NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

CURRICULUM AND SYLLABUSOF BTECH DEGREE IN CIVIL ENGINEERING PROGRAM

2023 ONWARD ADMISSION BATCH

V0:

First Year Curriculum Recommended by members of UGAC	19.08.2023
First Year Curriculum Approved by the Chairman, Senate	19.08.2023
First Year Curriculum & Syllabus ratified in the 71st Senate meeting (Item No. 71.5(b))	18.12.2023
Entire Curriculum and Syllabus Recommended by UGAC	09.12.2024
Entire Curriculum and Syllabus Approved by the 73rd Senate (Item No. 73.8)	23.03.2025

GROUP – 1

FIRST SEMESTER

Semester - I							
Sl. No	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	MAC01	Mathematics - I	3	1	0	4	4
2	CSC01	Computer Programming	2	1	0	3	3
3	XEC01	Engineering Mechanics	2	1	0	3	3
4	XEC02	Basic Electrical and Electronics Engineering	3	0	0	3	3
5	ESC01	Ecology and Environment	2	0	0	2	2
6	CYC01	Engineering Chemistry	3	0	0	3	3
7	CSS51	Computer Programming Laboratory	0	0	3	2	3
8	XES52	Basic Electrical and Electronics Engineering Laboratory	0	0	3	2	3
9	CYS51	Engineering Chemistry Laboratory	0	0	2	1	2
		TOTAL	**15**	**3**	**8**	**23**	**26**

SECOND SEMESTER

Semester - II							
Sl. No	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	MAC02	Mathematics - II	3	1	0	4	4
2	CSC02	Data Structure and Algorithms	2	1	0	3	3
3	PHC01	Engineering Physics	2	1	0	3	3
4	HSC01	Professional Communication	2	0	2	3	4
5	CSS52	Data Structure and Algorithms Laboratory	0	0	3	2	3
6	XES51	Engineering Graphics	0	1	3	3	4
7	PHS51	Engineering Physics Laboratory	0	0	2	1	2
8	XXS51	Extra Academic Activities	0	0	2	1	2
		TOTAL	9	4	12	20	25

GROUP – 2

FIRST SEMESTER

Semester - I							
Sl. No	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	MAC01	Mathematics - I	3	1	0	4	4
2	CSC01	Computer Programming	2	1	0	3	3
3	XEC01	Engineering Mechanics	2	1	0	3	3
4	PHC01	Engineering Physics	2	1	0	3	3
5	HSC01	Professional Communication	2	0	2	3	4
6	CSS51	Computer Programming Laboratory	0	0	3	2	3
7	XES51	Engineering Graphics	0	1	3	3	4
8	PHS51	Engineering Physics Laboratory	0	0	2	1	2
9	XXS51	Extra Academic Activities	0	0	2	1	2
		TOTAL	**11**	**5**	**12**	**23**	**28**

SECOND SEMESTER

Semester - II							
Sl. No	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	MAC02	Mathematics - II	3	1	0	4	4
2	CSC02	Data Structure and Algorithms	2	1	0	3	3
3	XEC02	Basic Electrical and Electronics Engineering	3	0	0	3	3
4	ESC01	Ecology and Environment	2	0	0	2	2
5	CYC01	Engineering Chemistry	3	0	0	3	3
6	CYS51	Engineering Chemistry Laboratory	0	0	2	1	2
7	CSS52	Data Structure and Algorithms Laboratory	0	0	3	2	3
8	XES52	Basic Electrical and Electronics Engineering Laboratory	0	0	3	2	3
		TOTAL	**13**	**2**	**8**	**20**	**23**

SEMESTER III							
Sl No.	**Course Code**	**Name of the course**	**L**	**T**	**S**	**C**	**H**
1	MAC331	Mathematics – III	3	1	0	4	4
2	ESC331	Geology for Civil Engineering	3	0	0	3	3
3	CEC301	Solid Mechanics	3	1	0	4	4
4	CEC302	Construction, Material and Concrete Technology	3	1	0	4	4
5	CEC303	Fluid Mechanics	3	0	0	3	3
6	CES351	Mechanics Laboratory	0	0	3	2	3
7	CES352	Civil Engineering Drawing	0	0	3	2	3
8	CES353	Estimation and Costing Sessional	0	0	3	2	3
9	XXS381	Co-Curricular Activities – III (Optional)	0	0	0	0	0
			15	**3**	**9**	**24**	**27**

N.B.: Although XXS381 is non-credit, participation will enrich individual grade cards.

SEMESTER IV							
Sl No.	**Course Code**	**Name of the course**	**L**	**T**	**S**	**C**	**H**
1	CEC401	Structural Analysis – I	3	1	0	4	4
2	CEC402	Design of Concrete Structures	3	1	0	4	4
3	CEC403	Water Resources Engineering	3	1	0	4	4
4	CEC404	Environmental Engineering	3	1	0	4	4
5	CEC405	Surveying	3	0	0	3	3
6	CES451	Structural Mechanics Laboratory	0	0	3	2	3
7	CES452	Design of Concrete Structures Sessional	0	0	3	2	3
8	CES553	Surveying Laboratory	0	0	3	2	3
9	XXS481	Co-Curricular Activities – IV (Optional)	0	0	0	0	0
			15	**4**	**9**	**25**	**28**

N.B.: Although XXS481 is non-credit, participation will enrich individual grade cards.

SEMESTER V							
Sl No.	**Course Code**	**Name of the course**	**L**	**T**	**S**	**C**	**H**
1	CEC501	Structural Analysis – II	3	1	0	4	4
2	CEC502	Design of Steel Structures	3	1	0	4	4
3	CEC503	Transportation Engineering	3	1	0	4	4
4	CEC504	Soil Mechanics	3	0	0	3	3
5	CEE510 to 519	Depth Elective – 1	3	0	0	3	3
6	CES551	Structural Analysis Sessional	0	0	3	2	3
7	CES552	Design of Steel Structures Sessional	0	0	3	2	3
8	CES553	Environmental and Water Resource Engineering Laboratory	0	0	3	2	3
9	XXS581	Co-curricular Activities - V (Optional)	0	0	0	0	0
			15	**3**	**9**	**24**	**27**

N.B.: Although XXS581 is non-credit, participation will enrich individual grade cards.

SEMESTER VI							
Sl No.	**Course Code**	**Name of the course**	**L**	**T**	**S**	**C**	**H**
1	HSC631	Economics and Accountancy	3	0	0	3	3
2	CEC601	Foundation Engineering	3	0	0	3	3
3	CSC631	AI & ML	3	0	2	4	5
4	CEE610 to 619	Depth Elective – 2	3	0	0	3	3
5	CEE620 to 629	Depth Elective – 3	3	0	0	3	3
6	CES651	Structural Engineering Laboratory	0	0	3	2	3
7	CES652	Civil Engineering Computation & Software Laboratory	0	0	3	2	3
8	CES653	Soil Mechanics and Foundation Engineering Laboratory	0	0	3	2	3
9	XX681	Co-curricular Activities - VI (Optional)	0	0	0	0	0
			15	**0**	**9**	**22**	**26**

N.B.: Although XXS681 is non-credit, participation will enrich individual grade cards.

SEMESTER VII							
Sl No.	**Course Code**	**Name of the course**	**L**	**T**	**S**	**C**	**H**
1	MSC731	Principles of Management	3	0	0	3	3
2	CEC701	Disaster Mitigation and Management	3	1	0	4	4
3	CEE710 to 719	Depth Elective – 4	3	0	0	3	3
4	CEE720 to 729	Depth Elective – 5	3	0	0	3	3
5	CEO***	Open Elective	3	0	0	3	3
6	CES751	Project - I	0	0	6	1	6
7	CES752	Summer Internship	0	0	2	1	2
8	CES753	Transportation Engineering Laboratory	0	0	3	2	3
			15	**1**	**11**	**20**	**27**

SEMESTER VIII							
Sl No.	**Course Code**	**Name of the course**	**L**	**T**	**S**	**C**	**H**
1	CES851	Project – II	0	0	15	6	15
2	CES852	Comprehensive Viva	0	0	0	1	0
			0	**0**	**15**	**7**	**15**

Semester	I+II	III	IV	V	VI	VII	VIII	TOTAL
Credit Unit	43	24	25	24	22	20	7	165

OPEN ELECTIVES

The students can opt from elective subject(s) that are offered in a particular semester, except the subjects with his /her own department code.

OPEN ELECTIVE – 1 : SEMESTER-VII							
S/N	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	CEO740	Introduction to Earthquake Engineering	3	0	0	3	3
2	CEO741	Elementary Civil Engineering					
3	CEO742	Finite Element Analysis and Applications	3	0	0	3	3
4	CEO743	Elementary Structural Design	3	0	0	3	3
5	CEO744	Reliability Engineering	3	0	0	3	3
6	CEO745	Numerical Methods in Engineering	3	0	0	3	3
7	CEO746	Watershed Planning and management	3	0	0	3	3
8	CEO747	Road Safety Awareness Program					

DEPTH ELECTIVES

The students primarily will opt from elective subject(s) that are offered in a particular semester by his /her own department. However, a student can opt for elective subject(s) that are offered by other department in a particular semester, with the permission/ consent from his/her Head of the Department and the concerned teacher of that subject.

DEPTH ELECTIVE – 1 : SEMESTER-V							
S/N	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	CEE510	Advanced Concrete Technology	3	0	0	3	3
2	CEE511	Advanced Structural Mechanics	3	0	0	3	3
3	CEE512	Principles of Reliability	3	0	0	3	3
4	CEE513	Applied Probability and Statistics in Civil Engineering	3	0	0	3	3
5	CEE514	Experimental Method and Analysis	3	0	0	3	3
6	CEE515	Transportation Infrastructure Design	3	0	0	3	3
7	CEE516	Transportation Planning and Management	3	0	0	3	3
8	CEE517	Remote sensing and GIS	3	0	0	3	3
9	CEE518	Hydrology & Irrigation Engineering	3	0	0	3	3
10	CEE519	Ground Water	3	0	0	3	3

DEPTH ELECTIVE – 2 : SEMESTER-VI							
S/N	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	CEE610	Advanced Structural Analysis	3	0	0	3	3
2	CEE611	Introduction to Finite Element Method	3	0	0	3	3
3	CEE612	Bridge Engineering	3	0	0	3	3
4	CEE613	Experimental Stress Analysis, Instrumentation & Sensor Technology	3	0	0	3	3
5	CEE614	Repair and Rehabilitation of Structures	3	0	0	3	3
6	CEE615	Pavement Analysis and Design	3	0	0	3	3
7	CEE616	Applied Numerical Methods	3	0	0	3	3
8	CEE617	Road Safety Analysis	3	0	0	3	3
9	CEE618	Intelligent Transportation System (ITS)	3	0	0	3	3
10	CEE619	Remote Sensing and its applications for Disaster Management	3	0	0	3	3

DEPTH ELECTIVE – 3 : SEMESTER-VI							
S/N	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	CEE620	Advanced Design of Concrete Structures	3	0	0	3	3
2	CEE621	Construction Planning and Management	3	0	0	3	3
3	CEE622	Introduction to Random Vibration	3	0	0	3	3
4	CEE623	Mechanics of Composite Structures	3	0	0	3	3
5	CEE624	Theory of Plates and Shells	3	0	0	3	3
6	CEE625	Environmental Pollution and control	3	0	0	3	3
7	CEE626	Geotechnical Physical Modelling	3	0	0	3	3
8	CEE627	System Approach to Civil Engineering	3	0	0	3	3
9	CEE628	Artificial Intelligence in Civil Engineering	3	0	0	3	3
10	CEE629	Open Channel Hydraulics	3	0	0	3	3

DEPTH ELECTIVE – 4 : SEMESTER-VII							
S/N	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	CEE710	Structural Dynamics	3	0	0	3	3
2	CEE711	Advanced Design of Steel Structures	3	0	0	3	3
3	CEE712	Earthquake resistant design of structure	3	0	0	3	3
4	CEE713	Green Building and Sustainable Materials	3	0	0	3	3
5	CEE714	Structural Health Monitoring	3	0	0	3	3
6	CEE715	Railways, Airportsand Harbour Engineering	3	0	0	3	3
7	CEE716	Industrial Waste	3	0	0	3	3
8	CEE717	Ground Improvement	3	0	0	3	3
9	CEE718	Soil Dynamics	3	0	0	3	3
10	CEE719	Slope Stability and Reinforced Earth	3	0	0	3	3

DEPTH ELECTIVE – 5 : SEMESTER-VII							
S/N	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	CEE720	Material Technology	3	0	0	3	3
2	CEE721	Offshore Structural Dynamics	3	0	0	3	3
3	CEE722	Pre-stressed Concrete	3	0	0	3	3
4	CEE723	Piping Engineering	3	0	0	3	3
5	CEE724	Theory of Elasticity and Plasticity	3	0	0	3	3
6	CEE725	Traffic Engineering and Management	3	0	0	3	3
7	CEE726	Soil Structure Interaction	3	0	0	3	3
8	CEE727	Machine Foundation	3	0	0	3	3
9	CEE728	Water Resources System Planning & Management	3	0	0	3	3
10	CEE729	Sediment Transport	3	0	0	3	3

Course Code	Title of the course	Program core (PCR) /Electives (PEL)	Total Number of contact hours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
MAC331	**Mathematics-III**	**PCR**	**3**	**1**	**0**	**4**	**4**
Pre-requisite(s)		CourseAssessmentmethods					
		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes	• CO1: Acquire the idea about mathematical formulations of phenomena in physics and engineering. • CO2: To understand the common numerical methods to obtain the approximate solutions for the intractable mathematical problems. • CO3: To understand the basics of complex analysis and its role in modern mathematics and applied contexts. • CO4: To understand the optimization methods and algorithms developed for solving various types of optimization problems.
Topics Covered	**Partial Differential Equations (PDE):** Formation of PDEs; Lagrange method for solution of first order quasilinear PDE; Charpit method for first order nonlinear PDE; Homogenous and Nonhomogeneous linear PDE with constant coefficients: Complimentary Function, Particular integral; Classification of second order linear PDE and canonical forms; Initial & Boundary Value Problems involving one dimensional wave equation, one dimensional heat equation and two dimensional Laplace equation. [14] **Numerical Methods:** Significant digits, Errors; Difference operators; Newton's Forward, Backward and Lagrange's interpolation formulae; Numerical solutions of nonlinear algebraic/transcendental equations by Bisection and Newton-Raphson methods; Trapezoidal and Simpson's 1/3 rule for numerical integration; Euler's method and modified Eular's methods for solving first order differential equations. [14] **Complex Analysis:** Functions of complex variable, Limit, Continuity and Derivative; Analytic function; Harmonic function; Conformal transformation and Bilinear transformation; Complex integration; Cauchy's integral theorem; Cauchy's integral formula; Taylor's theorem, Laurent's theorem (Statement only); Singular points and residues; Cauchy's residue theorem. [17] **Optimization:** **Mathematical Preliminaries:** Hyperplanes and Linear Varieties; Convex Sets, Polytopes and Polyhedra. [2] **Linear Programming Problem (LPP):** Introduction; Formulation of linear programming problem (LPP); Graphical method for its solution; Standard form of LPP; Basic feasible solutions; Simplex Method for solving LPP. [9]
Text Books, and/or reference material	**Text Books:** 1. An Elementary Course in Partial Differential Equations-T. Amarnath 2. Numerical Methods for scientific & Engineering Computation- M.K.Jain, S.R.K. Iyengar & R.K. Jain. 3. Foundations of Complex Analysis- S. Ponnuswami 4. Operations Research Principles and Practices- Ravindran, Phillips, Solberg 5. Advanced Engineering Mathematics- E. Kreyszig **Reference Books:** 1. Complex Analysis-L. V. Ahfors 2. Elements of partial differential equations- I. N. Sneddon 3. Operations Research- H. A. Taha

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Moderntool usage	Theengineerand society	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraideskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	2	-	-	-	-	2			
CO2	3	3	2	2	2	1	2	-	-	-	1	2			
CO3	3	3	2	2	3	-	1	-	-	1	-	2			
CO4	3	2	2	3	2	1	1	-	1	-	-	2			

Course Code	Titleofthe course	Program Core (PCR)/Electives (PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
ESC331	**Geology for Civil Enineering**	**PCR**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes (COs):	• CO1:Assimilation of Geological knowledge with Civil Engineering for better design ofEngineering Structures (Dam, Tunnels etc.). • CO2: Enhancing skill of problem solving in dam, tunnel and landslide etc. • CO3: Better understanding of groundwater as a vital resource in Water ResourceEngineering.
Topics Covered (Hrs)	Mineralogy: Definition, simple classifications, examples; Physical properties of minerals,chemical characteristics, occurrence [2] Petrology: Three types of rocks – Igneous, Sedimentary, Metamorphic, Igneous rocks –definition, classifications and examples, structures of intrusive and extrusive rocks,textures; Sedimentary rocks – Origin, classifications and examples, primary structures,textures; Metamorphic rocks – roles of agents of metamorphism, types of metamorphism,grades and degrees of metamorphism, metamorphic textures. [10] Structural Geology: Strike and Dip of planes, True dip, Apparent dip; Folds – Hinge, limbs, axis, axial plane, types of folds; Faults – Common terms for describing faults, types andclassification of faults; Joints – Definition, types and classification of joints; Cleavage andSchistosity – Definitions and types of cleavages. [5] Hydrogeology: Groundwater occurrence, vertical distribution, water bearing properties of rocks-porosity, retention, yield, permeability, Zone of aeration and saturation, perchedwater table, Coefficient of storage, Natural springs & seepages, Recharge and Dischargearea criteria, Geological Control on groundwater movement – Darcy's law, Fluctuation ofwater table in unconfined aquifer, Cone of depression, Groundwater exploration, Effectsof excessive trapping, Water logging, Water well. [8] Engineering Geology: Engineering properties of rocks – drifted rocks, in situ rocks, Buildingmaterials, Strength characteristics, Geological characteristics, general characteristics,Dams & Reservoirs, Tunnel, Landslide, Bridge. [8] Physical Geology: Gradation of a country; Geological works of wind and Running water. [3]
Text Books, and/or reference material (s)	***Text Books:*** 1. A Textbook of Geology : P. K. Mukherjee, World Press 2. Engineering Geology: Subinoy Gangopadhyay, Oxford University Press 3. The Principles of Petrology : G. W. Tyrrel; B. I. Publications 4. Groundwater Hydrology : D. K. Todd, Wiley Student Edition 5. Textbook of General and Engineering Geology: Prabin Singh; S. K. Kataria & Sons

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Modemtool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															

Course Code	Titleofthe course	Program Core (PCR)/Electives (PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC301	Solid Mechanics	PCR	3	1	0	4	4
Pre-requisite(s)		CourseAssessmentmethods					
KnowledgeofEngineering MechanicsandMathematics		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes (COs):	• CO1:Developmentof skillsforpredictingstructuralbehaviorof solidsunderdifferent loads • CO2: Knowledge of basics of analysis and design of structural components made of varietyof materials • CO3:Developingthe requisite skillthat helpsin studyingthe advanced courses
Topics Covered (Hrs)	**Concept of stress and strain**:Normalandshear stressesandstrainsinaxiallyloadedmembers, Elasticmoduliandtheirinter-relationships,strainenergyduetodirectstresses,impactloads.**(6)** **Beam Statics**: Definitions, support types and support reactions, concepts of redundancy, shear force and bending moment diagrams for beams. **(10)** **Symmetric Beam Bending**: Basic kinematical assumptions, moment of inertia, elastic flexure formulae and its application, moment carrying capacity. **(4)** **Bending stress and Shear stress:** Concepts of bending stress and shear stress, their distributions inbeamsections,combined effect of bending, shearanddirect stresses. **(8)** **Strain energy**: Dueto purebendingandshearing stress.**(3)** **Deflection of beams**: Moment-curvature relationship, determination of deflection by double integration method and Macauley's principle **(4)** **Torsion**: Pure torsion, Torsion of circular solid shaft, closed coil helical spring. Combined bending and torsion. **(4)** **Two-dimensional stress problems**: Principal stresses, maximum shear stresses, Mohr's circle of stresses, construction of Mohr's circle. **(5)** **Thinpressurevessels**:Hoopstressandmeridionalstress,volumetricchanges**(4)** **Columns**: Fundamentals, different types of equilibrium, column buckling theory, Euler's load for columns, limitations of Euler's theory – problems, eccentric load and secant formulae, empirical column formulae & IS code formulae. **(4)**
Text Books, and/or reference material (s)	***Text Books:*** 6. Elementsof Strength of MaterialbyS. P. Timoshenko&D.H. Young, 4th Ed. East West Press Publisher Pvt. Ltd 7. StrengthofMaterialsbyS. S. Bhavikatti, 5th Ed. Vikas Publishing 8. EngineeringMechanics of Solids byE. P. Popov, 2nd Ed. Pearson Education India ***ReferenceBooks:*** 9. StrengthofMaterialbySinger&Pytel, 4th Ed. Addison Wesley 10. A Text Book of Strength of Materials by Ghosh & Datta, 1st Ed. New Age International Publication Pvt. Ltd, New Delhi

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Moderntool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	2
CO2	-	3	2	-	-	-	-	-	-	-	-	-	3	-	3
CO3	-	3	-	2	-	-	-	-	-	-	-	-	3	2	3

<table>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Titleofthe course</th><th rowspan="2">ProgramCore (PCR) / Electives(PEL)</th><th colspan="4">TotalNumberofcontacthours</th><th rowspan="2">Credit</th></tr>
<tr><th>Lecture (L)</th><th>Tutorial (T)</th><th>Practical (P)</th><th>Total Hours</th></tr>
<tr><td>CEC302</td><td>Construction, Materials& Concrete Technology</td><td>PCR</td><td>3</td><td>1</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite(s)</td><td colspan="6">CourseAssessmentmethods</td></tr>
<tr><td colspan="2">Nopre-requisites</td><td colspan="6">Continuous(CT)andendassessment(EA).CT+EA</td></tr>
<tr><td>Course Outcomes (COs) :</td><td colspan="7">• CO1: Apply the knowledge about building materials for construction practices.
• CO2: Understand the building components and planning
• CO3: Learn the basic principles of construction</td></tr>
<tr><td>Topics Covered (Hrs)</td><td colspan="7">A). Construction (16):
Introduction to anthropometrics and ergonomics; Occupancy classification of Buildings; Essentials of National Building Code; Essentials of Building and development rules; Introduction to green building; Planning and orientation of buildings (6)
Introduction to different components and functions of a building in details: Foundation, Wall, Beam, Floor, Roof, Stair & Staircase, Door, Window, and etc. (10)
B). Building Materials (20):
Aggregates: Classification, sampling, properties of fine and coarse aggregates, standard tests, deleterious substances, Alkali-aggregate reaction, thermal properties, grading of aggregate. (4)
Cement: Introduction, chemical composition, major compounds, hydration, physical properties, testing, fineness, consistency, setting time, soundness, strength, heat of hydration, specific gravity, types of cement (8)
Water: Source, quality, impurities and effect of on concrete, sea water (2)
Admixture: Introduction, classification, specifications and functions of admixtures. (2)
Other materials: Brick, Timber, Lime, Cement mortar, Timber, Steel and Paint. (4)
C). Concrete Technology (16):
Introduction: classification, properties, grades, advantage, disadvantages and quality control. (1)
Fresh concrete: Introduction, workability, factors, measurement, segregation, bleeding and manufacture of concrete – batching, mixing, transporting, placing, compaction, finishing and curing. (5)
Hardened concrete: Introduction, strength, stress–strain characteristics, destructive and non-destructive test, shrinkage, creep, permeability, durability, attack of sulphates, acid, efflorescence, thermal properties and fire resistance. (4)
Concrete mix design: Factors and mix design using Indian Standard code. (4)
Special concrete: Introduction of Light weight, High density, High strength, Fibre reinforced, Polymer concrete and Ferro cement. (2)</td></tr>
<tr><td>Text Books, and/or reference material(s)</td><td colspan="7">Text Books:
1. EngineeringMaterialsbyS.C.Rangwala,K.S.RangwalaandP.S.Rangwala,Charotar Publishing House, Anand
2. BuildingConstructionbyS.C.Rangwala,CharotarPublishingHouse,Anand
3. ConcreteTechnologybyM.S.Shetty,S.ChandPublisher,New Delhi
4. IS10262:2009,ConcreteMixProportioning-Guidelines(1st Revision),BIS,NewDelhi.
5. IS383:1970,SpecificationforCoarseandFineaggregatesfromnaturalsourcesforconcrete(2nd Revision) BIS, New Delhi.
6. SP 7:2016, National Building Code of India 2016 (NBC 2016) Volume-1 and Volume-2
Reference Books:
7. ConcreteTechnologybyM. L.Gambhir,TataMcGrawHillandwww.nptel.ac.in</td></tr>
</table>

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineering knowledge	Problemanalysis	Design/development solutions	Conduct investigationsof complex	Modernto ol usage	Theengineerand society	Environment &sustainability	Ethics	Individual & team work	Communication	Project management&finance	Life-long learning	Plan,analyse, design and	Computeraided skill and tools	codalprovisions / guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	1	-	-	-	-	-	2	-	1
CO2	3	-	-	-	-	2	1	-	-	-	-	-	3	3	1
CO3	3	-	3	-	-	2	1	-	-	-	-	-	-	1	2

Course Code	**Titleofthe course**	**Program Core (PCR)/Electives (PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC303	**FluidMechanics**	**PCR**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
Mechanics		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes (COs) :	• CO1:Developmentof skillsforpredictingfluid behaviour • CO2:Knowledgeofbasics offluid flowmeasurement andmodel development • CO3:Developingthe requisite skillthathelpsin studyingtheadvanced courses
Topics Covered (Hrs)	**Fluid Properties:** EquationsofState, Unitsand Dimensions,FluidPressure,PressureGauges, Resultant Pressure on Plane and Curved Immersed Surfaces, Centre of Pressure, Equilibrium of Floating Bodies, Buoyancy and Meta Centre. **(9)** **Types of Flow**: Definitions, Continuity Equation, Equation of Flow along a Stream Line, Energy Equation, Momentum Equation, Fluid Acceleration, Flow in a Curved Path, Forcedand Free Vortex. **(7)** **Dimensional Analysis**: Similitude of fluid flow, non-dimensional numbers. **(3)** **Incompressibleflowinclosedconduits**:LaminarandTurbulentFlow,CriticalReynold's Number,PipeFrictionLaw,LaminarFlowinPipes,FrictionLossinSmoothandRough Pipes, Minor Losses in Pipes, HGL and EGL, Empirical Formula for Pipe flow. **(6)** **Flow measurement:**Orifice coefficient, External and Reentrant Mouth pieces, Measurement ofVelocityandDischargeinClosedConduits,Venturimeter,OrificemeterandPitotTube, Flow through Rectangular Weirs and V-Notch, Time of Emptying Tanks and Reservoirs. **(7)** **OpenChannels:**EquationofUniformFlow,ChezyandManningFormulae,Velocity Distribution and Economic Cross Section. **(4)**
Text Books, and/or reference material (s)	***Text Books:*** 1. FluidMechanicsbyFrankMWhite,TataMcGraw-Hill 2. IntroductiontoFluid Mechanics byRobertWFox&Alan TMcDonald,WILEY 3. FluidMechanicsbyV. L.Streeter&E BWylie,McGraw-Hill ***ReferenceBooks:*** 4. FluidMechanics andHydraulicsbyJackBEvett&ChengLiu,TataMcGraw-Hill

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement& finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	-	2	3	1	-	-	-	-	-	-	-	-	-	2	1
CO3	-	3	-	2	-	-	-	-	-	-	-	-	-	3	2

Course Code	**Titleofthe course**	**ProgramCore (PCR) / Electives(PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES351	**Mechanics Laboratory**	**PS**	**0**	**0**	**3**	**3**	**2**
Pre-requisite(s)		CourseAssessmentmethods					
NIL		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes (COs) :	• CO1: Development of skills to perform relevant laboratory experiments related to fluid mechanics and its applications in civil engineering. • CO2: Development of skills to conduct laboratory tests on different materials related to civil engineering • CO3: Development of understanding to interpret the results from experiments/testings, realise their limitations and correlate with theoretical knowledge. • CO4: Realisation of the importance of results from laboratory testing/experimentation in the analysis and design of civil engineering systems/structures for realistically predicting their behaviour. • CO5: Development of skills to work in a group to perform tests/experiments as well as produce laboratory reports in an appropriate way.
Topics Covered (Hrs)	**A). Fluid Mechanics** 1. Determinationofcoefficientofbend losing flowthroughpipes. 2. Experiment on friction loss in flow through pipes. 3. CalibrationofVenturimeter. 4. Calibration of V-notch. 5. Calibrationof Orificemeter. 6. Experimentonthe impactof jet. **B). Strength of Materials** 1. Determination of tensile strength of metals using Universal Testing Machine 2. Determination of hardness of a given specimen using Rockwell Hardness Test Machine 3. Determination of the strain energy of a given specimen using Charpy Impact Test Machine 4. Determination of torsional strength of a given specimen using Torsional Testing machine 5. Assesment of the compressive strength of concrete using Rebound Hammer 6. Determination of Poisson's Ratio of concrete using Ultrasonic Pulse velocity Meter (UPVM)

Text Books, and/or reference material (s)	***ReferenceBooks:*** 1. Fluid Mechanics by M White Frank,Tata McGraw-Hill 2. Introduction to Fluid Mechanics by W Fox Robert & T Alan McDonald,WILEY 3. Fluid Mechanics by V. L.Streeter, & E B,Wylie, McGraw-Hill. 4. Elementsof Strength of Material by S. P. Timoshenko & D.H. Young, East West Press Publisher Pvt. Ltd., New Delhi

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developm entof solutions	Conductinvestigationso f complex problems	Modemtool usage	Theengineerandsociety	Environment&sustainab ility	Ethics	Individual& team work	Communication	Projectmanagement& finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	Codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	3	1	-	-	-	-	-	-	-	1	2	-
CO2	2	-	-	3	1	-	-	-	-	-	-	-	3	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	3	-	2
CO4	2	-	3	-	-	-	-	-	-	-	-	-	3	-	3
CO5	-	-	-	-	-	-	-	-	3	2	-	-	1	-	-

Course Code	**Titleofthe course**	**ProgramCore (PCR) / Electives(PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES352	**Civil Engineering Drawing**	**PS**	**0**	**0**	**3**	**3**	**2**

Pre-requisite(s)	CourseAssessmentmethods
NIL	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :	• CO1: To learn the basic concepts of Civil Engineering drawings • CO2: To draw plan, elevation and section of load bearing and framed structures. • CO3: To prepare plan, elevation and section for Residential and Public Buildings from given requirements. • CO4: To prepare detailed drawings for Plumbing, water supply and drainage for buildings.
Topics Covered (Hrs)	Symbols, signs, and lines for different materials used in Civil Engineering. Detailed working drawings of • Panelled Doors, glazed windows and ventilators. • Trusses • RC Staircase Preparation of site plans and service plans as per national building code Preparation of building plan using the planning principles from given requirements of areas & Specifications. Preparation of sketch design and working drawings for: • Residential buildings - Flat and pitched roof, load bearing and non-load bearing structures • Public buildings – small public utility shelters, dispensaries, banks, schools, offices, libraries, hostels, restaurants, commercial complexes, factories etc.

