NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

CURRICULUM

OF

BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING

2021 ONWARD UNDERGRADUATE ADMISSION BATCH

V0:

Resolution of 50th Senate	18-05-2018	Item no: 50.7
Resolution of 51st Senate	04-10-2018	Item no: 51.2
Resolution of UGAC meeting	10-05-2019	
Final approval in 53rd Senate	13-05-2019	Item no: 52.3
Publication date	30-05-2019	

V1:

Incorporation of new elective subjects	27-06-2019

V2:

Rectification of minor errors	UGAC 31-08-2022

Final Approval in 67th Senate dated 20/09/2022 vide Item no: # 67.3

DEPARTMENT OF CIVIL ENGINEERING

Program Name: Bachelor of Technology in Civil Engineering

DETAILED CURRICULUM

CURRICULUM OF 2021 ONWARD UNDERGRADUATE ADMISSION BATCH FOR CIVIL ENGINEERING - B.TECH.

L= Lecture hour/ week; T= Tutorial hour/ week; S= Sessional/ practical hour/ week

C= Subject credit point; H= Subject contact hour/ week.

Semester - I							
Sl. No	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	MAC01	Mathematics - I	3	1	0	4.0	4
2	PHC01	Engineering Physics	2	1	0	3.0	3
3	CYC01	Engineering Chemistry	2	1	0	3.0	3
4	XEC01	Engineering Mechanics	2	1	0	3.0	3
5	ESC01	Environmental Science	2	0	0	2.0	2
6	XES51	Engineering Graphics	1	0	3	2.5	4
7	HSS51	Professional Communication Laboratory	1	0	2	2.0	3
8	PHS51	Physics Laboratory	0	0	2	1.0	2
9	CYS51	Chemistry Laboratory	0	0	2	1.0	2
10	WSS51	Workshop Practice	0	0	3	1.5	3
11	XXS51	Co-curricular Activities - I	0	0	2	1.0	2
		TOTAL	13	4	14	24.0	31
Semester - II							
Sl. No	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	MAC02	Mathematics - II	3	1	0	4.0	4
2	CSC01	Introduction to Computing	2	1	0	3.0	3
3	ECC01	Basic Electronics	2	1	0	3.0	3
4	EEC01	Electrical Technology	2	1	0	3.0	3
5	BTC01	Life Science	2	0	0	2.0	2
6	XXC01	Constitution of India and Civic Norms	1	0	0	1.0	1
7	XES52	Graphical Analysis using CAD	0	0	2	1.0	2
8	CSS51	Computing Laboratory	0	0	2	1.0	2
9	ECS51	Basic Electronics Laboratory	0	0	2	1.0	2
10	EES51	Electrical Technology Laboratory	0	0	2	1.0	2
11	XXS52	Co-curricular Activities - II	0	0	2	1.0	2
		TOTAL	12	4	10	21.0	26

Semester - III							
Sl.	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	MAC331	Mathematics - III	3	1	0	4.0	4
2	CEC301	Solid Mechanics	3	1	0	4.0	4
3	CEC302	Fluid Mechanics	3	0	0	3.0	3
4	CEC303	Building Construction and Concrete Technology	3	1	0	4.0	4
5	ESC331	Geology for Civil Engineering	3	0	0	3.0	3
6	ESS381	Geology Laboratory for Civil Engineering	0	0	3	1.5	3
7	CES351	Fluid Mechanics and Strength of Material Laboratory	0	0	3	1.5	3
8	XXS381	Co-curricular Activities - III (Optional)	0	0	0	0.0	0
		TOTAL	15	3	6	21.0	24
Semester - IV							
Sl.	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	CEC401	Structural Analysis-I	3	1	0	4.0	4
2	CEC402	Design of Concrete Structures	3	1	0	4.0	4
3	CEC403	Surveying	3	0	0	3.0	3
4	CSC432	Data Structure	3	0	0	3.0	3
5	YYO44*	Open Elective - I	3	0	0	3.0	3
6	CES451	Structural Analysis Sessional-I	0	0	3	1.5	3
7	CES452	Design of concrete Structures Sessional	0	0	3	1.5	3
8	CSS482	Data Structure Sessional	0	0	3	1.5	3
9	XXS481	Co-curricular Activities - IV (Optional)	0	0	0	0.0	0
		TOTAL	15	2	9	21.5	26
Semester - V							
Sl.	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	CEC501	Structural Analysis-II	3	1	0	4.0	4
2	CEC502	Design of Steel Structures	3	1	0	4.0	4
3	CEC503	Soil Mechanics	3	0	0	3.0	3
4	CEC504	Transportation Engineering	3	1	0	4.0	4
5	YYO54*	Open Elective - 2	3	0	0	3.0	3
6	CES551	Structural Analysis Sessional-II	0	0	3	1.5	3
7	CES552	Design of Steel Structures Sessional	0	0	3	1.5	3
8	CES553	Transportation Engineering and Soil Mechanics Laboratory	0	0	3	1.5	3
9	CES554	Surveying Laboratory and Estimation Sessional	1	0	3	2.5	4
10	XXS581	Co-curricular Activities - V (Optional)	0	0	0	0.0	0
		TOTAL	16	3	12	25.0	31

Semester - VI							
Sl.	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	HSC631	Economics and Management Accountancy	3	0	0	3.0	3
2	CEC601	Water Resource Engineering	3	1	0	4.0	4
3	CEC602	Foundation Engineering	3	0	0	3.0	3
4	CEC603	Environmental Engineering	3	1	0	4.0	4
5	CEE610--	Depth Elective - 1	3	0	0	3.0	3
6	CEE610--	Depth Elective - 2	3	0	0	3.0	3
7	CES651	Environmental Engineering Laboratory and Computational Laboratory- I	0	0	3	1.5	3
8	CES652	Concrete Technology Laboratory	0	0	3	1.5	3
9	XXS681	Co-curricular Activities - VI (Optional)	0	0	0	0.0	0
		TOTAL	18	2	6	23.0	26
Semester - VII							
Sl. No	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	MSC731	Principles of Management	3	0	0	3.0	3
2	CEE710--	Depth Elective - 3	3	0	0	3.0	3
3	CEE720 --	Depth Elective - 4	3	0	0	3.0	3
4	CEE730 --	Depth Elective - 5	3	0	0	3.0	3
5	YYO74*	Open Elective - 3	3	0	0	3.0	3
6	CES751	Project - I	0	0	4	2.0	4
7	CES752	Structural Engineering Laboratory and Computational Laboratory -II	0	0	3	1.5	3
8	CES753	Vocational Training / Summer Internship and Seminar	0	0	2	1.0	2
		TOTAL	15	0	9	19.5	24
Semester - VIII							
Sl. No	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	CEE810--	Depth Elective - 6	3	0	0	3.0	3
2	YYO84*	Open Elective - 4	3	0	0	3.0	3
3	YYO85*	Open Elective - 5	3	0	0	3.0	3
4	CES851	Project - II	0	0	15	5.0	15
5	CES852	Project Seminar	0	0	0	1.0	0
6	CES853	Viva Voce	0	0	0	1.0	0
		TOTAL	9	0	15	16.0	24

CREDIT UNIT OF THE PROGRAM:

Semester	I + II	III	IV	V	VI	VII	VIII	TOTAL
Credit Unit	45.0	21.0	21.5	25.0	23.0	19.5	16.0	171.0

DEPTH ELECTIVE COURSE BASKETS

THE STUDENTS PRIMARILY WILL OPT FROM THE DEPTH ELECTIVE SUBJECT(S) THAT ARE OFFERED IN A PARTICULAR SEMESTER BY HIS/ HER OWN DEPARTMENT. HOWEVER, A STUDENT CAN OPT FOR DEPTH 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.

6th Semester

	DEPARTMENT OF CIVIL ENGINEERING
CEE610	Advanced Design of Concrete Structures
CEE611	Advanced Structural Analysis
CEE612	Mechanics of Composite Structures
CEE613	Material Technology
CEE614	Applied Numerical Methods
CEE615	Bridge Engineering
CEE620	Analysis and Design of Pavement
CEE621	Finite Element Method
CEE622	Ground Improvement
CEE623	Remote sensing and GIS
CEE624	Traffic Engineering and Management
CEE625	System Approach to Civil Engineering

7th Semester

	DEPARTMENT OF CIVIL ENGINEERING
CEE710	Structural Dynamics
CEE711	Advanced Design of Steel Structures
CEE712	Theory of Plates and Shells
CEE713	Theory of Elasticity and Plasticity
CEE714	Structural Health Monitoring
CEE720	Soil Dynamics
CEE721	Environmental Pollution and control
CEE722	Construction Planning and Management
CEE723	Open Channel Hydraulics
CEE724	Ground Water

CEE725	Hydrology and Irrigation Engineering
CEE730	Principles of Reliability
CEE731	Offshore Structural Dynamics
CEE732	Pre-stressed Concrete
CEE733	Advanced Concrete Technology
CEE734	Advanced Structural Mechanics

8th Semester

	DEPARTMENT OF CIVIL ENGINEERING
CEE810	Sediment Transport
CEE811	Slope Stability and Reinforced Earth
CEE812	Soil Structure Interaction
CEE813	Industrial Waste
CEE814	Water Resources System Planning and Management
CEE815	Machine Foundation

DETAILED SYLLABUS
FIRST SEMESTER

Semester - I							
Sl. No	**Code**	**Subject**	**L**	**T**	**S**	**C**	**H**
1	MAC01	Mathematics - I	3	1	0	4.0	4
2	PHC01	Engineering Physics	2	1	0	3.0	3
3	CYC01	Engineering Chemistry	2	1	0	3.0	3
4	XEC01	Engineering Mechanics	2	1	0	3.0	3
5	ESC01	Environmental Science	2	0	0	2.0	2
6	XES51	Engineering Graphics	1	0	3	2.5	4
7	HSS51	Professional Communication Laboratory	1	0	2	2.0	3
8	PHS51	Physics Laboratory	0	0	2	1.0	2
9	CYS51	Chemistry Laboratory	0	0	2	1.0	2
10	WSS51	Workshop Practice	0	0	3	1.5	3
11	XXS51	Co-curricular Activities - I	0	0	2	1.0	2
		TOTAL	13	4	14	24.0	31

Department of Mathematics							
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	
MAC 01	MATHEMATICS - I	PCR	3	1	0	4	4
Pre-requisites		Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA))					
Basic concepts of function, limit, differentiation, and integration.		CT+MT+EA					
Course Outcomes	• CO1: To introduce the fundamentals of differential calculus of single and several variables • CO2: To develop the basic concepts of integral calculus including multiple integrals and its application in finding area, volume, centre of mass, centre of gravity etc. • CO3: To introduce the fundamental concepts of vector calculus • CO4: To develop the concept of convergence						

