Lab	0	0	2	2	0	0	2	2
			Total				**15**				**15**
SEMESTER V											
1.	PCC- T	PCE501	Design of Steel Structures	3	1	0	4	3	2	0	5
2.	PEC-II	PCEE**	Professional Elective II	3	0	0	3	3	0	0	3
3.	UMAN-V	MC	Environmental studies	0	0	0	0	2	0	0	2
4.	PCC-L	PCE504	Computer Aided Design & Drafting	0	0	2	2	0	0	3	3
5.	PCC-L	PCE505	Estimation, Costing and valuation	0	0	2	2	0	0	2	2
			Total				**11**				**15**
SEMESTER VI											
1.	PCC-T	PCE601	Finite Element Method	3	1	0	4	3	2	0	5
2.	PEC-III	PCEE**	Professional Elective –III	3	0	0	3	3	0	0	3
2.	PROJ II	PCE603	Project Work (Phase-I)	0	0	3	3	0	0	6	6
			Total				**10**				**14**
SEMESTER VII											
1.	PEC-IV	PCEE**	Professional Elective –IV	3	0	0	3	3	0	0	3
2.	PROJ II	PCE702	Project Work (Phase-II)	0	0	9	9	0	0	18	18
			Total				**12**				**21**
Total Credit - 86											

Semester	Credits	Hours / Week	Number of courses
I	13	15	5
11	11	15	5
III	14	15	5
IV	15	15	5
V	11	15	5
VI	10	14	3
VII	12	21	2
I – VII	**86**	**110**	**30**

Summary of the credits and hours

Year	Semester	Total Credits	Total Hours / Week	No. of courses	Value Addition Suggested
I	I	13	15	5	No
	II	11	15	5	No
II	III	14	15	5	No
	IV	15	15	5	No
III	V	11	15	5	No
	VI	10	14	3	No
IV	VII	12	21	2	No
	I – VII	**86**	**110**	**30**	



PROFESSIONAL ELECTIVE COURSE - CIVIL ENGINEERING
[PEC-CE]

Professional Elective Course I

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
PCEE01	PEC	Smart Structures and Materials	3	0	0	3
PCEE02	PEC	GIS for Civil Engineering	3	0	0	3
PCEE03	PEC	Water Quality Engineering	3	0	0	3
PCEE04	PEC	Pavement Design	3	0	0	3
PCEE05	PEC	Construction Equipment and Automation	3	0	0	3
PCEE06	PEC	Airport Planning and Design	3	0	0	3
PCEE07	PEC	Port and Harbour Engineering	3	0	0	3

Professional Elective Course II

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
PCEE08	PEC	Earthquake Engineering	3	0	0	3
PCEE09	PEC	Bridge Engineering	3	0	0	3
PCEE10	PEC	Advanced Structural Analysis	3	0	0	3
PCEE11	PEC	Basics of Computational Hydraulics	3	0	0	3
PCEE12	PEC	Water Resources Engineering	3	0	0	3
PCEE13	PEC	Environmental Geotechnology	3	0	0	3
PCEE14	PEC	Geotechnical Design	3	0	0	3

Professional Elective Course III

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
PCEE15	PEC	Environmental Fluid Mechanics	3	0	0	3
PCEE16	PEC	Environmental Impact Assessment	3	0	0	3
PCEE17	PEC	Design of Hydraulic Structures	3	0	0	3
PCEE18	PEC	Surface Hydrology	3	0	0	3
PCEE19	PEC	Repairs and Rehabilitation of Structures	3	0	0	3
PCEE20	PEC	Urban Hydrology and Hydraulics	3	0	0	3
PCEE21	PEC	Building Construction Practice	3	0	0	3

Professional Elective Course IV

Sub.Code	Category	Name of the Course	Hours per week			C
			L	T	P	
PCEE22	PEC	Tall Structures				
PCEE23	PEC	Environmental Law and Policy	3	0	0	3
PCEE24	PEC	Groundwater Engineering	3	0	0	3
PCEE25	PEC	Solid and Hazardous Waste Management	3	0	0	3
PCEE26	PEC	Pre-stressed and Prefabricated Structures	3	0	0	3
PCEE27	PEC	Contracts Management	3	0	0	3
PCEE28	PEC	Air and Noise Pollution and Control	3	0	0	3

Note

L – Lecture, T – Tutorial, P – Practical, C – Credit

Semester : **I**

Course Code : **PCE102**

Course Name : **MECHANICS OF SOLIDS-I**

Prerequisite : **ENGINEERING MECHANICS**

L	T	P	C
2	1	0	3

C	P	A
2.5	0	0.5

L	T	P	H
2	2	0	4

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Analyse stresses and strains in members when subjected to loads.	Cognitive	Analyse
CO2	Evaluate the strain energy under various forces	Cognitive	Analyse
CO3	Calculate the shear force and bending moment due to various loading conditions.	Cognitive	Analyse
CO4	Examine the stability of structural members by studying the reactions and internal forces.	Cognitive	Analyse
CO5	Assess the output of shafts and springs for its maximum energy.	Cognitive	Knowledge

COURSE CONTENT

UNIT I	**SIMPLE STRESSES & STRAINS**	**9**

Concept and types of Stress and Strain, Hooke's Law, Elastic moduli and the relationship between them, Thermal stress, deformation of simple and compound bars.

UNIT II	**STRAIN ENERGY**	**9**

Strain energy and strain energy density – strain energy in traction, shear in flexure and torsion – Strain Energy due to axial force - Resilience - stresses due to impact and suddenly applied load - Principal stress and principal planes - Mohr's circle

UNIT III	**TRANSVERSE LOADING AND STRESSES OF BEAMS**	**9**

Beams – types of supports and loads – shear force and bending moment for simply supported, cantilever and over hanging beams. Theory of simple bending – analysis of stresses.

UNIT IV	**ANALYSIS OF PLANE TRUSS, THIN CYLINDERS / SHELLS**	**9**

Types of truss – analysis of forces in truss members -method of joints- method of sections. - Thin cylinders and shells – under internal pressure – deformation of thin cylinders and shells

UNIT V	**TORSION AND SPRINGS**	**9**

Stresses and deformation in solid and hollow circular shaft– stepped shafts – shafts fixed at both ends. Spring – leaf springs – stresses in helical springs – deflection of springs.

L	T	P	Total
30	15	0	45

TEXT BOOKS

1.Dr. R.K.Bansal,“ Strength of Materials”, Laxmi Publications Pvt Ltd, New Delhi, 8th Edition

2. R.K. Rajput, “ Strength of Materials”, S.Chand and Company Ltd, New Delhi, 8th Edition

3. R.S. Khurmi, “Strength of Materials”, S. Chand & Company Ltd, New Delhi, 2013.

REFERENCE BOOKS

1. William Nash, Theory and Problems of Strength of Materials, Schaum’s Outline Series, McGraw-Hill International Edition.

2. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi

3. Egor P Popov, “Engineering Mechanics of Solids”, Prentice Hall of India, New Delhi, 2012, Second Edition.

Mapping of CO with PO’s

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	3		1	3						2		2	
CO 2	1	3				2					2		2	
CO 3	1	2	2	1			1	1			2		1	
CO 4	1	2	2	1			1	1			2		1	
CO 5	1	2												
Total	6	12	4	3	3	2	2	2			8		6	
Scaled Value	**2**	**3**	**1**	**1**	**1**	**1**	**1**	**1**			**2**		**2**	

Note:	**Total**	0	1-5	6-10	11-15
	Scaled value	0	1	2	3
	Relation	No	Low	Medium	High

Semester : **I**

Course Code : **PCE 103**

Course Name : **FLUID MECHANICS AND MACHINERY**

Prerequisite : **NIL**

L	T	P	C
2	1	0	3

C	P	A
2.5	0	0.5

L	T	P	H
2	2	0	4

Course Objectives

- To understand about properties of fluids
- To Analyse the flow of fluid under various conditions
- To understand about various hydraulic Machines

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Understand the basic terms used in fluid mechanics, under static condition	Cognitive	Understand and Apply
CO2	Apply the principles of fluids under kinematics and dynamic conditions	Cognitive	Apply and Analyse
CO3	Perform the dimensional analysis for problems in fluid mechanics	Cognitive Affective	Analyse
CO4	Apply and analyze distribution of water through pipe and pipes	Cognitive	Apply and Analyse
CO5	Understand the components, the hydro-machines	Cognitive Affective	Understand

COURSE CONTENT

UNIT I **PROPERTIES OF FLUID AND FLUID STATICS** **9**

Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton's law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Fluid Statics - Fluid Pressure: Pressure at a point, Pascal's law, Hydrostatic Law, Pressure measuring devices-manometers and its types- Pressure gauges and its types

UNIT II **FLUID KINEMATICS AND DYNAMICS** **9**

Classification of fluid flow - Types of Flow lines-stream function, velocity potential function, flow net- Continuity equation along stream lines and Cartesian coordinates. Equations of motion - Euler's equation; Bernoulli's equation – Derivation; Energy Principle; PRACTICAL applications of Bernoulli's equation: Venturimeter, orifice meter and Pitot tube; Momentum principle

UNIT III	FLOW THROUGH PIPES AND OPEN CHANNEL FLOW	9

Laminar flow through: circular pipes,-Hegen Poisullis Equation a Laminar flow through parallel plates. Loss of head through pipes, Darcy-Wisbech equation, minor losses, total energy equation- hydraulic gradient line- Pipes in series, equivalent pipes- pipes in parallel, power transmission through pipes., Syphon and Water hammer.

Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section

UNIT IV	DIMENSIONAL ANALYSIS AND HYDRAULIC SIMILITUDE	9

Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problem.

UNIT V	HYDRAULIC MACHINES	9

Turbines – classification –Pelton wheel –Francis and Kaplan turbines –draft tubes – performance of turbines – specific speed and their significance.

Pumps:-Centrifugal pump – description and working – head, discharge and efficiency of a Centrifugal pump. Reciprocating pump - description and working – types –working principle and use.

L	T	P	Total
30	15	0	45

TEXT BOOKS

1. R.K.Rajput, Fluid Mechanics and Hydraulic Machines, S.Chand& Company Ltd., New Delhi, 2002.
2. Bansal, R. K., Fluid Mechanics and Hydraulic Machines, Laxmi Publications (P) Ltd., New Delhi, 2011.
3. Hydraulics, Fluid Mechanics and Hydraulics Mechanics by P. N. Modi& S. M. Sethi Standard Publishers, New Delhi.
4. Hydraulics, Fluid Mechanics and Hydraulics Mechanics by K. R. Arora, Standard Publishers, New Delhi

REFERENCE BOOKS

1. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
2. Introduction to fluid mechanics, Robert W. Fox, Philip J. Pritchard & Alan T. Mcdonald, Wiley Student Edition, 2009.
3. Fluid Mechanics and Machinery, C. S. P. Ojha, R. Bengtsson and P. N. Chadramouli0, Oxford University Press, 2010.
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J.Fennimore, International Student Edition, McGraw Hill.

Mapping of CO with PO's														
	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO 1	2	1	0	0	0	1	0	1	1	1	0	0	0	1
CO 2	3	2	2	1	1	2	0	1	1	1	0	0	2	1
CO 3	**3**	**2**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**0**	**1**	**2**	**1**
CO 4	3	3	3	2	1	2	1	1	2	2	0	1	2	**1**
CO 5	**2**	**1**	**0**	**0**	**1**	**0**	**1**	**2**	**2**	**1**	**0**	**1**	**0**	**1**
Total	13	9	7	4	4	7	3	6	6	7	0	3	6	5
Scaled Value	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**1**

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : I

Course Code : PCE 104

Course Name : STRENGTH OF MATERIALS LAB

Prerequisite : MECHANICS OF SOLIDS-I

L	T	P	C
0	0	2	2

C	P	A
0	3	0

L	T	P	H
0	0	2	2

Course Outcome: After the completion of the course, students will be able to

		Domain C or P or A	Level
CO1	Perception about the behavior of solids under stress and strain.	Psychomotor	Respond
CO2	Calculate the forces and moments.	Psychomotor	Measure
CO3	Predict the properties of surfaces of solids.	Psychomotor	Measure
CO4	Behaviour of beams under different loading systems.	Psychomotor	Measure
CO5	Calculate the deflection of springs.	Psychomotor	Respond

COURSE CONTENT

1.Tension test on HYSD bar / MS rod

2. Impact Test (Izod and Charpy)

3. Hardness Test (Brinell and Rockwell)

4. Test on timber

   i) Compressive strength test

   ii)Tensile strength test

   iii)Shear Strength test

   iv) Static bending test

5. Deflection Test

6. Young's modulus of the given material (steel or wood)

7. Tests on springs.

L	T	P	Total
0	0	30	30

TEXT BOOKS

1. Egor P Popov, "Engineering Mechanics of Solids", Prentice Hall of India, New Delhi, 2012, Second Edition.
2. Srinath L.S, "Advanced Mechanics of Solids", Tata McGraw-Hill Publishing Co., New Delhi, 2009, Third Edition.
3. William Nash, Theory and Problems of Strength of Materials, Schaum's Outline Series, McGraw-Hill International Edition, 2011.

REFERENCE BOOKS

1. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.

2. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.

3. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, Pearson Prentice Hall, 2004

Mapping of CO with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2	3		1	3						2		2	
CO2	1	3				2					2		2	
CO3	1	2	2	1			1	1			2		1	
CO4	1	2	2	1			1	1			2		1	
CO5	1	2												
Total	**6**	**12**	**4**	**3**	**3**	**2**	**2**	**2**			**8**		**6**	
Scaled Value	**2**	**3**	**1**	**1**	**1**	**1**	**1**	**1**			**2**		**2**	

1 – Low, 2 – Medium, 3 – High

Semester : **I**

Course Code : **PCE 105**

Course Name : **FLUID MECHANICS AND MACHINERY LAB**

Prerequisite : **NIL**

L	T	P	C
0	0	2	2

C	P	A
0	3	0

L	T	P	H
0	0	2	2

Course Objectives

- Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,

Course Outcome:	**Domain C or P or A**	**Level**
Determine the coefficient of discharge through pipe and notch	Psychomotor	Respond
Verify the principle of Bernoullis Equation.	Psychomotor	Measure
Determine the minor losses for various fittings.	Psychomotor	Measure
Perform test on Efficiency of the Pumps	Psychomotor	Measure
Perform test on Efficiency of the Turbines	Psychomotor	Respond

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Verification of Bernoullis Equation.
4. Determination of friction factor for a given set of pipes.
5. Determination of minor losses for various fitting.
6. Determination of rate of flow through notches
7. Conducting performance test on centrifugal pump and draw their characteristic curves
8. Conducting performance test on Reciprocating pump and draw their characteristic curves
9. Conducting performance test submersible pump and draw their characteristic curves
10. Conducting load test on Pelton Turbine and draw their characteristic curves
11. Conducting load test on Francis Turbine and draw their characteristic curves
12. Study about Axial flow turbine- Kaplan turbine.

L	T	P	Total
0	0	15	15

TEXT BOOKS

1. R.K.Rajput, Fluid Mechanics and Hydraulic Machines, S.Chand& Company Ltd., New Delhi, 2002.
2. Bansal, R. K., Fluid Mechanics and Hydraulic Machines, Laxmi Publications (P) Ltd., New Delhi, 2011.
3. Hydraulics, Fluid Mechanics and Hydraulics Mechanics by P. N. Modi& S. M. Sethi Standard Publishers, New Delhi.
4. Hydraulics, Fluid Mechanics and Hydraulics Mechanics by K. R. Arora, Standard Publishers, New Delhi

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1. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
2. Introduction to fluid mechanics, Robert W. Fox, Philip J. Pritchard & Alan T. Mcdonald, Wiley Student Edition, 2009.
3. Fluid Mechanics and Machinery, C. S. P. Ojha, R. Bengtsson and P. N. Chadramouli0, Oxford University Press, 2010.
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J.Fennimore, International Student Edition, McGraw Hill.

	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO 1	2		2	2	1				1		1	1	1	
CO 2	1		1	1	1				1		1	1		
CO 3	1			1					1				1	
CO 4	1		1						1					
CO 5	2			1	1						1		1	1
Total	7		4	5	3				4		3	2	3	1
Scaled Value	**2**		**1**	**1**	**1**				**1**		**1**	**1**	**1**	**1**

Note:	**Total**	0	1-5	6-10	11-15
	Scaled value	0	1	2	3
	Relation	No	Low	Medium	High

Semester : **II**

Course Code : **PCE 201**

Course Name : **MECHANICS OF SOLIDS-II**

Prerequisite : **MECHANICS OF SOLIDS-I**

L	T	P	C
2	1	0	3

C	P	A
2.5	0	0.5

L	T	P	H
2	2	0	4

	Course Outcome: After the completion of the course, students will be able to	**Domain C or P or A**	**Level**
CO1	Determine the deflection of Simple and Curved members	Cognitive	Analyse
CO2	Analyse indeterminate structures for shear force and bending moment.	Cognitive& Affective	Analyzing & Respond
CO3	Discuss the failure criteria of the column and cylinder based on end condition	Cognitive& Affective	Understanding & Respond
CO4	Compute the deflection of beams by energy principles	Cognitive& Affective	Application & Receive
CO5	Analyse the degrees of freedom for static and kinematic frames.	Cognitive	Analyse

COURSE CONTENT

UNIT I **DEFLECTIONS OF BEAMS** **9**

Introduction, Equation of Elastic Curve, Methods for Determining Deflections (Double Integration, Macaulay's Method, Moment-Area Method). Strain energy and dummy unit load approaches to deflection of Simple and Curved members.

UNIT II **INDETERMINATE BEAMS** **9**

Propped cantilever and fixed beams-fixed end moments and reactions– Theorem of Three Moments – Shear force and Bending moment diagrams for continuous beams.

UNIT III **COLUMNS AND THICK CYLINDERS** **9**

Introduction – Short and Long Columns, Euler's Theory, Rankine-Gordon Formula, Eccentrically Loaded Columns - Thick cylinders – compound cylinders.

UNIT IV **ENERGY PRINCIPLES** **9**

Castigliano's theorems – principle of virtual work – Maxwell's reciprocal theorems.- application of energy theorems for computing deflections in beams and trusses.

UNIT V **INDETERMINATE BEAMS AND FRAMES** **9**

Degree of static and kinematic indeterminacies for beams and plane frames - analysis of indeterminate pin-jointed frames - rigid frames.

L	T	P	Total
45	0	0	45

TEXT BOOKS

1 .Dr. R.K.Bansal,“ Strength of Materials”, Laxmi Publications Pvt Ltd, New Delhi, 8th Edition

2. R.K. Rajput, “ Strength of Materials”, S.Chand and Company Ltd, New Delhi, 8th Edition

3. R.S. Khurmi, “Strength of Materials”, S. Chand & Company Ltd, New Delhi, 2013

REFERENCE BOOKS

1. William Nash, Theory and Problems of Strength of Materials, Schaum’s Outline Series, McGraw-Hill International Edition.

4. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi

5. Egor P Popov, “Engineering Mechanics of Solids”, Prentice Hall of India, New Delhi, 2012, Second Edition.

Mapping of CO with PO’s

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	1					1			1					
CO 2	2	1				1		1			1		3	
CO 3	1				1		1				1			
CO 4	3	1		3			1						1	
CO 5	3	3											1	
Total	10	5	0	3	1	2	2	1	1	0	2	0	5	0
Scaled Value	**2**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**		**1**		**1**	

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : II

Course Code : PCE 202

Course Name : GEOTECHNICAL ENGINEERING – I

Prerequisite : NIL

L	T	P	C
2	1	0	3

C	P	A
2	0.5	0.5

L	T	P	H
2	2	0	4

Course Objectives

- To understand the soil properties, composition and structure
- To Familiarize the students an understanding of permeability and seepage of soils
- To learn the stress-strain relationship
- To know about the strength of soil and its analysis

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	***Identify*** and ***analyze*** various types of soils for engineering utilization.	Cognitive & Psychomotor	Remembering & Observation
CO2	***Determine*** the necessary index and engineering properties of soils.	Cognitive Affective Psychomotor	Analyzing Respond to Phenomena Observation
CO3	***Predicts*** the stress distribution pattern of soil	Cognitive, Affective & Psychomotor	Application Respond to Phenomena Manipulation
CO4	***Illustrate*** the failure modes of Soil	Cognitive & Psychomotor	Understanding Manipulation
CO5	***Investigate*** the soil using appropriate methods and equipments.	Cognitive & Psychomotor	Remembering Observation

COURSE CONTENT

UNIT I SOIL PROPERTIES AND SUB SOIL INVESTIGATION 9

Origin of Soils and Rocks; Rock cycle; Soil minarology; Index properties including consistency limits and grain size distribution – Identification and classification of soil – Textural HRB and BIS specification

Methods of exploration, geophysical and conventional methods; Sounding drilling and boring technique; Field tests – penetration tests

UNIT II SOIL - WATER STATICS 7

Concept effective and neutral stresses – Darcy's law, Permeability – Field and Laboratory

permeability tests –Seepage flow, seepage pressure, exit gradient - Flownet – significance of Laplace equation – quick sand condition, Liquefaction

UNIT III COMPRESSIBILITY AND CONSOLIDATION OF SOIL 12

Compaction – Factors affecting compaction – proctor test – Field compaction – Field compaction controls, CBR value and CBR test

Consolidation of soils – Terzaghi's one dimensional consolidation theory – pressure void ratio relationship – prediction of pre consolidation pressure – Total settlement and time rate settlement – secondary compression – coefficient of consolidation – Curve fitting methods, consolidation models.