Text Books, and/or reference material (s)	***Text Books:*** 1. B.T.S. Prabhu, Building Drawing and Detailing, Spades Publishers, 2007. 2. J. De Chiara, Time Saver Standards for Site Planning, McGraw Hill, 1999. 3. IS 4963:1987, Recommendation for Buildings and Facilities for the Physically Handicapped. 4. IS 962:1989, Code of Practice for Architectural and Building Drawings. 5. M.G. Shah, M. Kalec, & S.Y. Patki, Building Drawing, New Delhi: Tata McGraw Hill, 2000. 6. SP 41: 1987, Handbook on Functional Requirements of Buildings. 7. SP 7: 2016, National Building Code of India 2016 (Vol I and II). 8. A.M.S. Tessie, The House, Its Plan & Use, Oxford and IBH Publishing Co., 2000.

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Moderntool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	3	-	-	-	3	-	3	3	3	3
CO2	3	-	-	-	-	3	-	-	-	3	-	3	3	3	3
CO3	3	-	-	-	-	3	-	-	-	3	-	3	3	3	3
CO4	3	-	-	-	-	3	-	-	-	3	-	3	3	3	3

Course Code	**Titleofthe course**	**ProgramCore (PCR) / Electives(PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES353	**Estimation and Costing sessional**	**PCR**	**0**	**0**	**3**	**3**	**2**
Pre-requisites:		CourseAssessmentmethods:					
CEC 303 & CEC403		Continuous(CT)andendassessment(EA). CT+EA					
Course Outcomes	• CO1: Learntheartofquantityestimation,preparationofBillofQuantities,andwriting specification. • CO2:Learnrate analysis • CO3: Acquire knowledge about specifications and software applications for estimation.						
Topics Covered	1. Preparation of bill of quantities of a simple residential building including sanitary works 2. Analysis of rate and preparation of cost estimate of a simple residential building 3. Computation of volume of earthwork, Preparation of mass haul diagram 4. Estimation of roadway, culverts, bridges etc. 5. Software application in estimation 6. Specifications of different items of work.						
Text Books, and/or reference material	***Text Books:*** 1. BuildingConstructionbyS.C.Rangwala,CharotarPub.House,Anand, 2. Estimatingandcostingincivilengineering–theoryandpractice,23rd editionbyB.N.Dutta, UBPSD, New Delhi, 1991. 3. Estimating, costing and specification in civil engineering, 6th edition by M. Chakraborty, Kolkata, 1979. ***Reference Books:*** 4. Text bookofestimatingandcosting(civil engineering) byG.S.Birdie, DhanpatRai &Sons,Delhi, 1986. 5. CivilengineeringContractsandEstimatesbyB.S.Patil,OrientLongman,NewDelhi, 1981.						

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineering knowledge	Problemanalysis	Design/development of solutions	Conduct investigationsof complexproblems	Moderntool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement & finance	Life-longlearning	Plan,analyse,design and prepare	Computeraideskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	3	-	-	-	-	3	-	3	-	-
CO2	3	3	-	-	-	3	-	-	-	-	3	-	3	-	-
CO3	3	3	-	-	-	3	-	-	-	-	3	-	3	3	-

Course Code	**Title of the course**	**Program Core (PCR) / Electives (PEL)**	**Total Number of contact hours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC-401	**Structural Analysis-I**	**PCR**	**3**	**1**	**0**	**4**	**4**
Pre-requisite(s)		Course Assessment methods					
Engineering & Solid Mechanics		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs) :	• CO1: Acquire the knowledge of structural systems, elements, joints, loads, stability, equilibrium, compatibility and indeterminacy • CO2: To apply geometric methods to obtain slope and deflections • CO3: To apply Energy methods to obtain slope and deflections • CO4: Evaluate & draw the influence lines for internal and external reactions in beams & girders due to moving load.
Topics Covered (Hrs)	**Introduction:** Structural system, support condition and loads **(2)** **Shear force and bending moment:** Recapitulation of bending moment, shear force, torsion of determinate structures. **(4)** **Slopes and deflections:** Slopes and deflections in beams and frames, elastic curve, application of elastic beam theory with moment area method, conjugate beam method. **(14)** **Energy methods:** Strain energy, complementary energy, real work, virtual work, application of Castigliano's Theorems & virtual work methods to beams, frames, trusses, Maxwell's Reciprocal theorem, Betti's Law **(14)** **Static and kinematic indeterminacy:** Application on different type of structures **(6)** **Influence Lines:** Application of influence lines & rolling loads for determinate beams and arches **(12)**
Text Books, and/or reference material (s)	***Text Books:*** 1. Basic Structural Analysis by C. S. Reddy (Tata McGraw Hill) 2. Elementary Structural Analysis by Wilbur & Norris (Mcgraw-Hill College) 3. Structural Analysis by R. C. Hibbeler (Pearson Edu.) 4. Structural Analysis by Devdas Menon, (Narosa) ***Reference Books:*** Structural Analysis by G. S. Pandit & S. P. Gupta (Tata McGraw Hill) Theory of structures by S. P. Timoshenko and D. H. Young Mc. Graw Hill book Co

Mapping of Course Outcomes COs□POs

	Engineering knowledge	Problemanalysis	Design/development of solutions	Conduct investigationsof complexproblems	Moderntool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement & finance	Life-longlearning
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	-	-	-	-	-	1	-	-	-	-	-
CO3	3	-	-	-	2	-	-	-	-	-	-	-
CO4	3	-	-	-	2	-	-	-	-	-	-	-

Course Code	**Titleofthe course**	**ProgramCore (PCR) / Electives(PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC402	**Designof Concrete Structures**	**PCR**	**3**	**1**	**0**	**1**	**4**
Pre-requisite(s)		CourseAssessmentmethods					
Solid Mechanics		Continuous(CT)andendassessment(EA).CT+EA					
Course Outcomes (COs) :	• CO1:Applyknowledgeofsolidmechanicsfordesignsolutions. • CO2:Understandbasicdesignphilosophiesapplicabletoconcretestructures. • CO3:Formulate,analyse,anddesignbasiccomponentsofCivilEngineeringReinforcedConcrete structures.						
Topics Covered (Hrs)	**Properties**ofconcreteandreinforcingsteel,Characteristicstrengths,Stressstraincurves, Shrinkage and creep phenomenon, I.S. specification **(4)** **Design philosophies** – working stress method and limit state method of design. **(8)** **Analysisanddesign** ofsectionsinflexurebyworkingstressandlimitstatemethod,Single and doubly reinforced sections, T and L sections **(10)** **Behaviourofbeams**inshearandbond,Designforshear,Anchorageandcurtailmentof reinforcement, Detailing of reinforcement. **(4)** **Serviceability**,Limitstatesofdeflectionandcracking,Calculationofdeflections. **(4)** **Design of columns**: Short and long columns, Eccentrically loaded columns **(8)** **Design of one-way and two-way slabs, Staircases. (6)** **Isolatedandcombinedfootings(6)** **Designof cantilevertyperetainingwalls(6)**						

Text Books, and/or reference material (s)	***Text Books:*** 1. ReinforcedConcreteDesign,2ndEdition,byS.UnnikrishnaPillaiandDevdasMenon, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003. 2. IS456:2000,IndianStandardPlainandReinforcedConcrete–CodeofPractice(4th Revision), BIS, New Delhi. 3. SP-16,DesignAidsforReinforcedConcretetoIS:456 –1978,BIS,New Delhi 4. www.nptel.iitm.ac.in/courses/ ***ReferenceBooks:*** 5. ReinforcedConcrete,6thEdition,byS.K.MallickandA.P.Gupta,Oxford&IBH Publishing Co. Pvt. Ltd. New Delhi, 1996. 6. ReinforcedConcreteDesign,1stRevisedEdition,byS.N.Sinha,TataMcGraw-HillPublishing Company. New Delhi, 1990.

MappingofCourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	2	-	-	-	3	-	2
CO2	3	-	3	-	-	-	1	-	-	2	-	2	-	2	-
CO3	-	-	3	-	-	-	-	2	-	2	1	3	2	1	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC403	**WaterResourceEngineering**	**PCR**	**3**	**1**	**0**	**4**	**4**
Pre-requisite(s)		CourseAssessmentmethods					
Fluid mechanics		Continuous(CT)andendassessment(EA).CT+EA					
Course Outcomes (COs):	• CO1: Understanding of occurrence, distribution, storage & transmission of water in different form in the space, on the surface and below the surface of the earth. • CO2:Understandingoftempo-spatialcollectionofdataandpreparationofhydro- meteorological information system. • CO3:learningimportance,requirement,method &infrastructureforimpartingirrigationwater to crop, development & conservation of water for its economic & efficient use						

Topics Covered (Hrs)	**Hydrology:** Hydrologic cycle & system model, Hydro-meteorological Information System and its Definition, need, generation, maintenance, validation, calibration of data sets, estimation of missing data, retrieval of data **(5)** **Precipitation:** Forms, types & measurement, Recording & non-recording gauges, Network, Analysis & Adjustment of data, Average depth, depth-area-duration analysis, Surface retention, Detention, Overland flow, Interception, Depression storage**. (6)** **Evaporation&Transpiration**:Factors,Measurement,formulaconsumptiveuse**(2)** **Stream flow:** Stage, discharge & relations, interpretation of stream flow records. Factors affecting the run off, yield, flow duration & mass curve **(4)** **Infiltration**:Process,Capacity,Measurement,Estimation**(2)** **Run-off:**Factors, Yield, Flow-duration curve, Flow mass curve. **(2)** **Hydrograph**:Baseflowseparation,Unithydrograph,Synthetichydrograph**(2)** **Irrigation:** Necessity, Advantages, Disadvantages, Types, Water distribution techniques, Quality of water, Duty, Delta, Base period, Indian crop seasons, Irrigation efficiencies, Soil- moisture –irrigation relationships, Estimating depth and frequency of irrigation. **(5)** **Canal irrigation system:** Capacities, losses, Design & construction of unlined, lined & stable channels, Sediment transport, Economics of canal lining, Cross drainage works **(3)** **Water-logging and control**:Causes,Control,Reclamationofsalineand alkalinelands,Surface & Sub-surface drainage **(3)** **Diversion head-works:** Definition of weirs, barrages & their classification, Layout of typical diversion head-works & function of its components. **(2)** **Reservoirs:**Types,selectionofsite,Storagezones,Fixationofcapacity,regulation. **(2)** **Dam:** Earthen and concrete dam, selection criteria, design **(4)** **Spillwaysandenergydissipaters:**Location,types,energydissipation,stillingbasin& spillway gate **(4)** **FloodForecasting:**Estimation,forecasting&mitigation,floodlandmanagement**(4)** **Flood routing:** Reservoir & Channel routing (hydrological method only) **(2)**
TextBooks, and/or reference material(s)	***Text Books:*** 1. EngineeringHydrologybyK.Subramanya,FourthEdition,McGrawHillsEducation(India) 2. IrrigationEngineeringandHydraulicStructuresbyS.K.Garg,KhannaPublishers,NewDelhi ***ReferenceBooks:*** 3.IrrigationandWaterPowerEngineeringbyB.C.Punmia,B.B.Pande,A.K.Jain,A.Kumar,,16th Edition, Laxmi Publications (P) Limited, New Delhi

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmento f solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment &sustainabili ty	Ethics	Individual & team work	Communication	Projectmanagement&fina nce	Life-longlearning	Plan,analysis,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	3		3		-	3	-	-	-	-	-	2	-	-
CO3	-	-	3	-	3	3	-	3	3	2	3	3	2	-	1

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC404	**Environmental Engineering**	**PCR**	**3**	**1**	**0**	**4**	**4**
Pre-requisite(s)		CourseAssessmentmethods					
None		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes (COs) :	CO1: Apply knowledge of water supply & wastewater engineering for design solutions. CO2: Understand basic design philosophies applicable to conveyance and treatment units of water & wastewater. CO3: Formulate, analyse, and design basic components of water supply & wastewater disposal.
Topics Covered (Hrs)	**Water – uses & requirement:** Sources, Quantity, Quality criteria, Intakes & transportation. **(9)** **Conventional water treatment methods:** Aeration, Sedimentation, Coagulation & flocculation, Filtration, Disinfection – including design of units. Other miscellaneous water treatment processes**. (13)** **Water storage & distribution systems**, Design of pipe networks. **(3)** **Introduction to plumbing systems** in buildings. **(2)** **Estimation of quantities** of sanitary wastewater & storm water runoff. **(3)** **Sewerage system**, Design of sewers, Sewer appurtenances, Materials of sewer construction. **(5)** **Quality & characterisation of domestic wastewater:** different parameters including oxygen demands, Standards of sewage disposal. **(4)** **Principles of wastewater treatment**, Physical, chemical & biological treatment methods, Primary & secondary treatment, Bio-filter, Activated sludge process, Stabilisation pond, Septic tank. **(12)** **Introduction to other treatment processes** including digestion & disposal of sludge. (3) **Principles of stream sanitation**. (2)
Text Books, and/or reference material (s)	**Text Book(s):** 1. Environmental Engineering – I: S. K. Garg 2. Environmental Engineering – I: B. C. Punmia **Reference Books:** 1. G.M. Fair, J.C. Geyer, D.A. Okun, Elements of Water Supply and Wastewater Disposal, John Wiley and Sons Inc., 2. CPHEEO: Manual on water supply and treatment, Ministry of Urban Development.

Mappingof CourseOutcomesCOs□POs□POs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement& finance	Life-longlearning	Plan,analyses,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	2	-	-	-	2	-	-
CO2	3	-	3	-	-	-	1	-	-	2	-	2	2	-	-
CO3	-	-	3	-	-	-	-	2	-	2	1	3	2	-	3

Course Code	Titleofthe course	ProgramCore(PCR)/ Electives (PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC405	**Surveying**	**PCR**	**3**	**0**	**0**	**3**	**3**
Pre-requisites		CourseAssessmentmethods					
None		Continuous(CT)andendassessment(EA).CT+EA					

Course Outcomes	• CO1:Learnbasicprinciplesofsurveyingandhandlingofvarioussurveyinginstruments. • CO2:Learntoconductengineeringsurveys. • CO3:Dataentryinfieldbooksandlevelbooks. • CO4:Makeandinterpretmaps. • CO5:Computeareaandvolumes.
Topics Covered (Hrs)	**Introduction:**Definition,primarydivision,classificationandPrinciplesofsurveying,Basicmeasurements. **(2)** **Linearmeasurements:**Instruments,Ranging,Chaining,Tapecorrections.**(3)** **Chain surveying:** Principles, Basic definitions, Equipment, Field work, Obstacles, Plotting & accuracy. **(2)** **Compasssurveying:**Instruments,Traverse,Bearingsandtheirdesignations,Magneticdeclination, Magnetic & true bearings, Field work, Plotting & adjustment of a closed traverse**. (3)** **Levelling:** Basic definitions, Instruments and their adjustments, Principles of levelling, Fieldwork and writing level books, Profile levelling & cross-sectioning, Reciprocal levelling, Difficulties in levelling, Errors. **(4)** **Contouring:** Basic definitions, Methods of locating contours, Characteristic of contours, Use of contour maps. **(2)** **Plane Table surveying:** Introduction and basic definitions, Instruments and their uses, Principles of plane tabling, Methods of plane tabling, Three point problems and its solutions, Two-point problem and its solution, Errors in plane tabling, Advantages and disadvantages.**(3)** **Theodolite:** Different parts, Temporary adjustments, Fundamental lines, Permanent adjustments, Measurement of horizontal and vertical angles. **(4)** **Theodolite Traversing:** Introduction and basic definitions, Field work, Angular measurements, Traverse computations, Balancing of the traverse, Accuracy of traverse surveying. **(4)** **Measurement of areas:** Area of a tract with irregular boundaries, Different methods, Planimeter and its uses. **(4)** **Measurement of volumes:** Computation of area of cross sections for different sections, Computation of volumes by different methods, Volume from contour map, Capacity of reservoir, Volume from spot levels, Mass-Haul diagram – its characteristics and uses. **(4)** **Electromagnetic distance measurements:** Working principle of EDM equipment, Uses, Range, Accuracy, Corrections to be applied to horizontal distances. **(4)**
Text Books, and/or reference material	***Text Books:*** 1. SurveyingandLevellingPartI&IIbyT.P.KanetkarandS.V.Kulkarni,PuneVidyarthiGriha Prakashan Pune – 30, 1979 2. SurveyingVol.I&II.by,B.C.Punmia,A.K.JainandA.K.JainA.K.,LaxmiPublications(P)Ltd., 2005 ***Reference Books:*** ***3.*** SurveyingVol.I.&IIbyK.R.Arora,StandardBookHouse,P.B.-1074,Delhi ***4.*** Surveyingcoursesavailableinhttp://nptel.iitm.ac.in/

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineering knowledge	Problemanalysis	Design/development of solutions	Conduct investigations of complexproblems	Modemtool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement & finance	Life-longlearning	Plan,analyse,design and prepare	Computeraideddskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO4	-	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	-	3	-	3	-	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial(T)	Practical (P)	Total Hours	
CES451	StructuralMechanics Laboratory	PS	0	0	3	3	2

Pre-requisite(s)	CourseAssessmentmethods
Engineering&SolidMechanics	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :	• CO1:Acquiretheknowledge of behavior of different structuralsystems through experiments/simulations • CO2:Ableto comparethevalues of structural parameters obtained from theoretical with experimental/simulation results. • CO3:Gain the ideato verify the energy theorems. • CO4:Acquire the knowledge of drawing influencelinesthrough experiments.
Topics Covered (Hrs)	1. Experiment/simulation on behavior (slopes, deflections etc.) of different types of structures (beams, columns, frames, arches etc.) with different loading conditions 2. Experiment/simulation on shear force and bending moment of different types of structures (beams, columns, frames, arches etc.) and point of contra flexure. 3. Experiments/simulation on Castigliano's Theorem and Maxwell's Reciprocal theorem for simple structures namely cantilever bema, frame etc. 4. Experiments/Simulation on fixed end beams, continuous beam, portal frames with fixed base and validation in regard to static and kinematic indeterminacy. 5. Experiments/simulation on continuous beam for moving unit loads to draw influence line diagram. 6. Experiments/simulation/field visit on typical civil engineering structures for preparation of report
Text Books, and/or reference material (s)	***Text Books:*** 1. BasicStructuralAnalysisbyC.S.Reddy, TataMcGrawHill 2. ElementaryStructural AnalysisbyWilbur &Norris, Mcgraw-HillCollege 3. Elementsof structuralanalysis byN. C. Sinha, NewCentral book agencypvt.Ltd. 4. StructuralAnalysisbyR.C.Hibbeler,Pearson Education ***ReferenceBooks:*** 5. StructuralAnalysisbyG. S.Pandit &S.P.Gupta,TataMcGraw Hill 6. Theoryof structures byS. P. Timoshenko and D. H. Young,Mc. Graw Hill bookCo

Mappingof CourseOutcomes COs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	Codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	3	3	-	-	2	3	-	3	-	3	-
CO2	3	3	-	3	3	3	-	-	2	3	-	3	-	3	-
CO3	3	3	-	3	3	3	-	-	2	3	-	3	-	3	-
CO4	3	3	-	3	3	3	-	-	2	3	-	3	-	3	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES452	**Designof Concrete Structuressessional**	**PS**	**0**	**0**	**3**	**3**	**2**

Pre-requisite(s)	CourseAssessmentmethods
Solid Mechanics	Continuous(CT)andendassessment(EA).CT+EA

Course Outcomes (COs) :	• CO1:Applyknowledgeof solidmechanics for design solutions. • CO2:Understandbasicdesignphilosophiesapplicabletoconcretestructures. • CO3: Formulate, analyse, and design basic components of Civil Engineering Reinforced Concrete structures.
Topics Covered (Hrs)	**Properties**ofconcreteandreinforcingsteel,Characteristicstrengths,Stressstraincurves, Shrinkage and creep phenomenon, I.S. specification **(4)** **Design philosophies** – working stress method and limit state method of design. **(8)** **Analysisanddesign** ofsectionsinflexurebyworkingstressandlimitstatemethod,Single and doubly reinforced sections, T and L sections **(8)** **Behaviourofbeams**inshearandbond,Designforshear,Anchorageandcurtailmentof reinforcement, Detailing of reinforcement. **(4)** **Serviceability**,Limitstatesofdeflectionandcracking,Calculationofdeflections.**(4) Design of columns**: Short and long columns, eccentrically loaded columns **(8) Design of one-way and two-way slabs, Staircases. (6)** **Isolatedandcombinedfootings(6)** **Designof cantilevertyperetainingwalls(6)**
Text Books, and/or reference material(s)	***Text Books:*** 1. Reinforced Concrete Design, 2nd Edition, by S. Unnikrishna Pillai and Devdas Menon,Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003. 2. IS456:2000,IndianStandardPlainandReinforcedConcrete–CodeofPractice(4th Revision), BIS, New Delhi. 3. SP-16,DesignAidsforReinforcedConcretetoIS:456 –1978,BIS,New Delhi 4. www.nptel.iitm.ac.in/courses/ ***ReferenceBooks:*** 5. ReinforcedConcrete,6thEdition,byS.K.MallickandA.P.Gupta,Oxford&IBH Publishing Co. Pvt. Ltd. New Delhi, 1996. 6. ReinforcedConcreteDesign,1stRevisedEdition,byS.N.Sinha,TataMcGraw-Hill Publishing Company. New Delhi, 1990.

MappingofCourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	2	-	-	-	3	-	2
CO2	3	-	3	-	-	-	1	-	-	2	-	2	-	2	-
CO3	-	-	3	-	-	-	-	2	-	2	1	3	2	1	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES453	Surveyinglaboratory	PCR	1	0	3	4	3
Pre-requisites:		CourseAssessmentmethods:					
CEC 303 & CEC403		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes	• CO1:learnthebasicsurveyingtechniquesandtheuseof basicsurveyinginstruments. • CO2: Measurement of distance using tape or EDM and angle using compass and theodolite • CO3: Profile levelling and contouring using levelling instruments • CO4: Principles and practices used in triangulation, traversing and surveying through Total Station equipment
Topics Covered	1). ChainSurvey. 2). Compasstraverse work. 3). Usesof dumpylevel,Profilelevelling and cross-sectioning. 4). Planetablesurveyingwork – usingradiationandintersection methods. 5). Contouringbyanymethod(Optionalsubjecttoavailabilityoftime). 6). Study of theodolite, function of its different parts, Measurement of horizontal and vertical angle 7). Total Station for detailed surveying for any structure.
Text Books, and/or reference material	***Text Books:*** 1. Basak, N. N., Surveying & Levelling, , 2nd Edition, McGrawHill Publishing House. 2. Ghosh, J. K., "Elementary Engineering Surveying", Studium Press (India) Pvt Ltd. 3. Duggal, S. K., "Surveying (Vol. 1, Vol 2)", Tata McGraw-Hill Education India 4. Subramanian, R., "Surveying and Leveling", Oxford University Press 5. Roy, S. K., "Fundamentals of Surveying", Prentice Hall India Learning Private Limited 6. Bossler, J.D , "Manual of Geospatial Science and Technology", Taylor and Francis.

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineering knowledge	Problemanalysis	Design/development of solutions	Conduct investigationsof complexproblems	Moderntool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement & finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS O3
CO1	3	-	-	-	-	-	-	-	-	-	3	3	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	3	3	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	3	3	3	-	-
CO4	3	-	-	-	3	-	-	-	-	-	3	3	3	-	-

Course Code	Title of the course	Program Core (PCR) / Electives (PEL)	Total Number of contact hours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC-501	Structural Analysis-II	PCR	3	1	0	4	4
Pre-requisite(s)		Course Assessment methods					
Solid Mechanics & Structural Analysis-I		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs) :	• CO1: To analyze indeterminate beams and frames by force methods • CO2: To analyse indeterminate beams and frames by displacement methods • CO3: To evaluate and draw the influence lines for internal and external forces in indeterminate beams and girders. • CO4: To study dynamic characteristics and dynamic analysis of mathematical model of a vibrating system • CO5: To apply approximate numerical method to analyze structural analysis problems
Topics Covered (Hrs)	**Force methods**: Application of Three moment equations to continuous beam, & Consistent deformation method & Flexibility methods to beams & frames. **(11)** **Displacement methods**: Application of Slope deflection, Moment distribution & Stiffness method to indeterminate beams, frames. **(11)** **Influence lines:** Indeterminate structures, Muller Breslau principle with application to redundant beams, frames. **(10)** **Approximate methods:** Introduction Structural dynamics **(10)** **Numerical structural analysis:** Introduction to Finite difference and Finite element method **(10)**
Text Books, and/or reference material (s)	***Text Books:*** 1. Basic Structural Analysis by C. S. Reddy (Tata McGraw Hill) 2. Elementary Structural Analysis by Wilbur & Norris (Mcgraw-Hill College) 3. Structural Analysis by Devdas Menon, (Narosa) 4. Structural Analysis by R. C. Hibbeler (Pearson Edu.) 5. Structural Dynamics: Theory and Computation by Mario Paz,Young Hoon Kim (Springer) ***Reference Books:*** 6. Structural Analysis by G. S. Pandit & S. P. Gupta (Tata McGraw Hill)

Mapping of Course Outcomes COs□POs

	Engineering knowledge	Problemanalysis	Design/development of solutions	Conduct investigationsof complexproblems	Moderntool usage	Theengineerand society	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement & finance	Life-longlearning
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	2	-	-	-	-	-	-	-
CO2	3	-	-	-	2	-	-	-	-	-	-	-
CO3	3	-	-	-	2	-	-	-	-	1	-	-
CO4	3	2	-	-	2	-	-	-	-	-	-	-
CO5	3	-	1	-	-	-	-	-	-	-	-	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC502	DesignofSteelStructures	PCR	3	1	0	4	4
Pre-requisite(s)		CourseAssessmentmethods					
Solid Mechanics		Continuous(CT)andendassessment(EA).CT+EA					

Course Outcomes (COs) :	• CO1:Applyknowledgeofsolidmechanicsfordesignsolutions. • CO2:Understandbasicdesignphilosophyapplicabletosteelstructures. • CO3:Formulate,analyse,anddesignbasiccomponentsofCivilEngineeringSteelstructures.
Topics Covered (Hrs)	**Introduction**,Propertiesofstructuralsteel,I.S.rolledsections,I.S.specifications**(2)** **Design philosophy** of Limit State method for Steel Structures **(6)** **DesignofTensionmembers**,Compressionmembersintruss**(6)** **Design of Beams** (laterally supported /unsupported) : Simple beam using rolled sections, Built upsections /compound beams **(8)** **DesignofGantrygirders(4)** **Design of Plate girders**, Connections, Stiffeners and curtailment of flange plates,Splicing – riveted and welded.**(6)** **DesignofSimpleConnections**:Riveted,Boltedandweldedconnections,momentresisting connections.**(6)** **DesignofStrutsandcolumns**includingbuilt-upcolumnsunderaxialandeccentricloadings, Lacing and battens, Column splicing. **(8)** **DesignofColumnbases**–slabbase,Gussetedbase.**(6)**
Text Books, and/or reference material(s)	***Text Books:*** 1. DesignofsteelStructures byN. Subrhamanium(Oxford publications) 2. IS800-2007:GeneralConstructioninSteel-CodeofPractice 3. IS808-1989:DimensionsofHotRolledSteelbeam,column,channeland angle sections 4. www.nptel.iitm.ac.in/courses/ ***ReferenceBooks:*** 5. LimitStateDesignof SteelStructuresbyS.K. Duggal(McGrawHill publications) 6. LimitStateDesignofSteelstructuresbyVirendraGehlot&Dr.RamChandra (Scientific publisher) 7. DesignofsteelStructuresbyS.S.Bhavikatti(IKIntlPublishingHouse,N Delhi)

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineer andsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	2	-	-	-	3	-	2
CO2	3	-	3	-	-	-	1	-	-	2	-	2	-	2	-
CO3	-	-	3	-	-	-	-	2	-	2	1	3	2	1	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC503	Transportation Engineering	PCR	3	1	0	4	4

Pre-requisite(s)	CourseAssessmentmethods
None	Continuous(CT)andendassessment(EA).CT+EA

Course Outcomes (COs) :

- CO1-To develop a basic understanding and knowledge of Transportation engineering, characteristics of various categories of road, and highway planning.
- CO2-To know the geometric design of the road and highway.
- CO3- To develop in-depth knowledge of Traffic Characteristics and the principle of intersections.
- CO4- To understand the influencing parameters of pavement and pavement materials
- CO5- To design the flexible, rigid pavement and understand its' construction, distresses, and maintenance

Topics Covered (Hrs)

Module 1: (6 hours) Road Classification and Transportation Planning:

Introduction - Highway development in India - Classification of roads - Typical cross sections of roads in urban and rural areas, O-D Survey and introduction of the transportation planning

Module 2: (12 hours) Road Alignment and Geometrical Design:

Requirements and factors controlling alignment of roads -Engineering surveys for highway location - Pavement surface characteristics - Camber and width requirements - Sight distances - stopping and overtaking sight distances, overtaking zone requirements - Design of horizontal alignment -speed, radius, superelevation, methods of providing superelevation, extra widening at curves, transition curves - Design of vertical alignment - gradient, grade compensation, summit curves, and valley curves - worked out problems on all the above topics.

Module 3: (12 hours) Traffic engineering:

Introduction - Road user, vehicle, and traffic characteristics - Speed, volume, delay, parking studies - Simple worked-out problems - Principles of design of at-grade intersections - Simple layouts - Objectives, classification, and uses of traffic signs and markings - Design of isolated signals.

Module 4: (12 hours) Pavement Materials and Design:

Desirable properties and testing of highway materials: road aggregates, bituminous materials, and subgrade soil - Design of flexible and rigid pavements- IRC guidelines – BBD method of flexible overlay design - worked out problems– Introduction to Mechanistic-Empirical Pavement Design.

Module 5: (10 hours) Pavement Construction and Maintenance:

Construction of earth roads, WBM roads, stabilised roads, bituminous pavements, cement concrete roads, and joints in cement concrete roads - Types and causes of distresses in flexible & rigid pavements – Remedial measures – Recycling of pavements.

Text Books, and/or reference material(s)

Text Books:

1. Khanna, S.K.,and Justo, C.E.G., Highway Engineering, Nemchandand Bros, 2015, Roorkee.
2. Kadiyali, L.R., and Lal, N.B., Principles and Practices of Highway Engineering, Khanna Publishers, 2013.
3. O' Flaherty, C.A., Highway-Traffic Planning and Engineering, Edward Arnold., 1986

Reference Book:

4. Indo-HCM -2017
5. IRC: 37, Guidelines for the Design of Flexible Pavements.
6. IRC: 58, Guidelines for the Design of Rigid Pavements.
7. IRC:15, Standard Specifications and Code of Practice for Construction of Concrete Roads
8. Ministry of Road Transport and Highways Specifications for Roads and Bridges.