Topics Covered	**Functions of Single Variable:** Rolle's Theorem and Lagrange's Mean Value Theorem (MVT), Cauchy's MVT, Taylor's and Maclaurin's series, Asymptotes & Curvature (Cartesian, Polar form). (8) **Functions of several variables:** Function of two variables, Limit, Continuity and Differentiability, Partial derivatives, Partial derivatives of implicit function, Homogeneous function, Euler's theorem and its converse, Exact differential, Jacobian, Taylor's & Maclaurin's series, Maxima and Minima, Necessary and sufficient condition for maxima and minima (no proof), Stationary points, Lagrange's method of multipliers. (10) **Sequences and Series:** Sequences, Limit of a Sequence and its properties, Series of positive terms, Necessary condition for convergence, Comparison test, D Alembert's ratio test, Cauchy's root test, Alternating series, Leibnitz's rule, Absolute and conditional convergence. (6) **Integral Calculus:** Mean value theorems of integral calculus, Improper integral and it classifications, Beta and Gamma functions, Area and length in Cartesian and polar co-ordinates, Volume and surface area of solids of revolution in Cartesian and polar forms. (12) **Multiple Integrals:** Double integrals, Evaluation of double integrals, Evaluation of triple integrals, change of order of integration, Change of variables, Area and volume by double integration, Volume as a triple integral. (10) **Vector Calculus:** Vector valued functions and its differentiability, Line integral, Surface integral, Volume integral, Gradient, Curl, Divergence, Green's theorem in the plane (including vector form), Stokes' theorem, Gauss's divergence theorem and their applications. (10)
Text Books, and/or reference material	**Text Books:** 1. E. Kreyszig, Advanced Engineering Mathematics: 10th ed., Wiley India Ed. (2010). 2. Daniel A. Murray, Differential, and Integral Calculus, Fb & c Limited, 2018. 3. Marsden, J. E; Tromba, A. J.; Weinstein: Basic Multivariable Calculus, Springer, 2014. **Reference Books:** 1. Tom Apostal, Calculus-Vol-I & II, Wiley Student Edition, 2011. 2. Thomas and Finny: Calculus and Analytic Geometry, 11th Ed., Addison Wesley.

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MAC01	CO1	2	3	2	3	1	1	-	-	1	1	1	2
	CO2	2	3	2	3	-	1	-	-	1	1	2	2
	CO3	2	3	2	3	-	1	1	-	-	2	2	2
	CO4	3	3	2	3	1	1	-	1	-	2	1	2

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
PHC01	**Engineering Physics**	**PCR**	**2**	**1**	**0**	**3**	**3**
Pre-requisites:		Course Assessment methods: (Continuous (CT), mid-term (MT) and end assessment (EA))					
NIL		CT+MT+EA					
Course Outcomes	CO1: To realize and apply the fundamental concepts of physics such as superposition principle, simple harmonic motion to real world problems. CO2: Learn about the quantum phenomenon of subatomic particles and its applications to the practical field. CO3: Gain an integrative overview and applications of fundamental optical phenomena such as interference, diffraction and polarization. CO4: Acquire basic knowledge related to the working mechanism of lasers and signal propagation through optical fibers.						
Topics Covered	**Harmonic Oscillations** - Linear superposition principle, Superposition of two perpendicular oscillations having same and different frequencies and phases, Free, Damped and forced vibrations, Equation of motion, Amplitude resonance, Velocity resonance, Quality factor, sharpness of resonance, etc. [8] **Wave Motion** - Wave equation, Longitudinal waves, Transverse waves, Electro-magnetic waves. [3] **Introductory Quantum Mechanics** - Inadequacy of classical mechanics, Blackbody radiation, Planck's quantum hypothesis, de Broglie's hypothesis, Heisenberg's uncertainty principle and applications, Schrodinger's wave equation and applications to simple problems: Particle in a one-dimensional box, Simple harmonic oscillator, Tunnelling effect. [8] **Interference & Diffraction** - Huygens' principle, Young's experiment, Superposition of waves, Conditions of sustained Interference, Concepts of coherent sources, Interference by division of wavefront, Interference by division of amplitude with examples, The Michelson interferometer and some problems; Fraunhofer diffraction, Single slit, Multiple slits, Resolving power of grating. [13] **Polarisation** - Polarisation, Qualitative discussion on Plane, Circularly and elliptically polarized light, Malus law, Brewster's law, Double refraction (birefringence) - Ordinary and extra-ordinary rays, Optic axis etc.; Polaroid, Nicol prism, Retardation plates and analysis of polarized lights. [5] **Laser and Optical Fiber** - Spontaneous and stimulated emission of radiation, Population inversion, Einstein's A & B co-efficient, Optical resonator and pumping methods, He-Ne laser. Optical Fibre– Core and cladding, Total internal reflection, Calculation of numerical aperture and acceptance angle, Applications. [5]						
Text Books, and/or reference material	**TEXT BOOKS**: 1. The Physics of Vibrations and Waves, H. John Pain, Willy and Sons 2. A Text Book of Oscillations and Waves, M. Goswami and S. Sahoo, Scitech Publications 3. Engineering Physics, H. K. Malik and A. K. Singh, McGraw-Hill.						

	REFERENCE BOOKS: 1. Vibrations and Waves in Physics, Iain G. Main, Cambridge University Press 2. Quantum Physics, R. Eisberg and R. Resnick, John Wiley and Sons 3. Fundamental of Optics, Jankins and White, McGraw-Hill 4. Optics, A. K. Ghatak, Tata McGraw-Hill 5. Waves and Oscillations, N. K. Bajaj, Tata McGraw-Hill 6. Lasers and Non-linear Optics, B. B. Laud , New Age International Pvt Lt

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PHC01	CO1	3	2	1	1	1	-	-	1	-	-	-	1
	CO2	3	2	-	2	-	-	-	-	-	-	-	1
	CO3	3	2	2	2	1	1	1	1	1	-	1	1
	CO4	3	2	2	2	1	1	1	-	1	-	1	1

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
CYC 01	Engineering Chemistry	PCR	2	1	0	3	3
Pre-requisites		Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA))					
None		CT+MT+EA					
Course Outcomes	• CO1: Introduced to chemical thermodynamics, kinetics, electrochemistry, absorption, and catalytic processes for engineering applications • CO2: To learn fundamentals of polymer chemistry and petroleum engineering. • CO3: Introduced to basic spectroscopic techniques for structure determination and characterization. • CO4: To study few inorganic and bioinorganic compounds of industrial importance.						
Topics Covered	**ORGANIC CHEMISTRY** i. Fundamentals of organic reaction mechanisms; Few important reactions and their mechanism along with their applications; Robinson annulation, Hydroboration reaction, Organometallic reagents (Gilman reagents), Metathesis using Grubb's catalyst and Wittig reaction. (3) ii. Fundamental concept on stereochemistry and application: Conformation and configuration of organic compounds, Diastereo-selective, enantio-selective, regio-selective, stereo-specific, and stereo-selective reactions. (3) iii. Polymer chemistry and polymer engineering: Fundamental concept on polymer chemistry; synthesis and application of important polymers, Rubber, and plastic materials. Conducting polymer. (2) iv. Petroleum Engineering and oil refinery: origin of mineral oils, separation principle and techniques of distillation of crude oil, Uses of different fractions,						

	octane number, cetane number, Knocking, anti-knock compounds, and Bio-Fuel. (2) v. Structure elucidation of organic compounds by modern spectroscopic methods; Application of UV-Visible and FT-IR spectroscopy. (3) **INORGANIC CHEMISTRY** i. **Coordination Chemistry:** Crystal Field Theory of octahedral and tetrahedral complexes, colour and magnetic properties, Jahn-Teller distortion, pseudo Jahn-Teller distortion, Isomerism, and stereochemistry. (5) ii. **Bioinorganic Chemistry:** Heme and non-heme O_2 transport protein (Haemoglobin, Myoglobin), Chlorophyll and photosynthesis. (3) iii. **Inorganic Materials:** Introduction towards industrially important inorganic materials like cementing material, refractory material, fertiliser, inorganic polymer. (2) iv. **Organometallic Chemistry:** π-acid ligands, stabilization of metal low oxidation state and 18 electron rules, metal carbonyls and nitrosyls, metal-alkene complexes. (4) **PHYSICAL CHEMISTRY** i. **Thermodynamics:** 2nd law of thermodynamics, entropy, free energy, Gibbs Helmholtz equation, change of phase. Cryogenics: joule Thomson experiment. (4) ii. **Chemical Kinetics:** 2nd and 3rd order rate expression, Reversible reaction, Chain reaction, Consecutive reaction, Temp effect on reaction rate. (4) iii. **Electrochemistry:** Electrochemical cell, Effect of pH, precipitation, and complex formation on EMF of oxidation/reduction processes. (2) iv. **Absorption:** Physical and Chemical absorption, Absorption isotherms. (1) v. **Catalysis:** Types of catalysis, Rate expression for Catalysed reaction, Acid-base and Enzyme catalysis. (2)
Text Books, and/or reference material	Suggested Text Books: (i) Physical Chemistry by P. Atkins, Oxford (ii) A guidebook to mechanism in Organic chemistry: Peter Sykes; Pearson Edu. (iii) Inorganic Chemistry Part-I & II, R. L. Dutta, The new book stall Suggested Reference Books: **Organic Chemistry**: (i) Basic stereochemistry of organic molecules: S. Sengupta; Oxford University press (ii) Engineering Chemistry: Wiley (iii) Elementary Organic Spectroscopy: William Kemp, ELBS with Macmillan **Inorganic Chemistry:** (i) Inorganic Chemistry: Principle structure and reactivity, J. E. Huheey, E. A. Keiter and R. L. Keiter, Pearson Education (ii) Bioinorganic Chemistry -- Inorganic Elements in the Chemistry of Life: An Introductionand Guide, 2nd Edition, Wolfgang Kaim, Brigitte Schwederski, Axel Klein. (iii) Inorganic Chemistry Fourth Edition, Shriver & Atkins, Oxford **Physical Chemistry:** (i) Physical Chemistry by G.W Castellan (ii) Physical Chemistry by P. C. Rakshit

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CYC 01	CO1	1	2	-	-	-	-	-	-	-	-	-	-
	CO2	1	-	-	-	-	-	2	-	-	-	-	-
	CO3	1	2	1	1	1	-	-	-	-	-	-	-
	CO4	-	1	-	-	2	-	1	-	-	-	-	-

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
XEC01	**ENGINEERING MECHANICS**	PCR	2	1	0	3	3
Pre-requisites		Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA))					
		CT+MT+EA					
Course Outcomes	• CO1: Acquire knowledge of mechanics and ability to draw free body diagrams. • CO2: Apply knowledge of mechanics for solving special problems like truss and frame analysis. • CO3: Ability to calculate centroid, moments of inertia for various shapes. • CO4: Learn momentum and energy principles. • CO5: Knowledge on virtual Work Principle and its application						
Topics Covered	Engineering Mechanics; measurement and SI units. [1] Vectors and force as a vector; Resultant of a system of forces on a particle; free body diagram and conditions of equilibrium of a particle; problems on particles; equilibrium of particles in space. [2] Resultant of a system of forces and couples on a rigid body; conditions of equilibrium of a rigid body; free body diagrams of rigid bodies subjected to different types of constraints; simple space problems of rigid bodies. [4] Coefficients of static and kinetic friction; problems involving friction; theories of friction on square threaded power screw and flat belt. [5] Simple trusses; analysis of trusses by method of joints and method of sections. [5] Centre of gravity and centre of mass; centroids of lines, curves and areas; first moment of area; second moment of area; polar moment of inertia; radius of gyration of an area; parallel axis theorem; mass moment of inertia. [4] Path, velocity, acceleration; rectilinear and curvilinear motion; motion of system of particles; introduction to the concept of plane kinematics of rigid bodies. [6] Newton's second law of motion; dynamic equilibrium and D'Alembert's principle; linear momentum; angular momentum; rectilinear and curvilinear motion; principles of work–energy and impulse–momentum; impact of system of particles; introduction to the concept of plane kinetics of rigid bodies. [12] Principle of Virtual Work, Solution of Problems on Mechanics using Principle of Virtual Work [3]						