UNIT IV STRESSES IN SOIL FROM SURFACE LOADS 8

Vertical stress distribution in soil - Boussinesq's and Westerguard's equations – Newmark's influence chart – Principle, Construction and use - Equivalent point load and other approximate procedures, stress isobars & pressure bulbs

UNIT V SHEAR STRENGTH OF SOIL 9

Shear Strength; Mohr – Coulomb failure criterion and models – laboratory and field tests – shear properties of cohesion less and cohesive soils - Shear Strength. Parameters for under consolidated, normally consolidated and over consolidated clays; Soil sensors applied in field, Modern advancements; Trenchless Technology

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Murthy, V. N. S. "Geotechnical Engineering: Principles and Practices ofSoil Mechanics and Foundation Engineering", CRC Press, 2002
2. Ranjan, Gopal & Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age Int. Pvt. Ltd., 2004.
3. Venkatramaiah, C. "Geotechnical Engineering", New Age International Publishers, New Delhi, 3rd edition, 2005, Reprint 2011.
4. Punmia. B.C.,Asok Kumar Jain and Arun Kumar Jain, "Soil Mechanics and Foundations" Laxmi Publications Pvt. Ltd., New Delhi, Sixteenth edi.tion,2005

REFERENCE BOOKS

1. Terzaghi, K., Peck, R. B. &Mesri, G., "Soil Mechanics in Engineering Practice", Wiley, 1996.
2. Craig, R.F. "Craig's Soil Mechanics", 7th Ed., Spon Press, 2004.
3. Holtz, R.D. & Kovacs, W.D., "An Introduction to Geotechnical Engineering", Prentice Hall, 1981.
4. Lambe, T.W. & Whitman, R.V., "Soil Mechanics", John Wiley & Sons, 1979.
5. Mitchell, J.K. & Soga, K., "Fundamentals of Soil Behaviour", John Wiley & Sons, 2005.
6. Coduto, D.P. "Geotechnical Engineering: Principles and Practices", Pearson Education, Prentice Hall, 2007.
7. Bolton, M.D. "A Guide to Soil Mechanics", Universities Press, 2003.
8. Das, B.M. "Principles of Geotechnical Engineering", Thomson Books, 2013.

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3. http://www.nitttrchd.ac.in/sitenew1/civil/civil.php#page=page-1

IS Codes

1. IS 1498:1970, Classification and identification of soils for general Engineering purposes (first revision) Reaffirm Dec 2011

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	1		1		1		2		1		1	2	2
CO 2	1	2	1	1		2		2		1		1	2	2
CO 3	2	1	1	1		1		3		1	1	1	2	2
CO 4	1	2	1	1	1	1		2		1	1	1	2	2
CO 5	1	3	1	1	1	1	2	2	3	1	1	1	2	2
Total	7	9	4	5	2	6	2	11	3	5	3	5	10	10
Scaled Value	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**3**	**1**	**1**	**1**	**1**	**2**	**2**

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : **II**

Course Code : **PCE 203**

Course Name : **CONCRETE TECHNOLOGY**

Prerequisite : **NIL**

L	T	P	C
3	0	0	3

C	P	A
2.5	0	0.5

L	T	P	H
3	0	0	3

Course Objectives

- Acquire knowledge on construction materials
- Study the properties of fresh and hardened concrete.
- Learn the mix design procedure

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	***Identify*** and ***test*** the properties of ingredients of Concrete	C	(Understand)
CO2	***Identify*** and ***test*** the properties of Concrete	C	(Remember)
CO3	***Carry out*** the mix design of M20 and M35 as per IS456	C,A	(Understand) Manipulation
CO4	***Ensure*** quality during Transporting, Laying, Compacting and finishing of concrete	C,A	(Understand) Manipulation
CO5	***Adopt*** special concreting technologies to meet out the modern construction requirements.	C	(Remember)

COURSE CONTENT

UNIT I	**CONSTITUENT MATERIALS**	**9**

Cement: - Properties - Testing – modern methods of analysis - Blended Cements; Aggregates: Classification- Properties - Testing - Artificial aggregates; Water: Various sources - Quality Testing; Admixtures and Chemicals: Properties – Uses - Use of eco-friendly recyclable and sustainable materials

UNIT II	**FRESH CONCRETE**	**9**

Rheology - Workability: Factors affecting - Measurement - Testing; Manufacture of concrete: Process -Compaction; Properties: Segregation - Bleeding - Setting times - Curing - Finishing.

UNIT III	**HARDENED CONCRETE**	**9**

Strength: Compressive - Tensile - Flexure - Strength relationships - Testing as per IS codes – Factors influencing strength – NDT techniques; Thermal properties: Durability of concrete: Shrinkage - Creep - Cracks - Acid, Sulphate and Chloride attack.

UNIT IV	**CONCRETE MIX DESIGN**	**9**

Concepts of mix design - Factors influencing mix design – ACI and IS code recommended mix design methods; Non-pumpable concrete; Pumpable concrete:.

UNIT V SPECIAL CONCRETES 9

Manufacture, Properties and Uses: High strength and high performance concrete - Waterproofing concrete - Fiber Reinforced concrete - Light weight and High Density Concrete - Aerated - No fines - Organic concrete; Special concreting methods: Self compacting concrete - Hot and Cold weather concreting - Prepacked - Vacuum - Gunite and Shotcrete – Ferrocement - Quality control - Sampling and testing-Acceptance criteria

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Shetty M S. Concrete Technology: Theory and Practice, 7th Edition, S. Chand & Company Ltd-New Delhi, 2014.
2. Varghese PC. Building Materials (English), 2nd Edition, PHI Learning, 2014.
3. Neville AM. Properties of Concrete, Pearson India, 2012.
4. Zongjin Li. Advanced Concrete Technology, John Wiley & Sons. 2011.

REFERENCE BOOKS

1. Santhakumar AR. Concrete Technology, 1st Edition , Oxford University Press-New Delhi, 2006.
2. Ghambir ML. Concrete Technology, 5th Edition , McGraw Hill Education, 2013.
3. Sandor Popovic. Concrete Materials, 2nd Ed.: Properties, Specifications, and Testing, William Andrew, 2012.
4. John Newman. Advanced Concrete Technology 3: Processes 1st Edition, Elsevier Science, 2003.

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http://nptel.ac.in/courses/105102012

http://nptel.ac.in/courses/105104030

http://freevideolectures.com/Course/3357/Concrete-Technology

http://engineeringvideolectures.com/course/289

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	1	3	1	1					1	3	1	3	1	
CO 2					1				2	2				
CO 3	1	3	3	3					1				3	
CO 4	1					1	1		1			1		1
CO 5					1					3				
Total	3	6	4	4	2	1	1		5	8	1	4	4	1
Scaled Value	1	2	1	1	1	1	1		1	2	1	1	1	1

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : **II**

Course Code : **P**204**

Course Name : **DISASTER MANAGEMENT**

Prerequisite : **NIL**

L	T	P	C
0	0	0	0

C	P	A
3	0	0

L	T	P	H
2	0	0	2

Course Outcome: After the completion of the course, students will be able to

		Domain C or P or A	**Level**
CO1	Understand the concepts of disasters, their significance and types	Cognitive	Understand
CO2	Understand the relationship between vulnerability, disasters, disaster prevention and risk reduction	Cognitive	Understand
CO3	Able to understanding of preliminary approaches of Disaster Risk Reduction (DRR)	Cognitive	Understand
CO4	Develop awareness of institutional processes in the country	Cognitive	Application
CO5	Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity	Cognitive	Application

COURSE CONTENT

UNIT I **INTRODUCTION TO DISASTERS** **6**

Importance &Significance, Types of Disasters, Climate Change, DM cycle

UNIT II **RISK ASSESSMENT** **12**

Risk, Vulnerability, Types of Risk, Risk identification, Emerging Risks, Risk Assessment, Damage Assessment, Risk modeling.

UNIT III **DISASTER MANAGEMENT** **10**

Phases, Cycle of Disaster Management, Institutional Framework, Incident Command System, DM Plan, Community Based DM, Community health and safety, Early Warning and Disaster Monitoring, Disaster Communication, Role of GIS and Remote Sensing, Do's and Don'ts in various disasters.

UNIT IV **DISASTER RISK MANAGEMENT IN INDIA** **10**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness), Disaster Management Act and Policy – Other related policies, plans, programmes and legislation

UNIT V **DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES** **7**

Landslide Hazard Zonation, Earthquake Vulnerability Assessment of Buildings and Infrastructure, Drought Assessment, Coastal Flooding, Forest Fire, Man Made disasters, Space Based Inputs for Disaster Mitigation and Management, Cast Study

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Singhal J.P. Disaster Management, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361)
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. KapurAnu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010

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1. Siddhartha Gautam and K Leelakrisha Rao, "Disaster Management Programmes and Policies", Vista International Pub House, 2012
2. Arun Kumar, "Global Disaster Management", SBS Publishers, 2008
3. Pardeep Sahni, Alka Dhameja and Uma medury, "Disaster mitigation: Experiences and reflections", PHI, 2000
4. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
5. Government of India, National Disaster Management Policy, 2009

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- NIDM Publications at http://nidm.gov.in- Official Website of National Institute of Disaster Management (NIDM), Ministry of Home Affairs, Government of India
- http://cwc.gov.in , http://ekdrm.net , http://www.emdat.be , http://www.nws.noaa.gov , http://pubs.usgs.gov , http://nidm.gov.ini http://www.imd.gov.ini

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1			2	1	1		1		1		1	1		
CO 2	1	1	3	2	3		1	1						
CO 3					2		1		1					
CO 4	1	1	2	2	2		1				1	1		
CO 5	2	3		2	3		1	2	1			2		
Total	4	5	7	7	11		5	3	3		2	4		
Scaled Value	1	1	2	2	3		1	1	1		1	1		

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : II

Course Code : PCE205

Course Name : GEOTECHNICAL ENGINEERING LAB

Prerequisite : GEOTECHNICAL ENGINEERING

L	T	P	C
0	0	2	2

C	P	A
2	0.5	0.5

L	T	P	H
0	0	2	2

Course Objectives

- To understand the handling of equipments
- To provide the hands on training in determination of Engineering and index properties of soils, applied in field problems.
- To provide the knowledge on the use of experimental results pertaining to foundation problems

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	***Identify*** and ***analyze*** various types of soils for engineering utilization.	Psychomotor	Remembering & Observation
CO2	***Determine*** the necessary index and engineering properties of soils.	Psychomotor	Analyzing Respond to Phenomena Observation
CO3	***Investigate*** the soil using appropriate methods and equipments.	Psychomotor	Remembering Observation

COURSE CONTENT

Experiments in Geotechnical Engineering **30**

- Water content determination (Oven drying method)
- Grain size distribution - Sieve analysis and Hydrometer analysis
- Determination of Specific gravity by Pycnometer and density bottle method
- Determination of Liquid and Plastic limit (Casagrande method)
- Determination of Shrinkage limit of soil
- Determination of moisture-density relationship (Standard Proctor's)
- Determination of Permeability by Constant and Variable head method
- Determination of in-situ density by sand replacement and core cutter method
- Determination of Relative density - Sand
- Unconfined compression test for fine grained soils
- Triaxial Compression Test
- Direct shear test for coarse grained soils
- California Bearing Ratio (CBR) Test
- Plate load test, SPT and SCPT – study experiments

L	T	P	Total
0	0	30	30

TEXT BOOKS

1. Murthy, V. N. S. “Geotechnical Engineering: Principles and Practices ofSoil Mechanics and Foundation Engineering”, CRC Press, 2002
2. Ranjan, Gopal & Rao, A.S.R., “Basic and Applied Soil Mechanics”, New Age Int. Pvt. Ltd., 2004.

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1. K.H. Head and R. J. Epps, “Manual of Soil Laboratory Testing vol II”, 3rd Edition, Whittles Publishing, 2011.
2. B.M. Das, “Soil Mechanics Laboratory Manual”, 6th Ed., London, University Press, 2001.
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IS Codes

1. IS 1498:1970, Classification and identification of soils for general Engineering purposes (first revision) Reaffirm Dec 2011
2. IS 1888: 1982 Method of Load Test on Soils. • IS 1892: 1979 Code of Practice for Subsurface Investigation for Foundations
3. IS 2131: 1981 Method for Standard Penetration Test for Soils.
4. IS 2720: Part 31: 1990 Methods of Test for Soils - Part 1 to 31:
5. IS 4968: Part III: 1976 Method for Subsurface Sounding for Soils - Part II: Static Cone Penetration Test.

Mapping of CO with PO’s

	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO 1	2				3			1				1	1	1
CO 2	2				3			1				1	1	1
CO 3	2				3			1	1	1		1	1	1
Total	6				9			3	1	1		3	3	3
Scaled Value	**2**				**2**			**1**	**1**	**1**		**1**	**1**	**1**

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester	**:**	**III**
Course Code	**:**	**PCE 301**
Course Name	**:**	**STRUCTURAL ANALYSIS**
Prerequisite	**:**	**MECHANICS OF SOLIDS**

L	T	P	C
3	1	0	4

C	P	A
2	0	1

L	T	P	H
3	2	0	5

Course Objectives

Students will be exposed to the theories and concepts of structural analysis.

An understanding of real issues in the behaviours of structures.

To introduce the students to various methods for the analysis of buildings

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Identify the behavior of structural element under various loading condition.	Cognitive Affective	Understand & Analyse
CO2	Analyse the continuous beams and rigid frames by slope defection method.	Cognitive Affective	Understand & Analyse
CO3	Understand the concept of moment distribution and analysis of continuous beams and rigid frames with and without sway.	Cognitive Affective	Understand & Analyse
CO4	Superimpose the effects of settlement and rotation of the supports over the regular analysis.	Cognitive Affective	Understand & Analyse
CO5	Apply knowledge on advanced methods of analysis of structures including arches and cables.	Cognitive Affective	Understand & Analyse

COURSE CONTENT

UNIT I INDETERMINATE FRAMES 12

Degree of static and kinematic indeterminacies for beams and plane frames - analysis of indeterminate pin-jointed frames - rigid frames.

UNIT II SLOPE DEFLECTION METHOD 12

Continuous beams and Rigid frames (with And without sway) – Symmetry and Asymmetry– Simplification for hinged end – Support Displacements.

UNIT III MOMENT DISTRIBUTION METHOD 12

Stiffness and carry over factors-Distribution and carryover of Moments– Analysis of continuous Beams with and without displacement – Plane Rigid Frames with and without Sway

UNIT IV MOVING LOADS AND INFLUENCE LINES 12

Influence lines for reactions in statically determinate structures – Influence lines for shear force and bending moment in beam sections – Calculation of critical stress resultants due to concentrated and distributed moving loads.

UNIT V ARCHES AND SUSPENSION CABLES 12

Types of Arches – Transfer of loads - Arch action- Horizontal forces- Analysis of Parabolic and Circular Arches(Hinged, fixed)- Cables- Components and their functions – Analysis of Suspension Cables, Reaction-Tension and Length of suspension cables.

L	T	P	Total
30	30	0	60

TEXT BOOKS

1. Vaidyanadhan, R and Perumal, P, "Comprehensive Structural Analysis – Vol. 1 & Vol. 2", Laxmi Publications, New Delhi, 2013.
2. L.S. Negi& R.S. Jangid, Structural Analysis", Tata McGraw-Hill Publications, New Delhi, 2013
3. S SBhavikatti, Structural Analysis", Vikas Publishing House, 2011.

REFERENCE BOOKS

1. C.K. Wang, "Analysis of Indeterminate Structures", Tata McGraw-Hill, 2010.
2. B.C Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Theory of Structures", Laxmi Publication, 2012.
3. DevdasMenon, "Structural Analysis", Narosa Publishers, 2010.

Mapping of CO with PO's

	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO 1	2	3				1							1	
CO 2	3	1	1			1								
CO 3	1	3	2					1	1		1			
CO 4	3	2	2		1	1					1		1	
CO 5	1	1	1		1								1	1
Total	10	10	6		2	3	2	1	1		2		3	1
Scaled Value	**2**	**2**	**2**		**1**	**1**	**1**	**1**	**1**		**1**		**1**	**1**

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : III

Course Code : PCE 302

Course Name : TRANSPORTATION ENGINEERING

Prerequisite : NIL

L	T	P	C
3	0	0	3

C	P	A
2	0.5	0.5

L	T	P	H
3	0	0	3

Course Objectives

- To understand the importance of transportation and characteristics, the history of highway development, surveys and classification of roads
- To study about the geometric design of highways, traffic characteristics and design of intersections, the pavement materials and design
- To know about the basics and design of various components of railway engineering, the types and functions of track, junctions and railway stations
- To learn about the aircraft characteristics, planning and components of airport
- To study about the types and components of docks and harbours
- To know about various urban transportation systems and Intelligent Transportation Systems

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	***Carryout*** surveys involved in planning and highway alignment, ***design*** cross section elements, sight distance, horizontal and vertical alignment	Cognitive & Affective Psychomotor	Remembering Respond & Observation
CO2	***Implement*** traffic studies, traffic regulations and control, and intersection design determine the characteristics of pavement materials design flexible and rigid pavements as per IRC	Cognitive Psychomotor	Analyzing Observation
CO3	***Carry out*** the surveys for railways, airports and harbours	Cognitive, Affective & Psychomotor	Application Respond to Phenomena Manipulation
CO4	***Plan*** the layout of different types of terminals	Cognitive & Affective	Understanding Manipulation
CO5	***Demonstrate*** the fundamentals of Intelligent Transportation Systems	Cognitive & Psychomotor	Remembering Observation

COURSE CONTENT

UNIT I INTRODUCTION 9

Importance of transportation, different modes of transportation, characteristics of road transport, scope of highway and traffic engineering Highway development and planning: Importance, classification of roads, road patterns, planning surveys; highway alignment and surveys Highway Geometric Design: Cross section elements, sight distance, design of horizontal and vertical alignment

UNIT II TRAFFIC ENGINEERING 9

Traffic characteristics - Traffic studies-speed, volume, speed and delay, origin-destination, parking and accident studies; capacity of urban roads and highways; traffic operations-regulation and control; design of intersections- at grade and grade separated Pavement Materials and Design: Specifications and tests on pavement materials, pavement design factors, design of flexible and rigid pavements as per IRC

UNIT III	RAILWAY ENGINEERING	9

Location surveys and alignment - Permanent way - Gauges - Components - Functions and requirements - Geometric design Track Junctions-Points and crossings - types and functions - design and layout - simple problems - Railway stations and yards. Signaling and interlocking - control systems of train movements

UNIT IV	AIRPORT ENGINEERING	7

Aircraft characteristics - Airport obstructions and zoning - Runway - taxiways and aprons- Terminal area planning

UNIT V	DOCKS AND HARBOURS AND URBAN TRANSPORTATION SYSTEMS	11

Types - Layout and planning principles- breakwaters - docks- wharves and quays - Transit sheds- warehouses- navigation aids.

Bus transit - Mass Rapid Transit System - Light Rail Transit. Transport economics and Financing - Intelligent Transportation Systems (ITS)

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Khanna, S.K and Justo, C.E.G., Highway Engineering, Nem Chand and Bros. 2001
2. Kadiyali, Principles of Highway Engineering, Khanna Publishers, 2019
3. M.M. Agarwal, Railway Engineering, Prabha & Co. 2007.
4. Khanna, S.K. and Arora, M.G. Airport Planning and Design, Nemchand and Bros. 1999.

REFERENCE BOOKS

1. Kadiyali, L.R, Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, 1999
2. Oza and Oza, Elements of Dock and Harbour Engineering, Charotar Publishing House, 1996.
3. Vazirani V N and Chandola S P “Transportation Engineering - Vol.2”, Khanna Publishers, 1998

E-REFERENCES

1. https://nptel.ac.in/courses/105/101/105101087/
2. https://nptel.ac.in/courses/105/105/105105107/
3. https://nptel.ac.in/courses/105/104/105104098/

IS Codes

1. IRC and IRC SP codes and manuals

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	1		1		1		2		1		1	2	1
CO 2	1	2	1	1		2		2		1		1	1	2
CO 3	1	2	1	1		1		2		1	1	1	2	1
CO 4	2	2	1	1	1	2		1		1	1	1	2	2
CO 5	1	3	1	1	1	1	2	2	3	1	1	1	1	1
Total	8	10	4	5	2	7	2	9	3	5	3	5	8	7

Scaled Value

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester	**:**	**III**
Course Code	**:**	**PCE 303**
Course Name	**:**	**ENVIRONMENTAL ENGINEERING**
Prerequisite	**:**	**NIL**

L	T	P	C
3	0	0	3

C	P	A
2.5	0	0.5

L	T	P	H
3	0	0	3

Learning Objectives

The objectives of this course is

- To acquire the knowledge on extent of pollution on land, water and air.
- To understand the physical, chemical, and biological phenomena for successful design, operation and maintenance of water and sewage treatment plants.

To make the students conversant with the processing and disposal of municipal solid waste and Hazardous Waste.

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Understand the qualities of water and wastewater	Cognitive	Knowledge
CO2	Analyse the principles of water and wastewater treatment technologies and their functions	Cognitive	Comprehension
CO3	Plan strategies to control, reduce and monitor air and noise pollution.	Cognitive	Analysis
CO4	Identify the most appropriate technique for solid waste treatment and disposal	Cognitive Affective	Understand & Analyse
CO5	Understand the fundamentals of Plumbing work in residential buildings	Cognitive Affective	Understand

COURSE CONTENT

UNIT I WATER AND SEWAGE 12

Water: -Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.

Sewage- Wastewater quality parameters Storm Water- Quantification and design of Storm water; Sewage and Sullage, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems, Pollution due to improper disposal of sewage. Government authorities and their roles in water supply, sewerage disposal

UNIT II WATER AND WASTEWATER TREATMENT 10

*Water Treatment: A*eration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes.

Wastewater treatment: Aerobic and anaerobic treatment systems, suspended and attached growth systems, Septic tank, grey water treatment .

UNIT III AIR AND NOISE 8

Air - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Effects of Air pollution, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Air quality standards, Control measures for Air pollution, construction and limitations.

Noise- Basic concept, measurement and various control methods.

UNIT IV SOLID AND HAZARDOUS WASTE MANAGEMENT 8

Solid waste management-Municipal solid waste, Composition and various chemical and physical parameters of MSW, Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes. Government authorities and their roles in Solid waste management and monitoring/control of environmental pollution.

Hazardous waste: Types and nature of hazardous waste

UNIT V BUILDING PLUMBING 7

Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Pressure reducing valves, Break pressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used.