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/development of solutions	Conductinvestigations of complex problems	Modemtool usage	Theengineer andsociety	Environment&sustainability	Ethics	Individual& team	Communication	Projectmanagement &finance	Life-longlearning	Plan,analyse,designand prepare	Computeraideskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	-	2	-	-	3	2	-	2
CO2	2	3	3	1	-	-	1	-	-	2	-	3	2	-	3
CO3	3	3	3	1	-	1	-	2	-	2	1	1	3	1	3
CO4	3	3	3	1	-	1	1	2		-	1	2	3	1	3
CO5	2	-			-	-	1	1		-		1	-	-	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC504	**Soil Mechanics**	**PCR**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
Engineeringand FluidMechanics		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes (COs) :	• CO1:AcquireknowledgeofclassifyingthesoilfromCivilEngg. Aspect • CO2:Abilitytoconduct Experimentand Analyse the datawith interpretation • CO3:AbilitytoanalyseSoilforSoil-StructurelikeDams (Earthen/Rigid) • CO4:Abilityto Design Soil related Civil Engg. Structure • CO5:Understandingneed oftheProfessional Ethics&future studies
Topics Covered (Hrs)	**Introduction:** Type of soil, Mineralogical composition, Basic definitions of soil parameters, Inter-phase relationships, Problems **(4)** **Index properties:** Index properties of soils and their determination, classification based on index properties. Problems **(4)** **Classification:** Various classification systems, IS, MIT, US bureau and soil classification, PRA, Plasticity chart. Group Index. Problems. **(3)** **Soil-Water Pressure:** Total, effective, and pore pressure in soil. Capillary rise, effect of seepage on pore pressure, Quick condition. Problems. **(3)** **Permeability:** Permeability and seepage through soil, Darcy's law, Determination of permeability by laboratory methods and field methods. Factors affecting permeability. Flow through stratified soil. Problems. **(4)** **Seepage analysis:** Laplace's equation for Isotropic & an-isotropic soils, Flow-nets, Seepage through sub-soil, earthen embankment & piping failure, Problems **(5)** **Stress distribution:** Stress distribution in soils, point loads, line loads, strip loads, rectangular footings, circular footings, arbitrary footings. Boussineq's equation, Westtergards' equation, Newmarks's equation. Significant depth, pressure bulb, Newmark's influence coefficients, stress due to linearly varying loads. Problems. **(6)** **Consolidation:** One-dimensional Consolidation theory, Oedometer test, e-log10P curve, settlement & its time required, determination of C_V, m_V, C_C. Definition of Normally & Over consolidated soils. Problems. **(7)** **Compaction:** Compaction, Standard Proctor Test, Modified Proctor Test, □dvs □curve. Field compaction tests and Field compaction. Problems. **(3)**
Text Books, and/or reference material (s)	***Text Books:*** 1.SoilMechanicsandFoundationEngineeringbyVNSMurthy,CBSpublisherandDistributor 2.SoilMechanicsandFoundationEngineeringbyS.K.Garg,Khanna Publishers 3.BasicandAppliedSoilMechanics byGopalRanjan&A.S.R.Rao,NewAge International ***Reference Books:*** 4.AdvancedSoilMechanicsbyB.M.Das,McGrawHills Publishers

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex	Modemtoolusage	Theengineerand society	Environment&sustainability	Ethics	Individual& team	Communication	Projectmanagement& finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	-	-	-	-	-	-	-	-	-	-	1	2	-
CO2	-	3	-	3	-	-	-	-	-	-	-	-	3	-	2
CO3	1	3	3	-	-	-	-	-	-	-	1	-	2	-	2
CO4	-	2	3	2	-	-	-	-	-	-	-	-	-	2	2
CO5	-	-	-	-	-	-	-	-	3	-	-	2	-	2	2

<table>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Title of the course</th><th rowspan="2">Program Core (PCR) / Electives (PEL)</th><th colspan="4">Total Number of contact hours</th><th rowspan="2">Credit</th></tr>
<tr><th>Lecture (L)</th><th>Tutorial (T)</th><th>Practical (P)</th><th>Total Hours</th></tr>
<tr><td>CES551</td><td>Structural Analysis Sessional</td><td>PS</td><td>0</td><td>0</td><td>3</td><td>3</td><td>2</td></tr>
<tr><td colspan="3">Pre-requisite(s)</td><td colspan="5">Course Assessment methods</td></tr>
<tr><td colspan="3">Solid Mechanics & Structural Analysis-I</td><td colspan="5">Continuous (CT) and end assessment (EA). CT+EA</td></tr>
<tr><td>Course Outcomes (COs) :</td><td colspan="7">• CO1: To analyze indeterminate beams and frames by force methods
• CO2: To analyse indeterminate beams and frames by displacement methods
• CO3: To evaluate and draw the influence lines for internal and external forces in indeterminate beams and girders.
• CO4: To study dynamic characteristics and dynamic analysis of mathematical model of a vibrating system
• CO5: To apply approximate numerical method to analyze structural analysis problems</td></tr>
<tr><td>Topics Covered (Hrs)</td><td colspan="7">Manual and computerised analysis of various building frames using different methods related to Structural Analysis –I and II.</td></tr>
<tr><td>Text Books, and/or reference material (s)</td><td colspan="7">Text Books:
1. Basic Structural Analysis by C. S. Reddy (Tata McGraw Hill)
2. Elementary Structural Analysis by Wilbur & Norris (Mcgraw-Hill College)
3. Structural Analysis by Devdas Menon, (Narosa)
4. Structural Analysis by R. C. Hibbeler (Pearson Edu.)
5. Structural Dynamics: Theory and Computation by Mario Paz,Young Hoon Kim (Springer)
Reference Books:
6. Structural Analysis by G. S. Pandit & S. P. Gupta (Tata McGraw Hill)</td></tr>
</table>

Mapping of Course Outcomes COs□POs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Modemtoolusage	Theengineerand society	Environment&sustainability	Ethics	Individua & team work	Communication	Projectmanagement& finance	Life-longlearning
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	2	-	-	-	-	-	-	-
CO2	3	-	-	-	2	-	-	-	-	-	-	-
CO3	3	-	-	-	2	-	-	-	-	1	-	-
CO4	3	2	-	-	2	-	-	-	-	-	-	-
CO5	3	-	1	-	-	-	-	-	-	-	-	-

Course Code	**Titleofthe course**	**ProgramCore (PCR) / Electives(PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES552	**DesignofSteelStructures Sessional**	**PS**	**0**	**0**	**3**	**3**	**2**
Pre-requisite(s)		CourseAssessmentmethods					
Solid Mechanics		Continuous(CT)andendassessment(EA).CT+EA					
Course Outcomes (COs) :	• CO1:Applyknowledgeof solid mechanics for designsolutions. • CO2:Understandbasic designphilosophyapplicable tosteel structures. • CO3:Formulate,analyse,anddesignbasiccomponentsofCivilEngineeringSteel structures.						
Topics Covered (Hrs)	**Introduction**,Propertiesofstructuralsteel, I.S.rolledsections,I.S.specifications**(2)** **Design philosophy** of Limit State method for Steel Structures **(6)** **DesignofTensionmembers**,Compressionmembersintruss **(6)** **DesignofBeams**(laterallysupported/unsupported):Simplebeamusingrolledsections, Built up sections /compound beams **(6)** **DesignofGantrygirders(4)** **Design of Plate girders**, Connections, Stiffeners and curtailment of flange plates, Splicing – riveted and welded.**(2)** **Design of Simple Connections**: Riveted, Bolted and welded connections, moment resisting connections.**(6)** **DesignofStrutsandcolumns**includingbuilt-upcolumnsunderaxialandeccentric loadings, Lacing and battens, Column splicing. **(6)** **Designof Columnbases** –slabbase,Gusseted base.**(4)**						
Text Books, and/or reference material(s)	***Text Books:*** 1. Designofsteel Structures byN. Subrhamanium,Oxford publications 2. IS800-2007:GeneralConstructioninSteel-CodeofPractice 3. IS808-1989:DimensionsofHot RolledSteelbeam,column,channeland angle sections 4. www.nptel.iitm.ac.in/courses/ ***ReferenceBooks:*** 5. LimitStateDesignofSteelStructuresbyS.K.Duggal,McGrawHill publications 6. Limit State Design of Steel structures by Virendra Gehlot & Dr. Ram Chandra, Scientific publisher 7. DesignofsteelStructuresbyS.S.Bhavikatti,IK IntlPublishingHouse,N Delhi						

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	2	-	-	-	3	-	2
CO2	3	-	3	-	-	-	1	-	-	2	-	2	-	2	-
CO3	-	-	3	-	-	-	-	2	-	2	1	3	2	1	3

Course Code	**Title of the course**	**Program Core (PCR) / Electives (PEL)**	**Total Number of contact hours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES553	**Environmental and Water Resource Engineering Laboratory**	**PS**	**0**	**0**	**3**	**3**	**3**

Pre-requisite(s)	Course Assessment methods
A first course in physics	Continuous (CT) and end assessment (EA). CT+EA

Course Outcomes (COs) :	• CO1: Understand the principles of design of experiments in Environmental Engineering and Water Resources Engineering • CO2: Understand the principles and development of experimental skills for estimating yield (run-off) from a basin • CO3: Achieve hands-on experience in dealing with basic laboratory equipment in a group work environment and learn to prepare professional laboratory report
Topics Covered (Hrs)	**A). Environmental Engineering**: pH and temperature, Turbidity, Conductivity, Total solids, Settleable solids and suspended solids, Chloride, Acidity, Alkalinity, Residual chlorine, Dissolved oxygen and Colony count of bacteria. **B). Water Resource Engineering**: Identification of a drainage basin from a topographic map. Identification of major stream in the identified drainage basin. Measurement of discharge in the identified stream by field approximation method. Maintaining and presenting time series of discharge. Collecting time series of concurrent precipitation and other meteorological data during the period over the identified drainage basin from IMD Network. Correlating discharge data with the precipitation data and presenting correlation coefficient. Measurement of velocity in a Channel/Flume by Acoustic Doppler Velocity Meter, Measurement of discharge in a Channel by using Electromagnetic Flow Meter, Verification of mass balance through Channels of different sizes: A1V1 = A2V2, Verification of Discharge in the channel by V-Notch, Identification of land-use in the mobile bed channel, Visualizations of land-form development in the mobile bed, Measurement of 3-D plan form of mobile bed after stabilization of flow in the channel for a particular land use, Measurement of 3-D plan form of mobile bed after stabilization of flow in the channel for barren land in the channel.
Text Books, and/or reference material(s)	Text Books: • Subramanya, K, "Engineering Hydrology", Fourth Edition, McGraw Hills Education (India) Private Limited, New Delhi *Reference Materials:* • Instruction sheets prepared by the faculty members of Water Resources Engineering Group

Mapping of Course Outcomes COs→POs (mentioning Correlation Level)

	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment & sustainability	Ethics	Individual & team work	Communication	Project management & finance	Life-long learning
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	3	-	-	-	-	-	-
CO2	-	3	3		-	-	-	-	-	-	-	-
CO3	-	-	-	3	3		3	3	3	3	3	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
HSC631	**Economics and Accountancy**	**PCR**	**3**	**0**	**0**	**3**	**3**

Pre-requisite(s)	CourseAssessmentmethods
NIL	Continuous(CT)andendassessment(EA).CT+EA

Course Outcomes (COs) :

- CO1:Learners will be able to review basic economic principles.
- CO2: Learners will be introduced to the basic capital appraisal methods used for carrying out economic analysis of different alternatives of engineering projects or works.
- CO3: Learners will gain a good knowledge of financial accounting, enabling them prepare, analyse and interpret financial statements for taking informed decisions.

Topics Covered (Hrs)

Part 1: Economics

Group A: Microeconomics

Sl no.	Name	L	T	P	Cr	H
Unit 1	Economics: Basic Concepts	2	0	0	2	2
Unit 2	Theory of Consumer Behaviour	3	0	0	3	3
Unit 3	Theory of Production, Cost and Firms	3	0	0	3	3
Unit 4	Analyses of Market Structures: Perfect Competition	3	0	0	3	3
Unit 5	Monopoly Market	2	0	0	2	2
Unit 6	General Equilibrium & Welfare Economics	2	0	0	2	2
	Total	**15**	**0**	**0**	**15**	**15**

Group B: Macroeconomics

Sl no.	Name	L	T	P	Cr	H
Unit 1	Introduction to Macroeconomic Theory	2	0	0	2	2
Unit 2	National Income Accounting	3	0	0	3	3
Unit 3	Determination of Equilibrium Level of Income	4	0	0	4	4
Unit 4	Money, Interest and Income	2	0	0	2	2
Unit 5	Inflation and Unemployment	2	0	0	2	2
Unit 6	Output, Price and Employment	2	0	0	2	2
	Total	**15**	**0**	**0**	**15**	**15**

PART 2: Management Accountancy

Sl no.	Name	L	T	P	Cr	H
Unit 1	Introduction to Accounting: Accounting Environment of Business; Objectives of Accounting; Accounting Equations for Financial Statements. Books of Accounting: Journal, Ledger,Cash book.	3	0	0	3	3
Unit 2	Financial Statement Preparation and Analysis: Preparation of Trial Balance, Trading, Profit & Loss account and Balance Sheet. Case study discussion.	5	0	0	5	5
Unit 3	Financial Ratio Analysis: Common Size Statements; Computation of Financial Ratios; Interpretation and analysis of Financial Ratios with the help of case studies.	4	0	0	4	4
	Total	**12**	**0**	**0**	**12**	**12**

Text Books, and/or reference material(s)	**PART 1: Economics** **Group A: Microeconomics** 1. Koutsoyiannis: Modern Microeconomics 2. Maddala and Miller: Microeconomics 3. AnindyaSen: Microeconomics: Theory and Applications 4. Pindyck&Rubenfeld: Microeconomics **Group B: Microeconomics** 1. W. H. Branson: Macroeconomics – Theory and Policy (2nd ed) 2. N. G. Mankiw: Macroeconomics, Worth Publishers 3. Dornbush and Fisher: Macroeconomic Theory 4. Soumyen Sikder: Principles of Macroeconomics **PART 2: Management Accountancy** 1. Gupta, R. L. and Radhaswamy, M: Financial Accounting; S. Chand & Sons 2. Ashoke Banerjee: Financial Accounting; Excel Books 3. Maheshwari: Introduction to Accounting; Vikas Publishing 4. Shukla, MC, Grewal TS and Gupta, SC: Advanced Accounts; S. Chand & Co.

Mapping of Course Outcomes COs→POs (mentioning Correlation Level)

	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment & sustainability	Ethics	Individual & team work	Communication	Project management & finance	Life-long learning
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	1	-	1	3	-	-	-	-	-
CO2	-	1	-	1	-	-	-	-	-	2	1	-
CO3	-	-	-	1	-	-	-	-	-	2	3	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC601	**Foundation Engineering**	**PCR**	**3**	**0**	**0**	**3**	**3**

Pre-requisite(s)	CourseAssessmentmethods
SoilMechanics	Continuous(CT)andendassessment(EA).CT+EA

Course Outcomes (COs) :	• CO1:Calculateshearstrengthofsoil • CO2:Determinetheearthpressuresonfoundationsandretainingstructures • CO3:Analysestabilityoffinite and infinitesoil &rock slopes • CO4: Calculate thebearingcapacityof soils andfoundation settlements
Topics Covered (Hrs)	**Shear strength of soil**: Determination of shear strength in laboratory and in field, Mohr-Coulomb failure criterion, Failure envelopes and shear strength parameters for different test conditions, Problem. **(6)** **Lateral earth pressure theories**: Analytical and graphical methods, Effect of surcharge, water table and stratification on earth pressure, Design of cantilever sheet pile, Problem. **(8)** **Stability of slopes**, infinite slopes, Analysis of finite slopes by method of slices, modified method of slices, friction circle method, Taylor's stability number, Effect of pore water pressure, Problem**(8)** **Bearing capacity of shallow foundations:** Selection of location and depth, Analytical method of using Terzaghi's equation, I.S. method, Skempton's equation, Field test method, Method based on SPT, Design of combined footings. **(8)** **Bearing capacity of pile foundation**: Types of piles, Bearing capacity of single and groupof piles, Problem. **(7)** **Wellfoundation**:Elementsofwells,Types. **(2)**
Text Books, and/or reference material(s)	***Text Books:*** 1. GeotechnicalEngineering:PrincipalandPracticesofSoilMechanicsandfoundation Engineering by V N S Murthy. 2. Basic and Applied SoilMechanics byG.Ranjan and A. S.Rao ***ReferenceBooks:*** 3. FoundationanalysisandDesign byJ.E. Bowles 4. SoilMechanicsandFoundationEngineeringbyS.K.Garg,KhannaPublishers 5. AdvancedSoilMechanics byB.M.Das,McGraw Hills Publishers

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntoolusage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	1	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	2	-	-	-	-	-	-	1	-	-	3	2	-
CO3	2	3	2	-	-	-	-	-	-	-	-	-	3	2	-
CO4	3	2	-	1	-	-	-	-	-	-	-	-	-	2	3

Department of Computer Science and Engineering							
Course Code	**Title of the course**	**Program Core (PCR) / Electives (PEL)**	**Total Number of contact hours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CSC631	**Artificial Intelligence and Machine Learning**	**PCR**	**3**	**0**	**2**	**5**	**4**
Pre-requisites		Course Assessment methods (Continuous evaluation (CE) and end assessment (EA))					
Basic Concepts of Probability and Statistics, Knowledge of Algorithm analysis		CE+EA					
Course Outcomes	• CO1: Identify problems where artificial intelligence (AI) techniques are applicable • CO2: Understand to apply search strategies to solve the problems. • CO3: Principal models used in machine learning and Apply them in machine learning to appropriate problems • CO4: Formulate valid solutions for problems involving uncertain inputs or outcomes by using decision making techniques. • CO5: Understanding different supevised and unsupervised learning methods.						
Topics Covered	**Introduction to Artificial Intelligence (AI):** What is Intelligence, Reasoning and Planning, Learning and Adaptation, and interaction with the real world, A brief history of AI, Application areas of AI, State of the art. (2) **Problem solving by search:** Problem types, Illustrative search problems; Search Space, Search tree; BFS, DFS, UCS; Local search; Hill climbing; Heuristics; A* search (6) **Knowledge Representation:** Propositional, predicate logic, first order logic, resolution and unification (5) **Reasoning under Uncertainty:** Conditonal independence representation, exact inference through variable elimination, and approximate inference through sampling. (5) **Introduction to Machine Learning:** Basic concepts, bias-variance trade off, evaluation metrics etc. (2) **Supervised Learning:**Simple linear regression, multiple linear regression, logistic regression, support vector machine, decision trees, Introduction to artificial neural network. (14) **Unsupervised Learning:**Clusteringalgorithms, k-means/k-medoid, hierarchical clustering (6) **Dimensionality reduction:** Principal component analysis. (2) **Sessional experiments:** Study of PROLOG programming language to implement different search techniques, Implementation of different machine learning techniques (linear and logistic regression; Decision Trees; Support Vector Machine; artificial neural network; Clustering						

	techniques) by programming in Python
Text Books, and/or reference material	**Text Books:** 1.Artificial intelligence : A Modern Approach- Stuart Russell, Peter Norvig, Prentice Hall, Fourth edition, 2020 2. Tom M. Mitchell, “Machine Learning”, McGraw Hill Education, International Edition, 2010 **Reference Books:** 1. Elaine Rich, Kevin Knight and Shivashankar B Nair, “Artificial Intelligence”, Tata McGraw Hill, 3rd Edition 2017. 2. Ethem Alpaydin, “Introduction to Machine Learning”, Third Edition, , MIT Press, 2014

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problem analysis	Design/development of solutions	nduct investigations of complex problems	Modern tool usage	The engineer and society	Environment & sustainability	Ethics	Individual & team work	Communication	t management & finance	Life-long learning	alyse, design and prepare	ided skill and tools	odal provisions / guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES651	Structural Engineering Laboratory	PCR	0	0	3	3	2

Pre-requisite(s)	CourseAssessmentmethods
Building Materials and Concrete Technology	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :

- CO1: Learn to determine the properties of different engineering materials like cement, fine & coarse aggregates, concrete etc.
- CO2: Design concrete mix proportion based on the properties of concrete ingredients.
- CO3: Acquiring knowledge about detailing of reinforced concrete beam under given conditions

Topics Covered (Hrs)

To observe the behavior of a mild steel specimen while being tested and to determine (i) upper and lower yield points, (ii) ultimate strength, (iii) breaking strength, (iv) percentage elongation of length, (v) percentage reduction of cross-section.

To determine the properties of bricks.

Todeterminethe(a)finenessofcementbysieving,(b)standardconsistencyofcementand(c) setting time of cement. **(6)**

Todeterminethe(a)specificgravityofcement(b)compressivestrengthofcementand(c) soundness of cement. **(6)**

Todeterminethe(a)particlesizedistribution,(b)specificgravityandwaterabsorptionand(c) bulk density and voids in coarse aggregate**. (6)**

Todeterminethe(a)particlesizedistribution,(b)specificgravityandwaterabsorptionand(c) bulk density and voids in fine aggregate. **(6)**

Concretemixdesign byI.S Method**. (6)**

(a) Preparationofconcretespecimenstodeterminethecompressivestrengthflexuralstrength and split tensile strength of concrete of a given mix proportions**. (6)**

(i) Compressivestrengthat07 days-3 noscube+ 3 nos cylinder

(ii) Compressivestrengthat28 days-3 noscube+ 3 nos cylinder

(iii) Splittensilestrengthat28 days-3nos cylinder

(iv) Flexuralstrengthat28days-3nosprism

(b) Testabovespecimenaccordingto theproper testingday(7 days and28days) **(3)**

(c) Todeterminetheconsistencyand workabilityoffreshlymixed concretebyi)Slumptestandii)Compactingfactortest

Design,detailingandbar bendingscheduleforR.C.beamunder given conditions.

Castingandstudyonthe strengthanddeflectionbehavior ofR.C. beams.

Text Books, and/or reference material (s)

Text Book:

1. Concrete Technology by M. S. Shetty, S. Chand & Co
2. Concrete Technology by M. L. Gambhir, Tata McGraw Hill
3. IS code of practice: 383-2016, 10262-2019, 456-2000 etc

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineering knowledge	Problemanalysis	Design/development of solutions	Conduct investigationsof complexproblems	Moderntool usage	Theengineerand society	Environment& sustainability	Ethics	Individual&t eam work	Communication	Projectmanagement & finance	Life-longlearning	Plan, analyse, designandprepare	Computeraided skill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	3	-	3	-	-	-	-	-	3	-	-	3
CO2	3	-	-	3	-	3	-	-	-	-	-	3	-	-	3
CO3	3	3	3	3	-	3	-	-	-	-	-	3	-	-	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES652	**Civil Engineering Computation & Software Laboratory**	**PS**	**0**	**0**	**3**	**3**	**2**

Pre-requisite(s)	CourseAssessmentmethods
Construction, Materials&Concrete Technology	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs)	• CO1: Acquiring knowledge on computer aided analysis, design with different commercially available software • CO2: Hands-on experience on industrial practices of different types of design problems in the field of civil engineering. • CO3: Develop computational skills for inter-disciplinary nature of jobs
Topics Covered (Hrs)	1. Practices on coding for the solution of different types of structural/geotechnical/ environmental problems using C^{++}/Python/MatLAB 2. Modelling and computer aided solution of civil engineering problems using StaadPRO 3. Analysis and design of complex civil engineering structural problems using ANSYS 4. Computer-aided design of typical civil engineering structures using ANSYS, ABACUS, COMSOL, ETABS/SAP/LS DYNA/PLAXIS, Geomedia etc 5. Computer-aided estimation of typical civil engineering structures and validation using commercially available software, coding
Text Books, and/or reference material(s)	***Reference Books:*** 1. Manuals of Commercial /Open source software related to Civil Engineering Applications (Eg. SAP, STAAD, ABAQUS, ETABS, LS DYNA, Plaxis, Geomedia etc.) 2. Applied Numerical Methods for Engineers Using Matlab and C by Robert J. Schilling, Sandra L. Harris, Nelson Engineering; Har/Cdr edition 3. Numerical Methods for Scientists and Engineers by R. W. Hamming, Dover Publications

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	-	-	3	-	-	3	3	3	3
CO2	3	3	3	3	3	3	-	-	3	-	-	3	3	3	3
CO3	3	3	3	3	3	3	-	-	3	-	2	3	3	3	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES653	SoilMechanics and Foundation Engineering Laboratory	PS	0	0	3	3	2

Pre-requisite(s)	CourseAssessmentmethods
Soil Mechanics and Foundation Engineering	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :	• CO1: Understand the principles of design of experiments in Soil Mechanics • CO2: Understand the principles and development of experimental skills for estimating index and engineering properties of soil • CO3: Achieve hands-on experience in dealing with basic laboratory equipment in a group work environment and learn to prepare professional laboratory report
Topics Covered (Hrs)	1). Determination of the specific gravity of soil 2). Mechanical analysis of soil (Fine fraction- Hydrometer method) 3). Mechanical analysis of soil (Coarse fraction- Sieve analysis) 4). Determination of consistency properties of soil 5). Relative Density or Density Index test 6). Light/Heavy compaction test (Standard/Modified Proctor test) 7). California Bearing Ratio (CBR) Test 8). Consolidation test 9). Direct shear test 10). Unconfined Compressive Strength (UCS) test 11). Triaxial tests 12). Permeability test
Text Books, and/or reference material(s)	***Text Books:*** 1. Engineering Soil Testing by Shamsher Prakash, (1979), Nemichand, New Delhi 2. Soil Testing for Engineers by William Lambe, (2003), MIT. ***Reference Books:*** 3. Relevant IRC/IS codes. 4. Engineering Properties of soil and their measurements by Joesph E Bowles, McGraw Hill 5. Geotechnical Laboratory Measurements by John T. Germaine, Amy V. Germaine, (2009), John Wiely

Mappingof CourseOutcomesCos□Pos□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-long learning	Plan,analyses,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	1	-	-	-	1	-	-	-	2	-	3
CO2	-	-	-	1	1	-	-	-	2	-	-	-	2	1	3
CO3	-	-	-	-	1	-	-	-	2	1	-	1	1	1	3

Course Code	Title of the course	Program Core (PCR) /Electives (PEL)	Total Number of contact hours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
MSC731	**Principles Of Management**	**PCR**	**3**	**0**	**0**	**3**	**3**
Pre-requisites		CourseAssessmentmethods(Continuousassessment(CA)and End Assessment (EA))					
		CA+EA					

Course Outcomes	• CO1:To make budding engineers aware of various management functionsrequired for any organization • CO2:To impart knowledge on various tools andtechniquesapplied bythe executives of an organization • CO3:To make potential engineers aware of managerial function sothat it would help for their professional career • CO4:To impart knowledge on organizational activities operational and strategic both in nature • C05: To impart knowledge on each functional area of management like Marketing, Finance, Behavioral Science, Quantitative Techniques and Decision Science
Topics Covered	**UNITI:**ManagementFunctionsandBusinessEnvironment:Businessenvironment-macro, Business environment -micro; Porter's five forces, Management functions – overview, Different levels and roles of management, Planning- Steps, Planning and environmental analysis with SWOT, Application of BCG matrix in organization **(12)** **UNIT II:** Quantitative tools and techniques used in management: Forecasting techniques, Decision analysis **(6)** **UNIT III:** Creating and delivering superior customer value: Basic understanding of marketing, Consumer behavior-fundamentals, Segmentation, Targeting & Positioning, Product Life cycle. **(8)** **UNIT IV:** Behavioral management of individual: Motivation, Leadership, Perception, Learning. **(8)** **UNITV:**Professionalethics:IntroductiontoProfessionalethics,Morals,valuesandEthics, Ethics in Business**. (2)**
TextBooks, and/or reference material	Text Books: 1. Marketing Management 15thEdition,Philip KotlerandKelvin Keller,Pearson India 2. Management Principles, Processes and practice, first edition, Anil Bhat and Arya Kumar, Oxford Higher education 3. Organizational Behavior,13 th edition, Stephen P Robbins, Pearson Prentice hall India 4. OperationsManagement, 7thedition(Qualitycontrol,Forecasting),Buffa &Sarin, Willey 5. A.C.Fernando:BusinessEthics&CorporateGovernance,PearsonEducation 2nd edition

Mappingof CourseOutcomesCos□Pos□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Moderntool usage	Theengineerand society	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	Codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	2		2	1	1	3			
CO2	-	-	-	-	-	-	1		1			3			
CO3	-	-	-	-	-	-	1	2	2	2	2	3			
CO4	-	-	-	-	-	-	1	2	2	1	1	3			
CO5	-	-	-	-	-	-	2	2	2	2	1	3			
CO6	-	-	-	-	-	-	2		2	1	1	3			

Course Code	Title of the course	Program Core (PCR)/ Electives (PEL)	Total number of contact hours				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total hours	
CEC701	Disaster Mitigation and Management	PCR	3	1	0	4	4
Pre-requisite(s)		Course Assessment methods					
Fundamentals of Civil Engineering		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs)	• CO1: To understand the different types of disasters and their impact. • CO2: To gain knowledge about state-of-the-art techniques and applications in disaster mitigation. • CO3: To gain knowledge about earthquake disasters and their impact • CO4: To gain knowledge about landslide disasters and the mitigation techniques • CO5: To understand the effect of disaster on infrastructures vulnerable to disasters • CO6: To understand the fundamentals of building resilient infrastructure, strengthening, retrofitting and rehabilitation
Topics Covered (Hrs)	**Disasters:Natural** - Geo-physical (Earthquake, Land sliding), Atmospheric and hydrological (Floods, Cyclones, Drought); **Man-made** - Blast, Fire, Nuclear hazards, socio-Economics of Disaster Management **(4)** **Applications of Science and Technology for Disaster Mitigation**: Hazard Analysis, Vulnerability Assessment and Risk Analysis, Geo-informatics (RS, GIS, GPS and RS), IoT, AI, ML, Disaster Communication System (12) **Earthquakes**: Causes and classification, magnitude and intensity, seismic waves, site effect, attenuation effect, recurrence intervals, fault behaviour models, seismic hazard and risk analysis, monitoring and early warning systems **(6)** **LandslideAssessment and Mitigation**: Introduction to landslides, landslide hazard and risk assessment, monitoring and early warning systems, landslide mitigation techniques **(10)** **Infrastructures vulnerable to disasters**: Buildings, Bridges, Dams, Power plants, Tunnels, Pipelines, Roads, Retaining structures, Reservoirs, Offshore structures, etc. **(10)** **Disaster Resilient Infrastructure, Strengthening, Retrofitting and Rehabilitation**: Earthquake resistant seismic design of structure and design provisions of latest IS:1893, design of structures for fire resistance and design provisions of latest of IS:1642, design of structures for blast resistance and design provisions of latest of IS: 4991, design provisions of international codes of design, state-of-the-art technologies of strengthening, retrofitting and rehabilitation. (10)
Text Books, and/or reference material	**TEXT BOOKS:** 1. William G. Ramroth, "Planning for Disaster: How Natural and Man-Made Disasters Shape the Built Environment", Kaplan Publishing, 2007, ISBN 1419593730, 9781419593734. 2. Carter, W N, Disaster Management, Asian Development Bank, Manila, 2006. 3. Hyndman D, Natural Hazards, and Disaster. Cole, 2006. 4. Reiter, L., Earthquake Hazard Analysis: Issues and Insights, Columbia University Press 5. Twigg, John, "Disaster Risk Reduction", London: Overseas Development Institute, Humanitarian Policy Group, 2015 6. Agarwal Pankaj and Shrikhande Manish, "Earthquake Resistant Design of Structures", PHI. 7. Cormie David, Mays Geoff and Smith Peter, "Blast Effects on Buildings", 3rd Edition, Thomas Telford Publishing. 8. Chopra, A. K., "Earthquake Engineering for Concrete Dams: Analysis, Design, and Evaluation", Wiley-Blackwell. 9. Wang, J. N., "Seismic Design of Tunnels", Parsons Brinckerhoff Quade & Douglas, Inc 10. Andrews, A. and Folger, P., "Nuclear Power Plant Design and Seismic Safety Considerations", Congressional Research Service