Text Books, and/or reference material	1) S P Timoshenko and D H Young, Engineering Mechanics, 5th Edition 2) J L Meriam and L G Kraige, Engineering Mechanics, 5th Edition, Wiley India 3) F P Beer and E R Johnston, Vector Mechanics for Engineers 4) I H Shames, Engineering Mechanics

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
XEC01	CO1	1	-	-	-	-	-	-	-	-	-	-	1
	CO2	1	1	1	1	-	-	-	-	-	-	-	1
	CO3	1	1	-	-	-	-	-	-	-	-	-	1
	CO4	1	2	-	-	-	-	-	-	-	-	-	1
	CO5	-	2	2	2	2	1	-	-	-	1	-	1

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
ESC01	**Environmental Science**	PCR	2	0	0	2	2
Pre-requisites		Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA))					
		CT+MT+EA					
Course Outcomes	• CO1: Understand the importance of environment and ecosystem. • CO2: Understand the fundamental aspect of pollutant tracking and its implementation in natural and anthropogenic pollution of air and water system. • CO3: Understand the scientific basis of local and as well as global issues. • CO4: Apply of knowledge to develop sustainable solution.						
Topics Covered	**Introduction:** Multidisciplinary nature of Environmental Studies; Basic issues in Environmental Studies. [2] Human population and the Environment. [1] Social issues and the Environment. [1] **Constituents of our Environment & the Natural Resources:** Atmosphere– its layers, their characters; Global warming, Ozone depletion, Acid rain, etc. [5] Hydrosphere - Its constituents, Oceans, Groundwater, Surface waters; Hydrological cycle. [4] Lithosphere - constituents of lithosphere; Rock and Mineral resources; Plate Tectonic Concept and its importance. [5] Biosphere– its components; Ecosystems and Ecology; Biodiversity; Biomes. [5] Natural disaster and their management – Earthquakes, Floods, Landslides, Cyclones. [3] **Pollution:** Pollutants and their role in air and water pollution. [2]						

Text Books, and/or reference material	1. Environmental Studies – Benny Joseph – Tata McgrawHill-2005 2.Environmental Studies – Dr. D.L. Manjunath, Pearson Education-2006. 3.Principles of Environmental Science and Engineering – P. V. Rao, PHI. 4. Environmental Science and Engineering – Meenakshi, Prentice Hall India. 5.Environmental studies – R. Rajagopalan – Oxford Publication - 2005. 6. Text book of Environmental Science & Technology – M. A. Reddy – BS Pub.

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ESC01	CO1	3	-	-	-	-	-	2	-	-	-	-	-
	CO2	1	-	-	-	-	-	2	-	-	-	-	-
	CO3	2	-	-	-	-	-	2	-	-	-	-	-
	CO4	1	-	3	-	-	2	1	-	-	-	-	-

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
XES51	**ENGINEERING GRAPHICS**	PCR	1	0	3	4	2.5
Pre-requisites		Course Assessment methods (Continuous (CT) and end assessment (EA))					
NIL		CT+EA					
Course Outcomes	• CO1: Ability of mental visualization of different objects • CO2: Theoretical knowledge of orthographic projection to solve problems on one/two/three dimensional objects • CO3: Able to read/interpret industrial drawing and to communicate with relevant people						
Topics Covered	Graphics as language of communication; technical drawing tools and their up-keep; types of lines; construction of geometrical figures; lettering and dimensioning. [6] Construction and use of scales; construction of curves of engineering importance such as curves of conic section; spirals, cycloids, involutes and different loci of points; use of equations for drawing some curves. [9] Descriptive geometry: necessity and importance of orthographic projection; horizontal and vertical reference planes; coordinate of points; orthographic projection of points and lines situated in different quadrants, viz. 1st, 2nd, 3rd and 4th quadrants; traces of lines. First angle and third angle projection of lines and planes; views from top, front and left (or right); true length and true inclination of lines with planes of projections; primary auxiliary projection of points, lines and planes; auxiliary plan and auxiliary elevation. [9] Projection of simple regular solids, viz. prisms, cubes, cylinders, pyramids, cones, tetrahedrons, spheres, hemi-spheres etc. [6] Section of solids; section by perpendicular planes; sectional views; true shapes of sections. [6] Dimensional techniques; international and national standards (ISO and BIS). [3] Freehand graphics. [3]						

Text and/or reference material	1)… Engineering Drawing and Graphics – K Venugopal 2)… Engineering Drawing – N D Bhat 3)… Practical Geometry and Engineering Graphics – W Abbott

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
XES51	CO1	1	-	-	-	-	-	-	-	-	-	-	-
	CO2	1	1	-	-	-	-	-	-	-	-	-	-
	CO3	1	-	1	-	-	-	-	-	-	-	-	-

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
HSS51	Professional Communication Lab	PCR	1	0	2	3	2
Pre-requisites		Course Assessment methods (Continuous (CT) and end assessment (EA))					
None		CT+EA					
Course Outcomes	• CO1: Improvement in linguistic proficiency of the learners • CO2: Improvement in communicative ability of the learners • CO3: Improvement in social connectivity skill						
Topics Covered	1. Professional Communication: Introduction (1) 2. Technical Writing: Basic Concepts (2) 3. Style in Technical Writing (3) 4. Technical Report (2) 5. Recommendation Report (2) 6. Progress Report (1) 7. Technical Proposal (3) 8. Business Letters (3) 9. Letters of Job Application (2) 10. Writing Scientific and Engineering Papers (3) 11. Effective Use of Graphic Aids (2) 12. Presentation Techniques (6) 13. Group Discussion (6) 14. Interview Techniques (6)						
Text Books, and/or reference material	**Text Book:** 1. English for Engineers –Sudharshana& Savitha (Cambridge UP) **Reference Books:** 1. English for Engineers -Sudharshana & Savitha (Cambridge UP) 2. Effective Technical Communication-M A Rizvi (McGraw Hill Education) 3. References to relevant NPTEL, MOOC, SWAYAM courses be given by the						

	Instructor

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
HSS51	CO1	1	_	_	1	_	1	_	1	2	3	1	_
	CO2	1	_	_	1	_	2	_	2	2	3	2	_
	CO3	_	_	_	1	_	3	_	3	3	3	2	_

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
PHS51	Physics Laboratory	PCR	0	0	2	2	1

Pre-requisites	Course Assessment methods: (Continuous evaluation (CE) and end assessment (EA))
NIL	CE+EA

Course Outcomes	CO1: To realize and apply different techniques for measuring refractive indices of different materials. CO2: To realize different types of waveforms in electrical signals using CRO. CO3: To understand charging and discharging mechanism of a capacitor. CO4: To understand interference, diffraction and polarization related optical phenomena. CO5: To acquire basic knowledge of light propagation through fibers.
Topics Covered	1. Find the refractive index of a liquid by a travelling microscope. 2. Determine the refractive index of the material of prism using spectrometer. 3. Determination of amplitude and frequency of electrical signals by oscilloscope. 4. To study the characteristics of RC circuits. 5. To study Brewster's law/Malus' law using laser light. 6. To study the diffraction of light by a grating. 7. To study the interference of light by Newton's ring apparatus. 8. To determine numerical aperture of optical fiber. 9. Determination of Planck constant.
Text and/or reference material	**SUGGESTED BOOKS**: 1) A Text Book on Practical Physics – K. G. Mazumdar and B. Ghosh 2) Practical Physics – Worsnop and Flint

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PHS51	CO1	3	2	1	-	-	-	-	-	2	1	-	1
	CO2	3	2	1	-	-	1	-	-	2	1	-	1
	CO3	3	1	-	-	-	-	-	-	2	1	-	1
	CO4	3	2	-	1	-	1	1	-	2	1	-	1
	CO5	3	2	1	-	1	1	1	-	2	1	-	1

Correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
CYS51	**CHEMISTRY LABORATORY**	PCR	0	0	2	2	1
Pre-requisites		Course Assessment methods (Continuous (CT) and end assessment (EA))					
None		CT+EA					
Course Outcomes	• CO1: To learn basic analytical techniques useful for engg applications. • CO2: Synthesis and characterization methods of few organic, inorganic and polymer compounds of industrial importance. • CO3: Learn chromatographic separation methods. • CO4: Applications of spectroscopic measurements.						
Topics Covered	i. Experiments based on pH metry: Determination of dissociation constant of we acids by pH meter. ii. Experiments based on conductivity measurement: Determination of amou of HCl by conductometric titration with NaOH. iii. Estimation of metal ion: Estimation of Fe^{2+} by permangnomentry iv. Estimation of metal ion: Determ. of total hardness of water by EDTA titration. v. Synthesis and characterization of inorganic complexes: e. g. $Mn(acac)_3$, Fe(acac cis-bis(glycinato)copper (II) monohydrate and their characterization by m. p FTIR etc. vi. Synthesis and charact. of organic compounds: e.g.Dibenzylideneacetone. vii. Synthesis of polymer: polymethylmethacrylate viii. Verification of Beer-Lamberts law and determination of amount of iron prese in a supplied solution. ix. Chromatography: Separation of two amino acids by paper chromatography x. Determination of saponification value of fat/ vegetable oil						
	Suggested Text Books: 1. Vogel's Quantitative Chemical Analysis (6th Edition) Prentice Hall 2. Advanced Physical Chemistry Experiments: By Gurtu&Gurtu 3. Comprehensive Practical Organic Chemistry: Qualitative Analysis By V. K. Ahluwalia and S. Dhingra Suggested Reference Books: 1. Practical Chemistry By R.C. Bhattacharya 2. Selected experiments in Physical Chemistry By N. G. Mukherjee						

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CYS51	CO1	2	1	-	1	-	-	-	-	-	-	-	-
	CO2	-	1	-	1	1	2	-	-	-	-	-	-
	CO3	2	-	-	1	1	-	-	-	-	-	-	-
	CO4	-	1	-	1	1	-	-	-	-	-	-	-

Correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
WSS51	WORKSHOP PRACTICE	PCR	0	0	3	3	1.5
Pre-requisites		Course Assessment methods (Continuous (CT) and end assessment (EA))					
NIL		CT+EA					

Course Outcomes

- CO1: Study and practice on machine tools and their operations
- CO2: Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding
- CO3: Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping
- CO4: Develop basic electrical engineering knowledge for house wiring practice

Topics Covered

M/c shop & Carpentry shop -- 3X3= 9hrs.