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. *Environmental Engineering*, Mc-Graw - Hill International Editions, New York 1985.
2. MetCalf and Eddy. *Wastewater Engineering, Treatment, Disposal and Reuse*, Tata McGraw-Hill, New Delhi.
3. Integrated Solid Waste Management, Tchobanoglous, Theissen& Vigil. McGraw Hill Publication International Editions, New York 1985.
4. CPHEEO Manual on Water Supply And Treatment,1999
5. CPHEEO Manual on Sewerage And Sewage Treatment,1993

REFERENCES

1. B.C. Punmia, Watersupply Engineering, Volume –II, Laxmi Publication 2008
2. B.C. Punmia, Wastewater Engineering, Volume – II, Laxmi Publication 2008
3. S.K. Garg, Wastewater Engineering, Khanna Publishers, New Delhi, 2007
4. Gurucharan Singh," Water supply and Sanitary Engineering", Standard Publishers Distributors, 2009
5. Garg, S.K., "Environmental Engineering I & II", Khanna Publishers, New Delhi 2007
6. Rangwala, " Water Supply and Sanitary Engineering PB,24/e, Charotar Publishing house Pvt. Ltd.- Anand, 2011
7. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
8. Standard methods for the Examination of Water and Wastewater,17thEdition,WPCF,APHA and AWWA,USA,1989.

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1		1	3	1	1	1			1				1	
CO 2		1	3	1	1	1			2				2	1
CO 3	1		1	2			1		1		1		2	
CO 4	1	1	1	1			1		2		1		1	
CO 5			2	2					3			2	5	
Total	2	3	9	7	2	2	2		9		2	2	11	1
Scaled Value	1	1	2	2	1	1	1	0	2	0	1	1	3	1

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : III
Course Code : PCE304
Course Name : ENVIRONMENTAL ENGINEERING LAB
Prerequisite :

L	T	P	C
0	0	2	2

C	P	A
3	0	0

L	T	P	H
0	0	2	2

Course Objectives

- To understand the analysis of water and Waste water
- To understand the level of Noise pollution
- To gain knowledge about the suitability of water for drinking and construction purpose
- To provide the knowledge of effluent standards for disposal.

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Understand and analyse the qualities of water	Psychomotor	Understanding & Observation
CO2	Understand and analyse the qualities of waste water	Psychomotor	Understanding & Observation
CO3	Identify the level of Noise pollution	Psychomotor	Analyzing
CO4	Gather the knowledge about the suitability of water and effluent disposal standards	Affective & Psychomotor	Analyzing & Observation

EXPERIMENTS **30 HRS.**

1. Physical Characterization of water: Turbidity, Electrical Conductivity, pH
2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile
3. Alkalinity and acidity
4. Total Hardness
5. Analysis of ions: chloride and sulfate
6. Optimum coagulant dose
7. Residual chlorine
8. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)
9. Chemical Oxygen Demand (COD)
10. Ambient noise measurement

P - 30Hrs.

TEXT BOOKS

1. CPHEEO Manual on Water Supply And Treatment,1999
2. CPHEEO Manual on Sewerage And Sewage Treatment,1993

REFERENCES

1. Standard methods for the Examination of Water and Wastewater,17th Edition,WPCF,APHA and AWWA,USA,1989.

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	2			1				1			1		
CO 2	2	2			1				1			1		
CO 3	2	1			1				1			1		
CO 4	2		3		1	1	1		1					1
Total	8	5	3		4	1	1		4			3		1
Scaled Value	2	1	1		1	1	1		1			1		1

Note:	**Total**	0	1-5	6-10	11-15				
	Scaled value	0	1	2	3				
	Relation	No	Low	Medium	High				

Semester : III

Course Code : PCE305

Course Name : CONCRETE AND HIGHWAY LAB

Prerequisite : TRANSPORTATION ENGINEERING

L	T	P	C
0	0	2	2

C	P	A
2	0.5	0.5

L	T	P	H
0	0	2	2

Course Objectives

- To understand the handling of equipments
- To provide the hands on training in determination of properties of pavement materials
- To provide the knowledge on the use of experimental results pertaining to pavement design

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	***Identify*** and ***analyze*** various types of pavement materials	Psychomotor	Remembering & Observation
CO2	***Determine*** the necessary properties of pavement materials	Psychomotor	Analyzing Respond to Phenomena Observation
CO3	***Investigate*** the appropriate methods and equipments.	Psychomotor	Remembering Observation

COURSE CONTENT

Experiments in Transportation Engineering	**30**

Tests on Aggregates

- CBR test.
- Aggregate crushing value test.
- Los Angeles abrasion value test of aggregates.
- Aggregate impact value test.
- Shape test of aggregates - Flakiness Index
- Specific gravity and water absorption test for coarse aggregates.
- Fineness modulus

Tests on Bituminous Materials

- Softening point (Ring and ball test) of bitumen.
- Penetration value test of bitumen.
- Marshall Stability test.
- Specific gravity.
- Loss on heating
- Design of B C mix
- Binder content

L	T	P	Total
0	0	30	30

TEXT BOOKS

1. Khanna.S. K., Justo.C.E.G and Veeraragavan A. “Highway Engineering”, Nemchand Publishers, 2014.
2. Subramanian K.P., “Highways, Railways, Airport and Harbour Engineering”, Scitech Publications (India), Chennai, 2010
3. Kadiyali.L.R. “Principles and Practice of Highway Engineering”, Khanna Technical Publications, 8th edition Delhi, 2013.

REFERENCE BOOKS

1. Highway Materials and Pavement Testing, Nem Chand and Bros., Roorkee, Revised Fifth Edition, 2009
2. Mix Design Methods Asphalt Institute Manual Series No. 2, Sixth Edition,1997, Lexington, KY, USA

E-REFERENCES

1. https://www.vlab.co.in/ba-nptel-labs-civil-engineering

IS Codes

1. Methods for testing tar and bituminous materials, IS 1201-1978 to IS 1220- 1978, Bureau of Indian Standards
2. Methods of test for aggregates, IS 2386 – 1978, Bureau of Indian Standards

Mapping of CO with PO’s

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2				3			1				1	1	1
CO 2	2				3			1				1	1	1
CO 3	2				3			1	1	1		1	1	1
Total	6				9			3	1	1		3	3	3

Scaled Value

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : **IV**

Subject Name : **DESIGN OF RCC STRUCTURES**

Subject Code : **PCE401**

Prerequisite : **STRUCTURAL ANALYSIS**

L	T	P	H
3	1	0	4

C	P	A
2.5	0	0.5

L	T	P	H
3	1	0	4

Course Objectives

1. Students will be exposed to the theories and concepts of structural design.
2. Hands-on design experience and skills will be gained and learned through problem sets and a comprehensive design project using software.
3. An understanding of real-world open-ended design issues will be developed.

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Perceive the knowledge on basics of design	Cognitive	Understand
CO2	Interpret ultimate and serviceability limit state approaches in current structural design philosophy	Cognitive	Understand
CO3	Understand the design concept of structural elements	Cognitive & Affective	Analyse & Apply
CO4	Model building structure and analyse structural elements for design actions	Cognitive & Affective	Analyse & Apply
CO5	Analyse and design different types of footing	Cognitive & Affective	Analyse & Apply

COURSE CONTENT

UNIT I **METHODS OF DESIGN OF CONCRETE STRUCTURES** **12**

Study of the strength, 45ehavior, and design of indeterminate reinforced concrete structures, Load and stresses, load combinations, Working stress and limit state approach. Concepts of Yield line theory

UNIT II **LIMIT STATE DESIGN FOR FLEXURE** **12**

Design of one way and two way slab – singly and doubly reinforced beams- continuous beams –Flanged beams – Staircase.

UNIT III **LIMIT STATE DESIGN FOR SHEAR, BOND AND TORSION** **12**

Behaviour of RC members in bond and anchorage – Design requirements –Behaviour of RC beams in shear and torsion – Design of RC members for combined bending shear and torsion.

UNIT IV **DESIGN OF COLUMNS** **12**

Types of columns –Design of short columns for axial, uniaxial and biaxial bending – Design of slender column.

UNIT V **DESIGN OF FOOTINGS** **12**

Design of Isolated footings (Flat and Sloped) – Design of combined rectangular footing for two columns only – Design of Raft Footing.

L	T	P	Total
45	15	0	60

TEXT BOOKS

1. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Pvt. Ltd., New Delhi,Second Edition, 2010.
2. Krishna Raju, N., "Design of Reinforced Concrete Structures", CBS Publishers & Distributors, New Delhi,2007.

REFERENCES

1. DevadasMenon&UnnikrishnanPillai, Reinforced Concrete Design,Tata McGraw-Hill Publishing Company Ltd., New Delhi 2011
2. Dr.P.Purushothaman, Reinforced Concrete Structures, Oxford Publication (P) Ltd, Delhi, 2007.
3. M.L.Gambhir, Design of reinforced concrete structures, PHI Learning Private Limited, 2013.
4. IS 456 -2000, Plain and Reinforced Concrete – Code of Practice, 4th revision
5. SP16-1980.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		1										2	
CO2	2	3		1		1	1						3	1
CO3	1	1	3	1		1	1	1			1		1	
CO4	1		2	1				1	1		1		3	
CO5	1		2	1				1	1		1		3	
	8	4	8	4		2	2	3	2		3		12	1

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : IV

Course Code : PCE 402

Course Name : GEOTECHNICAL ENGINEERING – II

Prerequisite : MECHANICS OF SOLIDS AND GEOTECHNICAL ENGINEERING - I

L	T	P	C
2	1	0	3

C	P	A
2	0.5	0.5

L	T	P	H
2	1	0	3

Course Objectives

- To understand the application of soil properties in stability of slope analysis, improvement of soil strength and effect of lateral earth pressure on geostructures.
- To estimate the load carrying capacity of different types of soils
- To satisfy the expectation of ability of calculating the dimensions of shallow foundations
- To know about the types, analysis and design of deep foundations, geo-environmental, geotechnical earthque engineering

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	***Identify*** and ***analyze*** different types slope failures.	Cognitive & Affective	Remembering & Analyzing
CO2	***Analyze*** earth retaining structures with different loading conditions and able to understand the soil stabilization methods	Cognitive Affective	Analyzing & Responding
CO3	***Determine*** the safe bearing capacity of different soils. ***Calculate*** the size and shape of foundation required for actual loading from structures.	Cognitive, Affective & Psychomotor	Applyzing & Manipulating
CO4	***Demonstrate*** the failure modes of piles, piers and caissons	Cognitive & Psychomotor	Understanding & Manipulating
CO5	***Understand*** the effect of soil pollution and soil dynamics on foundation performance	Cognitive & Affective	Remembering Analyzing

COURSE CONTENT

UNIT I STABILITY OF SLOPES 8

Classifications of slopes, Stability analysis of infinite slopes. Stability analysis of finite slopes by Swedish and Friction circle method.

Stability analysis by Taylor's stability number, Taylor stability number

curves. Stability of slopes of earthen embankments under sudden draw down, steady seepage and during construction. Bishop's method of stability analysis.

UNIT II SOIL RETAINING WALLS AND GROUND IMPROVEMENT TECHNIQUES 8

Active, passive and earth pressure at rest. Rankine's and Coulomb's theories of earth pressure. Rebhann's and Culman's graphical methods for active earth pressure for vertical and inclined back retaining walls, horizontal and inclined cohesion less back fill. Earth pressure on cantilever sheet piles Stability analysis of retaining walls.

Ground modification by vibro replacement, stone columns, preloading and prefabricated drains, Reinforced earth structures, Introduction to geotextiles and geomembranes,

applications of geotextiles, design methods using geotextiles, geogrids, geonets, geomembranes, geotubes, grouting, deep mixing, PVDs, vacuum consolidation.

UNIT III BEARING CAPACITY OF SOIL AND SHALLOW FOUNDATIONS 10

Methods of estimation of bearing capacity, effect of water table on bearing capacity, Terzaghi, Vesic, Hansen, Moyerhof's analysis, Bearing capacity of stratified soils. IS code recommendations for minimum depth, factor of safety, design for local shear and general shear failure. Methods of estimation of settlement of footings. Limits of settlements for various structures, Methods of finding out bearing capacity from plate load test, standard penetration test data. Collapsible soil; Identification, Collapse settlement: foundation design. Behaviour of expansive soil, foundation practices, underreamed piles. Methods of finding out load carrying capacity of under reamed piles in clayey and sandy soil. Provision of IS 2911 Part III-1980 for design of under-reamed pile foundations.

UNIT IV DEEP FOUNDATIONS AND MACHINE FOUNDATIONS 10

Philosophy of deep foundation, piles - classification, estimation of individual and group capacity, static and dynamic approaches, pile load test, settlement of pile and pile groups, negative skin friction. piers, caissons or well foundation – analysis, tilting and corrections, Cofferdams – construction, use.

Machine foundations; introduction, machine vibration, structural design of foundation to rotary machines, impact machines, vibration characteristics, design consideration of foundation to impact machine, grillage, pile and raft foundation.

UNIT V ENVIRONMENTAL GEOTECHNOLOGY AND EARTHQUAKE GEOTECHNOLOGY 9

A consideration of technical and scientific aspects of key geo-societal issues. Case studies and analysis of current and historic databases will be used to illustrate topics including impact of climate change, energy resources, water and soil pollution, and health risks posed by heavy metals and emerging pollutants. Sanitary land fills, settlement of sanitary land fill.

Introduction to soil dynamics, Different methods of analysis for earthquake conditions - Pseudo-static method of design - Effect of earthquake forces on various foundations, Liquefaction, Tsunami, soil behavior during earthquake – foundation settlement and land sliding during earthquake – remedial measures.

Application of Remote Sensing, GIS and GPS in contaminated soil mapping and other geotechnical study

L	T	P	Total
30	15	0	45

TEXT BOOKS

1. Murthy, V. N. S. "Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering", CRC Press, 2002
2. Purushothama Raj, P. Ground Improvement Techniques, Laxmi Publications. 2016
3. Venkatramaiah, C. "Geotechnical Engineering", New Age International Publishers, New Delhi, 3rd edition, 2005, Reprint 2011.
4. Punmia. B.C.,Asok Kumar Jain and Arun Kumar Jain, "Soil Mechanics and Foundations" Laxmi Publications Pvt. Ltd., New Delhi, Sixteenth edi.tion,2005

REFERENCE BOOKS

1. Terzaghi, K., Peck, R. B. &Mesri, G., "Soil Mechanics in Engineering Practice", Wiley, 1996.
2. Craig, R.F. "Craig's Soil Mechanics", 7th Ed., Spon Press, 2004.

3. Holtz, R.D. & Kovacs, W.D., “An Introduction to Geotechnical Engineering”, Prentice Hall, 1981.
4. Lambe, T.W. & Whitman, R.V., “Soil Mechanics”, John Wiley & Sons, 1979.
5. Mitchell, J.K. & Soga, K., “Fundamentals of Soil Behaviour”, John Wiley & Sons, 2005.
6. Coduto, D.P. “Geotechnical Engineering: Principles and Practices”, Pearson Education, Prentice Hall, 2007.
7. Jie Han, “Principles and Practice of Ground Improvement”, John Wiley & Sons, 2020
8. Das, B.M. “Principles of Geotechnical Engineering”, Thomson Books, 2013.

E-REFERENCES

1. https://nptel.ac.in
2. https://nptel.ac.in/courses/105/101/105101201/
3. http://www.nitttrchd.ac.in/sitenew1/civil/civil.php#page=page-1

IS Codes

1. IS : 2974 (Part I to V) code of practice for different types of machine foundation
2. IS : 6403 – 2016 – Code of practice for shallow foundation
3. IS : 1904 – 2002 – Code of practice for design and construction of foundation
4. IS : 2911 – 20016 – Code of practice for design and construction of pile
5. IRC – 78 – 2000 – Code of practice for road bridges and specifications

Mapping of CO with PO’s

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	1	1		1		1		1		1		1	1	2
CO 2	2	1	1	1		1		2		1		1	2	2
CO 3	1	1	2	1	1	1		3		2	1	1	1	2
CO 4	1	1	1	1	1	1		1		1	1	1	2	2
CO 5	2	2	1	1	1	1	1	3	3	1	1	1	2	2
Total	7	6	5	5	3	5	1	10	3	6	3	5	8	10

Scaled Value

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : IV

Course Code : PCE403

Course Name : CONSTRUCTION ENGINEERING & MANAGEMENT

Prerequisite : STRUCTURAL ANALYSIS

L	T	P	C
3	0	0	3

C	P	A
2	0	1

L	T	P	H
3	0	0	3

COURSE OBJECTIVES

To introduce the students to the basic concepts and principles of construction management.

To familiarize the students with the various construction management techniques including scheduling, resource management.

To study the elements of quality control and safety of construction projects.

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
At the end of this course, the students should be able to			
CO1	**Understand** the basic concepts of construction management such as types and functions of management, life-cycle stages of projects, project delivery types of contracts, and bidding	Cognitive	Understanding
CO2	**Ascertain** a basic ability to plan, control and monitor construction projects with respect to time and cost	Cognitive Affective	Understanding Responding
CO3	**Understanding** of modern construction practices.	Cognitive	Understanding
CO4	**Receiving** an idea how construction projects are administered with respect to contract structures and issues.	Cognitive Affective	Understanding Responding
CO5	**Ability** to put forward ideas and understandings to others with effective communication processes.	Cognitive Affective	Understanding Responding

COURSE CONTENT

UNIT I BASICS OF CONSTRUCTION 05

Unique features of construction, construction projects types and features, phases of a project, Agencies involved and their methods of execution.

UNIT II CONSTRUCTION PLANNING AND SCHEDULING 13

Stages of project planning: pre-tender planning, Pre-construction planning, detailed construction planning, Process of development of plans and schedules, work break-down structure, activity lists, estimating durations, sequence of activities, Techniques of planning- Bar charts, Gantt Charts. Networks:

preparation of CPM networks: activity on link and activity on node representation, computation of float values, PERT- determining three time estimates, analysis.

UNIT III CONSTRUCTION METHODS & EQUIPMENT BASICS 09

Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; Basics of Slip forming for tall structures)Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for

transportation of materials.

UNIT IV	PROJECT PLANNING,ORGANIZING, MONITORING & CONTROL	09

Site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: Funds: cash flow, sources of funds; and S-Curves. Earned Value; Resource Scheduling- Bar chart, resource constraints and conflicts; Common Good Practices in Construction. Supervision, record keeping, periodic progress, reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures.

UNIT V	CONSTRUCTION QUALITY & CONTRACTS MANAGEMENT	09

Concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of

Various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods. Classification of costs, time cost, trade-off in construction projects, compression and decompression.

L	T	P	Total
30	15	0	45

TEXT BOOKS

1. Kumar NeerajJha, “Construction Project management”, Dorling Kindersley, Publishers, New Delhi.2013.
2. Chitkara.K.K, “Construction Project Management planning, Scheduling and control”, Tata McGraw Hill Publishing Company, New Delhi, 2010.
3. *National Building Code,* Bureau of Indian Standards, New Delhi, 2017.

REFERENCES

1. Punmia, B.C., Khandelwal, K.K., “Project Planning with PERT and CPM”, Laxmi Publications, 2016.
2. Vohra.N.D., “Quantitative Techniques in Management”, Tata McGraw Hill Publishing Company, New Delhi, 2010.
3. Joy.P.K, “Total Project Management”, Macmillan India Ltd, New Delhi, 2000.

Cos Versus Pos Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1				1	3	2	1	1	**1**					1
CO2	2	1						2	1	1		1	1	1
CO3	2	1		2		1	1	1	2		1		1	
CO4						2	1	1	1	1			1	
CO5			2				1							
Total Values	4	2	2	3	3	5	4	5	5	2	1	1	3	2
Scaled Value	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : **IV**

Course Code : **PCE405**

Course Name : **CONSTRUCTION MANAGEMENT LAB**

Prerequisite : **Nil**

L	T	P	C
0	0	2	2

C	P	A
3	0	0

L	T	P	H
0	0	2	2

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Plan and Schedule of a construction project using MS PROJECT	Psychomotor	Guided Response
CO2	Plan and Schedule of a construction project using PRIMAVERA	Psychomotor	Guided Response
CO3	Draw a Gantt Chart for managing dependencies between task	Psychomotor	Guided Response

EXPERIMENTS **30 Hrs.**

1. Preparation of Planning and Scheduling by using MS PROJECT - scheduling for a small construction project - Allocation of resource- Tracking of a Project-Cost analysis- Reports preparation.
2. Preparation of Planning and Scheduling by using PRIMAVERA - scheduling for a small construction project - Allocation of resource- Tracking of a Project-Cost analysis- Reports preparation.
3. Prepare a schedule for the construction of Residential building using MS-Project.
4. Prepare a schedule for the construction of Residential building using PRIMAVERA.

TEXT BOOKS

1. Paulson. B.R., Computer Applications in Construction, McGraw Hill, 2005.
2. Feigenbaum .L, Construction Scheduling with Primavera Project Planner, 2009

REFERENCES

1. Krishnamoorthy .C.S and Rajeev .S, Computer Aided Design, Narosa publishing house, New Delhi, 2001.
2. Harrison .H .B, Structural Analysis and Design, vol. I & II, Pergamon press, 2001
3. Feigenbaum .L, Construction Scheduling with Primavera Project Planner, Prentice Hall Inc., 2009.

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1				1	3		1		**1**					1
CO 2	2	1							1	1		1	1	1
CO 3	2	1		2			1		2		1		1	
Total	4	2	2	3	3		4		5	2	1	1	3	2
Scaled Value	1	1	1	1	1		1		1	1	1	1	1	1

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : V

Course Code : PCE501

Course Name : DESIGN OF STEEL STRUCTURES

Prerequisite : MECHANICS OF SOLIDS

L	T	P	C
3	1	0	4

C	P	A
2	1	0

L	T	P	H
3	2	0	5

Course Objectives

To understand the provisions of IS800-2007 code of practice for the design of structural members using various connections and cross-sections.

To study the behavior and design of compression, tension members and flexural members using simple and built-up sections.

To study the design of bolted and welded connections.