Mappingof CourseOutcomesCos□Pos□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Moderntool usage	Theengineerand society	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	Codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	2	-	-	-	-	-	-	-	-
CO2	3	-	-	-	3	-	-	-	-	-	-	1	-	3	-
CO3	3	-	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO6	3	3	3	-	3	-	-	-	-	-	-	-	-	-	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES751	ProjectI	PS	0	0	4	4	2

Pre-requisite(s)	CourseAssessmentmethods
DesignofConcreteStructuresalong withConcreteTechnologyLaboratory	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :	• CO1:Demonstrateasoundtechnicalknowledge oftheirselectedprojecttopic. • CO2:Undertakeproblemidentification,formulationandsolution. • CO3:Designengineeringsolutionstocomplex problemsutilisingasystemsapproach. • CO4:Conductanengineeringproject.
Topics Covered (Hrs)	AnytypeofCivilEngineeringproblemeitherexperimentally,analytically,and Numerically.
Text Books, and/or reference material(s)	***Text Books:*** ***Reference Books:***

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement&financ e	Life-longlearning	Plan,analyses,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES752	SummerInternship	PS	0	0	2	2	1

Pre-requisite(s)	CourseAssessmentmethods
DesignofConcreteStructuresalong withConcreteTechnologyLaboratory	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :	• CO1: Able to construct the company profile by compiling the brief history, management structure, products / services offered, keyachievements and market performance for his / her organisation of internship. • CO2: For his / her organisation of internship, the student is able to assess its Strengths, Weaknesses, Opportunities and Threats (SWOT). • CO3: Able to determine the challenges and future potential for his / her internship organisation in particular and the sector in general. • CO4: Able to test the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period. • CO5: Able to apply various soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internshiporganisation. • CO6:Abletoanalysethefunctioningofinternshiporganisationandrecommendchanges for improvement in processes.
Topics Covered (Hrs)	
Text Books, and/or reference material(s)	***Text Books:*** ***ReferenceBooks:***

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&f inance	Life-longlearning	Plan,analyses,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES753	Transportation Engineering Laboratory	PS	0	0	3	3	2

Pre-requisite(s)	CourseAssessmentmethods
TransportationEngineering	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :

- CO1: Understand the principles of design of experiments in Transportation and Soil Mechanics
- CO2: Understand the principles and development of experimental skills for estimating material properties for roadways
- CO3: Understand the principles and development of experimental skills for estimating some index and engineering properties of soil
- CO4: Achieve hands-on experience in dealing with basic laboratory equipment in a group work environment and learn to prepare professional laboratory report

Topics Covered (Hrs)

A. Pavement Material Testing

1. Aggregate grading analysis; 2. Determination of flakiness index.; 3. Determination of aggregate impact value; 4. Los Angeles abrasion test; 5. Aggregate crushing value test; 6. Determination of softening point for the bitumen sample; 7. Determination of penetration value for bitumen sample; 8. Ductility test for the bitumen sample; 9. Viscosity test for the bitumen sample

B. Flexible Pavement Design lab

10. Marshall Mix Design for flexible pavement; 11. Marshall flow and stability test

C. Traffic Engineering Lab

12. Manual method for traffic volume study; 13. Heterogeneous Traffic Flow Data Collection; 14. Speed Data Collection by videography technique; 15. Speed Data Collection by Radergun; 16. Frequency of speeds obtained from a sample survey and estimation of design speed of the road; 17. Parking Studies: off-street and on-street parking; 18. Parking In-Out Survey: Calculation of accumulation, occupancy and parking load; 19. Parking study by license plate method; 20. Volume study and design at signalised intersections by IRC Methods; 21. Determine the safe stopping sight distance of signalised intersections; 22. Identify, classify, and record various traffic control devices such as signs, marking and signals installed along a street/ corridor; 23. Intersection delay study; 24. Travel time delay study; 25. Driver characteristics study

Text Books, and/or reference material(s)

Text Books:

1. HighwayEngineering by S. K. Khanna, C.E.G. Justo and A. Veeraraghavan, Nemchand & Bros.
2. ITE Manual of Transportation Engineering Studies, 2nd edition
3. Kadiyali, L. R. “Traffic Engineering and Transportation Planning”, Khanna Publishers, New Delhi, 1987
4. Papacostas, C.S. and Prevedouros, P.D. “Transportation Engineering & Plannig (third edition)”, PHI Learning Private Limited, Delhi, 2014
5. Papacostas, C.S. “Fundamentals of Transportation Engineering”, Prentice-Hall, New Delhi, 1987

ReferenceBooks:

6. Relevant IRC/IS codes.

Mappingof CourseOutcomesCos□Pos□PSOs

	Engineeringknowledge	Problemanalysis	Design/develpomentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-long learning	Plan,analyses,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	1	-	-	-	1	-	-	-	2	-	3
CO2	-	-	-	1	1	-	-	-	2	-	-	-	2	1	3
CO3	-	-	-	1	1	-	-	-	2	-	-	-	2	1	3
CO4	-	-	-	-	1	-	-	-	2	1	-	1	1	1	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES851	**ProjectII**	**PS**	**0**	**0**	**15**	**5**	**15**

Pre-requisite(s)	CourseAssessmentmethods
DesignofConcreteStructures along withConcreteTechnologyLaboratory	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :	• CO1:Demonstrateasoundtechnicalknowledgeoftheirselectedprojecttopic. • CO2:Undertakeproblemidentification,formulationandsolution. • CO3:Designengineeringsolutionstocomplex problemsutilisingasystemsapproach. • CO4:Conductanengineeringproject.
Topics Covered (Hrs)	AnytypeofCivilEngineeringproblemeitherexperimentally,analytically,and Numerically.
Text Books, and/or reference material(s)	***Text Books:*** ***ReferenceBooks:***

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CES852	Comprehensive Viva	PS	0	0	0	0	1

Pre-requisite(s)	CourseAssessmentmethods
DesignofConcreteStructures along withConcreteTechnologyLaboratory	Continuous(CT)and endassessment(EA). CT+EA

Course Outcomes (COs) :	• CO1Demonstrateknowledgeintheprogramdomain. • CO2Presenthisviewscogentlyandprecisely. • CO3Exhibitprofessionaletiquette suitableforcareerprogression
Topics Covered (Hrs)	
TextBooks, and/or reference material(s)	***Text Books:*** ***ReferenceBooks:***

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineer andsociety	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement& finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Code	Titleofthe course	Program Core (PCR)/Electives (PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEO740	**Introduction to EarthquakeEngineering**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisites:		CourseAssessmentmethods					
Nopre-requisites		Continuous(CT)andendassessment(EA). CT+EA					
Course Outcomes	• CO1:ApplyingEngineeringmathematicsinsolvingvibrationproblem • CO2:Abilityto design abuildingearthquakeresistive • CO3:LearnbasicofEarthquake engineering • CO4: Abilitytomanagedisaster						
Topics Covered	**Seismology:**Engineeringgeologyofearthquakes,platetectonics,Seismicityoftheworld, Seismicwaves,faults,plateboundaries,Intensity,Stronggroundmotion,Measuringof Earthquake,EarthquakeMagnitude-Local(Richter)magnitude,surfacewavemagnitude, Moment magnitude. Spectral Parameters: Peak Acceleration, Peak Velocity, Peak Displacement,FrequencyContentandduration.**(12)** **ElementaryVibration:**Vibrationofelementarysystem,Singledegreeandtwo-degree freedomsystems,Earthquakeanalysis,Responsespectrumconcept **(10)** **EarthquakeResistantDesign:**Philosophy,Codebasedmethodsforseismicdesignfor RC buildings.Behaviourofmasonrystructureduringearthquake,bands&reinforcementin masonry**(10)** **General Guidelines**:Efficient seismic resistant planning, selection of sites, importance of architectural features in earthquake resistant buildings, continuity of construction, projection specialconstructionfeatureslikepounding,floatingcolumn,softstorey,staircaseetc.,roleof engineersinthe earthquakemitigations&disastermanagement**(10)**						
Text Books, and/or reference material	***Text Books:*** 1. EarthquakeresistantdesignofstructuresbyPankajAgarwaland ManishShrikhande 2. BasicsofStructural dynamicsandaseismic DesignbyS.R.DamodarasamyandS.Kavitha ***Reference Books:*** 3. ElementsofEarthquakeEngineeringbyJaiKrishna,A.R.Chandrasekharan,Brijesh Chandra						

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	1	-	-	-	-	2	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	--	-	-	3	-	-	-	-	-	-

Course Code	Titleofthe course	Program Core (PCR)/Electives (PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEO741	**ElementaryCivil Engineering**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisites:		CourseAssessmentmethods					
Nopre-requisites		Continuous(CT)andendassessment(EA). CT+EA					
Course Outcomes	• CO1:Gain knowledgeaboutelementarylevel civil engineering • CO2: To learn theuseofsurveyinstruments • CO3:Tolearnaboutconstructionmaterialsandtechnology						
Topics Covered	**Measurement:**Measurementoflengths,heights,andanglesusingsurveyingequipment,chain, tape, Dumpy level, staffs, Theodolites. **(10)** **Survey:** Different mapping methods, elements of chain surveying, compass surveying, plane table surveying, theodolite surveying, leveling and contouring. **(10)** **Building Materials:**Commonbuildingmaterials,stone,brick,timbers,cement,concrete,lime concrete, their strength, characteristics and different types of each material. **(10)** **Construction:**Elementsofresidentialbuildings,methodofconstruction,miscellaneous temporary constructions, form work, timbering etc. **(12)**						
Text Books, and/or reference material	***Text Books:*** 1. Surveyingand LevellingPart IbyT. P. Kanetkar, and S. V. Kulkarni, Pune Vidyarthi Griha Prakashan Pune – 30, 1979 2. EngineeringMaterials byS.C. Rangwala,CharotarPub.House, Anand 3. BuildingConstructionbyS.C. Rangwala, CharotarPub. House, Anand ***Reference Books:*** 4. BuildingConstructionbyB.C.Punmia,A.K.JainandA.K.Jain,LaxmiPublications(P) Ltd.						

MappingofCourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	-	3	-	3	-	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEO742	**FiniteElementAnalysis and Applications**	**PEL**	**3**	**0**	**0**	**3**	**3**

Pre-requisite(s)	CourseAssessmentmethods
Mechanics, Mathematics, Engineeringproblemsinvarious fields	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :	• CO1: Knowledgeofimportance of FEAover classical methods and useit formodelling and analysis of real life engineering systems. • CO2: Learning to simulate physical systems related to various engineering fields throughFE modelling & interpret analysis data for prediction of system response. • CO3:Skillto usecomputational toolsforsolvingengineeringproblems. • CO4: Foundation for using advanced FEA software packages for modelling and analysis of problems related to relevant field of studies in both industry and research.
Topics Covered (Hrs)	**Introduction**:RecapitulationofMatrixManipulationTechniques,SolutionofSimultaneous LinearEquations,InverseofMatrix,EigenValuesandEigen Vectors,Computer Implementation.**(5)** **Engineering Problems:** Different numerical methods, History of Finite Element Method (FEM), Steps in FEM, Areas of Application, Verification problems, implementation of Engineering Problems in FEA**. (10)** **SpringElement:**General,ImplementationinFEA,Applications,Problems. **(5)** **BarElements**:Definition,PropertyMatrixusingDirectandEnergyApproach,Engineering ImplementationinFEA, ProblemsandValidation.**(6)** **ApplicationofFEA:**GeneralConductionProblems,Mechanicalsystems,Electricalsystems etc.Validation,convergencestudyanderroranalysisinsolutionofreallifeengineering problems.**(10)** **ComputerPrograms**/SOFTWARESinFEA.**(6)**
Text Books, and/or reference material(s)	***Text Books:*** 1. Finiteelementanalysis:theoryandprogrammingbyCSKrishnamurthy(2001).Publisher:Tata McGraw Hill Education 2. FiniteElementAnalysisTheoryandApplicationwithANSYSbyMoaveni.Publisher:Pearson (2008) 3. FundamentalsofFiniteElementAnalysisbyDavidV.Hutton.Publisher:TataMcgrawHillEducation Private Limited (2005) ***Reference Books:*** 4. FiniteElementProceduresbyKlaus-JurgenBathe.Publisher:Prentice-Hall(2009)

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	3	-	2	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	3	-	-	-	-	-	-	-	-	3	-
CO4	-	2	-	3	-	-	-	-	-	-	-	-	2	3	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEO743	ElementaryStructuralDesign	PEL	3	0	0	3	3
Pre-requisite(s)		CourseAssessmentmethods					
Engineering/SolidMechanics		Continuous(CT)andendassessment(EA).CT+EA					

Course Outcomes (COs) :	• CO1: Applyknowledgeofsolidmechanics fordesign solutions. • CO2:Understandbasic designphilosophyapplicable tosteel structures. • CO3:Formulate,analyze,anddesignbasiccomponentsofCivilEngineeringSteel structures.
Topics Covered (Hrs)	**Properties** of Reinforced Concrete and Structural Steel, Loads & load combinations, Design Philosophies-Working Stress Method, Limit State Method **(4)** **Limit State Method (LSM) of design for RC Structures:** Limit State of Flexure:Stress-strain characteristics of concrete & reinforcing steel, Moment of Resistance for singly reinforced,doublyreinforcedsections. LimitStateofShear,Bond&Anchorage,Development length, Design of Beams, slab, Short Columns under axial load, Design of isolated Footing. **(19)** **Limit State Method (LSM) of design for Steel Structures**: Limit state of collapse & serviceability, partial safety factor for material and loading, Connections: truss joint connections, Design of Tension member, Compression member, Design for Beams, Gusseted Column base foundation **(19)**
Text Books, and/or reference material (s)	***Text Books:*** 1. ReinforcedConcreteDesignbyS.UPillaiand Devdas Menon,Tata McGraw-Hill. 2. IS456:2000,IndianStandardPlainandReinforcedConcrete–CodeofPractice(4th Revision), BIS, New Delhi. 3. Designof steelStructuresbyN. Subrhamanium(Oxford publications) 4. IS800-2007:GeneralConstructioninSteel-Codeof Practice 5. IS808-1989:DimofHot RolledSteelbeam,column,channeland anglesections 6. www.nptel.iitm.ac.in/courses/ ***ReferenceBooks:*** *7.* ReinforcedConcreteDesignbyS.N.Sinha,Tata McGraw-Hill Publishing*:* 8. LimitStateDesignofSteelStructures byS.K.Duggal,McGrawHill publications

MappingofCourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	2	-	-	-	3	2	3
CO2	3	-	3	-	-	-	1	-	-	2	-	2	3	1	3
CO3	-	2	3	-	-	-	-	2	-	2	2	2	3	3	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives (PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEO744	**Reliability Engineering**	**PEL**	**3**	**0**	**0**	**3**	**3**

Pre-requisite(s)	CourseAssessmentmethods
EngineeringMathematics	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :	• CO1:Applythe conceptsof probabilityandstatistics in reliabilityanalysis. • CO2:Aanalyzedatafor findingfailureprobability. • CO3:ApplyMontecarlosimulationtechniqueinreliabilityanalysis tosolvedifferent engineering problems. • CO4:Develop theconcepts of statistical qualitycontrol andreliabilitytests.
Topics Covered (Hrs)	**Elements of probability and statistics**: Basictheory of probability, random variable, functions of random variables, multiple random variables, Joint PMF, PDF, CDF, Conditional probability, Probability distributions (discrete and continuous), basic statistics, covariance and correlation. (8) **Failuresof Engineeringsystems**:Data analysis, Hazardmodels.(4) **Basic reliability analysis**: Introduction, Definition of reliability, Different classical reliability analysis methods: First Order Reliability Method, Second Order Reliability Method, Engineering applications. (10) **Simulation Techniques**: Monte Carlo simulation technique, theory and applications. (4) **StatisticalQualityControlandReliabilityTests:**StatisticalQualityControl,Statistical Reliability Tests, Accelerated Testing, Goodness of fit tests. (8) **Systemreliability**:Modeling,parallelandseriessystem,Reliabilityimprovementandallocation. (6)
Text Books, and/or reference material(s)	**TextBook(s)** 1. Probabilityconcepts in engineeringand designbyAngand Tang,John Wiley. 2. Probability, reliability and statistical methods in engineering design by A. Halder and S. Mahadevan, John Wiley and Sons. New York. 3. Probability,randomvariablesandstochasticprocessesbyA.Papoulis,McGrawHillNew York. ***ReferenceBook(s):*** 4. Practical Reliability Engineering by Patrick O'Connor, Andre Kleyner,John Wiley and Sons, New York.

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	2	-	3	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	2	2	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	2	1	-	-	-	-	-	-	-	-	-	1	-

Course Code	Titleofthe course	Program Core (PCR)/Electives (PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEO745	**Numericalmethodsin Engineering**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
EngineeringMathematics		Continuous(CT)andendassessment(EA).CT+EA					

Course Outcomes (COs) :	• CO1:Assesstheerrorinvolvedinanumerical method • CO2:Solveproblemsinengineeringandsciencewitharequiredaccuracyusing appropriate numerical methods • CO3:Writealgorithm forthenumerical methods forefficient codingof program • CO4:Understandthemathematicsconceptsunderlyingthenumericalmethods
Topics Covered (Hrs)	**Fundamentals of numerical methods:** Need for Numerical methods in Civil Engineering, Sources of Errors, Absolute, Relative and Percentage, round off error, and stability of algorithms. **(4)** **Linear system of algebraic equations:** Gauss elimination method, LU decomposition method; iterative methods, ill conditioned systems. Jacobi, Gauss Seidel method, Relaxation method. **(8)** **Nonlinear equations:**Bisection method, Regula Falsi method, Newton Raphson method, Modified Newton-Raphson method, Higher order Newton's method Bairstow method,system of non-linear equations. **(8)** **Interpolation and approximation**: Newton's, Lagrange and Hermite interpolating polynomials, cubic splines; least square and minimax approximations**. (6)** **Numerical differentiation and integration:** Newton-Cotes and Gaussian type quadrature methods. **(6)** **Ordinary differential equations:** Initialvalueproblems:singlestepandmultistepmethods, stability and their convergence. Boundary value problems: functional approximation, finite difference method. **(8)**
Text Books, and/or reference material(s)	***Text Books:*** 1. NumericalMethodsforScientistsandEngineersbyR.W.Hamming,DoverPublications;2 edition 2. Numerical Methods: Problems and Solutions by Mahinder Kumar Jain (Author), S.R.K. Iyengar (Author), R. K. Jain, New age publishers 3. NumericalMethodsforEngineersbyChapra,S.C.,andCanale,R.P.,McGrawHill,Inc., 2007. ***Reference Books:*** 4. Applied Numerical Methods for Engineers Using Matlab and C by Robert J. Schilling (Author), Sandra L. Harris, Nelson Engineering; Har/Cdr edition 5. Numerical Analysis for Scientists and Engineers: Theory and C Programs by Madhumangal Pal, Alpha Science Intl Ltd; 1 edition

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineering knowledge	Problemanalysis	Design/development of solutions	Conductinvestigations of complex problems	Moderntool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement & finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	3	-	3	-	-	-	-	-	-	-	-	3	-
CO3	3	-	3	-	3	-	-	-	-	1	-	-	-	3	-
CO4	2	-	-	-	3	-	1	-	-	-	-	-	-	3	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEO746	Watershedplanning&Management	PEL	3	0	0	3	3

Pre-requisite(s)	CourseAssessmentmethods
FluidMechanics,Irrigation&WaterResources Engineering,EconomicsandComputer Applications	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :	• CO1:Aclearunderstandingofdifferentaspectsof watershed • CO2:Developmentofcapabilitiesforoptimizationtechniques,linearanddynamic programming for watershed management • CO3:Developmentofabilitytoformulatemodelforwatershedplanningwith deterministic as well as stochastic inputs,
Topics Covered (Hrs)	**Introduction**: Concept, Definition & Scope, Indian &Global Perspective, Timelinein India, Problems & Prospects, Problems & Constraints **(4)** **Land Capability & Planning**: Definition, Classification, Planning, Use, Restoration, Policy Analysis & Decision Support **(3)** **WatershedCharacteristics:**Physical&GeomorphologicFactors,Classification& Measurement, Physical, Geomorphologic & Quantitative Characteristics **(4)** **ImportanceofWatershedProperties:**WatershedManagement,EffectofPhysicalProperties, Effect of Geomorphologic Factors & Associated Processes **(4)** **Hydrologic Data**: Definition, Scope, Hydro-meteorological & Physiographical Data **(3)** **DelineationandPrioritization**:ConceptofTopographicorContourMap,Boundary Delineation,GISforDelineation,AccuracyinDelineation,ConceptofPriority,Factors, Basics & Methods, Purpose & Benefits **(4)** **WaterYieldAssessment&Measurement**:ConceptofWaterYield&itsassessment, benefits, Perspectives, Measurement, Modelling & Assessment **(3)** **HydrologicandHydraulicDesign**:Hydrologicdesign,rechargestructures,Earthen Embankments & Diversion Structures, Hydrology & Hydrologic design **(5)** **SoilErosion anditsControlMeasures**:Types,Problem&Control **(4)** **SedimentYieldEstimation**:Generation&TransportMechanism,TypesMethods Estimation & Modelling, Estimation of Different Load **(4)** **RainwaterConservation &Harvesting**:Need, Techniques,Design**(4)**
Text Books, and/or reference material (s)	***Text Books:*** 1. Watershed management challenges: Introduction and overview by E. R. Sharma & C. A.Scott, (2005), Watershed Management Challenges: Improving 2. LandandWaterManagementEngineeringbyV.V.N.Murthy&M.K.Jha,(2011),Kalyani Publishers, Ludhiana, India. 3. WatershedManagement-GuidelinesforIndianConditionsbyE.M.Tideman,(1999),Omega Scientific Publishers, New Delhi. 4. Integrated Watershed Management in Rainfed Agriculture by S. P. Wani, J. Rockström & K. L.Sahrawat, (2011). CRC Press. ***Reference Books:*** 5. http://www.ussi.co.uk/Weirs_and_Flumes.html.Lastseen:29thSeptember2013

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineering knowledge	Problem analysis	Design/development of solutions	investigationsof complex	Moderntool usage	Theengineer and society	Environment& sustainability	Ethics	Individual& team work	Communication	Project management& finance	Life-long learning	Plan,analyse, design and prepare	Computeraided skill and tools	codal provisions / guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	3	3	3	3	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	3	3	3	3	3	-	2	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEO747	**Road safety awareness program**	**PEL**	**3**	**0**	**0**	**3**	**3**

Pre-requisite(s)	CourseAssessmentmethods
TransportationEngineering	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :	CO1: Identify the factors contributing to accidents. CO2: Collect data pertaining to road crashes and prepare a comprehensive crash database CO3: Perform statistical analysis of crash data. CO4: Formulate traffic management measures for accident prevention and perform road safety audit and prepare an audit report.
Topics Covered (Hrs)	Module 1: (10 hours) **Introduction to road safety engineering** - Overview of road safety - Global road safety scenario and pattern - global trends and projections - national and state road safety level - problems in road safety in developing countries- magnitude, socioeconomic and health effects. Module 2: (10 hours) **Road user's prospects** - Characteristics of Road user, Motor vehicle, Roadway- the relationship between elements- human factors governing road user behavior- risk factors for traffic accidents- exposure to risk- crash involvement- crash severity- post-crash injury outcomes Module 3: (10 hours) **Analysis and prevention-** Collection of accident data strategies to Improve Highway Safety--Format of the accident data- Sample Accident Report-Statistical methods for the analysis of accident data Module 4: (10 hours) **Analysis and report preparation –** Statistical Comparison, Proportionality Test, T-testing, Empirical Bayes Method, ML modeling for accident data- Road Safety Audit- Blackspot Identification
TextBooks and/or reference material(s)	***ReferenceBooks:*** 1. David L. Geotsc. Occupational Safety and Health for Technologists, Engineers and Managers. 5th Edition, 2004. 2. World Health Organization, Road Traffic Injury Prevention Training Manual, 2006. 3. Matson, M.T., Smith, S.W., Hurd, W.F. Traffic Engineering, McGraw-Hill Book Company Inc., London, 1955. 4. Fuller, R., Santos, J.A. Human Factors for Highway Engineers, Pergamon, 2002. 5. Khisty, C.J., Lall, B.K. Transportation Engineering- An Introduction, Third Edition, Prentice Hall of India, New Delhi, 2006. 6. Jason C.YU, Transportation Engineering- Introduction to Planning, Design, and Operations, Elsevier, 1982. 7. Kadiyali, L.R. Traffic Engineering and Transportation Planning, Khanna Publishers, New Delhi, 2009. 8. IRC: 103-1988, Guidelines for Pedestrian Facilities, Indian Roads Congress, New Delhi. 9. IRC: SP: 32-1988, Road Safety for Children (5-12 Years old), Indian Roads Congress, New Delhi. 10. IRC: SP: 44-1996, Highway Safety Code, Indian Roads Congress, New Delhi. 11. IRC: SP: 88-2010, Road Safety Audit Manual, Indian Roads Congress, New Delhi.

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Modemtool usage	Theengineerand society	Environment&sustainability	Ethics	Individual& team	Communication	Projectmanagement &finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-		-	-
CO2	3	2	3	4	-	-	-	-	-	-	-	-	3	3	3
CO3	-	3	3	-	3	-	-	-	2	-	-	3	2	1	1
CO4	3	3	3	-	-	-	2	-	2	-	-	3	3	3	3

Course Code	Title of the course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE510	AdvancedConcrete Technology	PCL	3	0	0	3	3

Pre-requisite(s)	CourseAssessmentmethods
SolidmechanicsandConcrete Technology	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs)	• CO1: Identify and suggest suitable materials for cement concrete construction. • CO2: Design a concrete mix proportion based on the requirements and make a proper concrete for construction purposes. • CO3: Determine the hardened properties of concrete and make a durable concrete • CO4: Explore special concretes for construction
Topics Covered (Hrs)	**Concrete and its properties:** (**8**) Brief Introduction to Concrete Making Materials: Cement, Aggregates, Water, Admixture; *Mix Design*: Factors influencing design of mix, IS method of mix design; *Fresh Concrete*: Rheology of concentrated suspensions, pastes, mortars and concretes; workability, segregation and bleeding. **Strength of Concrete: (8)** Strength-porosity relationship, failure modes in concrete, factors affecting strength, behaviour of concrete under various stress states **Dimensional Stability: (6)** Types of deformations and their significance, Elastic behaviour, Drying shrinkage and creep, Thermal shrinkage **Durability: (6)** Significance, crystallization in pores, deterioration mechanism of concrete upon frost action, fire, chemical reactions, corrosion etc. **Advances in concrete: (6)** Structural lightweight concrete, high-strength concrete, high performance concrete, fiber-reinforced concrete, Heavyweight Concrete for Radiation Shielding, Mass concrete etc. **Microstructure of concrete: (5)** Significance of microstructure of concrete, microstructure of aggregate phase, microstructure of hydrated cement paste, interfacial transition zone
Text Books, and/or reference material(s)	***Text Books:*** 1. Engineering Materials by S. C. Rangwala, K. S. Rangwala and P. S. Rangwala, Charotar Publishing House, Anand 2. ConcreteTechnologybyM. S.Shetty,S. ChandPublisher,New Delhi 3. IS10262:2009,ConcreteMixProportioning-Guidelines(1stRevision),BIS,NewDelhi. 4. IS383:1970,SpecificationforCoarseandFineaggregatesfromnaturalsourcesfor concrete (2nd Revision) BIS, New Delhi. ***ReferenceBooks:*** 5. ConcreteTechnologybyM.L.Gambhir,Tata McGrawHilland www.nptel.ac.in

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	3	-	3	3	-	-	-	-	3	3	-	3
CO2	3	3	3	3	2	3	3	-	-	-	-	3	3	2	3
CO3	3	-	-	3	-	3	3	-	-	-	-	3	3	-	3
CO4	3	3	3	3	-	3	3	-	-	-	-	3	3	-	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE511	**AdvancedStructural Mechanics**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
Solid Mechanics		Continuous(CT)andendassessment(EA).CT+EA					
Course Outcomes (COs) :	• CO1:Todevelopbasicunderstandingofthefundamentalconceptsoftheadvanced topics. • CO2:Todefinethestressandstraintensorsforstructuralmembersandtowritethe stress-strain relationships. • CO3:Toevaluatethestateofstressorstateofstrainwithrespecttothedifferent theories of failure and compare. • CO4:Toapplythe principlesofstructural mechanicstospecial structures.						
Topics Covered (Hrs)	**Analysis of stress:** Definition of stresses; stress matrix; state of stress; Cauchy's stress relations; stress transformation, principal stresses; equations of equilibrium; different types of stresses; polar coordinates; three-dimensional Mohr's circle. **(6)** **Analysis of strain:** Definition of strains; deformation vector; strain-displacement relations; strain matrix; principal strains; total distortion and rigid body rotation; strain compatibility conditions; volumetric strain; polar coordinates. **(6)** **Stress-strainconstitutiverelations:**(3) **Theoriesoffailure:**(3) **Analysis of non-prismatic member**s: General Euler-Bernoulli Law; linear Euler-Bernoulli equation; effect of bending of non-prismatic members. **(2)** **Thin Walled Pressure Vessels**: Stresses, strains in cylindrical and spherical vessels; change in volume, strengthening of thin cylinders, solution of numerical problems to implement the above concepts. **(4)** **Thick Walled Pressure Vessels:** Cylinders and Spheres: stresses; compatibility; Lame's equation; special case of solid shaft; thick spherical shells. **(4)** **Curved Beams**: Introduction; stresses in curved beams; eccentricity; rings under loads; distribution of stresses and bending moments in rings. **(4)** **Unsymmetrical Beam Bending**: Introduction;beamswithdoublysymmetriccross-sections;beams with arbitrary cross sections. **(4)** **IntroductionToPlates**(3)						
Text Books, and/or reference material(s)	***Text Books:*** 1. SolidMechanics byS.M.A. Kazimi,Tata McGraw-HillPublishingCompanyLimited 2. AdvancedMechanicsof Solids byL.S. Srinath,TataMcGraw-Hill Publishing ***ReferenceBooks:*** 3. MechanicsofSolids byAbdulMubeen						

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individual&	Communication	Projectmanagement& finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	-	3	2	-	-	-	-	-	-	-	-	2	-	-
CO3	3	-	3	2	2	-	-	-	-	-	-	-	2	-	-
CO4	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE512	**Principlesof Reliability**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)			CourseAssessmentmethods				
EngineeringMathematicsandDesignof ConcreteStructures			Continuous(CT)andendassessment(EA). CT+EA				

Mapping of Course Outcomes (COs) :

- CO1:Understandofreliabilitytheorybasedonknowledgeoffundamentalsofprobabilityand statistics.
- CO2:ApplyMontecarlosimulationtechniquetosolvedifferentcivilengineering problems.
- CO3:Understandthedifferentreliabilityanalysismethods.
- CO4:To designthe elementsof civil engineeringstructures byusingreliabilitymethods.