- Introduction on machining process.
- Introduction to machine tools- Lathe, Shaper, Milling and Drill machine.
- Introduction to woods- Types, structure, disease and defect of wood.
- Introduction to wood working machines and tools.
- Making of dovetail joint and bridle joint.

Welding Shop & Sheet metal -- 3X3= 9hrs.

- Introduction to welding.Safety and precautions in welding.
- Formation of weld bead by SMAW on mild steel flat.
- Formation of weld bead by oxy-fuel welding on mild steel flat.
- Introduction to sheet Metal works.
- Tools and Machines used in sheet metal works.
- Concept of development, marking out of metal sheets.
- Cutting and joining of metal sheets.
- Safety precautions, General warning needed in the shop floor.

Black smithy & Foundry -- 3X3= 9hrs.

- Introduction Smithing and Forging- Tools, Machines, Furnaces and its accessories, fuels.
- Safety and precautions in blacksmithy.
- Making of bars of different cross-sections.
- Making of hexagonal headed bolts.
- Forge welding.
- Introduction to Foundry Technology.
- Preparation of sand mould using Solid/Split Pattern.

Fitting & Electrical shop -- 3X3= 9hrs.

- Introduction to hand metal cutting tools with specifications, nomenclature and their use.
- Marking tools, measuring tools and their use.

	• Fitting of joints of mild steel flats. • Introduction to electrical hazards and safety precaution. • Wire jointing and soldering. • PVC Conduit Wiring controlled by separate single way switches. • PVC Cashing Capping Wiring for two-way switches. • Conduit wiring for the connection of a Calling Bell with In& Out Indicators. • Batten Wiring and Cleat Wiring. • Tube Light Connection. • Insulation Resistance Testing of 1ph / 3ph Motor and House Wiring. • Earth Resistance Testing. • DOL Starter Connection. **Viva voce -- 1X3= 3hrs.**
Text Books, and/or reference material	1. Workshop Technology Part I and Part II by W. A. J. Chapman 2. Elements of Workshop Technology S. K. Hazra Chowdhury, A. K. Hazra Chowdhury and Nirjhar Roy 3. Mechanical Workshop Practice by K. C. John

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
WSS51	CO1	2	-	-	-	-	1	-	-	-	1	-	-
	CO2	1	-	1	-	-	1	-	-	-	1	-	-
	CO3	1	-	2	-	-	1	-	-	-	1	-	-
	CO4	1	-	-	-	-	2	-	-	-	1	-	-

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
XXS-51	**Co-curricular Activities**	PCR	**0**	**0**	**2**	**2**	**1**

Pre-requisites	Course Assessment methods (Continuous (CT) and end assessment (EA))
NIL	CT+EA

Course Outcomes	• CO1: Social Interaction: Through the medium of sports • CO2: Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them • CO3: Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes. • CO4: Personality development through community engagement

	• CO5: Exposure to social service
Topics Covered	**YOGA** • Introduction of Yoga. • Sitting Posture/Asanas- Padmasana, Vajrasana, Ardhakurmasana, Ustrasana, Bakrasana, Sasankasana, Janusirshasana, Suryanamaskar. • Mudra- Gyana mudra, Chin mudra, Shuni mudra, Prana mudra, Adi mudra, Anjali mudra. • Laying Posture/Asanas- PavanaMuktasana, UttanaPadasana, Sarpasana, Bhujangasana (Cobra Pose), Eka Pada Śalabhāsana, Dhanurasana, Chakrasana, Viparitkarani. • Meditation- Yognidra, Om chant, Pray chant. • Standing Posture/Asanas- Tadasana (Mountain Pose), Vrikshasana (Tree Pose), Ardhachandrasana, Trikonasana, Utkatasana, Padahastasana. • Pranayama- Deep breathing, AnulomVilom, Suryabhedi, Chandrabhedi. • Kriya- Kapalbhati, Trataka. **ATHLETICS** • Introduction of Athletic. • Starting Technique for Track events- Standing start, Crouch & Block start. • Finishing Techniques. • Relay Race- 4×100m, 4×400m & Baton Exchange Technique & Rules. • Track Marking with Fundamentals- 200m, 400m and Diagonal Distance Radius, Straight Distance, Staggers of Different Lanes & Curve Distance. **BASKETBALL** • Introduction and Players stance and ball handling. • Passing- Two hand chest pass, two hand bounce pass, One hand baseball pass, Side arm pass, Overhead pass, Hook pass. • Receiving- Two hand receiving, one hand receiving, receiving in stationary position, Receiving while jumping and Receiving while running. • Dribbling- Dribble, High dribble, Low dribble, Reverse dribble, Rolling dribble. • Rules of Basketball. • Basketball game. **VOLLEYBALL** • Introduction of Volleyball • Service- Underarm service, Sidearm service, Tennis service, Floating service, Jump service. • Pass: Underarm pass- Ready position, Teaching stage of underarm pass and Upper hand pass- Volley pass, Back pass, Short set, Jump set & Underarm set. • Rules and their interpretation. **FOOTBALL** • Introduction of Football

	• Push pass- Instep inside, Instep outer side. • Kicking- Spot kick, Instep kick, Lofted kick. • Dribbling- One leg, Both legs, Instep. • Trapping- Rolling ball sole trapping, High ball sole trapping, High ball chest trapping, High ball thigh trapping. • Throwing- Standing throw, Running throw, Seating throw. • Goal Keeping- Griping the ball, Full volley, Half volley, Drop Kick. • Rules and their interpretation. **CRICKET** • Introduction of Cricket • Batting gripping & Stance, Bowling gripping technique. • Batting front foot defense& Drive. • Batting Back foot defense& Drive. • Batting Square cut. • Bowling medium pace, Bowling off break. • Fielding drill, Catching (Short & High). • Rules & Regulation. **BADMINTON** • Basic introduction about Badminton and Badminton court. • Racket parts, Racket Grip, Shuttle Grip. • Basic stance, Basic Footwork, Shadow practice (Full court movement). • Strokes services: Forehand- Overhead & Underarm, Backhand- Overhead & Underarm. • Match practice (Single & Double). • Rules & Regulation. **TABLE TENNIS** • Introduction of Table Tennis. • Basic Stance and Grip (Shake hand & Pen hold). • Service Basic. • Stroke: Backhand- Push, Deep Push, Chop, Rally, Drive, Drop Shot, Flick, Block, Smash. • Stroke: Forehand- Push, Deep Push, Chop, Rally, Drive, Drop Shot, Flick, Block, Smash. • Rules and their interpretations. • Table Tennis Match (Singles & Doubles). **NCC** • FD-1 General Introduction and words of command. • FD-2 Attention, Stand at ease and Stand easy, Turning and inclining at the halt. • FD-3 Sizing, Forming up in three Ranks Numbering, Open and Close order March and Dressing. • FD-4 Saluting at the halt, Getting on parade, Dismissing and falling out.

	• FD-5 Marching, Length of pace and Time of Marching in quick time and Halt, Slow March and Halt. • FD-7 Turning on the March and Wheeling. • FD-12 Parade practice. **TAEKWONDO** • Introduction about Taekwondo- Meaning of Taekwondo, Korean language of dress, Fighting area, Punch, Block, Kicks etc. • Stance- Ready stance, Walking stance, Fighting stance, Front stance, Back stance, Cat stance etc. • Punch Technique- Front fist punch, Rear fist punch, Double fist punch, With stance etc. Blocks- Upper blocks, Middle block, Side block, Suto etc. • Foot Technique (Balgisul)- Standing kick (Saseochagi), Front kick (Abchagi), Doliyo (Chagi), Abdalchagi (Butterfly kick), Back kick etc. **NSS** • Swachha Bharat Mission • Free Medical Camp • Sanitation drive in and around the campus. • Unnat Bharat Abhiyaan • MatribhashaSaptah celebration

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
XXS51	CO1	-	-	-	-	-	2	-	-	3	-	-	-
	CO2	-	-	-	-	-	-	-	2	-	-	-	-
	CO3	-	-	-	-	-	-	1	-	-	-	-	3
	CO4	-	-	-	-	-	-	-	-	2	2	-	-
	CO5	-	-	-	-	-	3	1	-	-	-	-	-

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SECOND SEMESTER

Sl. No	Code	Subject	L	T	S	C	H
1	MAC02	Mathematics - II	3	1	0	4.0	4
2	CSC01	Introduction to Computing	2	1	0	3.0	3
3	ECC01	Basic Electronics	2	1	0	3.0	3
4	EEC01	Electrical Technology	2	1	0	3.0	3
5	BTC01	Life Science	2	0	0	2.0	2
6	XXC01	The Constitution of India and Civic Norms	1	0	0	1.0	1
7	XES52	Graphical Analysis using CAD	0	0	2	1.0	2
8	CSS51	Computing Laboratory	0	0	2	1.0	2
9	ECS51	Basic Electronics Laboratory	0	0	2	1.0	2
10	EES51	Electrical Technology Laboratory	0	0	2	1.0	2
11	XXS52	Co-curricular Activities - II	0	0	2	1.0	2
		TOTAL	12	4	10	21.0	26

<table>
<tr><td colspan="7">Department of Mathematics</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Title of the course</td><td rowspan="2">Program Core (PCR) / Electives (PEL)</td><td colspan="4">Total Number of contact hours</td><td>Credit</td></tr>
<tr><td>Lecture (L)</td><td>Tutorial (T)</td><td>Practical (P)</td><td>Total Hours</td><td></td></tr>
<tr><td>MAC 02</td><td>MATHEMATICS - II</td><td>PCR</td><td>3</td><td>1</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td colspan="3">Pre-requisites</td><td colspan="4">Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA))</td></tr>
<tr><td colspan="3">Basic concepts of set theory, differential equations, and probability.</td><td colspan="4">CT+MT+EA</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">• CO1: Develop the concept of basic linear algebra and matrix equations so as to apply mathematical methods involving arithmetic, algebra, geometry to solve problems.
• CO2: To acquire the basic concepts required to understand, construct, solve and interpret differential equations.
• CO3: Develop the concepts of Laplace transformation & Fourier transformation with its property to solve ordinary differential equations with given boundary conditions which are helpful in all engineering & research work.
• CO4: To grasp the basic concepts of probability theory.</td></tr>
</table>

Topics Covered	**Elementary algebraic structures:** Group, subgroup, ring, subring, integral domain, and field. (5) **Linear Algebra:** Vector space, Subspaces, Linear dependence and independence of vectors, Linear span, Basis and dimension of a vector space. Rank of a matrix, Elementary transformations, Matrix inversion, Solution of system of Linear equations, Eigen values and Eigen vectors, Cayley-Hamilton Theorem, Diagonalization of matrices. (15) **Ordinary Differential Equations:** Existence and uniqueness of solutions of ODE (Statement Only), Equations of first order but higher degree, Clairaut's equation, Second order differential equations, Linear dependence of solutions, Wronskian determinant, Method of variation of parameters, Solution of simultaneous equations. (12) **Fourier series:** Basic properties, Dirichlet conditions, Sine series, Cosine series, Convergence. (4)
	Laplace and Fourier Transforms: Laplace transforms, Inverse Laplace transforms, Convolution theorem, Applications to Ordinary differential equations. Fourier transforms, Inverse Fourier transform, Fourier sine and cosine transforms and their inversion, Properties of Fourier transforms, Convolution. (10) **Probability:** Historical development of the subject and basic concepts, Axiomatic definition of probability, Examples to calculate probability, Random numbers. Random variables and probability distributions, Binomial distribution, Normal distribution. (10)
Text Books, and/or reference material	**Text Books:** 1. E. Kreyszig, Advanced Engineering Mathematics: 10thed, Wiley India Ed. (2010). 2. Gilbert Strang, Linear algebra and its applications (4th Ed), Thomson (2006). 3. Shepley L. Ross, Differential Equations, 3rd Edition, Wiley Student Ed (2017). **Reference Books:** 1. S. Kumaresan, Linear algebra - A Geometric approach, PHI (2000). 2. C. Grinstead, J. L. Snell, Introduction to Probability, American Math. Society.