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Design of structural connections	Cognitive	Understand
CO2	Design of tension	Cognitive & Affective	Analyse & Apply
CO3	Design of compression members	Cognitive	Understand
CO4	Understand fabrication of plate girders and gantry girders	Cognitive	Understand
CO5	Design of structural elements of Industrial Structures.	Cognitive	Understand

COURSE CONTENT

UNIT I CONNECTIONS 9

Properties of steel – Structural steel sections – Limit State Design Concepts – Loads on Structures – Metal joining methods using welding, bolting – Design of bolted and welded joints – Eccentric connections - Efficiency of joints – High Tension bolts

UNIT II TENSION MEMBERS 9

Types of sections – Net area – Net effective sections for Angles and Tee – Design of connections in tension members – Use of lug angles – Design of tension splice – Concept of shear lag

UNIT III COMPRESSION MEMBERS 9

Types of compression members – Theory of columns – Basis of current codal provision for compression member design – Slenderness ratio – Design of single section and compound section compression members – Design of lacing and battening type columns – Design of column bases – Gusseted base

UNIT IV BEAMS 9

Design of laterally supported and unsupported beams – Built up beams – Beams subjected to biaxial bending – Design of plate girders– Intermediate and bearing stiffeners – Web splices – Design of beam columns

UNIT V TRUSSES AND INDUSTRIAL STRUCTURES 9

Roof trusses – Roof and side coverings – Design loads - Design of purlin and elements of truss- Design of gantry girder

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. N.Subramaniayan , “Design of Steel Structures: Theory and Practice” , Oxford University Press, 2010.
2. S.S Bhavikatti, “Design of Steel Structures”, I.K International Publishing Houses Pvt. Ltd, 2012.
3. Ramachandra S., “Design of Steel Structures – Vol. I & II”, Standard Publication, New Delhi,2010

REFERENCE BOOKS

1. Duggal S.K., “Limit state Design of Steel Structures”, 2nd edition, Tata McGraw - Hill Education, 2014
2. Dayaratnam, P., “Design of Steel Structures”, A.H.Wheeler& Co. Ltd., Allahabad, 2008
3. Jack C. McCormac , Stephen F.Csernak , “Structural Steel Design”Prentice Hall, Jul 2011

IS Codes

1. IS 800 -2007, General Construction in Steel, Code of Practice.
2. SP6 – 1 : ISI Hand Book of Structural Engineers, Part -I

Mapping of CO with PO’s

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	1	3	2			1	1	1				2	
CO 2	2	1	3	2			1		1				2	
CO 3	1	1	3	1		1							1	
CO 4	3	1	3	3	1	1							2	
CO 5	2	1	2	1		1							2	
Total	10	5	15	9	1	3	2	1	2				9	
Scaled Value	**2**	**1**	**3**	**2**	**1**	**1**	**1**	**1**	**1**				**2**	

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : **V**

Course Code :

Course Name : **ENVIRONMENTAL STUDIES**

Prerequisite :

L	T	P	C
0	0	0	0

C	P	A
2.5	0	0.5

L	T	P	H
2	0	0	2

Course Outcome: After the completion of the course, students will be able to

		Domain C or P or A	**Level**
CO1	***Describe*** the significance of natural resources and ***explain*** anthropogenic impacts.	Cognitive	Remembering and understanding
CO2	***Illustrate*** the significance of ecosystem, biodiversity and natural geo bio chemical cycles for maintaining ecological balance.	Cognitive	Understanding
CO3	***Identify*** the facts, consequences, preventive measures of major pollutions and ***recognize*** the disaster phenomenon	Cognitive Affecting	Remembering Receiving
CO4	***Explain*** the socio-economic, policy dynamics and ***practice*** the control measures of global issues for sustainable development	Cognitive	Understanding and Analyse
CO5	***Recognize*** the impact of population and ***apply*** the Environmental ethics towards environmental protection.	Cognitive	Understanding And Apply

COURSE CONTENT

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND RESOURCES 12

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, flood, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

UNIT II ECOSYSTEMS AND BIODIVERSITY 8

Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity - Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India Threats to biodiversity : Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT III	ENVIRONMENTAL POLLUTION	8

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: flood, earthquake, cyclone and landslide.

UNIT IV	SOCIAL ISSUES AND THE ENVIRONMENT	9

Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation – Consumerism and waste products – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context. Issues involved in enforcement of environmental legislation – Public awareness.

UNIT V	HUMAN POPULATION AND THE ENVIRONMENT	8

Human population growth: Impacts on environment, human health and welfare. Resettlement and rehabilitation of project affected persons; case studies. Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Mahua Basu,S. Xavier, Fundamentals of Environmental Studies, Cambridge University Press, 2019
2. Bharucha Erach,Textbook of Environmental Studies for Undergraduate Courses, Orient Blackswan Pvt Ltd, 2018
3. Anubha Kaushik, C.P. Kaushik, Perspectives in Environmental Studies, New Age International Pvt Ltd Publishers,2018
4. Divan Shyam,Environmental Law and Policy in India, OUP India,2019
5. Varun Dutt Sharma,S.K. Pandey,Vimal Kumar sharma, Environmental Education and Disaster Management, CBS Publishers & Distributors,2019

REFERENCE BOOKS

1. M.V. Subba Rao, Natural Resources, Conservation, Management and Health Care, Discovery Publishing Pvt.Ltd,2020
2. Masters Gilbert M. Introduction to Environmental Engineering 3rd Edition , Pearson Education India, 3rd edition ,2015.
3. P.D. Sharma, Ecology and Environment Thirteenth Edition, Rastogi Publications,2017
4. Dr. Avneesh Gaur, Environmental Engineering and Disaster Management, Vayu Education Of India,2021

E-REFERENCES

1. http://www.e-booksdirectory.com/details.php?ebook=10526
2. https://www.free-ebooks.net/ebook/Introduction-to-Environmental-Science
3. https://www.free-ebooks.net/ebook/What-is-Biodiversity
4. https://www.learner.org/courses/envsci/unit/unit_vis.php?unit=4
5. http://bookboon.com/en/pollution-prevention-and-control-ebook
6. http://www.e-booksdirectory.com/details.php?ebook=8557
7. http://www.e-booksdirectory.com/details.php?ebook=6804
8. http://bookboon.com/en/atmospheric-pollution-ebook
9. http://www.e-booksdirectory.com/details.php?ebook=3749
10. http://www.e-booksdirectory.com/details.php?ebook=2604
11. http://www.e-booksdirectory.com/details.php?ebook=2116
12. http://www.e-booksdirectory.com/details.php?ebook=1026
13. http://www.faadooengineers.com/threads/7894-Environmental-Science

Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1														
CO2	2					2	1			1		1		
CO3	2	1	3			3	1		2	1		1		
CO4	1	1	2			3	2	3				1		
CO5	2	1	1			3						1		
Total	10	3	6			11	4	3	2	2		5		
Scaled Value	2	1	2			3	1	1	1	1	1	1		

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : **V**

Course Code : **PCE504**

Course Name : **COMPUTER AIDED DESIGN & DRAFTING**

Prerequisite : **COMPUTER AIDED CIVIL ENGINEERING DRAWING**

L	T	P	C
0	0	2	2

C	P	A
0	3	0

L	T	P	H
0	0	3	3

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	To select the appropriate Structural system for a conventional reinforced concrete Structure	Psychomotor	Respond
CO2	Determine the preliminary designs of structures assuming preliminary dimensions	Psychomotor	Respond
CO3	Apply the fundaments of reinforced concrete to design structures like retaining walls, water tanks, staircase, and other structures of importance.	Psychomotor	Respond
CO4	Understand fabrication of plate girders and gantry girders	Psychomotor	Respond
CO5	Design of structural elements of Industrial Structures.	Psychomotor	Respond

COURSE CONTENT

Detailed design and drawing of the following reinforced concrete structures and steel structures using software packages like Auto CAD /Revit and Staad Pro / Etabs.

1. Design of Raft and Pile with pile cap (Four Piles only) Foundations and reinforcement details.
2. Design and Drawing of RCC cantilever and counterfort type retaining walls with reinforcement details.
3. Detailing and Drafting of Solid slab and RCC Tee beam bridges for IRC loading and reinforcement details.
4. Design and Drawing of staircase.
5. Detailing and Drafting of Circular and Rectangular Water Tank .
6. Design of plate girder bridge – Detailed Drawings including connections.
7. Design of Gantry girder– Detailed Drawings including connections.
8. Design of Roof Truss – Detailed Drawings including Connections.

L	T	P	Total
0	0	30	30

TEXT BOOKS

1. Krishna Raju, N., “Design of Reinforced Concrete Structures”, CBS Publishers & Distributors, New Delhi, 2007.

2. Devadas Menon & Unnikrishnan Pillai, Reinforced Concrete Design, Tata McGraw-Hill Publishing Company Ltd., New Delhi 2011

3. Ramachandra S., “Design of Steel Structures – Vol. I & II”, Standard Publication, New Delhi,2010

REFERENCE BOOKS

1. Dr.P.Purushothaman, Reinforced Concrete Structures, Oxford Publication (P) Ltd, Delhi, 2007.

2. Krishnamurthy, D., "Structural Design & Drawing – Vol. II", CBS Publishers & Distributors.

3. Duggal S.K.,"Limit state Design of Steel Structures", 2nd edition, Tata McGraw Hill, 2014.

IS CODES:

1. IS 456 -2000, Plain and Reinforced Concrete – Code of Practice, 4th revision

2.SP16-1980, SP6 – 1 : ISI Hand Book of Structural Engineers, Part -I

3. IS 800 -2007, General Construction in Steel, Code of Practice.

Mapping of CO with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	3		1										2	
CO2	2	3		1		1	1						3	1
CO3	1	1	3	1		1	1	1			1		1	
CO4	1	1	3	1		1							1	
CO5	3	1	3	3	1	1							2	
Total	**10**	**6**	**10**	**6**	**1**	**4**	**2**	**1**	**1**		**1**		**9**	**1**
Scaled Value	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**		**1**		**2**	**1**

1 – Low, 2 – Medium, 3 – High

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester : **V**

Course Code : **PCE505**

Course Name : **ESTIMATION, COSTING AND VALUATION**

Prerequisite : **Nil**

L	T	P	C
0	0	2	2

C	P	A
0	3	0

L	T	P	H
0	0	2	2

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Draw center line marking in the field as per the plan	Psychomotor	Guide Response
CO2	Estimate the quantities of items and labour requirements of Civil Engineering works.	Psychomotor	Guide Response
CO3	Prepare the abstract and detailed estimate of any construction project	Psychomotor	Guide Response

EXPERIMENTS **30 Hrs.**

1. Building marking
2. Detailed Estimate of Residential buildings (RCC and Masonry)
3. Detailed Estimate of Water supply & Sanitary work
4. Detailed Estimate of Culverts and Bridges
5. Detailed Estimate of Earthwork for Roads
6. Detailed Estimate of Steel Roof Trusses
7. Preparation of Bar bending schedule
8. Rate Analysis of Different Items for Construction work
9. Preparation of valuation report in standard Government form
10. Estimation using Spread Sheet

TEXT BOOKS

1. Dutta, B.N., “Estimating and Costing in Civil Engineering Theory and Practice”, UBS Publishers & Distributors Pvt. Ltd.,New Delhi, 2010.
2. Kohli, D.D and Kohli, R.C., “A Text Book of Estimating and Costing (Civil)”, S.Chand& Company Ltd., New Delhi, 2004
3. M.Chakraborty,”Estimating,Costing, Specification and Valuation in Civil Engineering”,Kolkata,1997.

REFERENCE BOOKS

1. Aggarwal, A., Upadhyay, A.K., Civil Estimating, Costing &Valuation, S.K Kataria& Sons, New Delhi.
2. Birdie.G.S., "A Text Book on Estimating and Costing", DhanpatRai and Sons, New Delhi
3. Chandola, S.P. and Vazirani, Estimating and Costing, Khanna Publication
4. Rangwala. S.C., "Elements of Estimating and Costing", Charotar Publishing House,Anand
5. IS 1200-1974, Parts 1-25, Methods of Measurements of Building and Civil Engineering works – Bureau of Indian Standards, New Delhi.
6. Standard Data Books and Schedule of rates of Central and State Public Works Departments

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	1		1	2		1	1			1	1		
CO 2	2	1		1			1				1	1		
CO 3	2	1	2	1			1				2	1	1	
Total	6	3	2	3	2		3	1			4	3	1	
Scaled Value	2	1	1	1	1		1	1			1	1	1	

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester	**:**	**VI**
Course Code	**:**	**PCE601**
Course Name	**:**	**FINITE ELEMENT METHOD**
Prerequisite	**:**	**STRUCTURAL ANALYSIS**

L	T	P	C
3	1	0	4

C	P	A
2.5	0	0.5

L	T	P	H
3	2	0	5

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Gain knowledge on basic concepts of FEM	Cognitive	Understand
CO2	Determine stresses and displacements for one and two dimensional elements under various loading.	Cognitive	Understand
CO3	Analyse the higher order elements using Isoparametric mapping and numerical integration.	Cognitive	Analyse
CO4	Identify and Apply concepts of FEM in fluid mechanics.	Cognitive	Apply

COURSE CONTENT

UNIT I	**INTRODUCTION – VARIATIONAL FORMULATION**	**12**

Methods of Engineering analysis – Basic concept of FEM and its procedure- Advantages and Disadvantages - Weighted Residual Method – Principle of Stationary Total Potential – Rayleigh Ritz method.

UNIT II	**ONE DIMENSIONAL FINITE ELEMENT ANALYSIS**	**12**

Finite element: modelling, coordinates, shape functions, stiffness matrix, stiffness equation, finite element equation for one dimensional element. Load or force vector – Temperature effects.

UNIT III	**TWO DIMENSIONAL FINITE ELEMENT ANALYSIS**	**12**

Finite element modelling, coordinates, shape functions, stiffness matrix, stiffness equation, finite element equation for two dimensional elements. Plane stress and plane strain – Constant Strain Triangular element – Linear Strain Triangular elements - Temperature effects.

UNIT IV	**ISOPARAMETRIC ELEMENTS AND FORMULATION**	**12**

Shape function for 4 noded elements using natural coordinate system and transformation – element stiffness matrix equations –Higher order two dimensional element – Shape function derivation for rectangular and triangular element – Lagrangean and Serendipity elements.

UNIT V	**APPLICATIONS TO FIELD PROBLEMS IN TWO DIMENSION**	**12**

Heat Transfer – Application to Heat Transfer in two dimensions – Application to Fluid Mechanics in two dimensions.

L	T	P	T
45	15	0	60

TEXT BOOKS

1. Krishnamoorthy,C.S.,"Finite Element Analysis –Theory and Programming", Second Edition,TataMcGraw Hill, 2015.
2. Bhavikati , S.S., "Finite Element Analysis ", New Age International Publishjers , 2016.
3. S.S.Rao, "The Finite Element Method in Engineering", Pergaman Press, 2011.

REFERENCES

1. J.N.Reddy, "An Introduction to Finite Element Method", McGraw-Hill, Intl.Student
2. Edition, 2013.
3. Chandrupatla, T.R., and Belegundu, A.D., "Introduction to Finite Element in Engineering", Third Edition, Prentice Hall, India, 2012.
4. O. C. Zienkiewicz, Robert Leroy Taylor, PerumalNithiarasu, "The Finite Element Method for Fluid Dynamics", Butterworth-Heinemann, 2013.

Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	1	3	2			1							1	1
CO2	2	2	3	1		1							1	
CO3	3	1	1	1		2				2		1	1	1
CO4	3	2	1		1	1	1	1	1	1	1			
Total	9	8	7	2	1	5	1	1	1	3	1	1	3	2
Scaled Value	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

PROFESSIONAL ELECTIVE

Semester :

Course Code : PCEE01

Course Name : Smart Structures and Materials

Prerequisite :

L	T	P	C
3	0	0	3

C	P	A
3	0	0

L	T	P	H
3	0	0	3

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Study about the smart materials and its characteristics	Cognitive	Understand
CO2	Evaluate the measurement techniques for strain	Cognitive	Understand
CO3	Design of sensors using smart materials	Cognitive	Understand
CO4	Design of actuators using smart materials	Cognitive	Understand
CO5	Energy harvesting using piezoelectric materials	Cognitive	Understand

COURSE CONTENT

UNIT I INTRODUCTION 9

Introduction to Smart Materials and Structures – Instrumented structures functions and response –Sensing systems – Self diagnosis – Signal processing consideration – Actuation systems and effectors.

UNIT II MEASURING TECHNIQUES 9

Strain Measuring Techniques using Electrical strain gauges, Types – Resistance – Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes.

UNIT III SENSORS 9

Sensing Technology – Types of Sensors – Chemical and Bio-Chemical sensing in structural Assessment – Absorptive chemical sensors – Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.

UNIT IV ACTUATORS 9

Actuator Techniques – Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Magneto structure Material – Shape Memory Alloys – Electro orheological Fluids– Electro magnetic actuation – Role of actuators and Actuator Materials.

UNIT V ADVANCES IN SMART STRUCTURES & MATERIALS 9

Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Autophagous Materials, Self-Healing Polymers, Intelligent System Design, Emergent System Design

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Brain Culshaw – Smart Structure and Materials Artech House – Borton. London.
2. Smart Materials and Structures/ M. V. Gandhi and B.So Thompson/ Chapman & Hall, London; New York.
3. Gauenzi, P., Smart Structures, Wiley, 2009
4. Michelle Addington and Daniel L. Schodek, "Smart Materials and Technologies: For the Architecture and Design Professions", Routledge 2004.

REFERENCE BOOKS

1. Electro ceramics: Materials, Properties/ A.J. Moulson and J.M-Herbert/ Wiley/ 2nd Edition, (ISBN: 0471497479).
2. Piezoelectric Sensories: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors. Materials and Amplifiers/ G. Gautschi/ Springer, Berlin; New York,2002 (ISBN:3540422595)
3. L. S. Srinath, "Experimental Stress Analysis", Tata McGraw-Hill, 1998

Mapping of CO with PO's

	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO 1	2	3		1	3						2		2	
CO 2	1	3				2					2		2	
CO 3	1	2	2	1			1	1			2		1	
CO 4	1	2	2	1			1	1			2		1	
CO 5	1	2												
Total	6	12	4	3	3	2	2	2			8		6	
Scaled Value	**2**	**3**	**1**	**1**	**1**	**1**	**1**	**1**			**2**		**2**	

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester :

Course Code : PCEE02

Course Name : GIS for Civil Engineering

Prerequisite : Nil

L	T	P	C
3	0	0	3

C	P	A
1.5	1.0	0.5

L	T	P	H
3	0	0	3

Course Objectives

- To understand the basic concepts of remote sensing
- To know the applications of Geographic information systems in Civil Engineering
- To identify the basic remote sensing concepts and its characteristics
- To implement the photogrammetry concepts and fundamentals of Air photo interpretation
- To use various analysis and interpretation of GIS results

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	***Explain*** about the fundamentals of remote sensing	Cognitive Affective	Remembering Respond & Observation
CO2	***Facilitating*** complex querying and analysis	Cognitive Affective	Analyzing Observation
CO3	***Maximizing*** the efficiency of planning and decision making	Cognitive, Affective Psychomotor	Application Respond to Phenomena Manipulation
CO4	***Integrating*** information from multiple sources	Cognitive Affective Psychomotor	Understanding Manipulation Apply
CO5	***Eliminating*** redundant data and minimizing duplication and apply in civil engineering field	Cognitive Psychomotor	Remembering Observation

COURSE CONTENT

UNIT I INTRODUCTION TO REMOTE SENSING 11

Definition of remote sensing and its components – Electromagnetic spectrum – wavelength regions important to remote sensing – Wave theory - Atmospheric scattering, absorption – Atmospheric windows – spectral signature concepts - Types of platforms and sensors - Passive and Active sensors – resolution concept - Image interpretation – Image processing

UNIT II INTRODUCTION TO GIS AND MAPS 9

History of GIS, Early Developments in GIS, Applications of GIS, Components of a GIS - Introduction – Maps and Globe – Types of map – Map scale - standard GIS software

UNIT III	GEOREFERENCING AND MAP PROJECTION	6

Understanding Earth – Georeferencing – Transformation – Coordinate System - Map projections – types of map projections – map analysis

UNIT IV	GIS – DATA ENTRY, STORAGE AND ANALYSIS	10

Spatial Database Management System – Data storage - Data Structure models – Vector and raster data – data compression – data input by digitization and scanning, data storage – attribute data analysis – integrated data analysis – Data interpolation - mapping concept - development of map overlay, overlay operation – Errors and quality control.

UNIT V	APPLICTIONS OF GIS IN CIVIL ENGINEERING	9

Web GIS - Modeling in GIS Highway alignment studies – Land Information System - Terrain Mapping and Analysis - Watershed Analysis - Environmental Engineering & Impact Studies - Wastewater and Stormwater Management - Disaster Management - Structural Engineering – Soil Mapping

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Shahab Fazal, , (2015), G I S Basics, New Age International Publications, Chennai
2. Burrough P.A. (2000), Principle of Geographical Information Systems for land resources assessment, Clarendon Press, Oxford.
3. Anji Reddy.M. (1998), Remote Sensing and Geographical information systems.

REFERENCE BOOKS

1. Lo & Yeung (2005), Geographic Information Systems, Prentice of India.
2. Lillesand, T.M. & Kiefer R.W. (1998), Remote Sensing and image interpretation, John Wiley & Sons, Newyork.
3. Clarke Parks & Crane (2005), Geographic Information Systems & Environmental Modelling, Prentice-Hall of India.
4. Wolf Paul (1998), Elements of Photogrammetry, McGraw Hill, New Delhi.
5. Goodchild, M.F., Longley, P.A., Maguire, D. J. & Rhind, D.W 2001, *Geographic information systems and science*, John Wiley & Sons Ltd. , England.