Course Outcomes (COs) – Topics Covered (Hrs)

Basic statistics and probability: Definition of probability, Axioms of probability, Conditional probability, Total probability theorem, Bayes' theorem, Basics of statistics, Definition of random variable, Different functions of random variable, Discrete and continuousrandomvariables,Multiplerandomvariables,probabilitydistributionofrandom variables (Bernoulli and Binomial distribution, Poisson, geometric, hypergeometric, uniform, normal, lognormal, gamma). **(10)**

Simulationtechnique: MonteCarlomethod,theoryandapplications.**(5)**

Reliability analysis: Definition of reliability, Limit state function, Reliability Index, Different classical reliability analysis methods, First order reliability method, Hasofer-Lind reliability method, Rackwitz-Fiessler reliability method, Introduction to second order reliability method. **(15)**

Reliability-based design: Load and resistance parameter model, reliability based code format,Calibrationofpartialsafetyfactorsforalevelcode,Applicationstosolvedesign problems.**(9)**

Text Books, and/or reference material (s)

Text Books:

1. StructuralReliabilityAnalysisandDesignbyRanganathan, JaicoPublishingHouse
2. Probability,ReliabilityandStatisticalMethodsinEngineeringDesignbyA.Halder and S. Mahadevan, John Wiley and Sons. New York.

ReferenceBooks:

3. ProbabilityConcepts in Engineeringand DesignbyAngand Tang,John Wiley.
4. Structural Reliability Analysis and Prediction by R. E. Melchers and A. T. Beck, John Wiley.

PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	1	-	3	-	-	-	-	-	-	-	-	-	3	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	1	-	3	-	-	-	-	-	-	-	-	-	3	-	-

Course Code	Title of the course	Program Core (PCR)/ Electives (PEL)	Total number of contact hours				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total hours	
CEE513	**Applied Probability and Statistics in Civil Engineering**	PEL	3	0	0	3	3
Pre-requisite(s)		Course Assessment methods					
		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs)	• CO1: understand the basic of probability and statistics • CO2: understand the random variables, different distributions of random variables, functions of random variable, joint distribution, sampling distributions, estimation theory, testing of hypothesis and goodness of fit tests. • CO3: solve different engineering problems applying the theory of probability and statistics. • CO4: apply the theories of probability and statistics to analyse data which is important for design of civil engineering problems.
Topics Covered (Hrs)	Probability: Axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence, civil engineering problems. **(4)** Random Variables: Discrete, continuous random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, probability and moment generating function, Markov inequality, Chebyshev's inequality problems. **(6)** Special Distributions: Discrete uniform, binomial, geometric, negative binomial, hypergeometric, Poisson, continuous uniform, exponential, gamma, Weibull, beta, normal, lognormal, civil engineering problems. **(8)** Function of a random variable: Different functions of a random variable. **(2)** Joint Distributions: Joint, marginal and conditional distributions, product moments, correlation and regression, independence of random variables, bivariate normal distribution. **(4)** Sampling Distributions: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions, problems **(2)** Estimation: Unbiasedness, consistency, the method of moments and the method of maximum likelihood estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions. **(5)** Testing of Hypotheses: Null and alternative hypotheses, the critical and acceptance regions, tests for one sample and two sample problems for normal populations, tests for proportion. **(6)** Goodness of fit tests: Chi-square goodness of fit test and its applications, civil engineering problems. **(2)**
Text Books, and/or reference material (s)	**Text Books**: 1. Ang, A. H. S. and Tang, W. H. 1975. Probability Concepts in Engineering Planning and Design: Volume 1, Basic Principles, Wiley. 2. Ang, A. H.-S. and Tang, W. H. 1984. Probability Concepts in Engineering Planning and Design: Volume 2 Decision, Risk and Reliability, Wiley, New York. 3. Ross, S, 1998. A First Course in Probability, Prentice Hall, NJ. 4. Montgomery, D.C. and Runger, G.C. 1998. Applied Statistics and Probability for Engineers, Wiley, New York. **REFERENCE BOOKS:** 1. Spiegel M. R., Schiller, J.J. and Srinivasan, R. A. 2010. Probability and Statistics, Tata-McGraw-Hill, New Delhi. 2. Papoulis, A. 1991. Probability. Random variable and Stochastic process, McGraw-Hill, New York.

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Moderntool usage	Theengineerand society	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	Codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-			
CO2	3	1	-	-	-	-	-	-	-	-	-	-			
CO3	2	3	2	1	2	-	-	-	2	-	-	-			
CO4	2	3	3	2	3	-	-	-	2	-	-	-			

Course Code	Title of the course	Program Core (PCR) / Electives (PEL)	Total Number of contact hours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE514	**Experimental methods and Analysis**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Basic Engineering, statistics & probability		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs):	• CO1: Development of skills for predicting engineering system behaviour • CO2: Knowledge of basics of data analysis for further applications. • CO3: Developing the requisite skill that helps in the advanced courses related to experimental study
Topics Covered (Hrs)	**Types of measurements and errors**: Internal & external estimates of errors, Relative frequency distribution, Histogram, True value, Precision of measurement, Best estimate of true value & precision, Methods of calculating best estimate of true value & standard deviation **(7)** **Combination of measurements**: Accuracy of mean, Significant digits. Method of least squares & its application for calculation of best estimate of true value, curve fitting, **(8)** **General linear regression**: Comparison & combination of measurements. Extensions of least square method. Theory of errors, Binomial & Gaussian distribution, Confidence limits, Significance test, principle of maximum likelihood & goodness of fit, Chi-square test. **(9)** **Displacement measurement**: Dial Gauge, Microcator, Optical Method, Pneumatic Transducer, Strain Gauges, Variable Inductance & Capacitance Transducer, Piezo-Electric, Electro-Kinetic, Photo-Electric, Ionization, Vibrating Wire & Vacuum Tube Transducer. **Force & Torque:** Elastic Type, Fluid Load Cell, Dynamometers. **Temperature:** Bi-Materials, Pressure & Resistance Thermometers, Thermocouples & Pyrometers. **Pressure:** McLeod Gauge, Pirani Gauge, Ionization Gauge, Manometers, Bourdon Tube, Resistance Gauges. **Fluid Velocity:** Pitot tube & Hot Wire Anemometer, LDA. Flow Measurement in Confined Passages & Open Channels. Miscellaneous measurements **(10)** **Dynamic Response** of a Measuring Instrument, Response to Transient & Periodic Signals, First & Second order systems as well as their Dynamic Response Characteristics. (**8)**
Text Books, and/or reference material (s)	***Text Books:*** 1. Instrumentation, Measurement and Analysis by B C Nakra and K K Chaudhary, Tata McGraw Hill, 1985. 2. Principles of Measurement, Precision, Error and Truth by N C Barford, Addison Wesley, 1967. ***Reference Books:*** 3. Physical Measurement and Analysis by N N Cook and E Rabinowicz, Addison Wesley, 1963 4. Experimental Methods for Engineers by J P Holman and W J Gajda, McGraw Hill Co., 1978

Mapping of Course Outcomes COs→POs→PSOs

	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment & sustainability	Ethics	Individual & team work	Communication	Project management & finance	Life-long learning	Plan, analyse, design and prepare	Computer aided skill and tools	codal provisions / guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	-	-	-	-	-	-	2	-	-	-	2	-	-
CO2	3	-	3	-	-	-	-	-	1	2	-	2	3	-	-

CO3	-	-	3	-	-	-	-	2	-	2	1	3	1	-	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE515	**Transportation Infrastructure Design**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
TransportationEngineering		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes (COs) :	CO1: Design the geometrical elements of midblocks and intersections. CO2: Perform safety evaluation of design of existing and proposed geometric designs. CO3: Plan and design the pedestrian, bicycle and parking facilities.
Topics Covered (Hrs)	**Module 1: (10 hours)Design of Urban and rural road:** Hierarchy of Highway System, Functions, Geometric Design Standards, Design Controls and Criteria – Vehicle, Driver and Traffic; Cross-Section Elements, Typical Sections, urban and rural road geometries and its standards –Cross-Sectional Elements, Urban Street Planning Measures, Urban Road Classification, Planning Considerations, Street Design for Regulating Mixed Traffic, Design Speed, Segregation of Lanes, and Traffic Calming Measures. **Module 2: (6 hours)Public Transport:** Bus Stops, Bus Bays, Bus Rapid Transit, Multi-modal Integration. Intermediate Public Transport **Commercial Traffic**: Planning and Design Measures, **Module 3: (6 hours)Cycle Traffic-** Types of Cycle Tracks, Location and Width of Cycle Track, Riding Surface and Lighting, Bicycle Parking Infrastructure, Parking and Storage **Module 4: (8 hours)Design of Intersections**: Types of Intersections and Controls, Principles of Intersection Design; Design of At-Grade Intersections – Design Elements, Channelisation, Design using Templates; Rotary and Roundabout – Design, Capacity; Signalised Intersections – Benefits and Drawbacks, Warrants, Design; Signal Coordination – Methods, Design; Grade separated intersections – Warrants, Types, Geometric Standards, Spacing and Space controls, Ramps and Gore area design, **Module 5: (5 hours)On-street Parking Facilities. Road Signs and Marking** **Module 6: (4 hours)Pedestrian Facilities:** Characteristics of Pedestrians and Bicycles, Issues Shared by Pedestrians and Bicycles, Pedestrian Facility Design - Walkways, Sidewalks, and Public Spaces, Pedestrian Facility Capacity and LOS, Signs and Pavement Markings , Intersections, Midblock Crossings, Flyovers and Subways; Bicycle Facility Design - Shared Roadways
TextBooks and/or reference material(s)	***ReferenceBooks:*** 1. Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna publishers, 1987. 2. IRC-SP41: Guidelines for the Design of At-Grade Intersections in Rural and Urban Areas 3. IRC-70-2017 guidelines on regulation and control of mixed traffic in urban areas 4. Salter, R. J., Highway Traffic Analysis and Design, ELBS, 1996. 4. Edward K. Morlock, Introduction to Transportation Engineering and Planning, International Student Edition, McGraw-Hill Book Company, New York, 1992. 5. Guide for the Planning, Design, and Operation of Pedestrian Facilities, AASHTO, 2004 6. Guide for the Development of Bicycle Facilities, AASHTO, 1999 7. Manual on Uniform Traffic Control Devices (MUTCD), 2009 8. Urban Intersection Design Guide, Texas Department of Transportation, 2005

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Modemtool usage	Theengineerand society	Environment&sustainability	Ethics	Individual& team	Communication	Projectmanagement &finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-		-	-
CO2	3	2	3	4	-	-	-	-	-	-	-	-	3	3	3
CO3	-	3	3	-	3	-	-	-	2	-	-	3	2	1	1

Course Code	Title of the course	Program Core (PCR) / Electives (PEL)	Total Number of contact hours				Credit
			L	T	P	H	
CEE516	**Transportation Planning and Management**	**PEL**	**3**	**0**	**0**	**3**	**3**

Pre-requisite(s)	Course Assessment methods
Engineering & Solids Mechanics with Structural Analysis	Continuous (CT) and end assessment (EA). CT+EA

Course Outcomes (COs) :	CO1- Develop an understanding of transportation planning to measure transportation demand. CO2- Design various travel behavior surveys to collect transportation planning related data and analyze the data for calibration and validation of various types of models involved in traditional four-step travel demand forecasting process. CO3-Develop in-depth knowledge on the classic four stage demand models including: 1) trip generation, 2) trip distribution, 3) mode choice, and 4) trip assignment. CO4- Able to understand econometric models and use statistical packages for sustainable transportation planning and land-use transport
Topics Covered (Hrs)	**Introduction to Transportation Systems Planning (5 hrs)** Basics of Transportation Planning process; Characteristics of transportation problem: Transportation ; transportation demand and supply problem; concept of equilibrium, Introduction to transportation modelling: Revealed and stated-preference models; Aggregate and disaggregate models; Cross-section and time-series models, Overview of Traditional Four-Step Travel Demand Forecasting Process; Information needs for travel demand forecasting; Zoning and O-D matrix estimation from traffic surveys **Transportation Data Collection (4 hrs)** Type of data collection methods; Survey instrument design; Sampling procedures **Trip Generation (8 hrs)** Introduction to trip-generation concepts; Factors affecting trip generation; Types of trips; Regression analysis; Linear regression technique and related statistical parameters; Development of regression models from field datasets; Category analysis; Temporal and geographical stability **Trip Distribution (8 hrs)** Trip distribution models: Growth factor models including Uniform factor method, Average factor method, Fratar method and Furness method; Synthetic methods including Gravity model, Intervening opportunities model and Competing opportunities model **Modal Split (8 hrs)** Basic modal split models: Trip end and Trip interchange type modal split models: Random Utility theory; Discrete choice modelling framework: Estimation, assumption and specifications of binary, multinomial, mixed and nested Logit and Probit models; Modelling with RP and SP data; Model aggregation and transferability; Introduction and application of N-logit econometric package **Traffic Assignment (4 hrs)** Basic concepts of assignment; Speed-flow and cost-flow curves; All-or-Nothing assignment; Incremental assignment; Capacity restraint assignment; Stochastic assignment; Stochastic user equilibrium assignment; System optimum assignment and introduction to Dynamic assignment; Shortest path tree building algorithms; Public transport assignments **Smart City planning (2 hrs)** Smart City Transportation Planning: Transit-Oriented Development (TOD), Pedestrian-Oriented Development, Liveable Street Planning
Text Books, and/or reference material(s)	***Text Books:*** 1. De Dios Ortuzar, J., and Willumsen, L. G. Modelling transport. John Wiley & Sons., 2011 ***2.*** Hutchinson B.G; Principles of Urban Transport Systems Planning; McGraw-Hill Book Company, 1974. ***Reference Books:*** 1. Papacosta, C.S., and Prevedouros Transportation Engineering and Planning, PHI Pvt. Ltd.,2004 2. Chakroborty, P. and Das, A. Principles of Transportation Engineering, PHI Pvt. Ltd., 2012 3. Train, K. E. Discrete choice methods with simulation. Cambridge university press, 2009 4. Kadiyali, L. R. Traffic Engineering and Transport Planning, Khanna Publishers, 2015

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/development of solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineer andsociety	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraideskilland tools	Codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	-	2	-	-	3	2	-	2
CO2	3	3	3	1	-	-	1	-	-	2	-	3	2	-	3
CO3	2	3	3	1	-	1	-	2	-	2	1	1	3	1	3
CO4	3	3	3	1	-	1	1	2		-	1	2	3	1	3

Course Code	Titleofthe course	Program Core (PCR)/Electives (PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC517	RemoteSensing&GIS	PEL	3	0	0	3	3
Pre-requisite(s)		CourseAssessmentmethods					
None		Continuous(CT)andendassessment(EA).CT+EA					

Course Outcomes (COs):	CO1: Learn about basic items, parameters & concepts related with remote sensing. CO2:Applytechniquesofvisualimageinterpretationanddigitalimageprocessing. CO3:UseGISand itscomponentsforbasic applicationsincivil engineering.
Topics Covered (Hrs)	**Remote Sensing**: History, Physical basis, Electromagnetic spectrum, Spectral reflectance curves, Spectral signatures, Resolutions, Passive & active remote sensing, Remote sensing platforms. **(12)** **Sensors**: Different types, Satellite band designations & principal applications, FCC, Aerial photography & its interpretation. **(9)** **Digital image processing**: Pixels & DN values, Digital image formats, Image processing functions– Imageenhancement, Imagetransformation, Imageclassification&analysis.**(9)** **Geographic Information System:** Introduction, GIS components – hardware, software & infrastructure, GIS data types, Data input & processing, DEM generation, Preparation of thematic map from RS data. **(6)** **Integration of RS & GIS techniques** and its applications in the field of Civil Engineering. (3)
Text Books, and/or reference material (s)	***Text Books:*** 1. RemoteSensing &GIS (2nd Ed.)byB.Bhatta(Oxford UniversityPress, New Delhi) 2. Textbook of Remote Sensing & Geographical Information Systems (3rd Ed.) by M. Anji Reddy (BS Publications, Hyderabad) ***ReferenceBooks:*** 3. Remote sensing & Image Interpretation (6th Ed.) by T.M. Lillesand, R.W. Kiefer & J.W. Chipman (Wiley India (P) Ltd., New Delhi) 4. GeographicalInformationSystems(2ndEd.)byP.A.Longley,M.F.Goodchild,D.J. Maguire & D.W. Rhind (John Wiley & Sons, Inc.)

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	1	-	-	-	-	-	-
CO2	3	2	-	2	2	-	1	-	1	1	-	3	-	-	-
CO3	3	2	3	-	2	-	1	-	1	1	-	3	-	-	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE518	**Hydrology andIrrigation Engineering**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
PhysicsandFluidMechanics		Continuous(CT)andendassessment(EA).CT+EA					

Course Outcomes (COs) :	• CO1:Understandingofoccurrence,distribution,storage&transmissionofwaterin different form in space, over & below surface of earth, data collection & processing • CO2:Understandingflowgeneration,occurrenceofflood,drought,environmentalflow requirement. • CO3:Realizingneedforfoodsufficiency,cropwater,irrigationrequirement,method& design of infrastructures for irrigation requirement.
Topics Covered (Hrs)	**Introduction**:BriefintroductiontoHydrologyand Irrigationsystem**(6)** **Diversionhead-works**: Definition of weirsandbarragesand their classification,Layoutof typical diversion head-works and function of its components. **(3)** **Concrete gravity dams:** Forces acting, Elementary profile, Design of gravity dams **(3) Earthen dams:** Types, Causes of failure, Seepage control, Slope protection **(3) Hydraulicpower:**Thermal-waterpower,systems,arrangement,equipment,operation**(2)** **River navigation:** Requirements of navigable waterways, Methods of achieving navigability, Open channel methods, Navigation dams, Navigation locks, Financing river navigation projects. **(4)** **Ground water:** Occurrence, Well hydraulics, Regional aquifer hydraulics, Ground water quality. **(4)** **Flood damage mitigation:** Design flood, Flood mitigation, Improvement, Evacuation and flood proofing, Land management and flood mitigation, Flood forecasting, Flood plain management, Economics of flood mitigation **(5)** **Planningforwaterresourcesdevelopment:**Level,Phases,objectives,formulation,evaluation, Environmental issues, Systems analysis, multiply purpose projects. **(2)** **Engineeringeconomyinwaterresourcesplanning:**Socialimportance,Annualcost comparisons, Interest and taxes, Frequency and economy, Economy studies for public works, Cost allocation. **(4)** **Planningforwaterresourcesdevelopment:**Levelofplanning,Phases,Objectives,Data requirements,Projectformulationandevaluation,Environmentalconsiderations,Systems analysis,Multiplepurposeprojects.**(3)**
Text Books, and/or reference material(s)	***Text Books:*** 1. EngineeringHydrologybyK.Subramanya,FourthEdition,McGrawHillsEducation(India)Private Limited, New Delhi 2. IrrigationandWaterPowerEngineeringbyB.C.Punmia,B.B.Pande,A.K.Jain&A.Kumar, 16th Edition, Laxmi Publications (P) Limited, new Delhi. ***Reference Books:*** 3. HydrologybyV.T.Chow,McGraw-HillBookCompany,Inc.,NewYork

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Moderntool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	3	3	3	-	-	-	-	-	-	-	-	1	-	1
CO3	-	-	-	-	3	3	3	3	3	3	3	3	1	-	2

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE519	GroundWater	PEL	3	0	0	3	3

Pre-requisite(s)	CourseAssessmentmethods
FluidMechanicsandWater ResourcesEngineering	Continuous(CT)andendassessment(EA).CT+EA

Course Outcomes (COs) :	• CO1: Understanding of occurrence, distribution, storage and transmission of water below the ground level. • CO2:Understandingof mechanics of flowofwaterundertheground • CO3:Techniquesfor exploitationof groundwateronsustainablebasis. • CO4:Abilitytodevelop modelsforstorage and transmissionofgroundwater. • CO5:Developmentofcapabilitiesinrecharging,management&conjunctiveuseof ground water
Topics Covered (Hrs)	**Fundamentalsofgroundwater:**Introduction–CharacteristicofGroundwater–Distributionof water - ground watercolumn–Permeability- Darcy'sLaw-Typesof aquifers -HydrogeologicalCycle–waterlevelfluctuations. **(6)** **Hydraulicsofflow:**Storagecoefficient-Specificfield-HeterogeneityandAnisotropy-Transmissivity–Governingequationsofgroundwaterflow-Steadystateflow–Dupuit Forchheimerassumptions– Velocitypotential-Flownets **(8)** **Estimationofparameters:**TransmissivityandStorativity–Pumpingtest-Unsteadystate flow - Thiess method – Jacob method - Image well theory – Effect of partial penetrations of wells - Collectors wells. **(6)** **Groundwaterdevelopment:**Infiltrationgallery-Conjunctiveuse-Artificialrecharge Rainwaterharvesting-Safeyield–Yieldtest–Geophysicalmethods–Selectionofpumps. **(6)** **Waterquality:**Groundwaterchemistry-Origin,movementandquality-Waterquality standards–Saltwaterintrusion –Environmentalconcern**(6)** **Artificialrecharge:**Artificialrechargeofgroundwater;conceptofartificialrecharge–rechargemethods,relativemerits,ApplicationofGISandRemoteSensinginArtificial RechargeofGroundWater**(3)** **Groundwatermanagement:**Groundwaterbasinmanagement;conceptsofconjunctionuse **(4)**
Text Books, and/or reference material(s)	***Text Books:*** 1. GroundWaterHydrologybyH.M.Raghunath,WileyEasternLtd., 2000. 2. GroundWaterHydrologybyD.K.Todd,JohnWileyandSons, 2000. 3. GroundWaterbyBawvwr,JohnWiley& Sons 4. GroundwaterSystemPlanning&Management byR.Willes&W.W.G.Yeh,Printice Hall. 5. AppliedHydrogeologybyC.W.Fetta,CBSPublishers&Distributers. ***Reference Books:*** 6.PrinciplesofPavementEngineeringbyNickTom

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineering knowledge	Problemanalysis	Design/development of solutions	Conduct investigationsof complexproblems	Moderntool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement & finance	Life-longlearning	Plan,analyse,design and prepare	Computeraideddskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	3	3	3	-	-	-

CourseCode	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE610	AdvancedStructural Analysis	PEL	3	0	0	3	3

Pre-requisite(s)	CourseAssessmentmethods
Engineering&Solids Mechanicswith StructuralAnalysis	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :	• CO1: Develop basic understanding of the fundamental concepts and theorems of the advanced topics in analysis of structures. • CO2: Model and analyze different structural systems bymatrix method of analysis using element approach of force/ flexibility method. • CO3: Model and analyze different structural systems bymatrix method of analysis using element approach of displacement/ stiffness method. • CO4: Understand the basic methodology adopted in developing computer programmes for structural analysis and thus, develop an overall understanding of the available structural analysis softwares. • CO5:Abilityto writethegoverningequations forstability&analysis ofstructures.
Topics Covered (Hrs)	**Recapitulation**ofbasicconceptsofstructuralanalysis,force&displacementmethods, statical & kinematic indeterminacies of pure truss, pure frame & generalized structures **(4)** **Stiffness / Displacement Method**: System approach of solution, global and local coordinate systems,elementstiffnessmatricesfortrussandframeelements,displacementandforce transformationmatrices,connectivityarrays,globalstiffnessmatrix,globalloadvector,assemblingof stiffness matrix and loadvector,solution ofstiffness equation, output ofglobal displacementsandlocalmemberendforces,introductiontowarpingtorsionandsheardeformation, three dimensional element stiffness matrix and transformation matrix, analysis of grids, different types of example problems. **(15)** **Flexibility/ Force Method**: System approach of solution, global and local coordinate systems, element flexibility matrices for truss and frame elements, force transformation matrices, global flexibility matrix, global load vector, assembling of flexibility matrix, solution of flexibility equation, output of displacements and member end forces, different types of example problems. **(10)** **ElasticStabilityAnalysis**of beam,columnandframes. **(10)**
TextBooks, and/or reference material(s)	***Text Books:*** 1. StructuralAnalysisbyL.S.Negi&R.S.Jangid,TataMcGraw-HillPublishingCompanyLimited 2. StructuralAnalysis:AUnifiedClassicalandMatrixApproach,AminGhali,AdamM.Neville by E& FN SPON 4th Ed. 3. StabilityAnalysisandDesignofStructurebyM.L.Gambhir,Springer2004edition ***Reference Books:*** 4. StructuralAnalysis:AMatrixApproachbyG.S.Pandit&S.P.Gupta,TataMcGraw-Hill PublishingCompanyLimited

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineering knowledge	Problemanalysis	Design/development of solutions	Conduct investigations of complexproblems	Moderntool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement & finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	3	-	1	-	-	-	-	-	-	-	2	-	-
CO3	3	3	3	1	1	-	-	-	-	-	-	1	2	-	-
CO4	-	-	-	-	2	-	-	-	-	-	1	2	-	-	-
CO5	3	3	2	1	-	-	-	-	-	-	-	1	-	-	1

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE611	**Introduction to FiniteElementMethod**	**PEL**	**3**	**0**	**0**	**3**	**3**

Pre-requisite(s)	CourseAssessmentmethods
SolidMechanics,StructuralEngineering& Engg. Mathematics	Continuous(CT)andendassessment(EA).CT+EA

Course Outcomes (COs) :

- CO1: Understanding the advantage of FEM over classical methods and use it for modelling and analysis of real life engineering structures.
- CO2:SkilltosimulatesimpleengineeringstructuresthroughFEmodelllingandinterpretdata from the FE analysis to ascertain their reliability and applicability in light of physical constraints of the system and common engineering sense.
- CO3:Abilityto use computational tools forsolvingCivil Engineeringproblems.
- CO4: Skill of using advanced FEA software packages and development of FE codes for modelling, analysis and investigation of problems related to industry and research.