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MAC02	CO1	3	3	2	1	2	-	2	-	-	-	1	2
	CO2	3	3	2	2	2	-	2	-	-	1	-	2
	CO3	3	3	2	2	3	1	1	-	1	1	1	2
	CO4	3	2	1	3	2	1	1	1	1	-	-	2

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
CSC01	**INTRODUCTION TO COMPUTING**	PCR	2	1	0	3	3
Pre-requisites		Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA))					
Basic knowledge of computer.		CT+MT+EA					
Course Outcomes	CO1: Recognize the changes in hardware and software technologies with respect to the evolution of computers and describe the function of system software's (operating Systems) and application software's, languages, number system, logic gates. CO2: Illustrate the flowchart and inscribe an algorithm for a given problem Inscribe C programs using operators. CO3: Develop conditional and iterative statements to write C programs. CO4: Exercise user defined functions to solve real time problems CO5: Inscribe C programs that use Pointers to access arrays, strings and functions. CO6: Exercise user defined data types including structures and unions to solve problems.						
Topics Covered	Fundamentals of Computer: History of Computer, Generation of Computer, Classification of Computers 2L Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. [2] Languages: Assembly language, high level language, compiler, and assembler (basic concepts) [1] Binary & Allied number systems representation of signed and unsigned numbers. BCD, ASII. Binary Arithmetic & logic gates. [2] Basic concepts of operating systems like MS DOS, MS WINDOW, UNIX, Algorithm & flow chart. [1] C Fundamentals: The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements. [2] Operators & Expressions: Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence, and order of evaluation. Input and Output: Standard input and output, formatted output -- printf, formatted input scanf. [8] Flow of Control: Statement and blocks, if - else, switch, loops - while, for do while, break and continue, go to and labels. [5] Fundamentals and Program Structures: Basic of functions, function types, functions returning values, functions not returning values, auto, external, static and register Variables, scope rules, recursion, function prototypes, C pre-processor, command line arguments. [5] Arrays and Pointers: One-dimensional, two-dimensional arrays, pointers and functions, multi-dimensional arrays. [10] Structures Union and File: Structure, union, structures and functions, arrays of structures, file read, file write.[5]						

Text Books, and/or reference material	Text Books: 1. Let us C by Kanetkar 2. C Programming by Gottfried 3. Introduction to Computing by Balaguruswamy 4. The C-programming language by Dennis Ritchie Reference Books: 1. Computer fundamental and programming in C by P Dey and M. Ghosh 2. Computer fundamental and programming in C by Reema Thareja 3. programming with C by Schaum Series

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSC01	CO1	3	1	2	1	-	-	-	-	-	-	-	-
	CO2	-	2	1	2	1	-	-	-	-	-	-	-
	CO3	1	2	-	-	3	-	-	-	-	-	-	-
	CO4	1	3	1	2	3	-	-	-	-	-	-	1
	CO5	2	1	-	-	3	-	-	-	-	-	-	-
	CO6	2	-	3	-	1	-	-	-	-	-	-	-

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
ECC01	**Basic Electronics**	PCR	2	1	0	3	3
Pre-requisites			Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA))				
(10+2) level mathematics and physics			CT+MT+EA				
Course Outcomes	• CO1: Knowledge of Semiconductor physics and devices. • CO2: Have an in depth understanding of basic electronic circuit, construction, operation. • CO3: Ability to make proper designs using these circuit elements for different applications. • CO4: Learn to analyze the circuits and to find out relation between input and output.						
Topics Covered	1. **Semiconductors** 1.1. Concept of band formation in solids; Fermi-Dirac distribution function, concept of Fermi level, invariance of Fermi level in a system under thermal equilibrium 1.2. Definitions of insulator, conductor and semiconductor using band diagram 1.3. Crystalline structure of semiconductor 1.3.1. Covalent bond 1.3.2. Generation of holes and electrons						

	1.3.3. Effect of temperature on semiconductor 1.4 Intrinsic semiconductor 1.5 Doping and Extrinsic semiconductor 1.5.1 n-Type semiconductor and band diagram 1.5.2 p-Type semiconductor and band diagram 1.5.3 Mass-action law of semiconductor 1.6. Conductivity of semiconductor (including mathematical expression) 1.7 Carrier transport phenomenon. (03 hrs.) 2. **Diodes** 2.1. Construction 2.2. Unbiased diode; Depletion layer and Barrier potential; junction capacitance (expression only) 2.3. Principle of operation with forward biasing and reverse biasing 2.4. Characteristics 2.5 Diode's three models/equivalent circuits.(02 hrs.) 3.**Diode Circuits** 3.1 Diode rectifier 3.1.1 Half wave rectifier 3.1.2 Full wave rectifier:centre tap and bridge rectifier 3.1.3 Capacitive filter and DC power supply (Numerical problems) 3.2 Special Diodes 3.2.1 Zenerdiode: Avalanche breakdown and Zener breakdown and characteristics. 3.2.2 Zener diode as a voltage regulator 3.2.3 Displaydevices: LED and LCD. (03 hrs.) 4.**Bipolar Junction Transistor (BJT)** 4.1 n-p-n and p-n-p transistor and their constructions 4.2 Principle of operation 4.3 Transistor configuration: common base, common emitter, and common collector 4.4 Transistor characteristics: input and output characteristics of CB and CE configurations 4.5 DC load line: quiescent (Q) point; cut-off, active, and saturation region 4.6 Amplifier: Principle of operation 4.7 Transistor as a switch. (04 hrs.) 5.**Transistor Biasing** 5.1 Need of biasing 5.2 Methods of biasing: base resistor or fixed bias, emitter feedback, voltage divider biasing 5.3 Stability of Q-point (qualitative discussions) 5.4 (Numerical problems). (02 hrs.) 6.**Single Stage Amplifier:** classification of amplifiers (voltage amplifier, current amplifier, power amplifier etc.) Class-A CE Amplifier with coupling and bypass capacitors, Qualitative discussions of magnitude characteristics of frequency response (graph only) (02 hrs.) 7.**Feedback Amplifier** 7.1 Positive and negative feedback

	7.2 Deduction of gain with negative feedback, explanation of stability of gain with negative feedback, other effects of negative feedback (no deduction), numerical problems. (03 hrs.) 8.**Other Semiconductor Devices** 8.1 JFET: Construction, principle of operation, characteristics 8.2 MOSFET: Construction, principle of operation, characteristics 8.3 Power Electronic Device-SCR: Brief discussions. (02 hrs.) 9.**Operational Amplifier** 9.1 Characteristics of ideal operational amplifier 9.2 Pin Configuration of IC 741, 9.3 Analysis of simple operational amplifier circuits: concept of virtual ground; noninverting amplifier and inverting amplifier. 9.4 Applications: voltage follower, summer, differentiator, integrator, and comparator (04 hrs) 10.**Oscillator** 10.1 Positive feedback and condition of oscillation 10.2 R-C phase-shift oscillator, Wien bridge oscillator.(02 hrs.) 11.**Boolean Algebra** 11.1 Boolean algebra, De Morgan's theorem, simplification of Boolean expressions 11.2 Number system, range extension of numbers, overflow 11.3 Different codes: gray code, ASCII code and BCD codes and them Applications. (01 hrs.) 12. **Logic Gates** 12.1 NOT, OR, AND, NOR, NAND, EX-OR, EX-NOR gates 12.2 Simplification of logic functions 12.3 Realizations of logic expressions using logic gates. (01 hrs.) 13. CRO and its applications and other test and measurement instruments. (01 hrs.)
Text Books, and/or reference material	Text Books: 1. Introduction Electronic Devices & Circuit Theory,11/e, 2012, Pearson: Boylestad & Nashelsky 2. Electronic Principles, by Albert Paul MalvinoDr. and David J. Bates, 7/e. Reference Books: 1. Integrated Electronics by Millman, Halkias and Parikh, 2/e, McGrawHill. 2. ELECTRONICS Fundamentals and Applications by Chattopadhyay and Rakshit,15/e, New Age Publishers. 3. The Art of Electronics by Paul Horowitz, Winfield Hill, 2/e, Cambridge University. 4. Electronics - Circuits and Systems by Owen Bishop, 4/e, Elsevier. 5. Electronics Fundamentals: Circuits, Devices & Applications by Thomas L. Floyd & David M. Buchla, 8/e, Pearson Education.