E-REFERENCES

1. https://nptel.ac.in/courses/105/102/105102015/
2. http://webhelp.esri.com/arcgisserver/9.3/java//index.htm#wms_service.htm

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	1	1	1		1		2		1		1	2	1
CO 2	1	2	1			2		2		1		1	2	2
CO 3	3	1	1	1		1		2		1	1	1	2	1
CO 4	2	2	1	1	1	2		1		1	1	1	2	2
CO 5	1	3	1	1	1	1	2	2	3	1	1	1	1	1
Total	10	9	5	4	2	7	2	9	3	5	3	5	9	7
Scaled Value														

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester :

Course Code : PCEE03

Course Name : WATER QUALITY ENGINEERING

Prerequisite : Environmental Engineering

L	T	P	C
3	0	0	3

C	P	A
2	0	1

L	T	P	H
3	0	0	3

Course Objectives

- To understand the significance of Physio-chemical treatment for water and wastewater
- To recognize the principles of Physical treatment
- To acquire knowledge on Chemical Treatment
- To apply the principles of treatment methodologies and to design the Municipal water treatment plants

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	*Understand* the significance of Physio-chemical treatment for water and wastewater	Cognitive	Understand
CO2	*Recognize* the principles of Physical treatment	Cognitive	Understand
CO3	*Acquire* knowledge on Chemical Treatment	Cognitive Affective	Understand Respond
CO4	*Apply* the principles of treatment methodologies and to design the Municipal water treatment plants	Cognitive Affective	Create Respond
CO5	*Apply* the principles and to design the Industrial water treatment units	Cognitive Affective	Create Respond

COURSE CONTENT

UNIT I	**POLLUTANTS IN WATER AND WASTE WATER**	**9**
	Characteristics, Standards for performance - Significance of physico-chemical treatment – Selection criteria-types of reactor- reactor selection-batch-continuous type	
UNIT II	**PRINCIPLES OF PHYSICAL TREAMENT**	**9**
	Screening – Mixing, Equalization – Sedimentation – Filtration – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption –Membrane separation, Reverse Osmosis, nano filtration, ultra filtration and hyper filtration	
UNIT III	**PRINCIPLES OF CHEMICAL TREATMENT**	**9**
	Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, advanced oxidation /reduction – Recent Trends	
UNIT IV	**DESIGN OF MUNICIPAL WATER TREATMENT PLANTS**	**9**
	Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation-clarifier–O&M aspects – case studies, Residue management – Recent Trends	

UNIT V DESIGN OF INDUSTRIAL WATER TREATMENT PLANTS 9

Design of Industrial Water Treatment Units- Selection of process – Design of softeners – Demineralisers –Reverse osmosis plants –Flow charts – Layouts –O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Rakesh Kumar and R.N. Singh,"Municipal Water and Wastewater Treatment" TERI publishers,2012
2. Gurucharan Singh," Water supply and Sanitary Engineering", Standard Publishers Distributors, 2009
3. Garg, S.K., "Environmental Engineering I & II", Khanna Publishers, New Delhi 2007
4. LinvilG.Rich, Unit operations of Sanitary Engineering, Tata Mcgraw Hill, New Delhi, 2007
5. Rangwala, " Water Supply and Sanitary Engineering PB,24/e, Charotar Publishing house Pvt. Ltd.-Anand, 2011

REFERENCE BOOKS

1. Metcalf and Eddy, "Wastewater Engineering, Treatment and Reuse", Tata McGraw Hill, New Delhi, 2003.
2. Qasim, S.R., Motley, E.M. and Zhu.G. "Water works Engineering – Planning, Design and Operation", Prentice Hall, New Delhi, 2002. 7
3. Lee, C.C. and Shun dar Lin, "Handbook of Environmental Engineering Calculations", McGraw Hill, New York, 1999.
4. F.R. Spellman, "Hand Book of Water and Wastewater Treatment Plant operations", CRC Press, New York (2009).
5. David Hendricks, "Fundamentals of Water Treatment Process", CRC Press New York (2011)

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1		1	1	1	1	1			1				1	
CO 2		1	2	1	1	1			2				2	1
CO 3	1		3	2			1		1	1	1		2	
CO 4	1	1	1	1			1	1	2			1	1	
CO 5			2	2				1	1	1		2	1	
Total	2	3	9	7	2	2	2	2	7	2	1	3	7	1
Scaled Value	1	1	2	2	1	1	1	1	2	1	1	1	2	1

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester :

Course Code : PCEE04

Course Name : PAVEMENT DESIGN

Prerequisite : NIL

L	T	P	C
3	0	0	3

C	P	A
2	0	1

L	T	P	H
3	0	0	3

Course Objectives

Through this course the students will

- To gain the knowledge on components of highway and airport pavements
- To study the load and stress due to traffic loads
- To design the flexible pavements
- To design the rigid pavements
- To learn maintenance and repair on bituminous and concrete layers
- To gain the knowledge on components of highway and airport pavements

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Understand the components of highway and airport pavements	Cognitive	Understanding
CO2	Utilize identified traffic factors efficiently in the pavement design.	Cognitive	Understanding
CO3	Optimally design of flexible pavements	Cognitive Affective	Understanding Respond
CO4	Optimally design of rigid pavements	Cognitive Affective	Understanding Respond
CO5	Assess pavement performance and suggest rectification options.	Cognitive	Understanding

COURSE CONTENT

UNIT I INTRODUCTION 9

Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements. Stresses and Deflections. Stresses and deflections in homogeneous masses. Burmister's two layer theory, three layer and multi-layer theories;

UNIT II TRAFFIC FACTORS IN PAVEMENT DESIGN 9

Wheel load stresses, various factors in traffic wheel loads; ESWL of multiple wheels. Repeated loads and EWL factors; sustained loads. Pavement behaviour under transient traffic loads.

UNIT III FLEXIBLE PAVEMENT DESIGN METHODS FOR HIGHWAYS AND AIRPORTS 9

Empirical, semi-empirical and theoretical approaches, development, principle, design steps, advantages; design of flexible pavements as per IRC; Stresses in Rigid Pavements: Types of stresses and causes, factors influencing the stresses; general considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses.

UNIT IV	RIGID PAVEMENT DESIGN	9

Types of joints in cement concrete pavements and their functions, joint spacings; design of CC pavement for roads and runways as per IRC, design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method. Design of continuously reinforced concrete pavements

UNIT V	PAVEMENT REHABILITATION	9

Maintenance, repair and rehabilitation of pavements including design of bituminous and concrete overlays as per IRC

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Yang H. Huang : Pavement Analysis and Design, prentice Hall; second edition, August 18, 2003.
2. T. Papagiannakis, E. A. Masad, Pavement Design and Materials, John Wiley & Sons, 2008.

REFERENCE BOOKS

1. S.K Khanna, C.E.G Justo, A Veeraragavan.Highway Engineering , Nem Chand and Brothers, 10th Edition, Roorkee, 2015.
2. Pavement design from AASHTO American Association of State Highway and Transportation Officials, 2010.
3. IRC-37–2001.Guidelines for the Design of Flexible Pavements, New Delhi, 2012.
4. IRC 58-2002. Guideline for the Design of Rigid Pavements for Highways, New Delhi, 2002

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	1	-	-	1	-								2
CO 2	2	1	-	-	1									2
CO 3	2	1	2	-	1									3
CO 4	3	2	2	1	1									3
CO 5	3	2	-	1	1									2
Total	12	7	4	2	5	0	0	0	0	0	0	0	0	12
Scaled Value	**3**	**2**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

COURSE CODE	**PCEE05**
COURSE NAME	**CONSTRUCTION EQUIPMENT AND AUTOMATION**
PREREQUISITES	**NIL**

C	P	A
2	0	1

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

To enable the students familiarize with modern construction equipments.

To understand the equipment management methods and equipment functional operations.

To learn the applications of the equipment in construction projects.

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
At the end of this course, the students should be able to			
CO1	Identify construction equipment appropriate to tasks	Cognitive	Understanding
CO2	Estimate equipment ownership and operating costs	Cognitive	Understanding
		Affective	Responding
CO3	Estimate and schedule activities using equipment productivity and cost data	Cognitive	Understanding
		Affective	Responding
CO4	Understand contemporary issues pertaining to construction methods, equipment usage and management.	Cognitive	Understanding
CO5	Recognize the concept of intelligent buildings	Cognitive	Understanding

COURSE CONTENT

UNIT I	**EQUIPMENT MANAGEMENT**	**09**

Identification –Planning - Equipment Management in Projects - Maintenance Management – Replacement - Cost Control of Equipment – Depreciation Analysis, Methods of calculation of depreciation- Safety Management.

UNIT II	**EARTHWORK EQUIPMENT**	**09**

Fundamentals of Earth Work Operations - Earth Moving operations-Types of Earthwork Equipment - Tractors, Motor Graders, Scrapers, Front end Loaders, Earth Movers – capacity calculations.

UNIT III	**PUMPS USED IN CONSTRUCTION**	**09**

Equipment for Dredging, Trenching, Tunnelling, Drilling and Blasting. Equipment for compaction - Types of pumps used in Construction - Equipment for Grouting - Pile Driving Equipment- Equipment of Erection and demolition

UNIT IV SCREENING EQUIPMENT 09

Crushers – Feeders - Screening Equipment - Batching and Mixing Equipment – Hauling equipment - Pouring and Pumping Equipment – Ready mixed concrete carriers.

UNIT V INTELLIGENT BUILDINGS & BUILDING MANAGEMENT SYSTEM 09

Concept-Purpose-Control Technologies- Automation Of All The Services And Equipment -Building Management Systems (BMS) -Energy Management Systems And Building controls.

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Sharma S.C. "Construction Equipment and Management", Khanna Publishers, Delhi, 2008.
2. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder.C, "Construction Planning Equipment and Methods", McGraw Hill. Singapore 2005.
3. William T.Mayer, " Energy Economics and Build Design ", McGraw Hill Book Co., 1983

REFERENCES

1. Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers Delhi, 2008.
2. Leonhard E.Bernold, "Construction Equipment and Methods",Wiley india Pvt. Ltd2005.
3. Mahesh Varma .Dr, "Construction Equipment and its planning and application", Metropolitan Book Company, New Delhi, 2003.

Mapping of CO with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1				1				1		1				
CO 2	3	2			2	2			2	2	1	3	2	1
CO 3	3	2			2	2					1	3		
CO 4			1								3			
CO 5			1				2		2					2
Total	**6**	**4**	**2**	**1**	**4**	**4**	**2**	**1**	**4**	**3**	**5**	**6**	**2**	**3**
Scaled Values	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester :

Course Code : PCEE06

Course Name : AIRPORT PLANNING AND DESIGN

Prerequisite : NIL

L	T	P	C
3	0	0	3

C	P	A
2	0.5	0.5

L	T	P	H
3	0	0	3

Course Objectives

Through this course the students will

- To learn about the aircraft characteristics, planning and components of airport.
- To know about the airport pavement design and maintenance.
- To learn about the navigational aids of airports.

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Gain an insight on the planning and site selection of Airport .	Cognitive	Understanding
CO2	Know about layout and passenger facility systems.	Cognitive Affective	Understanding Respond
CO3	Analyze and design the elements for orientation of runways.	CognitivePsychomotor	Understanding Mechanism
CO4	Design and maintain the pavements.	Cognitive Psychomotor	Understanding Mechanism
CO5	Understand the importance of navigational aids	Cognitive	Understanding

COURSE CONTENT

UNIT I	**INTRODUCTION**	**9**
	Introduction to air transport - Aircraft characteristics - Airport classification, Airport planning - Site selection- Airport obstructions and Zoning - Environmental guidelines for airport projects	
UNIT II	**AIRPORT LAYOUT**	**8**
	Typical Airport Layouts - terminal area, apron, hangers, parking and circulation Area.	
UNIT III	**GEOMETRIC DESIGN**	**10**
	Runway Design: Orientation, Wind Rose Diagram, Problems on basic and Actual Length, Geometric Design – Elements of Taxiway Design	
UNIT IV	**AIRPORT PAVEMENTS**	**10**
	Design factors – design methods for flexible and rigid pavements- maintenance and rehabilitation of pavements-airport drainage.	
UNIT V	**NAVIGATIONAL AIDS**	**8**
	Airport Markings and lighting –need of Air traffic control –air traffic control network – air traffic control aids .	

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Khanna S.K., AroraM.G.& Jain S.S Airport Planning and Design, Nemchand and Bros,2012.
2. Rangwala, "Airport Engineering", Charotar Publishing House, 2013.
3. Subash C Saxena, "Airport Engineering, Planning and Design"CBS Publishers & Distributors,2015.

REFERENCE BOOKS

1. Niles A.S and Newell Airplane Structures Vol.II John Wiley and sons,New York
2. Environmental guidelines for Airport projects, Ministry of Environment and Forest.
3. IRC : 76-1979 Guidelines for structural strength Evaluation of Rigid Airfield pavements.
4. IRC :105-1928 Specifications for Bituminous Concrete for Airfield Pavements.

Mapping of CO with PO's

	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO 1	1				1				1		1			
CO 2		2		2						2		1		
CO 3			3			1							2	
CO 4			2			1							2	
CO 5									1			1		
Total	1	2	5	2	1	2			2	2	1	2	4	
Scaled Value	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**0**

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester :

Course Code : **PCEE07**

Course Name : **PORT AND HARBOUR ENGINEERING**

Prerequisite : **NIL**

L	T	P	C
3	0	0	3

C	P	A
3	0	0

L	T	P	H
3	0	0	3

Course Objectives

Through this course the students will

- To develop a fundamental understanding of Port and Harbour Engineering and its necessity.
- To visualize the relationship between Site Considerations and its Planning of Harbours.
- To know about the various Design Elements of On-Shore and Off-Shore Structures.

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Develop an understanding of overall Port and Harbour Engineering and its impact.	Cognitive	Understanding
CO2	Absorbs the Key design Characteristics for design of Elements like Groins,Break waters, jetties etc.	Cognitive	Understanding
CO3	Fully conversant with advanced topics like coastal protection.	Cognitive	Understanding
CO4	Acquire a basic understanding about Navigational Aids	Cognitive	Understanding
CO5	Understand the various features in Ports, their construction, works and coastal Regulations to be adopted.	Cognitive	Understanding

COURSE CONTENT

UNIT I **INTRODUCTION** **9**

Types of water transportation, water transportation in India, requirements of ports and harbours, classification of harbours, selection of site and planning of harbours, location of harbour, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations

UNIT II **COASTAL STRUCTURES** **9**

Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, Harbour docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks, pumping plant, floating docks, slipways, locks, size of lock, lock gates, types of gates;

UNIT III **DREDGING AND COASTAL PROTECTION** **9**

Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone and beach profile.

UNIT IV **NAVIGATIONAL AIDS** **9**

Requirements of signals, fixed navigation structures, necessity of navigational aids, light houses, beacon lights, floating navigational aids, light ships, buoys, radar.

UNIT V	PORT FACILITIES	9

Port development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities. Inland waterways, Inland water transportation in India, classification of waterways, economics of inland waterways transportation, national waterways.

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Oza and Oza, Elements of Dock and Harbour Engineering, Charotar Publishing House, 1996.
2. Srinivasan R. Harbour, "Dock and Tunnel Engineering", 26th Edition 2013.
3. Rangwala, "Harbor Engineering", Charotar Publishing House, 2013.

REFERENCE BOOKS

1. Bindra S P, "A Course in Docks and Harbour Engineering", DhanpatRai and Sons, New Delhi, 2013.
2. Chandola S.P. A text on Transportation Engineering, S. Chand Limited, 2008.
3. B.L. GuptaAmit Gupta "Roads, Railways, Bridges, Tunnels & Harbour Dock",Standard Publishers Distributors ,2018.

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1							2							
CO 2	1			2									2	
CO 3									3	1				
CO 4				1								3		
CO 5			1				3				2	2		
Total	1		1	3			5		3	1	2	5	2	
Scaled Value	**1**	**0**	**1**	**1**	**0**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**0**

Note:	Total	0	1-5	6-10	11-15
	Scaled value	0	1	2	3
	Relation	No	Low	Medium	High

Semester	
Subject Name	**EARTHQUAKE ENGINEERING**
Subject Code	**PCEE08**
Prerequisite	**Nil**

L	T	P	H
3	0	0	3

C	P	A
2.5	0	0.5

L	T	P	H
3	0	0	3

Course Objectives

- To introduce the basics of Earthquake Engineering.
- To apply analytical methods for evaluating of seismic resistance of buildings.
- To introduce engineering seismology, building geometrics & characteristics and structural irregularities.

Course Outcome:		**Domain C or P or A**
CO1	Describe the basics of vibration.	C
CO2	Analyse SDOF and MDOF systems with distributed mass for continuous system.	C
CO3	Quantify the effect of seismic waves.	C & A
CO4	Understand the concept of response spectrum and application of structural dynamics.	C
CO5	Design of Earthquake resistant structures with codal provisions.	C

COURSE CONTENT

UNIT I	**THEORY OF VIBRATION**	**9**

Concept of inertia and damping - Types of Damping - Difference between static forces and dynamic excitation - Degrees of freedom, SDOF idealisation - Equations of motion of SDOF system for mass as well as base excitation - Free vibration of SDOF system - Response to harmonic excitation - Impulse and response to unit impulse and response to unit impulse

UNIT II	**MULTIPLE DEGREE OF FREEDOM SYSTEM**	**9**

. Two degree of freedom system - Normal modes of vibration - Natural frequencies, Mode shapes - Natural frequencies, Mode shapes - Introduction to MDOF systems - Decoupling of equations of motion - Concept of mode superposition (No derivations)

UNIT III	**ELEMENTS OF SEISMOLOGY**	**9**

Causes of Earthquake - Geological faults - Tectonic plate theory - Elastic rebound – Epicentre – Hypocentre - Primary, shear and Raleigh waves – Seismogram - Magnitude and intensity of earthquakes – Magnitude and Intensity scales – Spectral Acceleration - Information on some disastrous earthquakes

UNIT IV	RESPONSE OF STRUCTURES TO EARTHQUAKE	9

. Response and design spectra - Design earthquake – concept of peak acceleration – Site specific response spectrum - Effect of soil properties and damping - Liquefaction of soils - Importance of ductility - Methods of introducing ductility into RC structures.

UNIT V	DESIGN METHODOLOGY	9

. Design as per the code provisions of IS 1893 - IS 13920 and IS 4326 - Base isolation techniques - Vibration control measures - Important points in mitigating effects of earthquake on structures.

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. David Dowrick ., “Earthquake Resistant Design And Risk Reduction” John Wiley & Sons, 2011
2. Kavitha S., Damodarasamy S. R. “Basic of Structural Dynamics and Aseismic Design” PHI Learning Private Limited publishers,2009.
3. Anil K Chopra “ Dynamics of structures ’’ Theory and application to Earthquake Engineering, Prentice Hall.2012

REFERENCES

1. George G.Penelis and AndreasJ.Kappos,Earthquake Resistant Concrete Structures, Taylor and Francis,.London,UK,2014
2. Shashikant K. Duggal “Earthquke resistant design of structures”Oxford University Press, 2013
3. Mario Paz,William Leigh “Structural Dynamics-Theory &Computattions’’Kluwar Academic Publishers, USA,2004

Indian Standard Code Books

1. IS 1893(Part 1):2002, Criteria for Earthquake Resistant Design of Structures
2. IS 13920 - 2016 Ductile Design and Detailing Of Reinforced Concrete Structures Subjected to Seismic Forces
3. IS 4326 - 2013 Earthquake Resistant Design and Construction of Buildings

Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2			1				1			2	
CO2	2	3											1	
CO3	2	1	1			2				1			1	1
CO4	1	2			1		1	1	1	1	1	1		
CO5	2		3		1		1	1				1	2	1
Total	10	8	6		2	3	2	2	1	3	1	2	6	2
Scaled Values	2	2	2		1	1	1	1	1	1	1	1	2	1

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester	**PCEE09**
Subject Name	**BRIDGE ENGINEERING**
Subject Code	**XCEE 10**

L	T	P	H
3	0	0	3

C	P	A
3	0	0

L	T	P	H
3	0	0	3

Course Objective

- To get familiar with design concepts of long and short span bridges.
- To design the prestressed concrete, Steel and RC bridges.
- To design the substructure for bridges as per IRC loadings.

Course Outcome: After the completion of the course, students will be able to		Domain/Level C or P or A
CO1	Understand the components of bridges	C (Understand)
CO2	Assess the behavior of various bridges.	C (Analyse)
CO3	Design the steel and concrete bridges	C(Create)
CO4	Design the Cable and suspension bridges	C (Create)
CO5	Design the substructure of bridges.	C (Create)

COURSE CONTENT

UNIT I INTRODUCTION 9

General Basic Bridge forms – Beam, Arch, Suspension, Various types of Bridges, Selection of type of bridge and economic span length, drainage, road, kerb, Classification, Investigation and Planning. Design Loads for Bridges – Dead Load, Live Load, IRC loading, IRS Loading, AASHTO Loading, Wind Load, Longitudinal forces, Centrifugal Forces, Buoyancy, water current forces, thermal forces deformation and horizontal forces.

UNIT II DESIGN OF REINFORCED CONCRETE BRIDGES 9

Design Principles of Reinforced concrete bridges - Pigeaud curves - Courbon's theory - design of deck slab; T-beam bridge; balanced Cantilever Bridge

UNIT III DESIGN OF PRESTRESSED CONCRETE BRIDGES 9

Basic principles-General Design requirements - steel reinforcement in prestressed concrete member - Concrete cover and spacing of pre-stressing steel slender beams - analysis of section for flexure, shear and bond - losses in prestress - analysis and design of anchorage block

UNIT IV DESIGN OF STEEL BRIDGES 9

Introduction to Steel bridges: Plate girder bridge, truss bridge, suspension cable bridge, cable stayed bridge;

UNIT V BEARINGS AND SUBSTRUCTURES, QUALITY CONTROL9 Hrs.

Classification and types of bearings; Guidelines for selection of bearings-Design of Bearings - Types of foundations, Piers and abutments- Forces on piers and abutments, Design of piers and abutments, bed blocks.

Seismic design considerations; Aerodynamic stability considerations; special durability measures; provisions for inspection and maintenance;

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Johnson Victor.D, “Essentials of Bridge Engineering”, Oxford & IBH, 2009.
2. Krishnaraju.N, “Prestressed Concrete bridges”, CBS Publishers,2012
3. Ponnuswamy.S “Bridge Engineering”, Tata McGrawHill, 2007.

REFERENCES

1. Jagadeesh T.R. and Jayaram .M.A., “Design of Bridge Structures”, Prentice Hall of India Pvt Ltd., 2004.
2. V. K. Raina, “Concrete Bridges Practice Analysis, Design and Economics”, Shroff Publications, New Delhi 2nd Ed. 2005.
3. Vazirani, Ratwani and Aswani, “Design of Concrete Bridges”, Khanna Publishers, 2ndEd. 2008.