Topics Covered (Hrs)

Introduction:EngineeringProblems,Differentnumericalmethods,HistoryofFiniteElement Method(FEM),StepsinFEM,AreasofApplication,Verificationproblems,implementationof EngineeringProblemsinFEM**.(9)**

SolutionofEngineeringProblemsusingMatrixoperation: Importance,Matrix Manipulation Techniques,SolutionofSimultaneousLinearEquations,InverseofMatrix,ComputerImplementation. **(6)**

SpringElement: General,ImplementationinFEM,Applicationsincivilengineering,

Problems.**(6)**

Bar Elements: Definition, Stiffness Matrix, Load vector and displacementvector, ImplementationinFEM,ProblemsandValidation.**(6)**

FEModellingofEngineeringProblems: Trusses,beams,Framesetc.**(10)**

ComputerPrograms/SOFTWARESbasedonFEM:UseinsolutionofEngineeringProblems. (2)

Text Books, and/or reference material(s)

Text Books:

1. Finite element analysis: theory and programming by C S Krishnamurthy (2001): Tata McGraw Hill Education
2. AnIntroductiontotheFiniteElementMethodbyReddy,J.N., 2005.
3. FundamentalsofFiniteElementAnalysisbyDavidV.HuttonPublisher:TataMcgrawHill Education Private Limited (2005)

Reference Books:

4. FiniteElementProceduresbyKlaus-JurgenBathePublisher:Prentice-Hall(2009)

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	3	-	2	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	3	-	-	-	-	-	-	-	-	3	-
CO4	-	2	-	3	-	-	-	-	-	-	-	-	2	3	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE612	BridgeEngineering	PCL	3	0	0	3	3

Pre-requisite(s)	CourseAssessmentmethods
Survey,WaterResource Engineering, analysisanddesignofstructures	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs)	• CO1:Acquireknowledgetoselectdifferenttypebridgesbyassessingtheirmaterial,capacity, quality & suitability • CO2:Abilitytomakeabridgeplananddesignfollowingrequisitecriteria • CO3:Supervisetheconstructionprocedureofdifferentcomponentsofabridge • CO4:Assessthequalityandrolesofvariouscomponentsofbridge
Topics Covered (Hrs)	**Hydraulicdesign:**Survey,Catchment,Siteselection,Hydraulicgeometry,Linear waterways, Economic span, Afflux and Scour. **(4)** **Loadsonbridge:**Differenttypesofload actingonbridge alongwithnumerical**(6)** **Slabandboxculvert:**Analysisofdeckslab-effectivewidth&lengthmethodand numerical example with different type of live load. **(4)** **R.C.beam-slabandsteelcompositebridges:**R.C.T-beambridgeandsteelcomposite bridge design using Pigeaud's method and Courbon's method **(6)** **Dynamicresponseofbridgedeck:**Generalfeatures,factoraffectingvibration,practical approach for vibration analysis and numerical examples. **(2)** **Prestressed concrete bridge:** Generalfeatures,advantageofP.S.C.Bridge,designdetailsof pre-tensioned and post–tensioned bridge and numerical (**6**) **Bridgebearing:**Introduction,typesofbearing,designprinciplesofdifferentbearingand numerical examples **(4)** **Substructure:**Introduction,typeofpiers,forcesactingonpiers,stabilityanalysisof abutment, types of wing wall and numerical examples of Pier and Abutment. **(4)** **Bridgefoundation:**Generalaspect,typesoffoundations,designaspectofpileandwell foundations and numerical examples of pile and well foundations. **(3)**
Text Books, and/or reference material(s)	***Text Books:*** 1. BridgeEngineeringbyS. Ponnuswamy,TataMcGraw-HillPublishingCompanyLimited, New Delhi. 2. IRC:6-2017StandardSpecificationsandCodeof PracticeforRoadBridges 3. www.nptel.ac.in ***ReferenceBooks:*** 4. DesignandconstructionofHighwayBridgesbyK.S.Rakshit,NewCentral Book Agency (P) Ltd

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Modemtool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	3	3
CO2	-	3	2	-	3	-	1	-	-	-	-	-	3	3	3
CO3	-	-	-	-	-	-	-	-	3	2	-	1	-	-	1
CO4	-	-	-	-	-	-	-	-	-	-	-	3	1	-	1

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE613	**Experimental Stress Analysis, Instrumentation & Sensor Technology**	**PEL**	**3**	**0**	**0**	**3**	**3**

Pre-requisite(s)	CourseAssessmentmethods
EngineeringMechanics,Solids Mechanicsand StructuralAnalysis	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :	• CO1: Understand experimental approach, use strain gauges • CO2: Analyze the errors during measurement, instrumentation of electrical variables • CO3: understand the requirements during the transmission of measured signals, Construct Instrumentation/Computer Networks using proper sensor technologies
Topics Covered (Hrs)	Principles of Experimental Approach: Merit of Experimental Analysis introduction, uses of experimental stress analysis-Advantages of experimental stress analysis, Different methods, Simplification of problems.**[10]** Strain Measurement using Strain Gauges: Definition of strain and its relation to Experimental Determinations, properties of strain-gauge systems, Types of strain gauges, Mechanical and Optical strain gauges. Electrical Strain Gauges - Introduction, LVDT - resistance strain gauge - various types - gauge factor, Materials for adhesion base, etc. Strain Rosettes: Introduction, The three elements rectangular Rosette - The delta rosette - Corrections for Transverse strain effects.**[8]** Fundamentals of Measurement, Sensing. Instrumentation and data acquisition, common types of sensors; function of these sensors; interpretation of signals from sensor. Sensor Installation and Operation to i) Predict the response of sensors, methodology for sensor installation; Sensor selection, Sensor siting, Sensor Installation & Configuration, Measurement uncertainty.**[10]** Data Analysis and Interpretation, Fundamental statistical concepts, Data reduction and interpretation, Time domain signal processing, noise.**[8]** Frequency Domain Signal Processing and Analysis, its principles; to draw conclusions about physical processes based on analysis of sensor data; Combine signals in a meaningful way to gain deeper insight into physical phenomena, Basic concepts in frequency domain signal processing and analysis, Fourier Transform FFT, Noise reduction with filters, Leakage**.[3]**
TextBooks, and/or reference material(s)	Text Books: 1. Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann 2. David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press 3. S. Tumanski (2006), Principle of Electrical Measurement, Taylor & Francis 4. Ilya Gertsbakh (2010), Measurement Theory for Engineers, Springer 5. Experimental Stress Analysis by J.W.Dally and W.F.Riley 6. Experimental Stress Analysis by Dr. Sadhu Singh Reference Books: 7. Experimental Stress Analysis by Dove and Adams

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineering knowledge	Problemanalysis	Design/development of solutions	Conduct investigations of complexproblems	Modemtool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement & finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															

Course	Title of the	Program	Total number of contact hours	Credits

Code	course	Core (PCR)/ Electives (PEL)	Lecture (L)	Tutorial (T)	Practical (P)	Total hours	
CEE614	**Repair and Rehabilitation of Structures**	PEL	3	0	0	3	3
Pre-requisite(s)		Course Assessment methods					
Building Science and Technology/Concrete Technology		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs)	• CO1: Identify and understand the factors leads to the deterioration of structures. • CO2: Examine the distress in structural members and identify the causes for the failures. • CO3: Apply the modern techniques to repair and strengthen the structural members.						
Topics Covered (Hrs)	**Deterioration of Concrete Structures:** (10) Introduction, Requirement of repair and rehabilitation of structures, Major causes and signs of deterioration, Cracks – types, causes and characteristics **Condition assessment of structures:** (10) Preliminary and detailed investigations, damage classifications, In-situ and laboratory testing: non-destructive tests, semi-destructive tests, durability tests on concrete. **Repair Materials and Techniques:** (12) Selection of the repair material and method, compatibility of repair materials, various materials for repair: cement based repair materials, polymer modified repair materials, Resin-based products, composites etc., Various repair techniques: surface repairs, pre-placed aggregate techniques, grouting, stitching, gunite, gravity filling, drilling and plugging. **Strengthening of structures:** (7) Strengthening techniques, strengthening of different structural members (beam, slab, column, footing etc.)						
Text Books, and/or reference material (s)	**Text Books:** 1. Peter H. Emmons, Concrete Repair and Maintenance Illustrated: Problem Analysis; Repair Strategy; Techniques, Galgotia Publications Pvt. Ltd., 2002. 2. R. Dodge Woodson, Concrete Structures: Protection, Repair and Rehabilitation, Elsevier, 2009. 3. Jacob Feld and Kenneth L Carper, Construction Failures, Wiley Europe, 1997. 4. CPWD Handbook on Repair and Rehabilitation of RCC Buildings, Jain Book Agency, 2011.						

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Moderntool usage	Theengineerand society	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	Codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	-	2	-	-	-	-	-	3	3	-	3
CO2	3	3	3	3	2	-	-	-	-	-	-	3	3	-	3
CO3	3	2	3	3	3	2	2	-	-	-	-	3	3	-	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE615	**Pavement AnalysisandDesign**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
TransportationEngineering		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes (COs) :	• CO1: Identify the pavement types based on their behavior under traffic • CO2: Analyze the pavement components with respect to their material composition. • CO3: Estimate the stresses induced due to wheel load and temperature. • CO4: Design the pavement, flexible or rigid, for the conditions prevailing at the site.
Topics Covered (Hrs)	Module 1: (12 hours) **Introduction:** Types and Component parts of Pavements, Factors affecting Design and Performance of Pavements, Comparison between Highway and Airport pavements, Superpave. Stresses in Flexible Pavements: Stresses and Deflections in Homogeneous Masses, Burmister's 2- layer, 3- layer Theories, Wheel Load Stresses, ESWL of Multiple Wheels, Repeated Loads and EWL factors, Sustained Loads and Pavement behaviour under Traffic Loads. Module 2: (10 hours) **Methods of Flexible Pavement Design:** Empirical, Semi-empirical and Theoretical Approaches; Development, Principle, Design steps, Applications of different Pavement Design Methods. Module 3: (10 hours) **Stresses in Rigid Pavements:** Types of Stresses and Causes, Factors influencing the Stresses; General Conditions in Rigid Pavement Analysis, Wheel Load Stresses, Warping Stresses, Friction Stresses, Combined Stresses. Module 4: (7 hours) **Methods of Rigid Pavement Design:** Types of Joints in Cement Concrete Pavements and their Functions, Joint Spacings, Design of Slab Thickness, Design of Joint Details for Longitudinal Joints, Contraction Joints and Expansion Joints, IRC Method of Design – Continuously Reinforced Concrete Pavement Design - Rigid Overlay Design.
TextBooks and/or reference material(s)	***Text Books:*** 1. Yang H. Huang, Pavement Analysis and Design, Prentice Hall, 2003 2. Yoder and Witczak, Principles of Pavement Design, John Wiley and sons, Second Edition, 1975. 3. David Croney, The Design and Performance of Road Pavements, McGraw Hill, 1997 4. Harold N. Atkins, Highway Materials, Soils, and Concrete, Prentice Hall, 2002. 5. Lavin, P. G., Asphalt Pavements, Spon Press, 2003. 9. Mechanistic Empirical Pavement Design Guide, NCHRP, TRB, 2008. 6. RRL, DSIR, Concrete Roads, HMSO, IRC Publications 7. Nai C. Yang, Design of functional pavements, McGraw-Hill, 1973 ***ReferenceBooks:*** 1. IRC: 37, 'Guidelines for the Design of Flexible Pavements' 2. IRC: 58 'Guidelines for the Design of Rigid Pavements' 3. IRC: 81,'Strengthening of Flexible Road Pavements using Benkelman Beam Deflection Technique' 4. IRC:101, Guidelines for Design of Continuously Reinforced Concrete Pavement with Elastic Joints'

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof	Conductinvestigations of complex	Moderntool usage	Theengineerand society	Environment&sustai	Ethics	Individual&	Communication	Projectmanagement &finance	Life-longlearning	Plan,analyse,design and prepare	Computeraideddskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-		-	-
CO2	3	2	3	4	-	-	-	-	-	-	-	-	3	3	3
CO3	-	3	3	-	3	-	-	-	2	-	-	3	2	1	1
CO4	3	3	3	-	-	-	2	-	2	-	-	3	3	3	3

Course Code	**Titleofthe course**	**ProgramCore (PCR) / Electives(PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE616	**AppliedNumerical Methods**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
EngineeringMathematics		Continuous(CT)andendassessment(EA). CT+EA					
Course Outcomes (COs) :	• CO1:Assesstheerrorinvolvedinanumerical method • CO2:Solveproblemsinengineeringandsciencewitharequiredaccuracyusing appropriate numerical methods • CO3:Writealgorithmfor thenumerical methodsforefficientcodingof program • CO4:Understandthemathematicsconceptsunderlyingthenumericalmethods						
Topics Covered (Hrs)	**Fundamentals of numerical methods:** Need for Numerical methods in Civil Engineering, Sources of Errors, Absolute, Relative and Percentage, round off error, and stability of algorithms. **(04)** **Linear system of algebraic equations:** Gauss elimination method, LU decomposition method; iterative methods, ill conditioned systems. Jacobi, Gauss Seidel method, Relaxation method. **(08)** **Nonlinear equations:**Bisection method, Regula Falsi method, Newton Raphson method, Modified Newton-Raphson method, Higher order Newton's method Bairstow method, system of non-linear equations. **(8)** **Interpolation and approximation**: Newton's, Lagrange and Hermite interpolating polynomials, cubic splines; least square and minimax approximations. **(06)** **Numerical differentiation and integration:** Newton-Cotes and Gaussian type quadrature methods. **(06)** **Ordinary differential equations:** Initial value problems: single step and multistep methods, stabilityandtheirconvergence.Boundaryvalueproblems:functionalapproximation,finite differencemethod.**(07)**						
Text Books, and/or reference material(s)	***Text Books:*** 1. Numerical Methods for Scientists and Engineers by R. W. Hamming, Dover Publications;2 edition 2. NumericalMethods:ProblemsandSolutionsbyMahinderKumarJain(Author),S.R.K.Iyengar (Author), R. K. Jain, New age publishers 3. Numerical Methods for Engineers by Chapra, S. C., and Canale, R. P., McGraw Hill, Inc., 2007. ***ReferenceBooks:*** 4. AppliedNumericalMethodsforEngineersUsingMatlabandCbyRobertJ.Schilling (Author), Sandra L. Harris, Nelson Engineering; Har/Cdr edition 5. Numerical Analysis for Scientists and Engineers: Theoryand C Programs by Madhumangal Pal, Alpha Science Intl Ltd; 1 edition						

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	Engineeringknowledge	Problemanalysis	Design/development of solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment &sustainabi	Ethics	Individual & team	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	3	-	3	-	-	-	-	-	-	-	-	3	-
CO3	3	-	3	-	3	-	-	-	-	1	-	-	-	3	-
CO4	2	-	-	-	3	-	1	-	-	-	-	-	-	3	-

Course Code	**Titleofthe course**	**ProgramCore (PCR) / Electives(PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE617	**Road Safety Analysis**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
TransportationEngineering		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes (COs) :	CO1: Identify the factors contributing to accidents. CO2: Collect data pertaining to road crashes and prepare a comprehensive crash database CO3: Perform statistical analysis of crash data. CO4: Formulate traffic management measures for accident prevention and perform road safety audit and prepare an audit report.
Topics Covered (Hrs)	Module 1: (10 hours) **Introduction to road safety engineering** - Overview of road safety - Global road safety scenario and pattern - global trends and projections - national and state road safety level - problems in road safety in developing countries- magnitude, socioeconomic and health effects. Module 2: (10 hours) **Traffic Elements** - Characteristics of Road user, Motor vehicle, Roadway- relationship between elements- human factors governing road user behavior- risk factors for traffic accidents- exposure to risk- crash involvement- crash severity- post-crash injury outcomes Module 3: (10 hours) **Analysis and prevention**- Collection of accident data- Statistical methods for analysis of accident data, Speed in relation of safety- Weather and its effects on accidents- Vulnerable road users safety, parking influence on accidents- Traffic management measures for accident prevention- Legislation, Enforcement, Education and Propaganda- Formulating and implementing road safety policy. Module 4: (9 hours) **Road safety improvement program** - Road safety audit (RSA) - Procedure in road safety audit- design standards- audit tasks- stages of road safety audit- key legal aspects. Road design issues in RSA's – structuring and preparation of audit report.
TextBooks and/or reference material(s)	***ReferenceBooks:*** 1. David L. Geotsc. Occupational Safety and Health for Technologists, Engineers and Managers. 5th Edition, 2004. 2. World Health Organization, Road Traffic Injury Prevention Training Manual, 2006. 3. Matson, M.T., Smith, S.W., Hurd, W.F. Traffic Engineering, McGraw-Hill Book Company Inc., London, 1955. 4. Fuller, R., Santos, J.A. Human Factors for Highway Engineers, Pergamon, 2002. 5. Khisty, C.J., Lall, B.K. Transportation Engineering- An Introduction, Third Edition, Prentice Hall of India, New Delhi, 2006. 6. Jason C.YU, Transportation Engineering- Introduction to Planning, Design, and Operations, Elsevier, 1982. 7. Kadiyali, L.R. Traffic Engineering and Transportation Planning, Khanna Publishers, New Delhi, 2009. 8. IRC: 103-1988, Guidelines for Pedestrian Facilities, Indian Roads Congress, New Delhi. 9. IRC: SP: 32-1988, Road Safety for Children (5-12 Years old), Indian Roads Congress, New Delhi. 10. IRC: SP: 44-1996, Highway Safety Code, Indian Roads Congress, New Delhi. 11. IRC: SP: 88-2010, Road Safety Audit Manual, Indian Roads Congress, New Delhi.

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	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Moderntool usage	Theengineerand society	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement &finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-		-	-
CO2	3	2	3	4	-	-	-	-	-	-	-	-	3	3	3
CO3	-	3	3	-	3	-	-	-	2	-	-	3	2	1	1
CO4	3	3	3	-	-	-	2	-	2	-	-	3	3	3	3

Course Code	**Titleofthe course**	**ProgramCore (PCR) / Electives(PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE618	**Intelligent Transportation Systems**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
TransportationEngineering		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes (COs) :	• CO1: Understand ITS & ATIS • CO2: Explain the Advanced Transportation Management System. • CO3: Know about APTS, CVO, new technology and ETC. • CO4: Details about regional architecture, integration of infrastructure and operational planning.
Topics Covered (Hrs)	Introduction to ITS, including where ITS fits; roles and responsibilities Advanced Traveller Information Systems (ATIS), including functionality; business models; field trip to Smart Route Systems **(6)** Advanced Transportation Management Systems (ATMS), including network operations; incident detection; **(4)** congestion pricing, tolling, HOT lanes, example deployments **(4)** Fleet-oriented ITS services, including Advanced Public Transportation Systems (APTS); BRT; Commercial Vehicle Operation s (CVO); Intermodal Freight , including International Operations and Supply Chains **(4)** ITS and Technology, including automated highway systems (AHS); sensors, electronic toll collection (ETC); dedicated short range communication and standards **(4)** Regionally-scaled ITS deployment, including regional architecture; organizational an d institutional issues; standards; developed vs. developing countries; **(3)** ITS and strategic regional transportation planning; Integrating infrastructure and operations planning **(4)** Critical ITS Issues, including (as time permits) ITS and security; safety; human factors; privacy; sustainability; funding (as contrasted with conventional infrastructure); technology deployment/R &D/policy; other institutional issues (**4)** Conclusion, including regional ITS planning and architecture presentation; the future of ITS; **(4)** International ITS Programs Case Studies: applications in bus transport, metro, and highways; Emerging Issues.**(2)**
Text Books, and/or reference material(s)	*Text Books:* • Mashrur A. Chowdhury, and Adel Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, Inc., 2003. • Ghosh, S., Lee, T.S. Intelligent Transportation Systems: New Principles and Architectures, CRC Press, 2000. *Reference Books:* • May, A. D. Traffic Flow Fundamentals, PHI: USA, 1990 • Roess R., Prassas.E.S and McSHANE W. Traffic Engineering, 5th Edition, Pearson., 2019

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Moderntool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraideddskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-		-	-
CO2	3	2	3	4	-	-	-	-	-	-	-	-	3	3	3
CO3	-	3	3	-	3	-	-	-	2	-	-	3	2	1	1
CO4	3	3	3	-	-	-	2	-	2	-	-	3	3	3	3

	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE619	**Remote Sensing and its applications for Disaster Management**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisites:		CourseAssessmentmethods					
Nopre-requisites		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes

- CO1: Understand hazards, risks, and various types of natural disasters.
- CO2: Identify different remote sensing platforms and their applications in disaster management.
- CO3: Utilize GIS for spatial data analysis and disaster risk management.
- CO4: Understand disaster management components and government roles in disaster response.

Topics Covered

Introduction: Hazard, Vulnerability, Risk, Disaster, Earth Observation Using Satellites, Disasters- their types and effects: Hydrological Disasters - Flood, Flash flood, Drought, cloud burst, Geological Disasters- Earthquakes, Landslides, Avalanches, Volcanic eruptions, Mudflow, Wind related- Cyclone, Storm, Storm surge, tidal waves, Heat and cold Waves, Climatic Change, Global warming, Sea Level rise **(8) Basic Concepts of Remote Sensing:** History, Development, Definition, Concept & Principles, Electromagnetic Radiation (EMR) and Its Characteristics, Wavelength Regions and their Significance, Interaction of EMR with Atmosphere and Earth's Surface: Absorption, Reflectance and Scattering, Atmospheric Windows, Spectral Response and Spectral Signature, Spectral, Spatial, Temporal and Radiometric resolutions, Introduction to microwave remote sensing **(8) Satellite Platforms** – Types and their Characteristics: Satellites and their characteristics – geo-stationary and sun-synchronous Earth Resources Satellites - LANDSAT, SPOT, IRS, IKONOS satellite series Meteorological satellites – INSAT, NOAA, GOES **(8) Fundamental of GIS:** Definition, concept and history of developments in the field of information systems, Hardware and software requirements for GIS, Coordinate system and projections in GIS, Spatial data models – raster and vector, Spatial data analysis – significance and type, attribute query, spatial query, Vector based spatial data analysis, Raster based spatial data analysis, GPS, Web based GIS Technology **(8) Disaster Management:** Disaster Management Act 2005, Definitions, Components of DM Disaster Management Cycle, Impact of disaster on development, Disaster Management Authority at National, State and District levels, Roles and responsibilities of Govt. Authorities including Local Self Govt. at various levels, CBDRM **(7)**

Text Books, and/or reference material

Textbooks:

1.Ingleton, J. (1999). Natural disaster management. UK: Tudor-Rose.
2. Murthy, D. B. N. (2007). Disaster Management: Text and case studies. Deep and Deep Publications.

References:

3. Nayak, S., & Zlatanova, S. (Eds.). (2008). Remote sensing and GIS technologies for monitoring and prediction of disasters. Springer Science & Business Media.
4. Haripavan, N., Ramalingeshwararao, G. V., & Abbaiah, G. (2019). Proceedings of International Conference on Remote Sensing for Disaster Management.
5. Bhattacharya, T. (2012). Disaster Science and Management. Tata McGraw-Hill Education.
6. Botterill, L. C., & Wilhite, D. A. (Eds.). (2006). From disaster response to risk management: Australia's national drought policy (Vol. 22). Springer Science & Business Media.
7. UN/ISDR. (2004). Living with Risk: A global review of disaster reduction initiatives. 2004 Version, Volume I & II Annexes. Geneva.

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	Engineeringknowledge	Problemanalysis	Design/development solution	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individual&	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskillsand tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	-	3	3	3	2	3	-	3	-	-	-
CO2	2	3	-	-	3	2	-	3	-	2	-	2	-	-	2
CO3	2	3	3	2	3	2	-	3	2	3	-	2	-	3	-
CO4	3	3	-	3	-	3	3	3	2	3	3	3	-	-	-

Course Code	**Titleofthe course**	**ProgramCore (PCR) / Electives(PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE620	**AdvancedDesignof ConcreteStructures**	**PCL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
DesignofConcreteStructures		Continuous(CT)andendassessment(EA). CT+EA					
Course Outcomes (COs)	• CO1:Acquireknowledgeofengineeringdesign ofdifferent Member • CO2:Abilityto analyzetheUtilityStructures:Bunker, Silo, WaterTank, Shell etc • CO3: Abilityforunderstandingthe needoffuturestudies						
Topics Covered (Hrs)	TOPIC-1. Recapitulation and Quick revision of WSM & LSM, Indian Standard code,Serviceability Limit State: [3] TOPIC-2. Design of Continuous beam, Redistribution of Moments [3] TOPIC-3. Design of Curved beam in plan [4] TOPIC-4. Design of Deep Beams and corbels [4] TOPIC-5. Design of Multi-stored /Portal frames, frames, Design of Tension Members,Earthquake resistant design of structure, Ductile detailing. [6] TOPIC-6. Design of Combined Footing, Pile-cap [6] TOPIC-7. Design of Flat Slab, Methods of analysis and design [4] TOPIC-8. Analysis and Design of Bunkers, silo, Chimney [6] TOPIC-9. Design of Under-ground, Ground-supported, Overhead Tanks [6]						
Text Books, and/or reference material (s)	**Text Books:** 1. Reinforced Concrete Design, 2nd Edition, by S. Unnikrishna Pillai and DevdasMenon,Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003 2. Adv. R. C. C Design, by N.K. Raju, CBS Publishers & Distributor, New Delhi 3. IS 456: 2000, Plain and Reinforced Concrete – Code of Practice (4th Revision). 4. IS 875 (Part 1 to 5) : Design loads (other than earthquake) for buildings and structures 5. IS 3370 (I, II, IV): 2009 & 1965, Concrete structures for storage of Liquids. 6. IS 1893 (I): 2016, Criteria for earthquake resistance design of Structures-Generalprovisions and building (6th Revision), BIS, New Delhi. 7. IS 13920: 2016, Ductile design & detailing of R. C. structures subjected to seismicforces- code of practice (1st Revision), BIS, New Delhi 8. SP-24 : Explanatory Handbook on IS 456: 1978 9. SP-34, Handbook on Concrete, Reinforcement and detailing BIS, New Delhi **Reference Books:** 10. Adv. R. C. C Design, by S.S. Bhavikatti, New Age International (P) Limited, New Delhi 11. Design of Reinforced Concrete Structure N Subhramanian, Oxford Univ Press 12. www.nptel.ac.in						

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	1	2	2	3
CO2	-	-	3	-	2	-	1	-	-	-	-	1	2	2	3
CO3	-	-	-	-	-	-	-	-	-	-	-	3	1	1	1

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE621	**ConstructionPlanning and Management**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisites:		CourseAssessmentmethods					
CEC303 + CES544		Continuous(CT)andend assessment(EA). CT+EA					
Course Outcomes (COs)	• CO1:Learnpreliminariesofconstructionplanningandmanagement. • CO2: Learnconstructionsafetyaspects. • CO3:Learncontractmanagement.Getexposedtotenderingandcontracting. • CO4:Learnabouttherunning&operationofgovernment–run–engineeringdepart., elements of project financing, project selection & use of construction equipment.						
Topics Covered	**Construction project Organization:** Introduction, phases of construction project, principles of organization, Types of organization, Site organisation, Temporary services, Job layout. (**6**) **Construction planning:** Introduction to planning, Stages of planning, Work breakdown structure, Scheduling, Preparation of schedules for job, materials, labour, equipment and finance, Network techniques in construction management, direct and indirect cost, Resources allocation and levelling. (**12**) **Safety in construction:** Importance of safety & its measures in construction activities, Causes of accidents, incident investigation and analysis, Accident Statistics and Indices, Safety and health management system: safety policy and organization, safety budget, safety plan, safety audit. (**6**) **Construction Contracts:** Contract document, Different types of contracts, Notice inviting tender, Contract documents, Condition of contract, Earnest money, Security money, Termination of contract, Arbitration, Specification – different types. (**5**) **Public works accounts:** Muster roll, Measurement book, Cash book, Material-at-site account, Imprest, Temporary advance, Mode of payment, Bill, Voucher, Running account bill, Final bill, Advance payment to contractor, Secured advance, Stock, Tools and plants. (**4**) **Construction equipment:** Classification of construction equipment, Factors affecting selection of equipment, various construction equipment, Depreciation, method for calculation of depreciation. (**6**)						

Text Books, and/or reference material	***Text Books:*** 1. Estimating,costingandspecificationincivilengineeringbyM.Chakraborty 2. CivilengineeringContractsandEstimatesbyB.S.Patil,OrientLongman,NewDelhi, 1981. 3. PERT&CPMprinciplesandapplicationsbyL.S.Srinath,AffiliatedEast-WestPress Pvt. 4. ConstructionManagementandAccountsbyV.N.Vazirani,andS.P.Chandola,Khanna Publishers, Delhi-6, 1978. ***Reference Books:*** 5. Management in Construction Industry by P. P. Dharwadker, Oxford & IBH Publishing Co. Pvt.Ltd. New Delhi, 1992. 6. BuildingConstructionbyS.C.Rangawala,CharotarBookStall,Anand,1980. 7. Construction equipment and its planning & application by M. Verma, Metropolitan book co. (p) Ltd. New Delhi, 1979

MappingofCourseOutcomesCOs→POs→PSOs

	Engineering knowledge	Problem analysis	Design/development of solutions	investigationsof complex	Moderntool usage	Theengineer and society	Environment& sustainability	Ethics	Individual& team work	Communication	Project management& finance	Life-long learning	Plan,analyse, design and prepare	Computeraided skill and tools	codal provisions / guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	3	-	3	3	-
CO2	3	-	-	-	-	3	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	3	-	3	-	3

Course Code	**Title of the course**	**Program Core (PCR) / Electives (PEL)**	**Total Number of contact hours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE622	**Introduction to Random Vibrations**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Basic Engineering vibrations, statistics and probability		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: Development of skills for predicting engineering system behaviour under random vibrations • CO2: Knowledge of basics of random vibration analysis for further applications. • CO3: Developing the requisite skill that helps in the advanced courses related to random vibration study.						
Topics Covered (Hrs)	**Review** of basic topics in probability theory and vibrations **(4)** **Introduction** to the theory of random processes Time- and frequency-domain characteristics Stationary and nonstationary processes Continuity, differentiation and integration, Poisson, Gaussian processes. **(10)** **Random vibration** of linear structures Unit-impulse and frequency-response functions Time- and frequency-domain analysis Single- and multi-degree-of-freedom systems Stationary and nonstationary responses State-space formulation Modal cross-correlations Response to multi-support excitation, coherency function **(12)** **Crossings and reliability** analysis Threshold Crossings The envelope process First passage probability Distribution of local and extreme peaks **(8)** **Response spectrum** methods Response spectrum methods (CQC, CQC3, MSRS) PSD consistent with response spectrum**. (8)**						
Text Books, and/or reference	***Text Books:*** 1. Probabilistic Theory of Structural Dynamics by Y. K. Lin, McGraw-Hill, New York, NY, 1967 Krieger Pub., Huntington, NY, 1976. **2.** Probabilistic Structural Dynamics: Advanced Theory and Applications by Y. K. Lin and						

material(s)	G.Q. Cai, McGraw-Hill, New York, NY, 1995. ***Reference Books:*** 3. An Introduction to Random Vibrations, Spectral & Wavelet Analysis: Third Edition by D.E. Newland, Dover Publications, Mineola, NY, 2005. 4. Introduction to Random Vibrations by N. C. Nigam, MIT Press, Cambridge, MA, 1983. 5. Applications of Random Vibrations by N.C. Nigam and S. Narayanan, Narosa Pub., New Delhi,India, 1994.