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ECC01	CO1	2	3	2	2	-	1	-	-	-	-	-	1
	CO2	3	2	1	2	2	1	-	2	2	-	-	1
	CO3	3	2	2	2	3	-	-	-	2	-	-	1
	CO4	3	3	2	2	-	-	-	-	2	-	-	1

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

<table>
<tr><td colspan="7">Department of Electrical Engineering</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Title of the course</td><td rowspan="2">Program Core (PCR) / Electives (PEL)</td><td colspan="4">Total Number of contact hours</td><td rowspan="2">Credit</td></tr>
<tr><td>Lecture (L)</td><td>Tutorial (T)</td><td>Practical (P)</td><td>Total Hours</td></tr>
<tr><td>EEC01</td><td>ELECTRICAL TECHNOLOGY</td><td>PCR</td><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisites</td><td colspan="5">Course Assessment methods (Continuous (CT), Mid Term (MT), and end assessment (EA))</td></tr>
<tr><td colspan="2">NIL</td><td colspan="5">CT+MT+ EA</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Upon successful completion of this course, the student should be able to
• CO1: learn the fundamentals of Electric Circuits and Network theorems and analysis of electrical network based on these concepts.
• CO2: develop an idea on Magnetic circuits, Electromagnetism and learning the working principles of some fundamental electrical equipment’s
• CO3: learn about single phase and poly-phase AC circuits and analysis of such circuits based on these concepts.</td></tr>
<tr><td>Topics Covered</td><td colspan="6">Introduction: Overview of Electrical power generation systems (2)
Fundamentals of Electric Circuits: Ohm’s laws, Kirchhoff’s laws, Independent and Dependent sources, Analysis of simple circuits. (4)
Network theorems: Superposition Theorem, Thevenin’s Theorem, Norton’s Theorem, Maximum Power Transfer Theorem (4)
Magnetic circuits: Review of fundamental laws of electromagnetic induction, transformer and rotational emfs, Solution of magnetic circuits. Analysis of coupled circuits (self-inductance, mutual inductance, and dot convention)(8)
Transients with D.C. excitation for R-L and R-C circuits. (3)
Generation of alternating voltage and current, E.M.F. equation, Average and R.M.S. value, Phase and phase difference, Phasor representation of alternating quantity, Behavior of A.C. circuits, Resonance in series and parallel R-L-C circuits. AC Network: Superposition theorem, Thevenin’s theorem, Norton’s theorem, maximum power transfer theorem, solution of networks with AC</td></tr>
<tr><td>Textbooks/Reference material</td><td colspan="6">Textbooks:
1. Electrical & Electronic Technology by Hughes, Pearson Education India
Reference Books:
1. Advanced Electrical Technology by H. Cotton, Reem Publication Pvt. Ltd
2. Electrical Engineering fundamentals by Vincent Deltoro, Pearson Edu India</td></tr>
</table>

Mapping of CO (Course Outcome) and PO (Programme Outcome)

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

Correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
BTC01	LIFE SCIENCE	PCR	2	0	0	2	2
Pre-requisites		Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA))					
		CT+MT+EA					
Course Outcomes	CO1: Basic understanding of basic cellular organization of organisms and cellular communications, structure and functions of the macromolecules and their biosynthesis and cata--bolism. CO2: To give an understanding of the key features of the structure, growth, physiology and behavior of bacteria, viruses, fungi and protozoa CO3: To introduce molecular biology to understand biological processes in various applications. CO4: To provide a foundation in immunological processes and an overview of the interaction between the immune system and pathogens. CO5: To provide knowledge about biological and biochemical processes that require engineering expertise to solve them CO6: To provide knowledge about biological and biochemical processes that require engineering expertise to solve them						
Topics Covered	**1. Cell Biology (4)** a) Introduction to life science: prokaryotes & eukaryotes Definition; Difference b) Introduction to cells - Define cell, different types of cell c) Cellular organelles - All organelles and functions in brief d) Cellular communications Introduction to basic signaling; endocrine, paracrine signaling; concepts of receptor, ligand, on-off switch by phosphorylation/dephosphorylation **2. Biochemistry (4)** a) Biological function of carbohydrate and lipid - Introduction, structure and function b) Biological function of nucleic acids and protein - structure and function c) Catabolic pathways of Macromolecules - Introduction to catabolism, hydrolysis and condensation reactions; Catabolism of glucose- Glycolysis,						

	TCA; overall degradation of proteins and lipids d) Biosynthesis of Macromolecules Generation of ATP (ETS), Generation of Glucose (Photosynthesis) **3. Microbiology (5)** a) Types of microorganisms and their general features - Bacteria, Yeast, Fungi, Virus, Protozoa- general introduction with practical significance and diseases b) Microbial cell organization - Internal and External features of cell- bacterial cell wall, viral capsule, pilus etc, c) Microbial nutritional requirements and growth - Different Sources of energy; growth curve d) Basic microbial metabolism - Fermentation, Respiration, Sulfur, N_2 cycle **4. Immunology (5)** a) Basic concept of innate and adaptive immunity - Immunity-innate and adaptive, differences, components of the immune system b) Antigen and antibody interaction - Antigen and antibody, immunogen, factors affecting immunogenicity, basic antigen-antibody mediated assays, introduction to monoclonal antibody c) Functions of B cell - B cell, antibody production, memory generation and principle of vaccination d) Role of T cell in cell-mediated immunity - Th and Tc, functions of the T cell with respect to different pathogen and cancer cell **5. Molecular Biology (5)** a) Prokaryotic Genomes (Genome organization & structure) - Nucleoid, circular or linear b) Eukaryotic Genomes (Genome organization & structure) - Intron, exon, packaging, chromatin c) Central Dogma (Replication, Transcription and Translation) d) Applications of Molecular Biology (Diagnostics, DNA-fingerprinting, Recombinant products etc.) - Introduction to Recombinant DNA, fingerprinting, cloning **6. Bioprocess Development (5)** a) Microbial growth kinetics - Batch, fed-batch and continuous systems, Monod Equation b) Enzyme kinetics, kinetics of enzyme inhibition and deactivation Definition of enzymes, activation energy, Concepts of Km, Vmax, Ki c) Microbial sterilization techniques and kinetics Introduction to sterilization, dry and moist sterilization d) Thermodynamics of biological system - Concepts of Enthalpy, Entropy, favorable reactions, exergonic and endergonic reactions e) Material and energy balance for biological reactions - Stoichiometry
Text Books, and/or reference material	1. Biotechnology 01 Edition, authored by U. Satyanarayana, BOOKS & ALLIED (P) LTD. 2. Biochemistry by Lehninger. McMillan publishers 3. Microbiology by Pelczar, Chan and Krieg, Tata McGraw Hill 4. Brown, T.A., Genetics a Molecular Approach, 4th Ed. Chapman and Hall, 1992 5. Kuby J, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition,

	Freeman, 2002. 6. Bioprocess Engineering: Basic Concepts (2nd Ed), Shuler and Kargi, PHI.

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
BTC01	CO1	2	1	1	-	1	-	-	-	-	-	-	-
	CO2	2	1	1	-	1	-	1	-	-	-	-	-
	CO3	2	1	1	-	1	-	-	-	-	-	-	-
	CO4	2	1	1	-	1	-	-	1	-	-	-	1
	CO5	2	1	1	-	1	1	1	-	-	-	-	-

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
XXC01	The Constitution of India and Civic Norms	PCR	1	0	0	1	1
Pre-requisites		Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA))					
NIL		CT+MT+EA					
Course Outcomes	CO1: Elementary understanding of the evolution of historical events that led to the making of the Indian constitution, the philosophical values, basic structure and fundamental concerns enshrined in the Constitution of India. CO2: Aware of the fundamental rights and duties as a citizen of the country. CO3: Enable to know the civic norms to be followed according to the Indian constitution						
Topics Covered	**1.** Historical background of the Making of Indian Constitution (1 Hour) **2.** Preamble and the Philosophical Values of the Constitution (1 Hour) **3.** Brief Overview of Salient Features of Indian Constitution (1 Hour) **4.** Parts I & II: Territoriality and Citizenship (1 Hour) **5.** Part III: Fundamental Rights (2 Hours) **6.** Part IV: Directive Principles of State Policy (1 Hour) **7.** Part IVA: Fundamental Duties (1 Hour) **8.** Union Government: President, Prime Minister and Council of Ministers (2 Hours) **9.** Parliament: Council of States and House of the People (1 Hour) **10.** State Government: Governor, Chief Mister and Council of Ministers (1 Hour) **11.** State Legislature: Legislative Assemblies and Legislative Councils (1 Hour) **12.** Indian Judiciary: Supreme Court and High Courts (1 Hour) **13.** Centre-State Relations (1 Hour) **14.** Reservation Policy, Language Policy and Constitution Amendment (1 Hour)						

Text Books, and/or reference material	Primary Readings: 1) P. M. Bakshi, *The Constitution of India*, 18th ed. (2022) 2) Durga Das Basu, *Introduction to the Constitution of India*, 25th ed. (2021) 3) J.C. Johari, *Indian Government and Politics*, Vol. II, (2012) Secondary Readings: Granville Austin, *The Indian Constitution: Cornerstone of a Nation* (1966; paperback ed. 1999); Granville Austin, *Working a Democratic Constitution: The Indian Experience* (1999; paperback ed. 2003).

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	
XES52	**GRAPHICAL ANALYSIS USING CAD**	PCR	0	0	2	2	1
Pre-requisites		Course Assessment methods (Continuous (CT) and end assessment (EA))					
NIL		CT+EA					
Course Outcomes	• CO1: Introduction to graphical solution of mechanics problems • CO2: Knowledge on graphical solution methods for solving equilibrium in coplanar force system • CO3: Introducing Maxwell diagram and solution of plane trusses by graphical method • CO4: Determination of centroid of plane figures by graphical method • CO5: Exposure to AutoCAD software for computer aided graphical solution						
Topics Covered	• Graphical analysis of problems on statics. [14] • Graphical solution of engineering problems using CAD (with the help of "AutoCAD") [14]						
Text and/or reference material	1)… Engineering Drawing and Graphics – K Venugopal 2)… AutoCAD — George Omura 3)… Practical Geometry and Engineering Graphics – W Abbott						

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
XES52	CO1	2	-	-	-	-	-	-	-	-	-	-	-
	CO2	1	2	-	-	-	-	-	-	-	-	-	-
	CO3	2	1	-	-	-	-	-	-	-	-	-	-
	CO4	2	1	-	-	-	-	-	-	-	-	-	-
	CO5	1	-	-	-	2	-	-	-	-	-	-	-

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
CSS51	**COMPUTING LABORATORY**	PCR	0	0	2	2	1
Pre-requisites		Course Assessment methods (Continuous (CT) and end assessment (EA))					
NIL		CT+EA					
Course Outcomes	• CO1: To understand the principle of operators, loops, branching statements, function, recursion, arrays, pointer, parameter passing techniques • CO2: To detail out the operations of strings • CO3: To understand structure, union • CO4: Application of C-programming to solve various real time problems						
Topics Covered	**List of Experiments:** 1. Assignments on expression evaluation 2. Assignments on conditional branching, iterations, pattern matching 3. Assignments on function, recursion 4. Assignments on arrays, pointers, parameter passing 5. Assignments on string using array and pointers 6. Assignments on structures, union						
Text Books, and/or reference material	**Text Books:** 1. Let us C by Kanetkar 2. C Programming by Gottfried 3. Introduction to Computing by Balaguruswamy 4. The C-programming language by Dennis Ritchie **Reference Books:** 1. Computer fundamental and programming in C by P Dey and M. Ghosh 2. Computer fundamental and programming in C by Reema Thareja 3. programming with C by Schaum Series						

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSS51	CO1	3	-	1	-	-	-	-	-	-	-	-	-
	CO2	-	2	1	3	-	-	-	-	-	-	-	-
	CO3	-	1	-	2	1	-	-	-	-	-	-	-
	CO4	-	-	3	2	-	-	1	-	-	-	2	-