Mapping of course outcomes with program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO2**
CO1	3	3	2	1		1	1		1	1			1	2
CO2	1	3	2			1	1		1	**1**			1	2
CO3	2	2	3	2		1	1		1	**1**		1	3	2
CO4	2	2	3	2		1	1		1	**1**		1	3	2
CO5	2	2	3	2		1	1		1	**1**		1	3	2
Total	10	12	13	7		5	5		5	**5**		3	11	10
Scaled Values	2	3	3	2		1	1		1	**1**		1	3	2

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester	**PCEE10**
Subject Name	**ADVANCED STRUCTURAL ANALYSIS**
Subject Code	**XCEE05**
Prerequisite	**STRUCTURAL ANALYSIS**

L	T	P	H
3	0	0	3

C	P	A
2	0	1

L	T	P	H
3	0	0	3

Course Objectives

- To introduce the Influence line for indeterminate structures.
- To study the behaviour of different types of frames by classical methods.
- To analyse the plastic nature of the structure using theorems and mechanisms.

Course Outcome:		**Domain C or P or A**
CO1	Identify the behavior of indeterminate structure by influence lines.	C
CO2	Apply knowledge on advanced methods of analysis of structures including for planes and rigid frames.	C
CO3	Superimpose the effects of settlement and rotation of the supports over the regular analysis.	C
CO4	Apply knowledge of finite element for determinate and indeterminate structures.	C
CO5	Recognize the plastic analysis of structural elements.	C

COURSE CONTENT

UNIT I	**INFLUENCE LINES - INDETERMINATE STRUCTURES**	**9**

Influence lines -Maxwell Betti's theorem- Muller Breslau's principle – Influence lines for continuous beams and single storey rigid frames – Indirect model analysis for influence lines of indeterminate structures.

UNIT II	**STIFFNESS MATRIX METHOD**	**9**

Element and global stiffness matrices – Analysis of continuous beams – Co-ordinate transformations – Rotation matrix – Transformations of stiffness matrices, load vectors and displacements vectors – Analysis of pin-jointed plane frames and rigid frames.

UNIT III	**FLEXIBILITY MATRIX METHOD**	**9**

Equilibrium and Compatibility – Determinate vs indeterminate structures – Indeterminacy - Primary structure – Compatibility conditions – Analysis of indeterminate pin-jointed plane frames, continuous beams, rigid jointed plane frames (with redundancy restricted to two).

UNIT IV	**FINITE ELEMENT METHOD**	**9**

Introduction – Discrimination of a structure –differential equilibrium equations- strain displacement relation- isoparametric elements – Shape functions – Lagrange and Serendipity elements — Plane stress and plane strain.

UNIT V PLASTIC ANALYSIS OF STRUCTURES 9

Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – Plastic analysis of indeterminate beams and frames – Upper and lower bound theorems.

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. "Comprehensive Structural Analysis – Vol. 1 & Vol. 2", Vaidyanadhan, R and Perumal, P, Laxmi Publications, New Delhi, 2003
2. Structural Analysis", L.S. Negi& R.S. Jangid, Tata McGraw-Hill Publications, New Delhi, Sixth Edition, 2003
3. Indeterminate Structures", Wang, C.K., McGraw-Hill

REFERENCES

1. Ghali.A, Nebille, A.M. and Brown, T.G. "Structural Analysis" A unified classical and Matrix approach" –5th edition. Spon Press, London and New York, 2003.
2. Vazirani V.N, &Ratwani, M.M, "Analysis of Structures", Khanna Publishers, Delhi.
3. Structural Analysis – A Matrix Approach – G.S. Pandit& S.P. Gupta, Tata McGraw Hill., 2005

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2	3				1							1	
CO2	3	1	1			1								
CO3	1	3	2					1	1		1			
CO4	3	2	2		1	1					1		1	
CO5	1	1	1		1								1	1
Total	10	10	6		2	3	2	1	1		2		3	1
Scaled Values	2	2	2		1	1	1	1	1		1		1	1

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester :

Subject Name : **BASICS OF COMPUTATIONAL HYDRAULICS**

Subject Code : **PCEE11**

Prerequisite : **Hydraulic Engineering**

L	T	P	H
2	1	0	3

C	P	A
2.5	0	0.5

L	T	P	H
2	1	0	3

Course Objectives

- Explain the structure of the 1D, 2D and 3D flow equations as representations of conservation laws
- Classify differential equations in terms of ODE /PDE and determine the nature of a given PDE
- Indicate the nature of the initial and boundary and apply the method of characteristics to solve equations
- Implement finite difference schemes to solve ordinary and partial differential equations

Course Outcome:		**Domain C or P or A**
CO1	Simulation of the flow of water, together with its consequences	C
CO2	Apply hydrodynamic techniques and 1 dimensional expansions and contractions	C
CO3	Understand linearized method of characteristics	C
CO4	Able to understand forms of conservation and applications	C & A
CO5	Do different flow modeling using software	C

COURSE CONTENT

UNIT I **INTRODUCTION** **9**

Significance of computational hydraulics, discrete forms of the laws of construction of mass, momentum and energy. Examples of free surface flows. Derivation of governing equations for flow and transport in surface and sub-surface (saturated and unsaturated flow)

UNIT II **1-D EXPANSIONS** **9**

lateral inflow's 1-D expansions and contractions, homogeneous and stratified fluid flows. Equations for reactive transport; Coupled surface and sub-surface flow models; Basics of finite difference, finite element and finite volume methods

UNIT III **METHOD OF CHARACTERISTICS** **9**

Characteristics and invarients, regions of state, computation of hydraulic jump, indeterminacy conditions, the linearised method of characteristics. Consistency, stability, convergence, order of accuracy computational efficiency application of numerical methods for solving flow and transport equations,

UNIT IV **FORMS OF CONSERVATION LAWS** **9**

Difference forms of conservation laws, weak solutions applications, storm-sewer networks, diffusion problems, river morphotogy, linear wave propagation. fully coupled and iteratively coupled models; Model simplification, Parameter estimation (Model calibration and validation),

UNIT V COMPUTATIONAL FLUID DYNAMICS (CFD) 9 Hrs.

Numerical methods – Finite difference method with example 1-D horizontal flow. software for three-dimensional turbulent flow modeling, Software for sub-surface flow simulation.

L	T	P	Total
45	0	0	45

TEXT BOOKS:

1. Brebbia, C.A. and Ferrante, "A.J. Computational Hydraulics" Butterworth & Company (Publishers) Ltd., London, 1983
2. Chaudhary, M.H, "Applied Hydraulic Transients" (2 nd Edition) – Van Nostrand Reinhold Company Inc., New York, 1987

REFERENCES:

1. Mahmood, K. and Yeyjevieh, V, "Unsteady Flow in Open Channels (Vol. – I & II)" Water Resources Publications, Fort Collins, Colorado, U.S.A., 1975
2. Michael B. Abbott, Anthony W. Minns "Computational Hydraulics" - Routledge, 2017
3. J. A. Cunge, Michael Barry Abbott, "Engineering Applications of Computational Hydraulics" Pitman Advanced Publishing program.
4. Cornelis B. Vreugdenhil,"Computational Hydraulics: An Introduction", Springer Science & Business Media, 2012
5. Michael B. Abbott, Anthony W. Minns , "Computational Hydraulics" 1994 Routledge, 2017

Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1		2										
CO2	3	1												
CO3	3	1		2										
CO4	3	1		2										
CO5	3	1		2										
Total	15	5		8										
Scaled Values	3	1		2										

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester

Subject Name **WATER RESOURCES ENGINEERING**

Subject Code **PCEE12**

Prerequisite **NIL**

L	T	P	C
2	2	0	3

C	P	A
2.5	0	0.5

L	T	P	H
2	2	0	4

Course Objectives

- To prepare the students for a successful career as hydrologist and water resources engineers
- To develop the ability among students to synthesis data and technical concepts for application in hydrology and water resources engineering
- To provide students an opportunity to work as a part of interdisciplinary team
- To promote student awareness of the life-long learning and to introduce them professional ethics and codes of professional practice in water resource engineering

Course Outcomes:

At the end of the course, students must be in a position to:		**Domain C or P or A**
CO1	Understand the interaction among various processes in the hydrologic cycle	C
CO2	Understand the forms of precipitation and measurements.	C
CO3	Understand runoff , ground water and well hydrology	C
CO4	Understand water requirement of crops-Crops and crop seasons in India, Methods of applying water.	C
CO5	Understand application of Distribution systems- cannel, Dams, reservoir and spillway.	C

UNIT I **INTRODUCTION** **9**

Hydrologic cycle, water-budget equation, history of hydrology, world water balance, applications in engineering, sources of data. *Precipitation* - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth area- duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India

UNIT II **ABSTRACTIONS FROM PRECIPITATION** **9**

Evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration.

UNIT III **RUNOFF** **9**

Runoff volume, SCS-CN method of estimating runoff volume, flow duration curve, flow-mass curve, hydrograph, factors affecting runoff, hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows.*Ground water and well hydrology* - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests

UNIT IV WATER WITHDRAWALS AND USES 9

Water for energy production, water for agriculture, water for hydroelectric generation; flood control. Analysis of surface water supply, Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation.

UNIT IV DISTRIBUTION SYSTEMS 9

Canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining. *Dams and spillways* - embankment dams: Classification, design considerations, estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams. Spillways: components of spillways, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site.

L	T	P	Total
45	0	0	45

TEXT BOOKS:

1. Subramanya. K," Engineering Hydrology", Tata Mc-Graw Hill publishing pvt. Ltd., New Delhi, 2010.
2. K N Muthreja, "Applied Hydrology", Tata Mc-Graw Hill publishing pvt. Newdelhi
3. Larry W. Mays "Water Resources Engineering", Wiley; 2 edition (June 8, 2010)

REFERENCE BOOKS

1. G.L. Asawa "Elementary Irrigation Engineering" New Age International Publisher (1999).
2. G. L. Asawa, "Irrigation Engineering ", John Wiley & Sons Australia, Limited, 1994.
3. J D Zimmerman "Advances in Irrigation" Elsevier, 2013.

Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2		3		1	1								
CO 2	3	1	3		1	1								
CO 3	2	1	3		1	1								
CO 4	2	1	3		1	1								
CO 5	2		3		1	1								
Total	11	3	15		5	5								

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester :

Course Code : PCEE13

Course Name : ENVIRONMENTAL GEOTECHNOLOGY

Prerequisite :

L	T	P	C
3	0	0	3

C	P	A
2	0.5	0.5

L	T	P	H
3	0	0	3

Course Objectives

- Have an exposure to interdisciplinary issues pertaining to environment and geotechnical engineering
- Explain the effects of pollutants in soil properties
- Acquiring the knowledge of the problematic soil deposits under varying environmental conditions
- Awareness about the adverse effects of soil and ground water contaminants
- Analyze and apply the various techniques for remediation of the contaminants

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Analyse the soil contamination concentration and type	Cognitive	Understand
CO2	Be trained to develop sustainable and environmentally sound solutions for geotechnical problems	Cognitive Affective	Understand Respond
CO3	Solving environmental engineering problems unique to several soil and subsurface conditions.	Cognitive Psychomotor	Understand Guided Response
CO4	Monitor and analyse quality of ground water	Cognitive Psychomotor	Create Guided Response
CO5	Suggest the steps to remediation of soil and groundwater	Cognitive	Create Respond

COURSE CONTENT

UNIT I	**FUNDAMENTALS OF GEOENVIROMENTAL ENGINEERING**	**9**

Scope of geo environmental engineering - multiphase behaviour of soil – role of soil in geo environmental applications- sources and type of ground contamination sources, production and classification of waste– health risks posed by heavy metals and emerging pollutants. Impact of climate change, energy resources, case histories on geo environmental problems.

UNIT II	**GROUNDWATER CONTAMINATION**	**8**

Water quality standards - Sources of contamination- Soil-water-contaminant interactions and its implications – Hydro chemical behavior of contaminants - Trace metals - Trace non metals - Nitrogen, organic substances - Measurement of parameters - Velocity - Dispersivity - chemical partitioning- Factors effecting retention and transport of contaminants.

UNIT III	**REMEDIATION OF CONTAMINANTS FROM SOIL AND GROUND WATER**	**10**

contaminant transformation: sorption, biodegradation, ion exchange, precipitation ex situ and insitu remediation – solidification, bio–remediation, soil washing, electro kinetics, soil heating, verification, bio venting, Ground water remediation – pump and treat, air sparging, reactive well-Insitu remediation –Case studies

UNIT IV	SOLID WASTE DISPOSAL AND STABILIZATION	10

Hazardous waste control and storage system- mechanism of Stabilization, incineration-organic and inorganic stabilization reutilization of solid waste for soil improvement. Design of landfill: CNS layer, leachate and air collection units

UNIT V	ADVANCED SOIL CHARACTERIZATION	8

Site characterization – risk assessment of contaminated site -Contaminant analysis - water content and permeability measurements – electrical and thermal property evaluation –-. Site selection for dumping

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Rowe R.K., "Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
2. Reddi L.N. and Inyang, H. I., "Geoenvironmental Engineering, Principles and Applications" Marcel Dekker Inc. New York, 2000.
3. Yong, R. N., "Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation" CRC Press, New York, 2001.
4. Sharma H.D. and Reddy K.R., "Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004. 5. Zheng C., “Applied Contaminant Transport Modeling”, John Wiley & sons, First edition
5. Hsai-Yang Fang, “Introduction to Environmental Geotechnology”, CRC Press, New York
6. Berkowitz,B. Dror, I. and Yaron,B., "Contaminant Geochemistry" Springer, Germany, 2008.
7. Mohamed,A. M. O.,"Principles and Applications of Time Domain Electrometry in Geoenvironmental Engineering" Taylor and Francis, New York, 2006.

Mapping of CO with PO’s

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1		3	2	3			3		2					3
CO 2			1			3	2		2	1				2
CO 3			1	2			3		3	1				2
CO 4			3	3			3		3					3
CO 5			3	3			3		3					3
Total	0	3	10	11	0	3	14	0	13	2	0	0	0	13
Scaled Value	**0**	**1**	**2**	**2**	**0**	**1**	**3**	**0**	**3**	**1**	**0**	**0**	**0**	**3**

Note:	**Total**	0	1-5	6-10	11-15
	Scaled value	0	1	2	3
	Relation	No	Low	Medium	High

Semester :

Course Code : PCEE14

Course Name : GEOTECHNICAL DESIGN

Prerequisite :

L	T	P	C
3	0	0	3

C	P	A
2	0	1

L	T	P	H
3	0	0	3

Course Objectives

- To apply the knowledge of soil properties
- To acquire knowledge on geotechnical structures and design principles
- To select proper methods of construction for geotechnical structures

Course Outcome: After the completion of the course, students will be able to		**Domain C or P or A**	**Level**
CO1	Explain the various investigation specifications as per the infrastructure to be build on the proposed site	Cognitive	Understand
CO2	Evaluate the properties of materials required for the constructing a desired geotechnical infrastructure	Cognitive Affective	Understand Respond
CO3	Understand the design concepts of various foundation systems	Cognitive Affective	Understand Guided Response
CO4	Classify the design principles of dams, pavement and retaining walls	Cognitive Affective	Create Guided Response
CO5	Design a underground storage system, buried structures, Geosynthetics	Cognitive Affective	Create Respond

COURSE CONTENT

UNIT I	**SUBSURFACE SITE EVALUATION AND GEOTECHNICAL STRUCTURES**	**8**

Planning for subsurface exploration - Methods of exploration – Geophysical exploration - Soil sampling and samplers - In-situ tests - Soil investigation report

Functions and requisites of geotechnical structures - Different types - choice of types – general principles of design - Grouting techniques – Types of grout

UNIT II	**INTEGRATED DESIGN OF RETAINING WALLS**	**10**

Introduction - Types of earth pressures - Different theories of earth pressures - Rankine and Coulomb theory - Friction circle method - Terzaghi's analysis Different types of retaining structures - Stability analysis of rigid walls - Design of anchored sheet piles - Lateral pressure on sheeting in braced excavation - stability against piping and bottom heaving - Earth pressure around tunnel lining, shaft and silos.

UNIT III	PAVEMENTS AND MATERIALS FOR AIRPORTS, HIGHWAYS, HARBOR, ETC.	10

Material characterization for analytical pavement design – CBR and stabilometer tests – Resilient modulus – Fatigue subsystem – failure criteria for bituminous pavements – IRC design guidelines. Pavements types – Approaches to pavement design – vehicle and traffic considerations – behaviour of road materials under repeated loading – Stresses and deflections in layered systems.

UNIT IV	DESIGN OF DAMS AND OTHER WATER RETAINING STRUCTURES	10

Design consideration, Factors influencing design - Types of earth and rockfill dams - Design details - Provisions to control pore pressure - Design consideration - Factors influencing design - Types of earth and rockfill dams - Design details, Provisions to control pore pressure - Special design problems - Slope protection, Filter design, Foundation treatment - Earth dams on pervious soil foundation - Treatment of rock foundation - Construction Techniques - Quality control and performance measurement - Applications of Geosynthetics in earth and rockfill dams

UNIT V	UNDERGROUND STORAGE SYSTEM, BURIED STRUCTURES, GEOSYNTHETICS	7

Design & detailing of Underground Rectangular and Circular Water Tank – buried pipelines - Principles, Concepts and Mechanisms of reinforced earth - Main types of geosynthetics - charactersitics and manufacturing processes - Main functions of geosynthetics and applications in which these functions are most relevant - Principles of design with geosynthetics - Most important geosynthetics characterization tests.

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Analysis and Design of Substructures: Limit State Design by Swami Saran
2. Braja M. Das, Principles of Foundation Engineering, by, Cengage Learning
3. Singh A, Modern Geotechnical Engineering, 3rd Ed., CBS Publishers, New Delhi, 1999.
4. Punmia, B.C. Soil Mechanics and Foundation Engineering, Laxmi Publications Pvt. Ltd., New Delhi, 1995.
5. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi

REFERENCE BOOKS

1. AASHTO. (1990). AASHTO Guidelines for Pavement Management Systems, American Association of State Highway and Transportation Officials, Washington DC.
2. Koerner, R.M. and Welsh, J.P., Construction and Geotechnical Engineering using Synthetic Fabrics, John Wiley, 1990.
3. Robert M. Koerne. Designing with geosynthetics. 5th. New York: Prentice Hall, 2005. ISBN 978-0131454156.
4. IS: 12966(Part 2)-1990 “Code of practice for galleries and other openings in dams” (Part 2: Structural design)

1. IS: 13551-1992 “Structural design of spillway piers and crest–criteria”

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	1	3		1	1			2	1		1	1	2	1
CO 2	2	1	2	1	1	2				1	1	2	1	1
CO 3	1	2		1				1		1	1		1	1
CO 4	2	2	2		1	2	1		1	1				1
CO 5	2	1			1								1	
Total	8	9	4	3	4	4	1	3	2	3	3	3	5	4
Scaled Value	2	2	1	1	1	1	1	1	1	1	1	1	1	1

Note:	**Total**	0	1-5	6-10	11-15
	Scaled value	0	1	2	3
	Relation	No	Low	Medium	High

Semester	
Subject Name	**ENVIRONMENTAL FLUID MECHANICS**
Subject Code	**PCEE15**
Prerequisite	**FLUID MECHANICS**

L	T	P	C
3	0	0	3

C	P	A
3	0	0

L	T	P	H
3	0	0	3

Course Objectives

- Understand the effects of diffusion, advection, dispersion, and chemical reactions on concentrations in the environment
- Apply the governing transport equations to solve problems with diverse boundary and initial conditions
- Evaluate the important processes affecting fate and transport in a range of problem situations

Course Outcome:		**Domain C or P or A**
CO1	apply knowledge of basic mathematics, science, and engineering	C
CO2	Ability to function on multi-disciplinary teams	C
CO3	Ability to identify, formulate and solve engineering problems	C
CO4	Ability to understand the impact of engineering solutions in a global and societal context	C
CO5	Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	C

COURSE CONTENT

UNIT I	**INTRODUCTION**	**9**
	Introduction to fluid and mass transport in naturally occurring flows; topics include molecular and turbulent diffusion; dispersion; river, estuary, and ocean mixing; dissolution boundary layers; tidal mixing; offshore wastewater outfalls;	
UNIT II	**APPLICATION AND ANALYSIS**	**9**
	Fick's law -Diffusion equation -Integral solutions: CSTR solutions for marina design - Differential analysis: Instantaneous point source solution in 1D - Advective diffusion and solutions in 2D and 3D Initial spatial distributions; fixed concentrations -Other solutions, superposition and image sources	
UNIT III	**POTENTIAL FLOW**	**7**
	Potential flow -porous media flows, surface/internal waves in oceans and lakes.	
UNIT IV	**LAMINAR FLOW**	**11**
	Laminar flow (channel and overland flow, mud flow, transient and oscillatory boundary layer, induced streaming, mass transport)	
UNIT V	**TURBULENT FLOW**	**9**
	Turbulent flow (instability, characteristics, averaging, Reynolds and turbulent kinetic equations, applications: effluent discharge, boundary layer)	

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Chin, David A. (2006). Water Quality Engineering in Natural Systems. Wiley Interscience: Hoboken, New Jersey. (Available free online through the TAMU library)
2. Socolofsky, S. A. and Jirka, G. H. (2005), Special Topics on Mixing and Transport in the Environment
3. Fischer, Hugo B., List, E. John, Koh, Robert C. Y., Imberger, Jörg, and Brooks, Norman H. (1979), Mixing in Inland and Coastal Waters, Academic Press: San Diego, CA.