Mapping of Course Outcomes COs→POs→PSOs

	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment & sustainability	Ethics	Individual & team work	Communication	Project management & finance	Life-long learning	Plan, analyse, design and prepare	Computer aided skill and tools	codal provisions / guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	2	-	-	-	-	2	-	-	-	1	1	-
CO2	3	-	3	-	-	-	1	-	-	2	-	2	2	2	-
CO3	-	-	3	-	-	-	-	2	-	2	1	3	-	-	-

Course Code	**Title of the course**	**Program Core (PCR) / Electives (PEL)**	**Total Number of contact hours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE623	**Mechanics of Composite Structures**	**Program Elective (PEL)**	**3**	**0**	**0**	**3**	**3**

Pre-requisite(s)	Course Assessment methods
Knowledge of Solid Mechanics, Structural Analysis & Design	Continuous (CT) and end assessment (EA). CT+EA

Course Outcomes (COs) :	• CO1: Development of skills of finding out mechanical properties of composite materials as well as predicting structural behaviour of composites under different loads. • CO2: Knowledge of basics of analysis and design of structural components, made of variety of composite materials. • CO3: Knowledge of using numerical tools for modeling and analysis of simple structural components
Topics Covered (Hrs)	Introduction, Types of composite materials, Lamina and Laminate, Matrix and Fibre, Fibre-reinforced Composites, Comparison of strengths between bulk material and fibres. **(6)** Co-ordinate systems, Effect of orientation of fibres on the strength and stiffness of Composites. **(6)** Brief outline of manufacturing processes. **(4)** Micromechanics and Macro mechanics, Constitutive relations, Stresses and Strains, Failure criteria of composites. **(8)** Analysis of Composites: beams and plates **(12)** Finite Element Method in analysis of Composite Structures **(6)**
Text Books, and/or	***Text Books:*** 1. Mechanics of Composite Materials by Robert M. Jones, Taylor and Francis (2015) 2. Mechanics of Composite Structures by Autar K. Kaw, Taylor and Francis (2006)

reference material(s)	***Reference Books:*** 3. Mechanics of Composite Materials and Structures by Madhujit Mukhopadhyay, University Press (2004)

Mapping of Course Outcomes COs→POs→PSOs

	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment & sustainability	Ethics	Individual & team work	Communication	Project management & finance	Life-long learning	Plan, analyse, design and prepare	Computer aided skill and tools	codal provisions / guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-	3	-	2
CO3	-	2	-	-	3	-	-	-	-	-	-	-	-	3	-

Course Code	**Titleofthe course**	**ProgramCore (PCR) / Electives (PEL)**	**TotalNumberofcontact hours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE624	**TheoryofPlatesand Shells**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
SolidMechanics,StructuralAnalysis		Continuous(CT)andendassessment(EA).CT+EA					
Course Outcomes (COs):	• CO1:Derive theexpressionsofthecurvature anddisplacementrelationshipsofplates subjected to bending moments, twisting moments and shear force. • CO2: Analyse the simply supported plates and solve them byusing Navier's and Levy's Methods. • CO3:Analysethethinshellstructuresusingmembrane theory. • CO4:Designthe cylindershellandreviewthe IS codalprovisionsofit.						
Topics Covered (Hrs)	**Basiccurvatureanddisplacementrelationships**.Expressionsforbending,moment,twisting moments, shear forces. **(4)** **Plateequation**,Edgeconditions.Solutionofsimplysupportedplatesby Navier'sand Levy's methods. Introduction to anisotropic plates. **(10)** **Platesubjectedtoinplaneforces**,Bucklingofplates.Numericalanalysisofplates. Design of plates. **(6)** **Shellstructures**Classification,Differentialgeometry,Curvature,Strain,Displacement relations. **(4)** **Membranetheoryofthinshells**anddesignofcylindricalshellsofdoublecurvature (Synclastic and anticlastic), Shells of revolution, North light shell. **(9)** **Designofshell**andreviewofIScodeprovisions,Introductiontobendingtheories: Application to cylindrical shells and design. **(6)**						
Text Books, and/or reference material(s)	***TextBook(s):*** 1. Theoryof Platesand Shells byTimoshenko andKrieger, McGraw Hill 2. TheoryandAnalysisofPlatesbyClassicandNumericalMethods,RudolphSzilard, Prentice Hall Inc. New Jersey ***ReferenceBook:*** 3. Design and Construction of Concrete Shell Roofs byG.S. Ramaswamy, CBS Publisher & Distributors (2005)						

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-long learning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	3	1	-
CO4	-	1	3	-	-								3	2	3

Course Code	**Titleofthe course**	**Program Core (PCR)/Electives (PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE625	**EnvironmentalPollution & Control**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
None		Continuous(CT)andendassessment(EA).CT+EA					

Course Outcomes (COs) :	• CO1:Applyknowledgeofdifferenttypesofenvironmentalaffectingthecommunitylife pollutants (air, solid wastes and noise) for design solutions. • CO2:Understandbasicdesignphilosophiesapplicabletocontrolandsafedisposalof different types of environmental pollutants. • CO3:Formulate,analyze,anddesignbasiccontrolanddisposalsystemsofdifferenttypes of environmental pollutants.
Topics Covered (Hrs)	**Natural& manmadesourcesof pollution**,typesofpollutants. **(3)** **Airpollution**:Itseffects,measurement,methodsofcontrol,airpollutioncontrolequipment. **(14)** **CommunitySolidwastes**–quantity&characteristics,methodsofcollection,disposal& reuse. **(14)** **Noisepollution**-Itseffects,noisemeasurement,methodsofcontrolofenvironmentalnoise. **(6)** **Legalaspects**ofenvironmental pollution&control.**(2)**
Text Books, and/or reference material (s)	***Text Books:*** 1. IntroductiontoEnvironmentalEngineeringbyM.L.Davis&D.A.Cornwell(Tata McGraw-Hill Education Private Limited, New Delhi) 2. Environmental Engineering by H.S. Peavy, D. R. Rowe & G. Tchobanoglous [McGrawHill Education (India) Private Limited, New Delhi] ***ReferenceBooks:*** 3. EnvironmentalEngineering–ADesignApproachbyA.P.Sincero&G.A.Sincero (Prentice – Hallof India Private Limited, New Delhi)

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	2	-	-	-	2	-	-
CO2	3	-	3	-	-	-	1	-	-	2	-	2	2	-	-
CO3	-	-	3	-	-	-	-	2	-	2	1	3	3	-	2

	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE626	**Geotechnical Physical Modelling**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisites:		CourseAssessmentmethods					
Nopre-requisites		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes	• CO1: Understand different modelling techniques and the relevance of physical modelling in Geotechnical engineering • CO2: Learn different physical modelling techniques used in Geotechnical Engineering, limitations of each technique and understand the applications • CO3: Develop skills in centrifuge modelling pertinent to geotechnical engineering • CO4: Apply scaling laws and principles to ensure that physical models accurately represent real-world geotechnical scenarios.
Topics Covered	**Introduction:** Fundamentals and steps of modelling; Modelling techniques in Geotechnical engineering (Basic definitions and Examples)- Empirical, Theoretical, Numerical, Analogue, Physical Modelling **(3)** **Physical Modelling at 1g:** Full scale Prototype modelling (1:1); Small scale (1:N) modelling at 1g- development of scaling relationship, dimensional analysis; Buckingham π Theorem; Example Problems **(6)** **Physical Modelling at Ng:** Small scale (1:N) modelling at Ng (N = scale factor); Relevance of Ng Modelling; Hydraulic gradient simulate method and its applications (Example problems); Physical modelling using Centrifuge- Mechanics and principle of Centrifuge modelling and developments, Possibility of geotechnical centrifuge studies- modelling of prototypes, investigation of new phenomena, Parametric studies, validation of numerical model, Geotechnical engineering instruction **(8)** **Geotechnical Centrifuge Modelling:** Equipment - type of centrifuges, Beam centrifuge, Drum centrifuge; Rotational acceleration and stress field- vertical stress in the radial acceleration field, radial acceleration field effects, selection of effective radius for a beam centrifuge; Soil layer in prototype and its respective centrifuge model, dependency of soil behavior on stress level and stress history; Verification of static equilibrium of a centrifuge model; Scaling laws in Centrifuge modelling for static and dynamic models- force, work, energy, time, dynamic compaction, consolidation, seepage, capillary rise, earthquake, etc.; Coriolis effect in centrifuge; Limitations in centrifuge based physical modelling; Modelling of models; Grain size effects **(12)** **Applications of centrifuge modelling:** Embankments and Dams, Shallow foundations, Deep foundations, Retaining structures, Anchorages, Ground improvement, Environmental geotechnics, Earthquake effects, Other relevant Geotechnical problems **(10)**
Text Books, and/or reference material	***Text Books:*** 1. David Muir Wood, Geotechnical Modelling, CRC Press, Taylor & Francis, 2004. 2. Madabhushi, G., Centrifuge Modeling for Civil Engineers, CRC Press, Taylor and Francis Group, 2015. 3. Taylor, R.N., Geotechnical Centrifuge Technology, Taylor and Francis Publication, 1994. **Reference Materials:** 4. Relevant IRC/IS codes/Technical papers 5. Basic and Applied Soil Mechanics by Gopal Ranjan & A.S.R. Rao, New Age International (P) Ltd. 6. Foundation Analysis and Design by J. E. Bowles

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/development of solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individual & team	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	2	2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	1	1	-	1	1	-	-	-	-	-	-	-	1	-	-
CO4	1	2	2	2	-	-	-	-	-	-	-	-	3	-	2

Course Code	**Titleofthe course**	**ProgramCore (PCR) / Electives(PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE627	**SystemsapproachtoCivil Engineering design**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisites:		CourseAssessmentmethods					
Nopre-requisites		Continuous(CT)andendassessment(EA). CT+EA					
Course Outcomes	• CO1:Developsystemapproachbasedmodelsof CivilEngineeringsystems. • CO2:Solveoptimizationproblems. • CO3:Learndecisiontheoryanditsapplicationto CEproblems						
Topics Covered	**Introduction:**Systemconceptforengineeringdesign,Systemclassification,system modeling, Methodology of system design. **(3)** **OptimizationTechniques:**LinearProgramming-SimplexMethodDualityTheory,Dual Simplex, Sensitivity analysus, Integer programming **(8)** **Networkanalysis:** Transportation problems, Assignment problems, Maximal flow, Project management **(8)** **Non-Linearprogramming:**Basicconcept,IntroductiontoLagrangemultipliers,Kuhn- Tucker conditions **(3)** **CommonProbabilisticmodels(8)** **Decision theory:** Decision problems, Decision criteria, Maximax, Equally likely, Minimax, Maximumlikelihood,Bays'decisionrule,Applicationtocivilengineeringsystemsdesign. **(9)**						
Text Books, and/or reference material	***Text Books:*** 1. EngineeringHydrologybyR.S.Varshney,NemChand&Bros.Roorkee(U.P.)1986. 2. Operations Research by A. Ravindran, D. J. Philips, and J. J. Solberg, Principles and Practice 2nd Edition, John Weley & Sons, New York, 1987. 3. Engineering Optimization – Theory and Practice by S. S. Rao, 3rd Edition, New Age Int. (P) Ltd. Publishers, New Delhi, 2001. 4. IntroductiontoOperationsResearch–AcomputerorientedAlgorithmicApproachbyB.E. Gillett, TMH Edition, New Delhi 1985. ***Reference Books:*** 5. Nonlinear Programming – Theory and Algorithms by M. S. Bazaraa, & C. M. Shetty, John Wiley & Sons, New York, 1990. 6. Introduction to Optimum Design by J. S. Arora, McGraw Hill Int. Editions, McGraw Hill BookCo. Singapore, 1989. 7. EngineeringOptimization–methodsandApplicationsbyG.V.Reklaitis,A.Ravindran,andK. M.Ragsdell,JohnWiley&Sons,NewYork, 1983.						

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraideddskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	3	-	-	-	-	2	2	-	-	-	3	-	-
CO2	-	3	3	-	-	-	1	-	-	3	-	2	3	-	-
CO3	-	3	3	-	-	-	-	-	-	-	-	-	3	-	-

	Titleofthe course	**ProgramCore (PCR) / Electives(PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE628	**Artificial Intelligencein Civil Engineering**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisites:		CourseAssessmentmethods					
Nopre-requisites		Continuous(CT)andendassessment(EA). CT+EA					
Course Outcomes	• CO1: understand the basic of machine learning • CO2: cognize the theory of machine learning based on knowledge of probability statistics and linear algebra. • CO3: solve different engineering problems applying the machine learning methods. • CO4: apply the different software of machine learning to solve civil engineering problems.						
Topics Covered	**Introduction to Machine Learning:** What is learning? What is machine learning? Machine learning activities, Basic types of data in machine learning. **(4 hours)** **Basis of Probability and Statistics:** Axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' theorem and independence, Random Variable, Few Distributions, Joint Distributions, Some Basic Statistics. **(4 hours)** **Linear Algebra:** Linear algebra and problem. (**2 hours)** **Artificial Neural Network:** Understanding biological neuron, artificial neuron, architectures of neural network, learning process of ANN. **(6 hours)** **Bayesian Learning:** Bayes theorem and concept learning. Naïve Bayes classifier. **(2 hours)** **Machine Learning:** Types of machine learning Approach: Supervised learning, Unsupervised learning and Reinforced learning, Applications of machine learning, usage of different software. **(6 hours)** **Supervised Learning:** (a) Supervised learning-classification- Basics of supervised learning classification, Decision tree, Support vector machine. **(8 hours)** (b) Supervised learning -Regression- Simple regression, other regression techniques. **(4 hours)** **Applications of Machine Learning:** Apply machine learning methods to solve Civil Engineering problems using Python, Keras, TensorFlow, etc. **(4 hours)**						
Text Books, and/or reference material	***Text Books:*** 1. Goulet, James-A, Probabilistic Machine Learning for Civil Engineers, MIT Press. 2. Mitchell Tom M. Machine Learning, McGraw-Hill Education. **REFERENCE BOOKS:** 1. Marsland Stephen, Machine Learning, CRC Press. 2. Ang, A. H.-S. and Tang, W. H. 1984. Probability Concepts in Engineering Planning and Design: Volume 2 Decision, Risk and Reliability, Wiley, New York.						

Mappingof CourseOutcomesCos→Pos→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-			
CO2	1	1	-	3	-	-	-	-	-	-	-	-			
CO3	3	3	-	-	2	-	-	-	-	-	-	-			
CO4	1	3	3	-	3	-	-	-	-	-	-	-			

Course Code	**Titleofthe course**	**ProgramCore (PCR) / Electives(PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE629	**OpenchannelHydraulics**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
Fluid Mechanics		Continuous(CT)andendassessment(EA).CT+EA					

Course Outcomes (COs) :	• **CO1:**Understandingmechanics offlow, energy&momentum in an openchannel • **CO2:**Computation ofdifferent componentsof flowin anopen stream. • **CO3:**Capabilityfordesignofdifferenttypeofopenchannelforoperationalizationof water-resources systems
Topics Covered (Hrs)	**Introduction:**Descriptions,typesofflow,state offlow,regimeofflow **(2)** **Open-Channels and their properties:**Types, geometry, geometric elements of channel sections, velocity distribution, wide open channel, measurement of velocity, velocity- distribution coefficients and determination, pressure distribution in a channel section, effect of slope on pressure distribution. **(7)** **Energy and Momentum Principles:** Energy, specific energy, criterion for a critical state offlow,interpretationoflocalphenomena,energyinnon-prismaticchannels,momentumin open-channel flow, specific force, momentum principle applied to non-prismatic channels. **(6)** **CriticalflowcomputationsandApplications:** Criticalflow,factors,flowcomputation, hydraulic exponent for flow computation, control & measurement **(6)** **Uniform flow in open channels:** Qualifications, establishment, expressing the velocity of a uniform flow, hydraulic gradient, Equation for uniform flow, Chezy formula, Chezy's resistance, factor, Manning's formula, Mannining's roughness coefficient, factors, Mannining's roughness coefficient table.**(6)** **Computations of Uniform Flow:** The conveyance of a channel section, the section factor for uniform-flow computation, the hydraulic exponent for uniform-flow computation, flow in a channel section with composite roughness. Determination of the Normal Depth and Velocity, determination of the Normal and Critical Slopes, problems of uniform flow computation, computation of flood discharge, uniform surface flow **(6)** **Design ofChannels forUniformFlow:(6)** **Non-erodiblechannels:**Non-erodiblechannel,non-erodiblematerialandlining,minimum permissible velocity, channel slopes, freeboard, best hydraulic section, determination ofsection dimensions **Erodible channels with scour not silt:** Method of approach, maximum permissible velocity, method of permissible velocity, tractive force, tractive-force ratio, permissibletractive force, method of tractive force, stable hydraulic section **Grassed channel:** Grassed channel, retardance coefficient, the permissible velocity, selection of grass, procedure of design.

Text Books, and/or reference material(s)	***Text Books:*** 1. OpenChannelHydraulicsbyK.Subramanya,FourthEdition,McGrawHillsEducation(India) Private Limited, New Delhi. ***Reference Books:*** 2. Open-ChannelHydraulicsbyV.T.Chow,McGraw-HillBookCompany,Inc.,New York

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineering knowledge	Problemanalysis	Design/development of solutions	Conduct investigations of complexproblems	Moderntool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Project management&finance	Life-longlearning	Plan, analyse, designandprepare	Computeraided skill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1
CO2	-	3	-	-	-	-	-	-	3	-	-	-	2	1	1
CO3	-	-	3	-	3	3	-	-	-	3	3	3	1	1	2

Course Code	**Titleofthe course**	**ProgramCore(PCR)/ Electives (PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE710	**StructuralDynamics**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
Solid Mechanics		Continuous(CT)andendassessment(EA).CT+EA					

Course Outcomes (COs) :	• CO1:Develop& analyze damped&un-damped SDOFsystemsfor free&forced vibration. • CO2:DevelopandanalyzetheMDOFsystemsforfree &forced vibration. • CO3:Modelcivilengineeringstructures&derivethedynamicpropertiesof structures • CO4:Calculatenaturalfrequencies,modeshapes&structuralresponsesnumerically • CO5:Applytheconcepts&principlesofstructuraldynamicsforearthquakeanalysisofcivil engineering structures & evaluate their seismic performance
Topics Covered (Hrs)	**Introduction:**D'Alembert's principle, dynamic loads, definition of degrees of freedom **(1)** **SDOFsystem:**Equationsofmotion,undampedanddampedSDOFsystems,viscous damping,criticallydamped,over-dampedandunder-dampedsystem,dampingcoefficient determination, dynamic magnification factor and transmissibility. **(6)** **Forcedvibrationof SDOFsystems:**Vibrationunder sinusoidal loads, response to general dynamic loading - Duhamel's integral: impulse, rectangular, triangular loading problems. **(4)** **Fourier analysis and response in the frequency domain** theory, problems **(2)** **MDOFsystem:**Developmentand solutionofequationsof motion,problems**(2)** **Free vibration of MDOF systems:** Eigen values and vectors, natural frequencies and modes, orthogonality of modes, normalization of modes, modal expansion, concept of normal/generalized coordinates, problems **(5)** **Freevibrationresponse**:Freevibrationofun-dampedsystems,modalanalysis.**(3)** **Forced vibration of MDOF systems:** Modal expansion of excitation vector, modal analysis, modal contribution factors. **(3)** **Forced vibration response:** Modal analysis, forced vibration for un-damped systems subjected to sinusoidal loading and arbitrary loading**. (5)** **Damping in structures:** Classical, non-classical damping, mass proportional, stiffness proportional, Rayleigh, Caughey damping, Modal analysis for classically damped free and forced vibration systems **(4)** **Earthquake analysis of structures:** Equations of motion for un-damped and classically damped systems single and multiple degree of freedom systems, modal participation factors, modal analysis, response spectrum analysis, modal combination rules **(4)**

Text Books, and/or reference material(s)	***Text Books:*** 1. DynamicsofStructuresbyAnilK.Chopra,PHI 2. EarthquakeResistantDesignofstructurebyPankajAgarwalandManishShrikhande. 3. StructuralDynamics:TheoryandComputationbyMarioPaz,KluwerAcademicPublishers ***Reference Books:*** 4. ElementsofEarthquakeEngineering,JaiKrishna,A.R.Chandrasekaran,B.Chandra.SouthAsian Publishers. 5. TheoryofVibrationwithApplications,W.T.Thomson,PHI

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineering knowledge	Problemanalysis	Design/development of solutions	Conduct investigationsof complexproblems	Modemtool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Project management& finance	Life-longlearning	Plan,analyse, design and prepare	Computeraided skill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	-	-	-	-	-	-	-	-	-	2	-	
CO2	2	3	3	-	-	-	-	-	-	-	-	-	2	-	
CO3	3	2	2	-	1	-	-	-	-	-	-	2	-	1	2
CO4	3	3	3	3	2	-	-	-	-	-	1	2	-	1	1
CO5	3	2	-	2	1	1	-	1	-	-	1	2	-	-	-

Course Code	**Titleofthe course**	**ProgramCore (PCR) / Electives(PEL)**	**TotalNumberofcontacthours**				**Credit**
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE711	**AdvancedDesign of SteelStructures**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
DesignofSteel Structures		Continuous(CT)andendassessment(EA).CT+EA					
Course Outcomes (COs) :	• CO1:Understandthedesignaspects,principlesoffewsteelstructuresasawhole. • CO2:Applybasicknowledgeofsteeldesignofcomponentsfordesignsolutionsofwhole structure. • CO3:Formulate,analyze,anddesignofvariousCivilEngineeringSteel structures.						
Topics Covered (Hrs)	**Design of Industrial Shed**: Description of Different components, Loads Calculation, Analysis and Design of Truss members, Purlin, Top Chord and Bottom Chord Diagonals, Shoe Plate and Bolts design, Columns Design, Base Plate and Anchor Bolts Design. **(10)** **Design of water tank**:Staging, Columns braced type staging. **(8)** **Design of Castellated beams** and open web structures**. (4)** **Bridges:** Design loads for highway / railway bridges, Design of truss bridges for highway and railway**. (10)** **Introduction to Plastic Design**: Plastic hinge, Plastic-Collapse method, Plastic Analysis of Frames **(7)**						

Text Books, and/or reference material(s)	***Text Books:*** 1. Designof steelStructures byN. Subrhamanium(Oxford publications) 2. IS800-2007:GeneralConstructioninSteel-CodeofPractice 3. IS808-1989:DimensionsofHotRolledSteelbeam,column,channeland angle sections 4. SP6(1)-1964:HandbookforStructuralEngineers. 5. IS3370-1965codefor concretestructuresfor hestorageof liquids 6. IS805:1968 Codeof Practicefor Useof SteelinGravityWater Tanks 7. IRC:6-2017StandardSpecificationsandCodeof PracticeforRoadBridges 8. www.nptel.iitm.ac.in/courses/ ***ReferenceBooks:*** 9. LimitStateDesignof SteelStructuresbyS.K. Duggal(McGrawHill publications) 10. DesignofsteelStructures byS.S.Bhavikatti(IKIntlPublishingHouse,N Delhi)

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement& finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	3	-	-	-	-	2	2	-	-	-	3	-	2
CO2	3	-	3	-	-	-	1	-	-	3	-	2	-	2	-
CO3	-	3	3	-	1	-	-	2	-	2	1	3	2	1	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE712	**Earthquake Resistant Design of Structures**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
Basic Civil Engineering		Continuous(CT)andendassessment(EA).CT+EA					
Course Outcomes (COs) :	• CO1: Learn basic of earthquake engineering • CO2: Applying engineering mathematics in seismic analysis • CO3: Ability to design a structure earthquake resistive • CO4: Ability to manage earthquake disaster						

Topics Covered (Hrs)	**Earthquake ground Motion Engineering Seismology (5) [CO1]** Theory of plate tectonics, seismic waves, earthquake size and magnitude, earthquake ground motion, characteristics, seismic zoning map of India **Earthquakes Resistant Design and general guideline (5) [CO1]** Basic elements of earthquakes resistant design, structural modelling, seismic method of analysis – code based procedures and design philosophy, response spectra and design spectrum. Effect of Structural Irregularities on seismic performance of RC buildings. **Earthquake resistant design of RC buildings (10) [CO2, CO3]** Determination of design lateral load: Equivalent lateral force procedure, dynamic analysis procedure. **Earthquake resistant design of masonry buildings (5) [CO2, CO3]** Earthquake resistant design of masonry buildings - elastic properties of structural masonry, Behaviour of masonry structure during earthquake, bands & reinforcement in masonry, lateral load analysis. **Vulnerability assessment and rapid visual screening (5) [CO1, CO4]** Rapid visual screening by FEMA, Preliminary investigation and detailed evaluation **Repair and Retrofitting (9) [CO1, CO4]** Repair, rehabilitation and retrofitting, local and global retrofitting. Materials for Retrofitting. Seismic base isolation
Text Books, and/or reference material(s)	***Text Books:*** 1. Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande 2. Basics of Structural dynamics and aseismic Design by S. R. Damodarasamy and S. Kavitha 3. Elements of Earthquake Engineering by Jai Krishna, A.R. Chandrasekharan, Brijesh Chandra

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement& finance	Life-longlearning	Plan,analyses,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						1	1					1	3		2
CO2	2	2												1	2
CO3			3		2									1	2
CO4	3										2		3		

Course Code	Title of the course	Program Core (PCR)/ Electives (PEL)	Total number of contact hours				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total hours	
CEE713	Green Building and Sustainable Materials	PEL	3	0	0	3	3

Pre-requisite(s)	Course Assessment methods
Building Science and Technology	Continuous (CT) and end assessment (EA). CT+EA

Course Outcomes (COs)	• CO1: Understand the concepts of green buildings, and sustainable construction. • CO2: Learn about national and international green building assessment system and requirements. • CO3: Learn the green building design elements and use of sustainable materials. • CO4: Understand the techniques to reduce the carbon footprint of a green building.
Topics Covered (Hrs)	**Introduction to Green Buildings: (7)** Sustainable Development and Sustainable Construction, Rationale for High-Performance Green Buildings, Green Building Progress and Obstacles. **Green Building Assessment: (10)** Purpose of Green Building Assessment Systems, Major Green Building Assessment Systems (international and national): BREEAM, LEED, GRIHA etc., Case study. **Green Building Design: (10)** Conventional vs green building delivery systems, executing the green building project, the integrated design process role of Charrette in the design process; green building documentation requirements, Sustainable Site and Landscape **Low-energy building strategies: (12)** Components of embodied energy, Calculation of embodied energy for construction materials, Energy concept and primary energy, Embodied energy via-a-vis operational energy in conditioned building, Life Cycle energy use, Control of energy use and carbon-footprint in building, distinguishing between green building products and green building materials, LCA of building materials and products, environmental product declaration; materials and product certification systems, emerging construction materials and products.
Text Books, and/or reference material (s)	**Text Books** 1. G. Ballard, I. Tommelein, L. Koskela and G. Howell, Lean construction tools and techniques, 2002. 2. C. J. Kibert, Sustainable Construction: Green Building Design & Delivery, 4th ed. Wiley Publishers, 2016. 3. C. Corfe and B. Clip, Implementing lean in construction: Lean and the sustainability agenda, CIRIA, 2013. 4. C. A. Langston & G.K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.

Mappingof CourseOutcome

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Moderntool usage	Theengineerand society	Environment&sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	Codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	2	-	3	3	-	-	-	-	3	3	-	3
CO2	3	-	3	3	2	3	3	-	-	-	2	3	3	2	3
CO3	3	2	3	3	3	3	3	-	-	-	-	3	3	-	3
CO4	3	3	3	3	-	3	3	-	-	-	-	3	3	-	3

Course Code	Titleofthe course	Program Core (PCR)/Electives (PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE714	StructuralHealth Monitoring	PEL	3	0	0	3	3

Pre-requisite(s)	CourseAssessmentmethods
KnowledgeofSolidMechanicsand Structural Design	Continuous(CT)andendassessment(EA).CT+EA

Course Outcomes (COs) :	• CO1: Knowledge of assessment and monitoring of existing structures as well as for newlyconstructed structures. • CO2:ExposureandskilltouserelevantNDTequipmentforresearchandindustrial applications. • CO3: Knowledgeon instrumentations in structures, theiruseand interpret the collected data from instrumentations. • CO4:Basedontheabove,thestudentsareexpectedtosuggestremedialmeasuresfor distressed structures.
Topics Covered (Hrs)	**Preamble:** Definition of structure, different types of structures, behaviour of structures under variety of loading conditions, deterioration and failure of structures, structural materials. **(4)** **Introduction:**WhatisstructuralhealthandSHM,importance,applicationandpresent scenario of SHM in India and abroad, parameter related to structural health. **(3)** **TypesofSHM:**Periodicandcontinuous,methodsforimplementationofeach.**(6)** **Measurement techniques**: Destructive and non-destructive **(6)** **Equipment:** For non-destructive testing, working principles of this equipment and use **(8)** **Healthmonitoringindynamiccondition:**Basicsofstructuraldynamics,sensing technologies, data collection and analysis, basic concept of signal processing, identification of structural health using modal parameters. **(10)** **Fieldvisit:**Visittothesite(s)ofoldstructure(s)forassessingtheirexistingconditionforSHM purpose. **(2)**
Text Books, and/or reference material (s)	***Text Books:*** 1. Structural Health MonitoringbyVictor Giurgiutiu 2. Newtrendsin StructuralHealthMonitoringbyOstachowich, Witslaw,Guemes, Alfredo. 3. DynamicsofstructuresbyAKChopra,Pearson/PrenticeHall. ***ReferenceBooks:*** 4. Non-destructiveTestingofMaterialsandstructuresbyBuyukozturkandTasdemir: Springer

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	-	-	-	3	2	-	-	-	-	-	-	-	-	2	3
CO3	-	-	-	2	3	-	-	-	-	-	-	-	-	3	1
CO4	-	3	-	-	-	-	-	-	-	-	-	-	3	-	-

Course Code	Title of the course	Program Core (PCR) / Electives (PEL)	Total Number of contact hours				Credit
			L	T	P	H	
CEE715	**Railways, Airports, and Harbour Engineering**	**PCR**	**3**	**0**	**0**	**3**	**3**

Pre-requisite(s)	Course Assessment methods
None	Continuous (CT) and end assessment (EA). CT+EA

Course Outcomes (COs) :	CO1- To develop a basic understanding and knowledge of Railway, Airport, and water transportation to measure transportation demand. CO2- Develop in-depth knowledge for assessing the infrastructural facility CO3- To understand the influencing parameters and components for infrastructural facilities like- railways, airports, runways, ports, and harbors. CO4- Design the infrastructure like- railways, airports, runways, ports, and harbours.
Topics Covered (Hrs)	MODULE-I (8 Classes) **Components & Geometric Design of Railways:** Introduction of Indian railways, component parts of railway track, problems of multi-gauge system, coning of wheels, alignments, and survey, permanent way track components, Type of rail sections, creep of rails, wear and failure in rails, Ballast requirements, sleeper requirements, types of sleepers, various train resistances. MODULE-II (6 Classes) **Railway Operation and Control:** Gradients and grade compensation, various speeds on a railway track, super-elevation, horizontal and vertical curves, Points and crossings, Design of simple turn-out, Signalling, and interlocking. MODULE-III (4 Classes) **Urban Mass Transit Rail:** Introduction of modern urban rail facilities like- Metro Rail, Mono Rail, Suburban Railway, Light rail, regional rapid rail, Team, etc---- Technical details of those facilities,--National Urban Transport Policy MODULE-IV (8 Classes) **Airport Engineering:** Airport site selection, Air craft characteristics, various surface of an airport, Wind rose diagram, Geometric elements of run way and taxiway, holding apron, parking configuration, terminal building, visual aids, air traffic control, airport marking and lighting. MODULE-V (8 Classes) **Harbour Engineering:** Classification of Harbour basin, general layout of harbors, Docks, and Different components of docks. MODULE-V (5 Classes) **Inland waterways**, Inland water transportation in India, classification of waterways, economics of inland waterways transportation, national waterways
Text Books and/or reference material(s)	Books: 1. A text book on railway engineering, By S.C.Saxena and M.G.Arora 2. Railway Engineering by Satish Chandra & MM Agrawal, Oxford University Press. 3. Transportation Engineering, Volume-II- Railways, Airports, Docks and Harbours, Bridges and Tunnels by C. venkatramaih, Universities Press 4. Air-port Engineering by S.K.Khanna and M.G.Arora

Mappingof CourseOutcomesCos-POs-PSOs

	Engineeringknowledg	Problemanalysis	Design/developme ntof	Conductinvestigations of complex	Moderntool usage	Theengineer	Environmen t&sustainab	Ethics	Individual & team	Communication	Projectmanagement& finance	Life-longlearning	Plan,analyse,designan d prepare	Computeraidedskillan d tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	-	2	-	-	3	2	-	2
CO2	2	3	3	1	-	-	1	-	-	2	-	3	2	-	3
CO3	3	3	3	1	-	1	-	2	-	2	1	1	3	1	3
CO4	3	3	3	1	-	1	1	2		-	1	2	3	1	3

Course Code	Titleofthe course	Program Core (PCR)/Electives (PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEC716	Industrial Wastes	PEL	3	0	0	3	3
Pre-requisite(s)		CourseAssessmentmethods					
EnvironmentalEngineering		Continuous(CT)andendassessment(EA).CT+EA					

Course Outcomes (COs) :	• CO1:Applyknowledgeofdifferenttypesofindustrialpollutants(air,solidwasteand wastewater) for design solutions. • CO2:Understandbasicdesignphilosophiesapplicableforcontrolandsafedisposalof different types of industrial pollutants. • CO3: Formulate, analyze, and design basic control and disposal systems of different types of industrial pollutants.
Topics Covered (Hrs)	**Industrialsourcesofpollution**,typesofpollutants.**(5)** **Airpollution**–Itseffects,measurement,methods&equipmentof control.**(12)** **Solidwastes**–quantity&characteristics,methodsofcollection,disposal&reuse.**(12) Wastewater** – characteristics, methods of collection, treatment & disposal. **(10)**
Text Books, and/or reference material (s)	***Text Books:*** 1. Environmental Engineering by H.S. Peavy, D. R. Rowe & G. Tchobanoglous, McGrawHill Education (India) Private Limited, New Delhi 2. IntroductiontoEnvironmentalEngineeringbyM.L.Davis&D.A.Cornwell,Tata McGraw-Hill Education Private Limited, New Delhi ***ReferenceBooks:*** 3. EnvironmentalEngineering–ADesignApproachbyA.P.Sincero&G.A.Sincero, Prentice – Hall of India Private Limited, New Delhi 4. IndustrialWaterPollutionControlbyW.W.Eckenfelder,Jr.(McGraw-HillHigher Education)