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	
ECS 51	**Basic electronics Lab**	PCR	0	0	2	2	1
Pre-requisites		Course Assessment methods (Continuous (CT) and end assessment (EA))					
NIL		CT+EA					
Course Outcomes	• CO1: Acquire idea about basic electronic components, identification, and behavior. • CO2: To determine IV characteristics of these Circuit elements for different applications. • CO3: Learn to analyze the circuits and observe and relate input and output signals.						
Labs Conducted.	1. To know your laboratory: To identify and understand the use of different electronic and electrical instruments. 2. To identify and understand name and related terms of various electronics components used in electronic circuits.: Identify different terminals of components, fid their values and observe numbering associate with it. 3. Use of oscilloscope and function generator: Use of oscilloscope to measure voltage, frequency/time and Lissajous figures of displayed waveforms. 4. Study of half wave and Full-wave (Bridge) rectifier with and without capacitor filter circuit. 5. Realization of basic logic gates: Truth table verification of OR, AND, NOT, NOT and NAND logic gates from TTL ICs 6. Regulated power supply: study LM78XX and LM79XX voltage regulator ICs 7. Transistor as a Switch: study and perform transistor as a switch through NOT gate 8. Zenner diode as voltage regulator 9. To study clipping and Clamping circuits 10. To study different biasing cirtis. 11. Study of CE amplifier and observe its frequency response.						
Text Books, and/or reference material	Text Books: 1. Experiments Manual for use with Electronic Principles (Engineering Technologies & the Trades) by Albert Paul MalvinoDr., David J. Bates, et al. Reference Books: 1. The Art of Electronics 3e, by Paul Horowitz, Winfield Hill 2. Electronic Principles, by Albert Paul MalvinoDr. and David J. Bates						

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ECS51	CO1	3	2	1	2	2	1	-	-	2	-	-	-
	CO2	3	2	2	2	3	-	-	-	2	-	-	-
	CO3	3	3	2	2	-	-	-	-	2	-	-	-

Correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

<table>
<tr><td colspan="7">Department of Electrical Engineering</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Title of the course</td><td rowspan="2">Program Core (PCR) / Electives (PEL)</td><td colspan="4">Total Number of contact hours</td><td rowspan="2">Credit</td></tr>
<tr><td>Lecture (L)</td><td>Tutorial (T)</td><td>Practical (P)</td><td>Total Hours</td></tr>
<tr><td>EES51</td><td>ELECTRICAL TECHNOLOGY LABORATORY</td><td>PCR</td><td>0</td><td>0</td><td>2</td><td>2</td><td>1</td></tr>
<tr><td colspan="2">Pre-requisites</td><td colspan="5">Course Assessment methods (Continuous (CT) and end assessment (EA))</td></tr>
<tr><td colspan="2">None</td><td colspan="5">CT+EA</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">• CO1: understand the principle of superposition.
• CO2: understand the principle of maximum power transfer
• CO3: understand the characteristics of CFL, incandescent Lamp, carbon lamp.
• CO4: understand the calibration of energy meter.
• CO5: understand open circuit and short circuit test of single-phase transformer.
• CO6: analyze RLC series and parallel circuits
• CO7: understand three phase connections.
• C08: understand determination of B-H curve</td></tr>
<tr><td>Topics Covered</td><td colspan="6">List of Experiments:
1. To verify Superposition and Thevenin’s Theorem.
2. To verify Norton and Maximum power transfer theorem
3. Characteristics of fluorescent and compact fluorescent lamp
4. Calibration on energy meter
5. To perform the open circuit and short circuit test on single phase transformer
6. To study the balanced three phase system for star and delta connected load
7. Characteristics of different types of Incandescent lamps
8. Study of Series and parallel R-L-C circuit
9. Determination of B-H Curve for magnetic material</td></tr>
<tr><td>Textbooks, and/or reference material</td><td colspan="6">Textbooks:
1. Handbook of Laboratory Experiments in Electronics and Electrical Engineering by A M Zungeru, J M Chuma, H U Ezea
2. Laboratory Courses in Electrical Engineering (5th Ed) by S. G. Tarnekar, P. K. Kharbanda, S. B. Bodhke, S. D. Naik, D. J. Dahigaonkar (S. Chand Pub.)</td></tr>
</table>

Mapping of CO (Course Outcome) and PO (Programme Outcome)

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	1	1	1	2	2	2	3
CO2	3	3	3	3	3	1	1	1	2	2	2	3
CO3	3	3	3	3	3	1	1	1	2	2	2	3
CO4	3	3	3	3	3	1	1	1	2	2	2	3
CO5	3	3	3	3	3	1	1	1	2	2	2	3
CO6	3	3	3	3	3	1	1	1	2	2	2	3

CO7	3	3	3	3	3	1	1	1	2	2	2	3
CO8	3	3	3	3	3	1	1	1	2	2	2	3

Correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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**	
XXS-52	**Co-curricular Activities**	PCR	**0**	**0**	**2**	**2**	**1**
Pre-requisites	Course assessment methods: (Continuous evaluation((CE) and end assessment (EA)						
NIL	CE + EA						
Course Outcomes	• CO1: Social Interaction: Through the medium of sports • CO2: Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them • CO3: Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes. • CO4: Personality development through community engagement • CO5: Exposure to social service						
Topics Covered	**YOGA** • Sitting Posture/Asanas- Gomukhasana, Swastikasana, Siddhasana, Ustrasana, Janusirsasana, ArdhaMatsyendrasana (Half-Spinal Twist Pose), Paschimottanasana, Shashankasana, Bhadrasana. • Mudra- Vayu, Shunya, Prithvi, Varuna, Apana, Hridaya, Bhairav mudra. • Laying Posture/Asanas- Shalabhasana (Locust Posture), Dhanurasana (Bow Posture), ArdhaHalasana (Half Plough Pose), Sarvangasana (Shoulder Stand), Halasana (Plough Pose), Matsyasana, SuptaVajrasana, Chakrasana (Wheel Posture), Naukasana (Boat Posture), Shavasana (Relaxing Pose), Makaraasana. • Meditation- 'Om'meditation, Kundalini or Chakra Meditation, Mantrameditation. • Standing Posture/Asanas- ArdhaChakrsana (Half Wheel Posture), Trikonasana (Triangle Posture), ParshwaKonasana (Side Angle Posture), Padahastasana, Vrikshasana (Tree Pose), Garudasana (Eagle Pose). • Pranayama- Nadisodha, Shitali, Ujjayi, Bhastrika, Bhramari. • Bandha- Uddiyana Bandha, Mula Bandha, Jalandhara Bandha, Maha Bandha. • Kriya- Kapalabhati, Trataka, Nauli. **ATHLETICS** • Long Jump- Hitch kick, Paddling, Approach run, Take off, Velocity, Techniques, Flight & Landing						

	• Discus throw, Javelin throw and Shot-put- Basic skill & Technique, Grip, Stance, Release & Follow through. • Field events marking. • General Rules of Track & Field Events. **BASKETBALL** • Shooting- Layup shot, Set shot, Hook shot, Jump shot. Free throw. • Rebounding- Defensive rebound, Offensive rebound. • Individual Defensive- Guarding the man without ball and with ball. • Pivoting. • Rules of Basketball. • Basketball game. **VOLLEYBALL** • Spike- Straight spike, Body turn spike, Tip spike, Back attack, Slide spike, Wipe out spike. • Block- Single block, Double block, Triple block, Group block. • Field Defense- Dig pass, Double pass, Roll pass. • Rules and their interpretation. **FOOTBALL** • Dribbling- Square pass, Parallel pass, Forward pass. • Heading (Standing & Running)- Fore head, Side fore head, Drop heading, Body covering during heading. • Kicking- Full volley, Half volley, Drop kick, Back volley, Side volley, Chiping (lobe). • Tackling: Covering the angle, Chessing time sliding chese, Heading time shoulder tackle etc. • Feinting- Body movement to misbalance the opponent and find space to go with ball. • Rules of Football. **CRICKET** • Batting straight drive. • Batting pull shot. • Batting hook shot. • Bowling good length, In swing. • Bowling out swing, Leg break, Goggle. • Fielding drill. • Catching (Long & Slip). • Wicket keeping technique. • Rules & Regulation. **BADMINTON** • Net play- Tumbling net shot, Net Kill, and Net Lift. • Smashing. • Defensive high clear/Lob. • Half court toss practice, Cross court toss drop practice, Full court Game practice. • Player Positioning, Placements.

	• Rules & Regulation. • Doubles & Mixed doubles match practice. **TABLE TENNIS** • Stroke: Backhand- Topspin against push ball, Topspin against deep ball, Topspin against rally ball, Topspin against topspin. • Stroke: Forehand- Topspin against push ball, Topspin against deep ball, Topspin against rally ball, Topspin against topspin. • Stroke- Backhand lob with rally, Backhand lob with sidespin, Forehand lob with rally, Forehand lob with sidespin. • Service: Backhand/Forehand- Push service, Deep push service, Rally service. • Service: Backhand sidespin (Left to right & Right to left). • Service: Forehand- High toss backspin service, High toss sidespin service, High toss reverse spin service. • Rules and their interpretations. • Table Tennis Match (Singles & Doubles). **NCC** • FD-6 Side pace, Pace Forward and to the Rear. • FD-7 Turning on the March and Wheeling. • FD-8 Saluting on the March. • FD-9 Marking time, Forward March and Halt in Quick Time. • FD-10 Changing step. • FD-11 Formation of Squad and Squad Drill. • FD-12 Parade practice. **TAEKWONDO** • Poomsae (Forms)- Jang, Yi Jang. • Self Defense Technique- Self defense from arms, Fist and Punch. • Sparring (Kyorugi)- One step sparring, Two step sparring, Fight (Free sparring). • Combination Technique- Combined kick and punch. • Board Breaking (Kyokpa)- Sheet breaking. • Interpretation Rules above Technique of Taekwondo. **NSS** • No Smoking Campaign • Anti- Terrorism Day Celebration • Any other observation/celebration proposed by Ministry/institute • Public Speaking • Discussion on Current Affairs • Viva voce

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
XXS52	CO1	-	-	-	-	-	2	-	-	3	-	-	-
	CO2	-	-	-	-	-	-	-	2	-	-	-	-
	CO3	-	-	-	-	-	-	1	-	-	-	-	3
	CO4	-	-	-	-	-	-	-	-	2	2	-	-
	CO5	-	-	-	-	-	3	1	-	-	-	-	-