REFERENCES

1. Chapra, Steven C. (1997), Surface Water-Quality Modeling, McGraw-Hill: Boston, MA.
2. Hemond, Harold F. and Fechner-Levy, Elizabeth J. (2000), Chemical Fate and Transport in the Environment, 2nd Edition, Academic Press: San Diego, CA.
3. Wainwright, J. and Mulligan, M., eds. (2004), Environmental Modelling: Finding Simplicity in Complexity, John Wiley & Sons , Ltd.: Hoboken, NJ.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	1	1			1	1			1			1	1
CO 2	1	1	1			1	1			1			1	1
CO 3	2	1	1			1	1			1				
CO 4	2		2			3	1			1			3	2
CO 5	3		3			2	1			1			3	2
Total	**9**	**3**	**8**			**8**	**5**			**5**			**8**	**6**
Scaled Values	**2**	**1**	**2**			**2**	**1**			**1**			**2**	**2**

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester	
Subject Name	**ENVIRONMENTAL IMPACT ASSESSMENT**
Subject Code	**PCEE16**
Prerequisite	**Nil**

L	T	P	H
2	0	0	2

C	P	A
2	0	0

L	T	P	H
2	0	0	2

Course Objectives

- To provide a basic understanding of the EIA process as it is used for research, planning, project or program evaluation, monitoring, and regulatory enforcement.
- To perceive the knowledge on Methodologies for assessment
- To understand the concepts of legal, economic, social, administrative and technical process
- To prepare the Environmental audit reports.
- To provide experience and training in environmental planning and related professions

Course Outcome:		**Domain C or P or A**
CO1	Understand the EIA process to apply for research, planning, project	C
CO2	Acquire the knowledge on Assessment methodologies	C
CO3	Understand the concepts of legal, economic, social, administrative and technical process.	C
CO4	Create Environmental audit reports	C
CO5	Experienced and Trained in Environmental Planning and related professions	C

COURSE CONTENT

UNIT I	**INTRODUCTION**	**6**
	Evolution of EIA: Concepts of EIA methodologies, Screening and scoping; Rapid EIA and Comprehensive EIA; General Framework for Environmental Impact Assessment. Characterization and site assessment.	
UNIT II	**METHODOLOGIES AND ASSESSMENT**	**6**
	Environmental Risk Analysis, Definition of Risk, Matrix Method. Checklist method, Fault tree analysis, Consequence Analysis; Life Cycle Assessment	
UNIT III	**ENVIRONMENTAL MANAGEMENT PLAN**	**6**
	Environmental Legislation; Introduction to Environmental Management Systems; Environmental Statement - procedures; Environmental Audit	
UNIT IV	**ECONOMIC ANALYSIS**	**6**
	Cost Benefit Analysis; Resource Balance, Energy Balance & Management Review; Operational Control;	
UNIT V	**CASE STUDIES**	**6**
	EIA for infrastructure projects – Bridges – Stadium – Highways – Dams – Multi-storey Buildings – Water Supply and Drainage Projects	

L	T	P	Total
30	0	0	30

TEXT BOOKS

1. Canter, L.W., "Environmental Impact Assessment", McGraw-Hill, New York. 2006.
2. Lawrence, D.P., "Environmental Impact Assessment - Practical solutions to recurrent problems", Wiley-Interscience, New Jersey 2003.
3. Petts, J., "Handbook of Environmental Impact Assessment", Vol., I and II, Conwell Science London. 2009.

REFERENCE

1. Biswas, A.K. and Agarwala, S.B.C., "Environmental Impact Assessment for Developing Countries", Butterworth Heinemann, London. 2004.
2. The World Bank Group, "Environmental Assessment Source Book Vol. I, II and III. The World Bank, Washington. 2001.
3. John G. Rau and David C Hooten (Ed)., Environmental Impact Analysis Handbook,
4. McGraw-Hill Book Company, New York, 2010.
5. Judith petts, handbook of environmental impact assessment vol. i & ii, blackwell science, 1999

Mapping CO's with PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	1	1	2			3	1	1		1				2
CO2	1	3	1	1		3		1			1	1		1
CO3	1	2	2			2		1			1	1		1
CO4	1	2				1	1							2
CO5	1	2				2	1							3
Total	4	8	5	1		9	2	3		1	2	2		7
Scaled Values	1	2	1	1		2	1	1		1	1	1		2

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester :

Subject Name : DESIGN OF HYDRAULIC STRUCTURES

Subject Code : PCEE17

Prerequisite : NIL

L	T	P	C
3	0	0	3

C	P	A
2	0	1

L	T	P	H
3	0	0	3

Course Objectives

- To impart knowledge regarding tank irrigation and impounding structures
- To learn the capacity and design of canal transmission and regulation structures.
- To study on importance of irrigation water management structures.

Course Outcome:		**Domain C or P or A**
CO1	***Design*** the Tank irrigation structure and ***draw*** the components.	C & A
CO2	***Design*** of dams and energy dissipation structures	C & A
CO3	***Design and plot*** canal transmission structures	C & A
CO4	***Analyse and design*** canal regulation structures	C & A
CO5	***Develop*** strategies for water management in irrigation structures.	C

COURSE CONTENT

UNIT I	**TANK IRRIGATION STRUCTURES**	**9 Hrs.**

Design and Drawing of Tank surplus weirs–Tank sluices weirs on pervious foundations - Percolation ponds

UNIT II	**IMPOUNDING STRUCTURES**	**9 Hrs.**

Design of Gravity Dams – Earth dams– Spill ways – Energy dissipation devices

UNIT III	**CANAL TRANSMISSION STRUCTURES**	**9 Hrs.**

Design and Drawing of Aqueducts – Siphon aqueducts – Super passage – Canal siphon – Canal drops – Notch type – Rapid type fall – Siphon well drops

UNIT IV	**CANAL REGULATION STRUCTURES**	**9 Hrs.**

Design of lined and unlined channels – Design and Drawing of Canal head works – Canal regulator – Canal escape

UNIT V	**IRRIGATION WATER MANAGEMENT STRUCTURES**	**9 Hrs.**

On farm development works – Structures for proportional field distribution-Drought management-Case study.

L	T	P	Total
30	0	0	30

TEXT BOOKS

1. Garg, S.K. Irrigation Engineering and Hydraulic Structures. Khanna Publishers, Delhi," 2008
2. Sharma R.K, "Irrigation Engineering and Hydraulic Structures", Oxford and IBH Publishing Co., New Delhi, 2016
3. N NBasak " Irrigation Engineering', Tata Mcgraw Hill publishing company limited, NewDelhi,2007

REFERENCES

1. Punmia, BC; and PandeBrijBansiLal, `Irrigation and Water Power Engineering', Delhi, Standard Publishers Distributors,2016
2. Sharma, SK; `Principles and Practice of Irrigation Engineering', , Prentice Hall of India Pvt. Ltd. , New Delhi
3. Madan Mohan Das, Mimi Das Saikia, "Irrigation And Water Power Engineering", PHI Learning Private Limited, Delhi,2009

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3	2	2				2	1	1	3	2
CO2	3	2		2	2	2				1	1	1	3	2
CO3	3	2		3	2	2				1	1	1	3	2
CO4	3	2		2	2	2				1	1	1	3	2
CO5					3	2	2	1	1	2		1		1
Total	12	8	1	10	11	10	2	1	1	7	4	5	12	9
Scaled Values	3	3	1	2	3	2	1	1	1	2	1	1	3	2

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester

Subject Name **SURFACE HYDROLOGY**

Subject Code **PCEE18**

Prerequisite

L	T	P	H
3	0	0	3

C	P	A
2.5	0	0.5

L	T	P	H
3	0	0	3

Course Objectives

- To study the hydrologic cycle and evaporation techniques
- To know the infiltration and runoff
- An ability to analyse the various methods of floods frequency analysis

Course Outcome:		**Domain C or P or A**
CO1	Calculate the various components of hydrologic cycle	C
CO2	Apply the principle of hydrograph to estimate flood characteristics	C
CO3	Understand the infiltration processes	C & A
CO4	Able to understand the runoff detailing	C
CO5	Estimate the flood peak discharge	C

COURSE CONTENT

UNIT I	**INTRODUCTION**	**9**

Introduction: Hydrologic cycle - systems concept - hydrologic system model - hydrologic model classification. Stream flow measurement - measurement of stage – discharge measurements. Stage – discharge relations - selection of a stream gauging site – stream gauge network.

UNIT II	**EVAPORATION**	**9**

Measurement, estimation and control of evapo-transporation (ET) – evapo-transpiration and consumptive use – lysimeters and field pots – potential ET and its computation – pan evaporation - Pennman's method – Blaney Criddle method – reference crop ET and crop coefficient – interception and depression storage.

UNIT III	**INFILTRATION PROCESSES**	**9**

Measurement – Infiltration Capacity And Indices – Model Of Infiltration. Rain Water Harvesting – Advantages – Alterations In Hydrologic Cycle – Methods Of Water Conservation.

UNIT IV	**RUNOFF**	**9**

Components of runoff – Characteristics of runoff – factors affecting runoff – components of hydrograph – base flow separation – rain fall – runoff relations – flow duration curve – flow Mass curve – hydrograph analysis – unit hydrograph theory – derivation of unit hydrograph – applications and limitations of unit hydrograph – 'S' hydrograph – instantaneous unit hydrograph – unit hydrograph for ungauged catchments – synthetic hydrograph – conceptual elements – linear reservoirs – Nash model. Yield from a catchment – flow duration curves – flow mass curve.

UNIT V FLOODS 9

Floods – estimation of peak discharge – rational method – unit hydrograph method. Probabilistic and statistical methods – basic concept of probability and frequency distribution – skewness coefficient – return period discrete distribution – Binomial distribution – continuous distribution – flood frequency analysis – normal, lognormal, Gumbel and Log-Pearson Type III methods. Flood routing – reservoir routing – Modified pulse method – channel routing – Musking hum method.

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Garg S.K., Hydrology and Water Resources Engineering
2. Subramanya, K., Engineering Hydrology, Tata McGraw Hill, New Delhi.
3. Raghunath, H.M., Groundwater, 1987, Wiley Eastern Ltd., New Delhi.
4. Modi, P.N., Irrigation Water Resources and Water Power Engineering, Standard Book House, New Delhi.

REFERENCES

1. Todd, D.K., Groundwater Hydrology, 1993 John Wiley & Sons..
2. Raghunath, H.M., Hydrology – Principles, Analysis and Design, 1986, Wiley
3. Dr. P.Jaya Rami Reddy, A Textbook of Hydrology, University Science Press.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1				2	1			1				2
CO2	1	1				2	1			2				2
CO3	1	1				2	1			2				2
CO4	1	2				3	1			2				3
CO5	2	1				3	1			3				3
Total	6	6				12	5			10				12
Scaled Values	2	2				3	1			2				2

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester :

Subject Name : **REPAIR & REHABILITATION OF STRUCTURES.**

Subject Code : **PCEE19**

Prerequisite : **Concrete Technology**

L	T	P	H
3	0	0	3

C	P	A
3	0	0

L	T	P	H
3	0	0	3

Course Objectives

- To gain the knowledge on maintenance and repair strategies
- To perceive the knowledge on quality of concrete
- To recognize various types of materials and its properties
- To assess the damage to structures using various tests
- To learn various repair techniques of damaged structures and corroded structures

Course Outcome:		**Domain C or P or A**
CO1	Understand the importance of maintenance and repair	C
CO2	Understand the concept of quality assurance of concrete properties	C
CO3	Understand the various concrete materials used for repair works	C
CO4	Knowledge in the application of repair techniques in concrete construction	C
CO5	Understand the repair, rehabilitation and retrofitting of structures	C

COURSE CONTENT

UNIT I	**MAINTENANCE AND REPAIR STRATEGIES**	**9**

Maintenance and Repair Strategies Maintenance, Repair and Rehabilitation, Facts of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration;

UNIT II	**STRENGTH AND DURABILITY OF CONCRETE**	**9**

Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete – Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion – Effects of cover thickness

UNIT III	**SPECIAL CONCRETES**	**9**

Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes;

UNIT IV	**REPAIR TECHNIQUES**	**9**

Techniques for Repair and Protection Methods- Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection;

UNIT V	**REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES**	**9**

Evaluation of root causes; Underpinning & shoring; some simple systems of rehabilitation of structures; Guniting, shotcreting; Non-Destructive testing systems; Use of external plates, carbon fibre wrapping and carbon composites in repairs. Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake – Demolition Techniques – Engineered demolition methods – Case studies.

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Denison Campbell, Allen and Harold Roper, “Concrete Structures”, Materials, Maintenance and Repair, Longman Scientific and Technical UK, 1991.
2. Norbert Delatte, “Failure, Distress and Repair of Concrete Structures”, Woodhead Publishing, 2009.
3. Shetty.M.S., “Concrete Technology - Theory and Practice”, S.Chand and Company, New Delhi, 2009.

REFERENCES

1. Deterioration, maintenance and repair of structures, Johnson SM McGraw Hill International Publishers, New York.
2. Santhakumar, A.R., “Training Course notes on Damage Assessment and repair in Low Cost Housing”, “RHDC-NBO” Anna University,1992.
3. Raikar, R.N., “Learning from failures - Deficiencies in Design”, Construction and Service - R & D Centre (SDCPL), RaikarBhavan, Bombay, 1987.
4. Ravishankar.K., Krishnamoorthy.T.S,"Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures"Allied Publishers, 2004

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1								2	1
CO2	2	1	-	-	1								2	1
CO3	2	1	-	-	1								2	1
CO4	3	2	1	1	1								3	1
CO5	3	2	1	1	1								3	1
Total	12	7	2	2	5								12	5
Scaled values	3	2	1	1	1								3	1

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester :

Course Code : PCEE19

Course Name : URBAN HYDROLOGY AND HYDRAULICS

Prerequisite :

L	T	P	C
3	0	0	3

C	P	A
2	0	1

L	T	P	H
3	0	0	3

Course Objectives

At the end of the course the student will be able to

- Develop intensity duration frequency curves for urban drainage systems.
- Develop design storms to size the various components of drainage systems.
- Apply best management practices to manage urban flooding.
- Prepare master drainage and hydraulics plan for an urbanized area.

Course Outcome: *After the completion of the course, students will be able to*		**Domain C or P or A**	**Level**
CO1	Understand the importance of short duration rainfall runoff data for urban hydrology studies	Cognitive	Understand
CO2	Understand the importance of short duration rainfall runoff data for urban hydrology studies	Cognitive	Understand
CO3	Understand the importance of short duration rainfall runoff data for urban hydrology studies	Cognitive Affective	Understand Respond
CO4	Learn some of the best management practices in urban drainage.	Cognitive	Understand
CO5	Understand the concepts of preparation master urban drainage system.	Cognitive Affective	Understand Respond

COURSE CONTENT

UNIT I PRECIPITATION ANALYSIS: 9

Urbanization and its effect on water cycle – urban hydrologic cycle – trends in urbanization – Effect of urbanization on hydrology. Importance of short duration of rainfall and runoff data, methods of estimation of time of concentration for design of urban drainage systems, Intensity-Duration -Frequency (IDF) curves, design storms for urban drainage systems.

UNIT II APPROACHES TO URBAN DRAINAGE: 9

Time of concentration, peak flow estimation approaches, rational method, NRCS curve number approach, runoff quantity and quality, wastewater and storm water reuse, major and minor systems.

UNIT III HYDROLOGIC DESIGN: 9

Analysis of Precipitation Data, Construction of IDF curves, Estimation of Evaporation and Evapotranspiration, Determination of Yield from A Catchment, Derivation of Unit Hydrograph, Estimation of Design Flood, Regional Flood Frequency Analysis, Hydrologic and Hydraulic flood routing, Derivation of Synthetic Unit Hydrograph.

UNIT IV URBAN HYDRAULICS: 9

Sources and distribution of water in urban environment, including surface reservoir requirements, utilization of groundwater, and distribution systems. Analysis of sewer systems and drainage courses for the disposal of both wastewater and storm water. Pumps and lift stations. Urban planning and storm drainage practice.

UNIT V ANALYSIS AND MANAGEMENT: 9

Storm water drainage structures, design of storm water network- Best Management Practices–detention and retention facilities, swales, constructed wetlands, models available for storm water management.

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. 'Manual on Drainage in Urbanized area 'by Geiger W. F., J Marsalek, W. J. Rawls and F. C. Zuidema, (1987 – 2 volumes), UNESCO,
2. 'Urban Hydrology' by Hall M J (2015), Elsevier Applied Science Publisher.
3. 'Hydrology – Quantity and Quality Analysis' by Wanielista M P and Eaglin (2016), Wiley and Sons.
4. 'Urban Hydrology, Hydraulics and Storm water Quality: Engineering Applications and Computer Modeling' by Akan A.O and R.L. Houghtalen (2016), Wiley International.

REFERENCE BOOKS

1. 'Storm water Detention for Drainage' by Stahre P and Urbonas B (2000), Water Quality and CSO Management, Prentice Hall.
2. 'Urban water cycle processes and interactions' by Marsalek et al (2016), Publication No. 78, UNESCO, Paris (http://www.bvsde.paho.org/bvsacd/cd63/149460E.pdf)
3. 'Frontiers in Urban Water Management – Deadlock or Hope' by Maksimovic C and J A Tejada-Guibert (2015), IWA Publishing.

Mapping of CO with GA's

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3	2			2							2
CO 2	3	2			2							2
CO 3	3	2	1	2	2							2
CO 4	3	2	1	2	2							2
CO 5	3	2	1		2			1			2	2
Total	15	10	3	4	10	0	0	1	0	**0**	2	10
Scaled Value	3	2	1	1	2	0	0	1	0	**0**	1	2

Note:	**Total**	0	1-5	6-10	11-15
	Scaled value	0	1	2	3
	Relation	No	Low	Medium	High

Semester :

Course Code : **PCEE21**

Course Name : **BUILDING CONSTRUCTION PRACTICE.**

Prerequisite : ----

L	T	P	C
3	0	0	3

C	P	A
2	0	1

L	T	P	H
3	0	0	3

Course Objectives

- To make aware of site clearance, marking and earthwork
- To gain the knowledge in masonry and finishes
- To perceive the knowledge on shuttering and scaffolding
- To understand the latest construction techniques for sub structure
- To understand the latest construction techniques for super structure

Course Outcome: *After the completion of the course, students will be able to*		**Domain C or P or A**	**Level**
CO1	Able to understand the construction activities	Cognitive	Understand
CO2	Perceive the knowledge on various masonry and finishes	Cognitive	Understand
CO3	Explain the shuttering and scaffolding methods	Cognitive	Understand
		Affective	Respond
CO4	Identify various techniques adopted in sub structure construction	Cognitive	Understand
CO5	Understand the different techniques used in super-structures	Cognitive	Understand

COURSE CONTENT

UNIT I	**INTRODUCTION**	**9**
	Specifications, details and sequence of activities and construction co-ordination – Site Clearance – Marking – Earthwork	
UNIT II	**MASONRY AND FINISHES**	**9**
	Masonry – stone masonry – Bond in masonry - concrete hollow block masonry – flooring – laying brick Building foundations – basements – weather and water proof – roof finishes - acoustic and fire protection;	
UNIT III	**SHUTTERING AND SCAFFOLDINS**	**7**
	Temporary shed – centring and shuttering – slip forms – scaffoldings – de-shuttering forms – Fabrication and erection of steel trusses – frames – braced domes.	
UNIT IV	**SUB STRUCTURE CONSTRUCTION**	**11**
	Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement-Tunnelling techniques – Piling techniques - well and caisson - sinking cofferdam - cable anchoring and grouting-driving diaphragm walls, sheet piles - shoring	

for deep cutting - well points -Dewatering and stand by Plant equipment for underground open excavation;

UNIT V SUPER STRUCTURE CONSTRUCTION 9

Launching girders, bridge decks, off shore platforms – special forms for shells - techniques for heavy decks – in-situ pre-stressing in high rise structures, Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors - Erection of articulated structures, braced domes and space decks;

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., Construction Planning, Equipment and Methods, McGraw Hill, Singapore, 5th Edition, 2015.
2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, DhanpatRai and Sons, New Delhi 2007.

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1. Jha, J and Sinha, S.K., Construction and Foundation Engineering, KhannaPublishers,New Delhi, 2004.
2. Sharma S.C. Construction Equipment and Management, Khanna Publishers New Delhi, 1988.
3. Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers, New Delhi, 1988.
4. Mahesh Varma, Construction Equipment and its Planning and Application, Metropolitan Book Company, New Delhi, 1983

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	1	2				1								1
CO 2	1	2				1								1
CO 3	2	2				1								1
CO 4	3	3				2								2
CO 5	3	3				2								2
Total	10	12	0	0	0	1	0	0	0	0	0	0	0	1
Scaled Value	3	2	1	1	1	0	0	0	0	0	0	0	2	1

Note:	**Total**	0	1-5	6-10	11-15
	Scaled value	0	1	2	3
	Relation	No	Low	Medium	High

Semester	
Subject Name	**TALL STRUCTURES**
Subject Code	**PCEE22**
Designed by	**Department of Civil Engineering**
Prerequisite	**Design of Concrete Structures, Design of Steel Structure**

L	T	P	C
3	1	0	3

C	P	A
2	0	1

L	T	P	H
3	0	0	3

Preamble

This course provides the basic knowledge of the design principles and the material properties of tall buildings. The study includes the various structural behaviour of different types of frames. It also deals with the analysis and design parameters of tall structures.

Course Objective:

1. To know the design criteria based on different loading conditions.
2. To gain knowledge about the structural behavoiur of various frames.
3. To learn about the different methods of analysis of tall structures.
4. To make the students understand about the stability factors of tall buildings.

Course Outcome:		**Domain**
	On the successful completion of the course, students will be able to	
CO1	Identify the design criteria and design philosophy.	C(Understand)
CO2	Approach the design of tall buildings with static and dynamic loading.	C(Application)
CO3	Assimilate the behaviour of different types of structural systems.	C (Understand)
CO4	Analyse the members and identify the reduction techniques	C(Analyse)
CO5	Correlate the translational and torsional effects in tall buildings	C(Evaluate)

COURSE CONTENT

UNIT - I	**DESIGN CRITERIA**	**9**

Design philosophy - Loading - sequential loading - strength and stability - stiffness and drift limitations - human comfort criteria, creep – shrinkage and temperature effects – fire – foundation, settlement and soil structures interaction.

UNIT - II	**LOADS ON TALL BUILDINGS – CODE RECOMMENDATIONS**	**9**

Gravity loadings: Dead load & live load – Live load reduction methods – impact load – gravity load –construction load.