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	2	-	-	-	1	-	-
CO2	3	-	3	-	-	-	1	-	-	2	-	2	3	1	1
CO3	-	-	3	-	-	-	-	2	-	2	1	3	3	2	2

Course Code	Titleofthe course	Program Core (PCR)/Electives (PEL)	TotalNumberof contacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE717	GroundImprovement	PEL	3	0	0	3	3
Pre-requisite(s)		CourseAssessmentmethods					
SoilMechanics&Foundation Engineering		Continuous(CT)andendassessment(EA). CT+EA					
Course Outcomes (COs) :	• CO1:understandhowtoimprovethegeotechnicalpropertiesofsoftsoilbydifferent techniques. • CO2:identifygroundconditions andsuggest methodofimprovement • CO3:understandtheprinciplesofsoilreinforcementandconfinementinengineering constructions.						
Topics Covered (Hrs)	**Introduction:**Formationofsoil,majorsoiltype,collapsiblesoil,expansivesoil,ground improvements; objective, potential. **(8)** **GroundImprovementinGranularSoil**:Inplacedensificationby(i)Vibrofloatation (ii) Compaction pile (iii) Vibro Compaction Piles (iv) Dynamic Compaction. **(12)** **Ground Improvement in Cohesive Soil**: Preloading with and without vertical drains, Compressibility,verticalandradialconsolidation,preloadingmethods.Typesof Drains,DesignofverticalDrains,constructiontechniques.StoneColumn:Function Design principles, load carrying capacity, construction techniques, settlement of stone column foundation. **(19)**						
TextBooks, and/or reference material (s)	***Text Books:*** 1. GroundImprovementbyM.P.MoseleyandK.Krisch,(2006)–IIedition,TaylorandFrancis 2. DesigningwithGeosynthetics byKoerner,R.M(1994),PrenticeHall,NewJersey 3. EngineeringPrinciples of GroundModificationsbyHausmann, M. R.(1990), McGrawHill publications ***Reference Books:*** 4. EarthReinforcementandsoilstructuresbyJonesC.J.F.P.(1985),Butterworths,London. 5. GroundControlandImprovementbyXianthakos,AbreimsonandBruce 6. GroundControlandImprovementbyK.Krisch&F.Krisch(2010),JohnWiley&Sons, 1994. 7. FoundationDesignprinciplesandPracticesbyDonaldPCoduto,2ndedition,Pearson, Indian edition, 2012						

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment&sustainability	Ethics	Individu al& team	Communication	Projectmanagement& finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	Codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	2	-	-	-	-	-	-	-	-	3		1
CO2	-	2	3	2	-	-	1	-	-	-	-	-		3	1
CO3	-	3	2	-	-	-	-	-	-	-	-	-	3		1

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial(T)	Practical (P)	Total Hours	
CEE718	Soil Dynamics	PEL	3	0	0	3	3
Pre-requisite(s)		CourseAssessmentmethods					
Soil Mechanics		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes	• CO1:developamechanismtodesignthefoundationsforresistingvibrationsandachieve static equilibrium conditions of structures. • CO2:understandtheclassicalgeotechnicalfailuresduetoliquefactionandmitigatethe same. • CO3:designoffoundationsinlargestructureslikepowerplants,otherindustrialbuildings etc., for analysing the vibrating waves which can be isolated and measures for achieving safety of the adjacent foundations.
Topics Covered (Hrs)	Vibrationofelementarysystem,Singledegreeandtwo-degreefreedomsystems,Wave propagation in an elastic, homogeneous, isotropic medium.**(10)** Propagation of waves in saturated media, Behaviour of dynamically loaded soils, Evaluationof dynamic properties of soil. **(10)** Theoriesforvibrationoffoundationsinelasticmedia,Designproceduresfordynamically loaded foundations for vertical and rocking vibrations. **(10)** Foundationsunderreciprocatingengines,Foundationsforforgehammers,motorgenerators, turbo-generators and crushers. **(9)**
Text Books, and/or reference material (s)	***Text Books:*** 1. SoilDynamicsandMachineFoundationbySwamiSaran,Galgotia Publicaions 2. VibrationsVibrationAnalysisandFoundationDynamicsbyNSVKameswaraRao, Wheeler Publishing, New Delhi. 3. Fundamentalsof SoilDynamics byBM Das ***ReferenceBooks:*** 4. Vibrationsof Soilsand FoundationsbyRichartHall and Woods 5. FoundationsofMachines-AnalysisandDesignbyPrakashandPuri. 6. Analysisand designof FoundationsforVibrations byP JMoore 7. Dynamicsofbases andFoundationsbyDDBarkar

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	3	2	-	-	-	-	-	1	-	-	2	-	3
CO2	-	3	-	-	-	-	1	-	-	-	-	-	3	-	1
CO3	-	-	3	-	-	-	2	-	-	-	1	-	3	-	2

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial(T)	Practical (P)	Total Hours	
CEE719	**SlopeStability and ReinforcedEarth**	**PEL**	**3**	**0**	**0**	**3**	**3**

Pre-requisite(s)	CourseAssessmentmethods
FoundationEngineering	Continuous(CT)andendassessment(EA).CT+EA

Course Outcomes (COs) :	• CO1:learnbasicmechanismofreinforcedearth. • CO2:designwallwithreinforcedbackfill • CO3:analyzestabilityofreinforcedslopes
Topics Covered (Hrs)	**Introduction,**Basicmechanismofreinforcedearth,Practicalapplication.**(4)** **Basic components of reinforced soil**: Soil or fillmatrix, Reinforcements, facingelements. **(7)** **Strengthcharacteristics of reinforced soil**:Basicconcept,SigmaandTaumodels,laboratory studies, sliding shear test, pull-out tests. **(8)** **Wall with reinforced backfill**: Pressure intensity on the wall, Stability against sliding, overturning and bearing failure, Increase of earth pressure due to a line load on the backfill, design procedure. **(10)** **MethodsofSlopeStability**:TaylorCharts,MethodofSlices,EffectofTensionCracks, Vertical Cuts. Bishop's Analysis. Non-circular Failure Surfaces, Stabilization of slopes: Drainage measures, Soil reinforcement (geosynthetics/soil nailing etc). **(10)**
Text Books, and/or reference material(s)	***Text Books:*** 1. ReinforcedEarth&GeotextilesbyKoerner 2. ReinforcedEarth&GeotextilesbyG.V. Rao 3. Earth and Earth-Rock Dams by Sherard, Woodward, Gizienski and Clevenger. John Wiley &. Sons. 1963 4. EarthandRockFillDamsbyBharatSinghandH. D.Sharma,1999 ***ReferenceBooks****:* 5. SlopeStabilityandStabilisationmethods byL.W.Abramson,T.S.Lee,andS.Sharma, John Wiley & sons. (2002) 6. TheStabilityofSlopesbyE.N.Bromhead,(1992),Blackieacademicandprofessional, London. 7. Earth&RockfillDams,PrinciplesofDesignandConstructionbyChristian,KutznerPublished Oxford and IBH. 8. HandbookofSlope StabilizationbyJ.A.R. Ortiago,andA.S.F. J.Sayao,2004.

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	2	3	-	-	-	-	-	-	-	-	-	2	1	1
CO3	-	3	-	2	-	-	-	-	-	-	-	-	2	1	1

Course Code	Titleofthe course	ProgramCore(PCR) /Electives (PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE720	Material Technology	ProgramElective (PEL)	3	0	0	3	3

Pre-requisite(s)	CourseAssessmentmethods
EngineeringMechanicsand Mathematics	Continuous(CT)andendassessment(EA).CT+EA

Course Outcomes (COs) :	• CO1:Developmentofskillsforpredictingstructuralbehaviourofdifferentmaterials under different loads • CO2:Knowledgeofbasicsofanalysisanddesignofstructuralcomponents,madeof variety of materials • CO3: Developing the requisite skill that helps in studying the advanced courses related to Structural Analysis, Design of Structures
Topics Covered (Hrs)	**MaterialandMaterialDefects**:Metallicmaterials,PolymericMaterials,Ceramicsand Composites,elasticandplasticdeformation,Mechanismofdeformationanditssignificance indesignandshaping**(8)** **FailuremechanismsofMaterials**:**Fracture:**Definitionandtypesoffacture,Brittle fracture:Criticalstressandcrackpropagationvelocityforbrittlefracture.Ductilefracture: Notcheffect onfracture. Fracturetoughness. Ductilitytransition.Definitionand signification.Conditionsofductilitytransitionfactorsaffectingit.**(6)** **FatigueFailure:**Definitionoffatigueandsignificanceofcyclicstress.Mechanismof fatigueandtheoriesoffatiguefailure,Fatiguetesting.Testdatapresentationandstatistical evolution.S-NCurveanditsinterpretation.Influenceofimportantfactorsonfatigue.Notch effect,surfaceeffect,Effectofpre-stressing,corrosionfatigue,Thermalfatigue.**(4)** **Creep:**Definitionandsignificanceofcreep.Effectoftemperatureandcreeponmechanical behavioursofmaterials.Creeptestinganddatapresentation.**(6)** **IntroductiontoNewMaterials**:**Composites:**Basicconceptsofcomposites,Processingof composites,advantagesovermetallicmaterials,varioustypesofcompositesandtheir applications.NanoMaterials:Introduction,Concepts,synthesisofnanomaterials,examples, applications and nano-composites. Polymers:Basic concepts, Processing methods, advantages anddisadvantagesovermetallicmaterials,examplesandapplications.**(8)** **StrengthAnalysisofmaterialsunderdifferentloading:**Stress,strainduetonormal, shear,flexure, impact,torsionloads.Analysis byenergymethod.**(7)**
Text Books, and/or reference material(s)	***Text Books:*** 1. ATextBookofStrengthofMaterialsbyGhosh&Datta,2ed,NewAgeInternational Publication Pvt. Ltd, New Delhi 2. EngineeringMaterialsTechnologybyW. Bolton,3ed,Taylor&FrancisLtd ***ReferenceBooks:*** 3. EngineeringMaterials:AnIntroductiontoProperties,ApplicationsandDesignbyDavid R.H.Jones,MichaelF.Ashby,4ed,Elsevier(BH)

Mappingof CourseOutcomesCOs□POs□PSOs

	Engineering knowledge	Problemanalysis	Design/development of solutions	Conductinvestigations of complex problems	Modemtool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraideddskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	2	-	-	-	3	-	1
CO2	3	-	3	-	-	-	1	-	-	2	-	2	3	1	1
CO3	-	-	3	-	-	-	-	2	-	2	1	3	3	-	1

Course Code	Titleofthe course	Program Core (PCR)/Electives (PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE721	OffshoreStructural Dynamics	PEL	3	0	0	3	3
Pre-requisite(s)			CourseAssessmentmethods				
Solidmechanics&Structural analysis			Continuous(CT)andendassessment(EA). CT+EA				

Course Outcomes (COs) :	• CO1:Identifythetypesofoffshorestructures,parametersgoverningsolid-fluidinteraction and environmental forces acting on offshore structures. • CO2:Applystatic methods of analysis forstresses in Offshore structures • CO3:Solveforresponseanalysisofoffshorestructures–singleandmulti-degreeof freedom problems, frequency and time domain analyses. • CO4:Evaluateresponses underrandomwanes
Topics Covered (Hrs)	**Introduction:** Loads and structural terms of different types of offshore structures. **(2)** **Fundamental of offshore structural analysis:** Stress and strain, bending of beams, Beams undertorsion,Beamdeflection,Bucklingofbeams,Bernoulli-Eulerbeamtheory,Matrix analysis of plane, Space trusses, and Plane space frames. **(8)** **Environmental loadings:** Winds forces, Ocean surface waves, Wave loads on offshore structures, Buoyant forces, Current loadings, additional environmental loadings. **(6)** **Static methods of analysis:** Frame analysis of steel offshore structures, bending stresses correction from axial loading, Pressure induced stresses in steel structures, Ring stiffeners, Analysis of joints. **(10)** **Dynamics of offshore structures:** Modellingofoffshorestructures-.Singleandmulti-degree freedom systems-Dynamic amplification factor- Response of offshore structures- Coupled anduncoupledmotions-Frequencydomainanalysis-Timedomainanalysis-NewMark-Beta method- Wilson θ method- Response analysis of fixed platforms- Response analysis of compliant platforms. Response in Random Waves **(13)**
Text Books, and/or reference material(s)	***Text Books:*** 1. OffshoreStructuralEngineeringbyThomasHDawson,PrenticeHall, 1983 2. DynamicAnalysisandDesignofOceanStructuresbySrinivasanChandrasekaran, Springer, 2015. 3. DynamicsofOffshoreStructures byWilson,J. F.,JohnWiley, 2002. ***ReferenceBooks:*** 4. Offshore Mechanics by Madjid Karimirad, Constantine Michailides and Ali Nematbakhsh,Wiley, 1 edition 5. Offshore structures – Vol. 1 & 2 by Clauss, G, Lehmann, E & Ostergaard, C., Springer-Verlag, 1992.

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Modemtool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	1	-	-	-	-	-	2	-	-
CO2	3	-	2	-	3	-	-	-	-	-	-	-	3	-	-
CO3	3	-	2	-	3	-	-	-	-	1	-	-	3	2	-
CO4	3	-	2	-	3	-	-	-	-	1	-	-	3	2	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE722	Pre-stressedConcrete	PCL	3	0	0	3	3

Pre-requisite(s)	CourseAssessmentmethods
SolidmechanicsandDesignof ConcreteStructures	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs)	• CO1:Applyknowledgeof solid mechanics&concrete structuresfordesign solutions. • CO2:Understandbasicdesignphilosophiesapplicabletopre-stressedconcretestructures. • CO3:Formulate,analyse,anddesignbasiccomponentsofCivilEngineeringPre-stressed Concrete structures.
Topics Covered (Hrs)	**Introduction:**Basicprinciples,advantage,ComparisonwithRC, Typesof pre-stressing and Stress analysis **(4)** **Materials:** Specifications and characteristics of concrete and high tensile steel **(2)LossofPrestressed**:Differenttypeoflosswithderivationandnumericalproblems **(4)** **FlexuralAnalysis:**Derivationofmomentofresistance,Pre-stressingforceand eccentricity with numerical problems **(6)** **Shearandtorsion:** Designofbeamforshearandtorsion**(5)** **Deflection and Cracking:** Cause and requirement along with numerical problems **(5)** **Designofendblocks:**Transmissionlength,designofbearingplateandburst reinforcement **(4)** **Member Design:** Oneway slab and beam design, two-way pre-stressing, Circular pre-stressing, Partial pre-stressing, Composite construction with pre-stressed concrete and reinforced concrete. **(9)**
Text Books, and/or reference material(s)	***Text Books:*** 1. PrestressedConcrete,5th EditionbyN.KrishnaRaju,TataMcGraw-HillPublishing Company Limited, New Delhi. 2. PrestressedConcrete,5th Edition,byS.Ramamrutham,DhanpatRaiPublishingCo.Pvt. Ltd. New Delhi. 3. IS1343:2012,PrestressedConcrete –CodeofPractice(2nd Revision),BIS,NewDelhi. 4. www.nptel.ac.in ***ReferenceBooks:*** 5. Fundamentalsof PrestressedConcretebyN.C. Sinha&S. K. Roy,S.Chand & CompanyLtd, New Delhi

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	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Moderntool usage	Theengineerand society	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,design and prepare	Computeraidedskill and tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	2	-	-	-	2	2	2
CO2	3	-	3	-	-	-	1	-	-	2	-	2	3	3	3
CO3	-	-	3	-	-	-	-	2	-	2	1	3	3	3	3

Course Code	Titleofthe course	ProgramCore (PCR) / Electives (PEL)	TotalNumberofcontact hours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE723	**Piping Engineering**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		CourseAssessmentmethods					
SolidMechanics,StructuralAnalysis		Continuous(CT)andendassessment(EA).CT+EA					

Course Outcomes (COs):	• At the end of the course, the student will be able to: • CO1: understand basic of piping system • CO2: analyse the piping based on the knowledge of mechanics. • CO3: design the pipes using the analytical and codal specifications • CO4: apply the different software of machine learning to solve civil engineering problems.
Topics Covered (Hrs)	**Introduction to Piping Engineering:** Role of piping, Scope of piping engineering, selection of materials, piping specifications. **(9 hours)** **Pipe Stress Analysis:** Forces and moments on a piping system, Failure theories, Stress categories, Stress limits, Fatigue **(10 hours)** **Design of Pipes:** Sustained loads, Occasional loads, Expansion loads, Hydraulic design consideration. Calculation of minimum wall thickness of a pipe. **(10 hours)** **Pipe Supports:** Rigid supports, Spring support, Snubbers, Sway Braces. Design of pipe supports. **(6 hours)** **Codes, standards, and regulations:** Use of different codes, standards and regulations related to piping. **(4 hours)**
Text Books, and/or reference material(s)	***TEXT BOOKS:*** *1. Sam Kannapan, P.E. Pipe Stress Analysis Willey – Interscience Publications.* *2. Sahu, G.K. Handbook of Piping Design, New Age International Publisher.* ***REFERENCE BOOKS:*** *1. Kellogg, Design of Piping System, 2/e M.W. Kellogg Co. 1976.* *2. McAllister E.W. Pipeline Rules of Thumb Handbook, Gulf Publication*

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	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-long learning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	3	1	2	-	-	-	2	-	-	-	-	-	-
CO4	-	3	3	-	-	-	-	-	2	-	-	-	-	-	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE724	Theoryof Elasticity and Plasticity	PEL	3	0	0	3	3

Pre-requisite(s)	CourseAssessmentmethods
Engineering&SolidMechanics	Continuous(CT)andendassessment(EA).CT+EA

Course Outcomes	• CO1:To develop basic understandingof thebehaviour ofmaterials. • CO2:Todefinethestressandstrainbehaviourofstructuralelements. • CO3:Toapplytheoryofelasticityinbendingandtorsionproblems. • CO4:To applytheoryofplasticityinfailures of different materials and structures.
Topics Covered	**Stress & Strain**: Stress equilibrium equations, rectangular, cylindrical and spherical co-ordinates, Generalized Hooke's Law, Stress and strain compatibility equations. Plane stress and plane strain problems, Airy'sstress function, Principal Stresses and strains, stress & strain invariants, numerical problems. **(12)** **Torsion**: Shafts of circular and non-circular prismatic sections, Saint Venant theory, warping function, stress function. **(7)** **Theories of Failure**: Basic concepts and Yield Criteria, Different Theories of Failure, Yield Locus and Yield Surfaces. Equations of Plasticity. **(8)** **Plasticity**: hydrostatic stresses, deviatoric stresses, invariants of deviatoric stresses, yield criteria, von Misses, Tresca yield criteria, theories of plastic flow, plane stress, plane strain problems in plasticity, thick cylinders, thick spheres. **(12)**
Text Books, and/or reference material	***TextBooks:*** 1. TheoryofElasticityandPlasticitybyS.Timoshenko, MCGraw HillBookcompany. 2. TheoryofElasticityandPlasticitybySadhuSingh,KhannaPublishers. ***Reference Books:*** 3. AdvancedStrengthofmaterialsbyPapov,MCGrawHillBookCompany. 4. PlasticityforstructuralEngineersbyChen,W.F.andHan,D.J,Springer-Verlag,New York.

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	1	1	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	2	1	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-	2	2	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberof contacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE725	**TrafficEngineeringand Management**	**PEL**	**3**	**0**	**0**	**3**	**3**

Pre-requisite (s)	CourseAssessmentmethods
TransportationEngineering	Continuous(CT)andendassessment(EA).CT+EA

Course Outcomes (COs):	• CO1: Applyknowledgeof trafficstudy&analysis fordesignsolutions. • CO2:Understandbasicdesignphilosophyapplicabletotrafficflow&highway intersections. • CO3:Formulate,analyze,anddesignbasiccomponentsofhighwayintersections.
Topics Covered (Hrs)	**Trafficcharacteristics**,Trafficengineeringstudiesandanalysis:Volume,speed,delay, origin and destination. (18) **Highway intersections**, Traffic flow theory, Traffic capacity, Traffic operations and control, Signal systems, Parking and terminal facilities, Traffic safety. (18 **Impactofhighwaytraffic**onenvironment. (3)
Text Books, and/or reference material(s)	***Text Books:*** 1. TrafficEngineeringbyR.P. Roess, W.R.McShaneand E.S.Prassas, PrenticeHall. ***ReferenceBooks:*** 2. TransportationEngineeringandPlanning,C.S.Papacostas,andP.D.Prevedouros, Prentice Hall India 3. PrinciplesofTransportationEngineering,P.ChakrobortyandA.Das,PrenticeHallIndia.

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	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	2	-	-	-	3	3	1
CO2	3	-	3	-	-	-	1	-	-	2	-	2	3	2	1
CO3	-	-	3	-	-	-	-	2	-	2	1	3	1	2	3

Course Code	Titleofthe course	Program Core(PCR)/ Electives (PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE726	**SoilStructure Interaction**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)			CourseAssessmentmethods				
StructuralAnalysis,SoilMechanicsand FoundationEngineering			Continuous(CT)andendassessment(EA). CT+EA				

Course Outcomes (COs) :	• CO1:Understandthebasis ofsoil-structure interaction. • CO2:Understandvarioussoilinteractionmodelslikebeamsonelasticfoundation (Winkler beam model), infinite beam, finite beam models. • CO3:Applysoil-structureinteractionmodelstodifferenttypeoffoundationslikepile, sheet pile walls (cantilever and anchored sheet pile walls). • CO4:Analysethefoundationofdifferentcivilstructureswithconsideringsoil-structure interaction in static as well as dynamic conditions.
Topics Covered (Hrs)	**Introduction**, Superstructure-foundation interaction, Analytical formulations. **(4)** **Interaction problems** of shallow foundation combined footing, Rigid method, and Flexible method. **(5)** **Beams on elastic foundation**, Infinitebeam,Finitebeam,Modulusofsubgradereactionand effecting parameters. **(8)** **Sheet pile wall**, Cantilever and anchored sheet pile wall, Fixed earth support, Free earth support. **(6)** **Retainingwalls**,Conduits,Loadondifferenttypesofconduits,Design charts.**(5)** **Braced excavation**, Pressure distribution in braced walls, Estimation of strut load etc., Stability of bottom of excavation. **(4)** **Piles** under different loading conditions, Analysis under lateral load, Different approaches, Mechanism of failure, Ultimate load, Deflections, Elastic continuum approach, Analysis and design**. (7)**
Text Books, and/or reference material(s)	***Text Books:*** 1. GeotechnicalEngineering:PrincipalandPracticesofSoilMechanicsandfoundationEngineering by V N.S. Murthy, 2. FoundationanalysisandDesign byJ.E. Bowles. 3. Basic and Applied SoilMechanics byG.Ranjan and A. S.Rao ***ReferenceBooks:*** 4. AdvancedGeotechnicalEngineeringsoil-structureInteractionusingComputerand Material Models by C. S. Desai, and M. Zaman 5. AdvancedSoilMechanicsbyB.M. Das, McGraw Hills Publishers

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	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigations of complex problems	Modemtool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	-	2	-	-	-	-	-	-	-	-	-	2	1	1
CO4	1	2	-	1	-	-	-	-	-	-	-	-	2	1	1

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE727	Machine Foundation	PEL	3	0	0	3	3
Pre-requisite(s)		CourseAssessmentmethods					
Mechanicsof structures		Continuous(CT)andendassessment(EA). CT+EA					

Course Outcomes (COs) :	• CO1: Acquire knowledge of Machines and its Foundation: Types and Forces actingupon, dynamic analysis • CO2:Ability toconductField-ExperimentandAnalyzethedatawithinterpretationfor determining dynamic properties of Soil • CO3:Ability toDesignSuitableFoundationsbasedonSoilasaSpring,andasaHalf- Space continuum • CO4:Abilityfor understandingthe need offuturestudies
Topics Covered (Hrs)	**Single Degree freedom system:** Free vibration of Single Degree freedom system, natural frequency and time period, damping, Amplitude, Forced vibration, dynamic magnification factor **(5)** **Two Degree Freedom System:** Freeand Forced VibrationofTwoDegreeFreedomSystem, Natural frequencies and their arrangement, Eigen value and Eigen vector, normalcoordinates, Effect of damping, generalized mass and stiffness matrices. **(7)** **Soil Stiffness and damping:**Experimental Procedure for finding out Soil Stiffness and damping. **(2)** **Machine Vibration:** Type of Machines, permissible amplitude vs. time period, Soil modelingaslinearun-dampedsprings.SoilasHalf-Space,inclusionofdamping,embedment effect. **(6)** **Foundation design:** Foundation analysis and design as linear spring, vertical vibration, pure sliding and rocking vibration. **(6)** **Couplevibrationofslidingandrocking.(6)** **Elastichalf-spaceapproachof analysisanddesign(7)**
Text Books, and/or reference material(s)	***Text Books:*** 1. Hand book of Machine Foundations by P. Srinivasulu and C.V. Vaidyanathan, Tata-Mc-Graw-Hill Publishing Company ltd. ***ReferenceBooks:*** 2. Design AidsinSoil Mechanics andFoundation Engineering by S.R. Kaniraj,Tata-Mc-Graw-Hill Publishing Company ltd.

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	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Modemtool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	3	-	-	-	-	-	-	-	1	-	-
CO2	-	3	-	-	2	-	-	-	-	-	-	-	1	1	1
CO3	-	-	3	-	-	2	-	1	-	-	-	-	2	1	1
CO4	-	-	-	-	-	2	-	1	-	-	-	3	1	1	1

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE728	**Waterresource System Planningand Management**	**PEL**	**3**	**0**	**0**	**3**	**3**

Pre-requisite(s)	CourseAssessmentmethods
FluidMechanics,IrrigationEngineering, Water Resources Engineering, EconomicsandComputerApplications	Continuous(CT)andendassessment(EA). CT+EA

Course Outcomes (COs) :	• CO1:Understandingofdifferentaspectsofsystemsofwaterresources • CO2:Learningofoptimizationtechniques,linear anddynamic Programming. • CO3:Abilitytoformulatemodelsofreservoirsystems,size,operationandhydropower production
Topics Covered (Hrs)	**Introduction:**Overview andRoleofengineers**(2)** **Engineering economic analysis:** Principles of engineering economics, Mathematics of economic analysis, Price theory and resources allocation, Conditions of project optimality, Benefit-cost analysis, Discount rate. **(5)** **Identification and evaluation of water management plans:** System concept, System design methodology, Optimal design, Introduction to classical optimisation techniques with simple numerical examples, Simulation analysis. **(5)** **Planning for flood control:** Planningcontext,Developingthesupply,Estimatingthedemand, Project feasibility. **(5)** **Planning for drainage:** Planning context, Developing the supply, Estimating the demand, Project feasibility. **(5)** **Planning for water supply:** Planning context, Developing the supply, Estimating irrigation demand, Estimating urban demand and Project feasibility. **(5)** **Planning for hydroelectric power:** Planning context, Developing the supply, Estimating the demand, Project feasibility**. (4)** **Planning for navigation:** Planning context, Developing the supply, Estimating the demand, Project feasibility**. (4)** **Irrigation planning and operation:** Planning context, Developing the supply, Estimating the demand, Project feasibility**. (4)**
Text Books, and/or reference material(s)	***Text Books:*** 1. WaterResourcesSystems–ModellingTechniquesandAnalysisbyS.VedulaandP.P. Mujumdar, Tata McGraw-Hill Publishing Company Limited, New Delhi. ***Reference Books:*** 2. IrrigationSystemDesign–AnEngineeringApproachbyH.Cuenca,Richard,PrentieHall,Englewood Cliffs, New Jersey 07632 3. WaterDemandManagementbyButler,DavidandMemon,FayyazAli,IWAPublishing,London

Mappingof CourseOutcomesCOs→POs→PSOs

	Engineeringknowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsof complex problems	Moderntool usage	Theengineerandsociety	Environment& sustainability	Ethics	Individual& team work	Communication	Projectmanagement&finance	Life-longlearning	Plan,analyse,designand prepare	Computeraidedskilland tools	codalprovisions/ guidelines
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	3	-	-

Course Code	Titleofthe course	ProgramCore (PCR) / Electives(PEL)	TotalNumberofcontacthours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CEE729	SedimentTransport	PEL	3	0	0	3	3
Pre-requisite(s)		CourseAssessmentmethods					
CEC302,CEC601.		Continuous(CT)andendassessment(EA).CT+EA					

Course Outcomes (COs):	• CO1:Understandingoftheoriginandmechanismofsediment transport • CO2:Developmentofcapabilitiestoanalyzesedimentload. • CO3:Abilityto develop modelto predict sediment load. • CO4:Capabilityto designstablechannel to carrythe predicted sediment load
Topics Covered (Hrs)	**Introduction:(2)** **Sediment properties:** particle size shape and density, fall velocity, viscosity, colloids andflocculation. Introduction **(4)** **Thresholdofparticlemotion.(3)** **Sandtransportbyair:**Surfacecreep,effectsofsandmovementonwind,instability ofa flat sand surface, ridges and dunes. **(4)** **Sedimentmovementinwater:**bedfeaturesandmeanders,analyticalmodels,stressesin flow of fluid-solid mixtures. **(4)** **Channelroughness andresistanceto flow.(2)** **Sediment load:** Bed Load, Bed Forms; Effective bed roughness; Armouring, suspended sediment, diffusion approach, energy approach, statistical approach, suspended sediment load, total Load. **(6)** **Stable Channel Design**: The empirical stable channel design - Tractive force method of stable channel design - Drag distribution and resistance to motion - Design values for boundary shear - The stable cross-section - Design by tractive force method **(8)** **Cohesivesediments:(2)** Erosion,deposition,scour,localscouratdifferent structures.**(2)** DimensionalAnalysisandSimilitude **(2)**
Text Books, and/or reference material(s)	***Text Books:*** 1. MechanicsofSedimentTransportationandAlluvialStreamProblemsbyR.J.Garde,K. G.RangaRaju,RevisedThirdEdition,NewAgeInternationalPublishers,andNew Delhi. 2. Looseboundaryhydraulics byA. J. Raudkivi, 2ndedition Pergamon press ***ReferenceBooks:*** 3. SedimentTransportbyV.T.Chow, McGraw-HillBookCompany,Inc.,New York

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CO2	-	3	-	-	-	-	-	-	3	-	-	-	2	-	-
CO3	-	-	-	-	3	-	-	3	-	-	-	-	2	-	-
CO4	-	-	-	-	-	-	-	-	-	3	3	3	2	-	-