Wind Loading : Static & dynamic approach – Analytical & wind tunnel experimental method

Earthquake Loading : Equivalent lateral force – model analysis –combination of loading

UNIT-III	BEHAVIOUR OF STRUCTURAL SYSTEMS	9

Rigid frames – braced frames – In filled frames – shear walls –coupled shear walls – wall frames tubular – cores & hybrid mega systems.

UNIT -IV	ANALYSIS AND DESIGN	9

Modeling for approximate analysis - Accurate analysis and reduction Techniques - Analysis of buildings as total structural system considering overall integrity and major subsystem interaction - Analysis for member forces - drift and twist - computerized general 3D analysis.

UNIT - V	STABILITY OF TALL BUILDING	9

Overall buckling analysis of frames - wall - frames - Approximate methods - second - order effects of gravity loading - p - Delta analysis Simultaneous first order and P-Delta analysis, Translational - Torsional instability out of plumb effects - stiffness of member instability - effect of foundation rotation.

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Dave parker, Antony wood , “The Tall Buildings-Reference Book”, Routledge - Taylor & Francis group, London, 2013
2. Guy Nordenson, Terence riley, “Tall buildings”, The museum of modern art, New York, 2003.
3. Bryan Stafford Smith, Alexcoull, Tall Building Structure Analysis and Design, John Wiley & Sons, 1991.

REFERENCES

1. Wolf Gang Schuller, “High Rise Building Structures”, John Wiley &sons, 1977.

2.Taranath.B.S , “Structural Analysis & Design of Tall Buildings”, Tata McGraw Hill, 1988.

3. Lynn, S.Beedle, “Advances in Tall Buildings”, CBS Publishers, Delhi, 1986.

Semester

Subject Name **ENVIRONMENTAL LAW AND POLICY**

Subject Code **PCEE23**

Prerequisite **Environmental Engineering**

L	T	P	C
2	0	0	2

C	P	A
2	0	1

L	T	P	H
2	0	0	2

Course Objectives

- To recognize statutory goal setting means and approaches
- To gain knowledge in implementing the environmental law statutes to factual situations.
- To analyse the legal opinions and legal principles

CO1	Describe different methods for setting environmental goals and the means to achieve those goals	C (Knowledge)
CO2	Read and understand legal opinions and analyze opinions to find legal principles	C (Knowledge)
CO3	Apply common law environmental remedies and explain how those remedies supplement environmental statutory law	C (Apply)
CO4	Apply major common law environmental causes of action and environmental law statutes to factual situations.	C (Apply)

COURSE CONTENT

UNIT I INTRODUCTION 6

Concept of laws and policies, Origin of environmental law, Introduction to environmental laws and policies, Environment and Governance, sustainable development and environment.

UNIT II ENVIRONMENTAL PROTECTION 6

Duties and responsibilities of citizens for environmental protection – Subjects related to environment in the seventh schedule of the Constitution: Union list, State list and Common or Concurrent list - Scheme of labelling of environmentally friendly products (ecomark) – Significance of Environmental Education – Environmental Information Systems (ENVIS)

UNIT III ENVIRONMENTAL LAWS IN INDIA 6

Legal control of Environmental pollution in India with special reference to: Environment (Protection) Act, 1986 - Powers of Central Government under EPA - The Water (Prevention and Control of Pollution) Act 1974 - Air (Prevention and Control of Pollution) Act, 1981 – Forest Conservation Act, 1980 – Wildlife (Protection) Act, 1972 - The National Green Tribunal Act, 2010

UNIT IV GUIDELINES AND RULES FOR ENVIRONMENTAL PROTECTION 5

Guidelines for Common Effluent Treatment Plants (CETPs) – Guidelines for environmentally sound management of e-waste 2008 - The Biomedical waste (Management and Handling) Rules 1998 - Hazardous Waste (Management and Handling) Rules, 1989 - The Municipal Solid Wastes (Management and Handling) Rules, 2000 - The Ozone Depleting Substances (Regulation and Control) Rules, 2000

UNIT V MAJOR INITIATIVES/POLICIES FROM MOEF 7

Central and State Pollution Control Boards: Powers and functions of pollution control boards - Penalties and procedure - National Policies for Environmental Protection in India: National River Conservation Plan (NRCP), National Green Tribunal (NGT), Capacity Building for Industrial Pollution Management (CBIPM), National Environmental Protection Authority (NEPA), Green India Mission – Environmental Clearances: National Environmental Assessment and Monitoring Authority (NEAMA)

L	T	P	Total
30			30

TEXT BOOKS

1. Constitution of India Eastern Book Company Lucknow 12th Ed. 1997.
2. Constitutional Law of India – J.N. Pandey 1997 (31st Edn.) Central Law Agency Allahabad.
3. Administrative Law U.P.D. Kesari 1998. Universal Book Trade Delhi.
4. Environmental Law H.N. Tiwari, Allahabad Law. Agency 1997.

REFERENCES

1. Environmental, A., Divan and Noble M. Environmental Law and Policy in India (cases, Materials and Statutes) 1991 Tripathi Bombay.
2. Environmental Policy. Forest Policy. Bare Acts – Government Gazette Notification.

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- cpcb.nic.in/
- http://envfor.nic.in/
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- edugreen.teri.res.in/explore/laws.htm
- envfor.nic.in/legis/crz/crznew.html
- rti.gov.in/
- www.ngosindia.com/resources/pil.php

Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2	2		1								1	2	1
CO2	2	2	1	1								2	3	2
CO3	1	3	1			1	1			1		1	2	3
CO4	2	2	3	2		1							1	3
CO5	2	1	3	1								2	1	2
	9	10	8	5		2	1			1		6	9	11
Scaled values	3	3	2	1		1	1			1		1	2	2

Semester

Subject Name **GROUNDWATER ENGINEERING**

Subject Code **PCEE24**

Prerequisite **Nil**

L	T	P	C
3	0	0	3

C	P	A
2	0	1

L	T	P	H
3	0	0	3

COURSE OBJECTIVE

- Water quality criteria and standards, and their relation to public health, environment and urban water cycle;
- Water quality concepts and their effect on treatment process selection;
- The interaction of water quality and the materials being used;
- Hydraulic concepts and their relationship to water transport in treatment plants, pipelines and distribution networks;
- Be able to define and evaluate project alternatives on basis of chosen selection criteria;
- Water quality engineering within a watershed context.
-

Course Outcome:		**Domain**
After the completion of the course, students will be able to		**C or P or A**
CO1	Relate and Interpret the Development and evolution of ecosystems.	C
CO2	Explain and Apply Fluvial Ecosystem Diversity.	C
CO3	Classify and Develop the stream water chemistry.	C & A
CO4	Classify and Dissect necessity of Water quality models.	C
CO5	List and respond to Formulation of anisotropic and non-homogenous flow of groundwater.	C & A

COURSE CONTENT

UNIT I	**INTRODUCTION:**	**9**

Development and evolution of ecosystems – Principles and concepts – Energy flow and material cycling – productivity – Classification of Eco technology – ecological engineering- Classification of systems – Structural and functional interactions of environmental systems – Mechanisms of steady-state maintenance in open and closed systems- Modeling and Eco technology – Classification of ecological models – Applications- Ecological economics- Self-organizing design and processes.

UNIT II	**FLUVIAL ECOSYSTEMS:**	**9**

Fluvial Ecosystem Diversity- The Water Cycle – Stream flow- Flow Variation- The Stream Channel- Sediments and their Transport- Fluvial Processes along the River Continuum.

UNIT III	**STREAMWATER CHEMISTRY:**	**9**

Dissolved Gases -Major Dissolved Constituents of River Water-Variability in ionic concentrations -The dissolved load -Chemical classification of river water-The Bicarbonate Buffer System-Influence of Chemical Factors on the Biota-Variation in ionic concentration-Salinization -Effects of acidity on stream ecosystems.

UNIT IV **WATER QUALITY:** **9**

Water quality models – Historical development – Non point source pollution- Mass balance equation – Streeter - Phelps Equation – Modification to Streeter – Phelps Equation – Waste load allocations – Dissolved oxygen in Rivers and estuaries; Lake Water Quality Models; Models for Nitrogen, Bacteria, Phosphate and toxicants - Ground Water Quality Modeling - Contaminant solute transport equation, Numerical methods legislations for water quality.

UNIT V **GROUNDWATER MODELING:** **9**

Formulation of anisotropic and non-homogenous flow of groundwater, finite difference methods for solving groundwater flow problems, regional groundwater flow modeling.

L	T	P	Total
45			45

TEXT BOOKS

1. Chow, V.T., Maidment, D.R. and Mays, L.W. (2010),"Applied Hydrology", Tata McGraw Hill Edition
2. Warren Viessman, Jr. and G L Lewis, (2018), “Introduction to Hydrology”, Prentice Hall India Pvt. Ltd., New Delhi
3. Davis, S.N. and De Weist, R.J.M. (2012), "Hydrogeology", John Wiley & Sons, N York
4. Watters, G.Z, Analysis and control of pipe flow in pipes, Butter Worth Publishers, 2014.

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1. Dandekar, M.M., and Sharma, K.N., (2013), Water Power Engineering, Vikas Publishing Company, New Delhi.
2. Stahre, P., Urbonas, B., (2014), “Stormwater Detention for Drainage, water quality and CSO Management”, Prentice Hall, New Jersey.
3. McCuen R.H., Hydrologic Analysis and Design, Prentice Hall Inc. N York, 2015

Mapping of COs with GAs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2	3			2							2		
CO2	2	2			3							2		
CO3	3	2	1	2	2							2		
CO4	3	2	1	2	2							2		
CO5	3	2	1		2			1			2	2		
	13	11	3	4	11			1			2	10		

Semester	**VIII**
Subject Name	**SOLID AND HAZARDOUS WASTE MANAGEMENT**
Subject Code	**PCEE25**
Prerequisite	**Environmental Engineering**

L	T	P	C
2	0	0	2

C	P	A
2	0	1

L	T	P	H
2	0	0	2

Course Objectives

The objectives of this course is

- To make the students conversant with the types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste.

CO1	Characterize the physical and chemical composition of Solid and Hazardous waste	C & A
CO2	Explain the functional elements for solid waste management System	C
CO3	Identify the methods of collection, segregation and transport of solid and Hazardous waste	C
CO4	Understand the techniques and methods used in energy recovery and recovery of materials from solid wastes	C & A
CO5	Describe methods of disposal of solid and hazardous waste.	C

COURSE CONTENT

UNIT I SOURCES, CLASSIFICATION AND REGULATORY FRAMEWORK 6

Types and Sources of solid wastes - Need for solid waste management – Elements of integrated waste management and roles of stakeholders - Salient features of Indian legislations on management and handling of municipal solid wastes , hazardous wastes, biomedical wastes, E-wastes, Lead Acid batteries, plastics and fly ash - Financing waste management.

UNIT II WASTE CHARACTERIZATION AND SOURCE REDUCTION 6

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes –Hazardous characteristics - TCLP tests - Waste generation from nuclear power plants- Waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse.

UNIT III STORAGE, COLLECTION AND TRANSPORT OF WASTES 6

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation –compatibility, storage, labeling and handling and Transport of hazardous wastes.

UNIT IV WASTE PROCESSING TECHNOLOGIES 6

Material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration- solidification and stabilization of hazardous wastes – bio medical waste treatment.

UNIT V WASTE DISPOSAL 6

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - Design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation- Hazardous and Nuclear waste disposal options.

L	T	P	Total
30			30

TEXT BOOKS

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.
2. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001

REFERENCES

1. CPHEEO, "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.
2. Vesilind P.A., Worrell W and Reinhart, Solid waste Engineering, Thomson Learning Inc., Singapore, 2002.

Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	2	2		1								1	2	1
CO2	2	2	1	1								2	3	2
CO3	1	3	1			1	1			1		1	2	3
CO4	2	2	3	2		1							1	3
CO5	2	1	3	1								2	1	2
	9	10	8	5		2	1			1		6	9	11

Semester	
Subject Name	**PRESTRESSED AND PRE FABRICATED STRUCTURES**
Subject Code	**PCEE26**
Prerequisite	**DESIGN OF CONCRETE STRUCTURES**

L	T	P	H
3	0	0	3

C	P	A
2	0.5	0.5

L	T	P	H
3	0	0	3

Course Objectives

- To introduce the concept of prestressing, methods and advantages.
- Todesign the prestressed concrete structures subjected to flexure, shear, tension and compression.
- To acquire knowledge about the concept of circular prestressing and its application.

Course Outcome:		**Domain C or P or A**
CO1	Understand the need of the prestressed concrete and the methods of prestressing.	C
CO2	Identify and apply the design codes relevant for the designof prestressed concrete members	C & P
CO3	Accomplish the design calculation to predict circular prestressing behaviour of prestressed concrete structures.	A
CO4	Understand the behaviour of composite section and analyse the stress under different conditions.	C
CO5	Analyse the behaviour of statically indeterminate structures for the primary and secondary moments.	C

COURSE CONTENT

UNIT I	**INTRODUCTION – THEORY AND BEHAVIOUR**	**9**

Basic concepts – Advantages – Materials required – Systems and methods of prestressing –Analysis of sections by Stress concept, Strength concept and Load balancing concept - Effect of tendon profile on deflections – Factors influencing deflections – Calculation of short term and long term deflections –Losses of prestress.

UNIT II	**DESIGN OF MEMBERS.**	**9**

Behaviour of flexural members, determination of ultimate flexural strength – Various Codal provisions - Design for shear, bond and torsion, Design of Tension member, Design of Compression member. Stress distribution in end block-Design of anchorage zone reinforcement.

UNIT III	**CIRCULAR PRESTRESSING**	**9**

Prestressed Concrete Pipes- Advantages, Loads - Design of cylinder and non-cylinder pipes. Prestressed Concrete Tanks-Choice of types of tanks.

UNIT IV	**COMPOSITE CONSTRUCTION**	**9**

Types of composite Construction - Analysis of stresses – Differential Shrinkage - Estimation of Deflection. Partial prestressing - its advantages and applications.

UNIT V	**CONTINUOUS BEAMS**	**9**

Analysis of continuous beams - Methods of achieving continuity - concept of linear transformations, concordant cable profile and cap cables.

L	T	P	Total
45			45

TEXT BOOKS

1. Krishna Raju. N, Prestressed Concrete, Tata McGraw Hill Publishing Co. Ltd, New Dehi, 2012
2. Pandit.G.S. and Gupta.S.P., "Prestressed Concrete", CBS Publishers and Distributers Pvt. Ltd, 2012.
3. Libby J.R., Modern Prestressed Concrete, 3e,CBS Publishers & Distributors, New Delhi, 2007

REFERENCES

1. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.
2. Ramaswamy G.S., Modern prestressed concrete design, Arnold Heinimen, New Delhi.
3. David A.Sheppard, William R. and Philips, Plant Cast precast and prestressed concrete – A design guide, McGraw Hill, New Delhi,2012.

IS Codes

1. IS1343:2012, Code of Practice for Prestressed Concrete, Bureau of Indian Standards, New Delhi, 2012
2. IS 3370-3 (1967): Code of Practice Concrete structures for the storage of liquids, Part 3: Prestressed concrete structures, Bureau of Indian Standards, New Delhi, 2008
3. IS 3370-4 (1967): Code of practice for concrete structures for the storage of liquids, Part 4: Design tables, Bureau of Indian Standards, New Delhi, 2008

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1		1	1	1	1		2	1	1	2	4
CO2	1		2	1	1	1	1	1		1		2	1	3
CO3	2	2	3	1	1	2		1	1				2	1
CO4	1		2	1		1	1			1	1	1	1	2
CO5	1	2	3	1		2		1		1		2	1	2
Total	6	6	11	4	3	7	3	4	1	5	2	6	7	12
Scaled Values	2	2	3	1	1	2	1	1	1	1	1	2	2	3

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester :

Course Code : PCEE27

Course Name : CONTRACTS MANAGEMENT

Prerequisite : ----

L	T	P	C
3	0	0	3

C	P	A
2	0	1

L	T	P	H
3	0	0	3

Course Objectives

- To understand the various types of construction contracts.
- To learn about the tenders, arbitration and labour regulations.
- To Know the various legal implications related to contracts.

Course Outcome: *After the completion of the course, students will be able to*		**Domain C or P or A**	**Level**
CO1	Recognize the various types of construction contracts	Cognitive	Understanding
CO2	Understand the tenders, arbitration and legal requirements	Cognitive Affective	Understanding Responding
CO3	Gain knowledge about various tax laws	Cognitive	Understanding
CO4	Able to analyse, evaluate and design construction contract documents	Cognitive Affective	Understanding Responding
CO5	Gain knowledge in labour regulations.	Cognitive	Understanding

COURSE CONTENT

UNIT I INTRODUCTION TO CONSTRUCTION CONTRACT 9

Definition of Contract Legal issues in contract – Standard forms of contracts- General and special conditions of contracts- Contract pricing by the client, project management consultants and the contractor, Contract correspondence and contract closure. Types of contracts, Documents forming a contract, General conditions of Indian contracts - International contracts - Contract administration.

UNIT II TENDERS 9

Prequalification – Bidding – Accepting – Evaluation of Tender from Technical, Contractual and Commercial Points of View – Contract Formation and Interpretation – Potential Contractual Problems - World Bank Procedures and Guidelines – Tamilnadu Transparency in Tenders Act.

UNIT III ARBITRATION 9

Comparison of Actions and Laws – Agreements – Appointment of Arbitrators – Conditions of Arbitration – Arbitration Tribunals - Powers and Duties of Arbitrator – Enforcement of Award – Arbitration and Conciliation Act 1996 - Arbitration case study.

UNIT IV TAX LAWS 9

Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local Government Laws for Approval – Statutory Regulations

UNIT V LABOUR REGULATION 9

Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration – Insurance and Safety Regulations – Workmen's Compensation Act – Indian Factory Act – Tamilnadu Factory Act – Child Labour Act - Other Labour Laws

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Anurag K Agarwal, “Contracts and Arbitration for Managers”, SAGE Response, 2015.
2. S. RanagaRao, “Contract Management & Dispute Resolutions”, Engineering staff College of India, 2008.
3. C. J. Schexnayder and R. E. Mayo, “Construction Management Fundamentals”, McGraw Hill, New Delhi. 2003.

REFERENCES

1. Prof AkhileshwarPathak, “Contract Terms Are Common Sense”, Penguin Portfolio, 2018.
2. B. S. Patil “Civil Engineering Contracts and Estimates”, Universities Press, 2009.
3. D.S. Berrie and B.c.Paulson, “Professional construction management including C.M.Design construct and general contracting” McGraw Hill International, 1992.

Mapping of CO with PO’s

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1											1		1	
CO 2			2			3		3	2	1	1		1	
CO 3	2	2							2	1	1			
CO 4	2	1		2		3						1		
CO 5					2		3			2				1
Total	**4**	**3**	**2**	**2**	**2**	**6**	**3**	**3**	**4**	**4**	**3**	**1**	**2**	**1**
Scaled Value	1	1	1	1	1	2	1	1	1	1	1	1	1	1

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High

Semester :

Course Code : PCEE28

Course Name : AIR AND NOISE POLLUTION AND CONTROL

Prerequisite : Environmental Engineering

L	T	P	C
3	0	0	3

C	P	A
3	0	1

L	T	P	H
3	0	0	3

Course Objectives

- To learn the effects of air pollutants
- To gain the knowledge on various particulate control methods
- To understand the impact of gaseous pollutants and controlling methods
- To perceive knowledge on air sampling and pollutant measurement
- To identify the concepts of noise pollution and control methods

Course Outcome: *After the completion of the course, students will be able to*		**Domain C or P or A**	**Level**
CO1	*Understand* the effects of air pollutants	Cognitive	Understand
CO2	*Understand* the particulate control methods	Cognitive	Understand
CO3	*Understand* the gaseous pollutants and controlling methods	Cognitive	Understand
CO4	*Acquire* knowledge on air sampling and pollutant measurement	Cognitive	Knowledge
CO5	*Recognise* the concepts of noise pollution and control methods	Cognitive	Knowledge

COURSE CONTENT

UNIT I AIR POLLUTANTS 9

Air pollutants, Sources, classification, Combustion Processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects-Smoke, smog and ozone disturbance, Greenhouse effect.

UNIT II PARTICULATE CONTROL 9

Air Pollution control- at source-equipments for control of air pollution-For particulate matter-Settling chambers-Fabric filters-Scrubbers-Cyclones Electrostatic precipitators

UNIT III GAS POLLUTANT CONTROL 9

Gaseous pollutants-control by absorption-adsorption scrubbers-secondary combustion after burners, Working principles advantages and disadvantages, design criteria and examples

UNIT IV AIR SAMPLING AND LEGISLATIONS 9

Air sampling and pollution measurement methods, principles and instruments, Ambient air quality and emission standards, Air pollution indices, Air Act, legislation and regulations, control principles

UNIT V INDOOR AIR QUALITY AND NOISE POLLUTION 9

Indoor air quality .Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Noise control methods.

L	T	P	Total
45	0	0	45

TEXT BOOKS

1. Noel de Nevers, Air Pollution Control Engineering, McGraw Hill, New York, 2010.
2. Lawrence K. Wang, Norman C. Parelra, Yung Tse Hung, Air Pollution Control Engineering, Tokyo, 2004.
3. Anjaneyulu. Y, 'Air Pollution and Control Technologies', Allied Publishers (P) Ltd., India, 2002

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1. David H.F. Liu, Bela G. Liptak 'Air Pollution', Lewis Publishers, 2000.
2. Arthur C.Stern, ' Air Pollution (Vol.I – Vol.VIII)', Academic Press, 2006.
3. Wayne T.Davis, 'Air Pollution Engineering Manual', John Wiley & Sons, Inc., 2000

E REFERENCES

Mapping of CO with PO's

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1				3		2	3		3					
CO 2			2	3			3		3					2
CO 3	1		1	3			3		3	1			1	1
CO 4	1			3	2		3	2	3		1		1	1
CO 5				3			3	3	3		1			
Total	2		3	15	2	2	15	5	15	1	2		2	4
Scaled Value	1	0	1	3	1	1	3	1	3	1	1	0	1	1

Note:

Total	0	1-5	6-10	11-15
Scaled value	0	1	2	3
Relation	No	Low	Medium	High