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MAC01	CO1	3	3	1	2	-	-	-	-	1	-	-	-
	CO2	3	3	1	2	-	-	-	-	1	-	-	-
	CO3	3	3	1	2	-	-	-	-	1	-	1	1
	CO4	3	-	-	2	-	2	-	-	1	-	-	-
PHC01	CO1	3	2	1	1	1	-	-	1	-	-	-	1
	CO2	3	2	-	2	-	-	-	-	-	-	-	1
	CO3	3	2	2	2	1	1	1	1	1	-	1	1
	CO4	3	2	2	2	1	1	1	-	1	-	1	1
CYC01	CO1	1	2	-	-	-	-	-	-	-	-	-	-
	CO2	1	-	-	-	-	-	2	-	-	-	-	-
	CO3	1	2	1	1	1	-	-	-	-	-	-	-
	CO4	-	1	-	-	2	-	1	-	-	-	-	-
XEC01	CO1	1	-	-	-	-	-	-	-	-	-	-	1
	CO2	1	1	1	1	-	-	-	-	-	-	-	1
	CO3	1	1	-	-	-	-	-	-	-	-	-	1
	CO4	1	2	-	-	-	-	-	-	-	-	-	1
	CO5	-	2	2	2	2	1	-	-	-	1	-	1
ESC01	CO1	3	-	-	-	-	-	2	-	-	-	-	-
	CO2	1	-	-	-	-	-	2	-	-	-	-	-
	CO3	2	-	-	-	-	-	2	-	-	-	-	-
	CO4	1	-	3	-	-	2	1	-	-	-	-	-
XES51	CO1	1	-	-	-	-	-	-	-	-	-	-	-
	CO2	1	1	-	-	-	-	-	-	-	-	-	-
	CO3	1	-	1	-	-	-	-	-	-	-	-	-
HSS51	CO1	-	-	-	-	-	1	-	-	1	3	-	3
	CO2	-	-	-	-	-	2	-	-	2	3	-	3
PHS51	CO1	3	2	1	-	-	-	-	-	2	1	-	1
	CO2	3	2	1	-	-	1	-	-	2	1	-	1
	CO3	3	1	-	-	-	-	-	-	2	1	-	1
	CO4	3	2	-	1	-	1	1	-	2	1	-	1
	CO5	3	2	1	-	1	1	1	-	2	1	-	1
CYS51	CO1	2	1	-	1	-	-	-	-	-	-	-	-
	CO2	-	1	-	1	1	2	-	-	-	-	-	-
	CO3	2	-	-	1	1	-	-	-	-	-	-	-
	CO4	-	1	-	1	1	-	-	-	-	-	-	-
WSS51	CO1	2	-	-	-	-	1	-	-	-	1	-	-
	CO2	1	-	1	-	-	1	-	-	-	1	-	-
	CO3	1	-	2	-	-	1	-	-	-	1	-	-
	CO4	1	-	-	-	-	2	-	-	-	1	-	-
MAC02	CO1	2	3	1	3	-	-	-	-	2	-	-	-
	CO2	2	3	1	2	-	-	-	-	2	-	-	-
	CO3	2	2	2	3	2	-	-	-	3	-	1	1
	CO4	2	3	2	3	2	1	1	-	2	-	-	-

CSC01	CO1	3	1	2	1	-	-	-	-	-	-	-	-
	CO2	-	2	1	2	1	-	-	-	-	-	-	-
	CO3	1	2	-	-	3	-	-	-	-	-	-	-
	CO4	1	3	1	2	3	-	-	-	-	-	-	1
	CO5	2	1	-	-	3	-	-	-	-	-	-	-
	CO6	2	-	3	-	1	-	-	-	-	-	-	-
ECC01	CO1	-	-	-	-	-	-	-	-	-	-	-	-
	CO2	-	-	-	-	-	-	-	-	-	-	-	-
	CO3												
	CO4	-	-	-	-	-	-	-	-	-	-	-	-
EEC01	CO1	3	1	-	-	2	-	-	-	-	1	-	-
	CO2	2	3	2	-	2	-	-	-	-	-	-	-
	CO3	2	3	1	-	-	-	-	-	-	1	-	-
	CO4	3	1	2	-	1	-	-	-	-	-	-	-
	CO5	3	1	2	-	1	-	-	-	-	-	-	-
BTC01	CO1	2	1	1	-	1	-	-	-	-	-	-	-
	CO2	2	1	1	-	1	-	1	-	-	-	-	-
	CO3	2	1	1	-	1	-	-	-	-	-	-	-
	CO4	2	1	1	-	1	-	-	1	-	-	-	1
	CO5	2	1	1	-	1	1	1	-	-	-	-	-
XES52	CO1	2	-	-	-	-	-	-	-	-	-	-	-
	CO2	1	2	-	-	-	-	-	-	-	-	-	-
	CO3	2	1	-	-	-	-	-	-	-	-	-	-
	CO4	2	1	-	-	-	-	-	-	-	-	-	-
	CO5	1	-	-	-	2	-	-	-	-	-	-	-
CSS51	CO1	3	-	1	-	-	-	-	-	-	-	-	-
	CO2	-	2	1	3	-	-	-	-	-	-	-	-
	CO3	-	1	-	2	1	-	-	-	-	-	-	-
	CO4	-	-	3	2	-	-	1	-	-	-	2	-
ECS51	CO1	3	2	1	2	2	1	-	-	2	-	-	-
	CO2	3	2	2	2	3	-	-	-	2	-	-	-
	CO3	3	3	2	2	-	-	-	-	2	-	-	-
EES51	CO1	3	-	2	-	3	-	-	-	1	-	-	-
	CO2	3	-	2	-	3	-	-	-	1	-	-	-
	CO3	2	3	2	2	1	-	2	-	1	-	-	-
	CO4	2	3	1	2	2	-	1	-	1	1	-	-
	CO5	2	3	1	2	2	-	-	-	1	-	-	-
	CO6	2	3	2	2	2	-	-	-	1	-	-	-
XXS51	CO1	-	-	-	-	-	2	-	-	3	-	-	-
	CO2	-	-	-	-	-	-	-	2	-	-	-	-
	CO3	-	-	-	-	-	-	1	-	-	-	-	3
	CO4	-	-	-	-	-	-	-	-	2	2	-	-
	CO5	-	-	-	-	-	3	1	-	-	-	-	-
XXS51	CO1	-	-	-	-	-	2	-	-	3	-	-	-
	CO2	-	-	-	-	-	-	-	2	-	-	-	-
	CO3	-	-	-	-	-	-	1	-	-	-	-	3
	CO4	-	-	-	-	-	-	-	-	2	2	-	-

	CO5	-	-	-	-	-	3	1	-	-	-	-	-

THIRD SEMESTER

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	
CEC301	**Solid Mechanics**	**PCR**	**3**	**1**	**0**	**4**	**4**

Pre-requisite(s)	Course Assessment methods
Knowledge of Engineering Mechanics and Mathematics	Continuous (CT) and end assessment (EA). CT+EA

Course Outcomes (COs):	• CO1: Development of skills for predicting structural behaviour of solids under different loads • CO2: Knowledge of basics of analysis and design of structural components made of variety of materials • CO3: Developing the requisite skill that helps in studying the advanced courses
Topics Covered (Hrs)	**Concept of stress and strain**: Normal and shear stresses and strains in axially loaded members, Elastic moduli and their inter-relationships, strain energy due to direct stresses, impact loads. **(4)** **Beam Statics**: Definitions, support types and support reactions, concepts of redundancy, shear force and bending moment diagrams for beams. **(8)** **Symmetric Beam Bending**: Basic kinematical assumptions, moment of inertia, elastic flexure formulae and its application, moment carrying capacity. **(3)** **Bending stress and Shear stress distributions** in beam sections, Combined bending and direct stresses. **(8)** **Strain energy**: Due to pure bending and shearing stress. **(2)** **Deflection of beams**: Moment-curvature relationship, determination of deflection by direct integration method, moment area method and energy method. **(6)** **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. **(4)** **Thin pressure vessels**: Hoop stress and meridional stress, volumetric changes **(2)** **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:*** 1. Elements of Strength of Material by S. P. Timoshenko & D. H. Young 2. Strength of Materials by S SBhavikatti 3. Engineering Mechanics of Solids by E. P. Popov ***Reference Books:*** 4. Strength of Material by Singer &Pytel 5. A Text Book of Strength of Materials by Ghosh &Datta, New Age International Publication Pvt. Ltd, New Delhi

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-
CO3	-	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	
CEC302	**Fluid Mechanics**	**PCR**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Mechanics		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs) :	• CO1: Development of skills for predicting fluid behaviour • CO2: Knowledge of basics of fluid flow measurement and model development • CO3: Developing the requisite skill that helps in studying the advanced courses
Topics Covered (Hrs)	**Fluid Properties:** Equations of State, Units and Dimensions, Fluid Pressure, Pressure Gauges, 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, Forced and Free Vortex. **(7)** **Dimensional Analysis**: Similitude of fluid flow, non-dimensional numbers. **(3)** **Incompressible flow in closed conduits**: Laminar and Turbulent Flow, Critical Reynold's Number, Pipe Friction Law, Laminar Flow in Pipes, Friction Loss in Smooth and Rough Pipes, Minor Losses in Pipes, HGL and EGL, Empirical Formula for Pipe flow. **(6)** **Flow measurement:** Orifice coefficient, External and Reentrant Mouth pieces, Measurement of Velocity and Discharge in Closed Conduits, Venturimeter, Orificemeter and Pitot Tube, Flow through Rectangular Weirs and V-Notch, Time of Emptying Tanks and Reservoirs. **(7)** **Open Channels:** Equation of Uniform Flow, Chezy and Manning Formulae, Velocity Distribution and Economic Cross Section. **(4)**
Text Books, and/or reference material (s)	***Text Books:*** 1. Fluid Mechanics by Frank M White, Tata McGraw-Hill 2. Introduction to Fluid Mechanics byRobert W Fox & Alan T McDonald, WILEY 3. Fluid Mechanics by V. L. Streeter & E B Wylie, McGraw-Hill ***Reference Books:*** 4. Fluid Mechanics and Hydraulics by Jack B Evett& Cheng Liu, Tata McGraw-Hill

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	-	2	3	1	-	-	-	-	-	-	-	-
CO3	-	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	
CEC303	**Building Construction& Concrete Technology**	**PCR**	**3**	**1**	**0**	**4**	**4**
Pre-requisite(s)		Course Assessment methods					
No pre-requisites		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs) :	• CO1: Acquire knowledge ofselection and application of building materials • CO2: Understand the building components and planning • CO3: Gain an integrative ideaon materials, preparation and mix design of concrete

Topics Covered (Hrs)	**A). Building planning and construction:**Planning and orientation of buildings, 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:** Brief idea on different building materials **(2)** **Aggregates:** Classification, sampling, mechanical, physical 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. **(8)** **C). Concrete Technology:** Introduction, classification, properties, grades, advantage, disadvantages and quality control of concrete.**(2)** **Fresh concrete:** Introduction, workability, factors, measurement, segregation, bleeding and manufacture of concrete – batching, mixing, transporting, placing, compaction, finishing and curing.**(6)** **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 andmix design using Indian Standard code. **(4)** **Special concrete:** Introduction of Light weight, High density, High strength, Fibre reinforced, Polymer concrete and Ferro cement. **(4)**
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. Building Construction by S. C. Rangwala, Charotar Publishing House, Anand 3. Concrete Technology by M.S. Shetty, S. Chand Publisher, New Delhi 4. IS 10262: 2009,Concrete Mix Proportioning-Guidelines (1st Revision), BIS, New Delhi. 5. IS 383: 1970, Specification for Coarse and Fine aggregates from natural sources for concrete (2nd Revision) BIS, New Delhi. ***Reference Books:*** 6. Concrete Technology by M.L. Gambhir, Tata McGraw Hill and www.nptel.ac.in

Mapping of Course Outcomes COs→POs

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

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	
CES351	**Fluid and Strength of Material Laboratory**	**PS**	**0**	**0**	**3**	**3**	**1.5**
Pre-requisite(s)		Course Assessment methods					
NIL		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes	• CO1: Conduct experiments for the determining the properties of harden concrete and mild steel, and other construction materials.						

(COs) :	• CO2: Perform different experiments on fluid mechanics related problems for determination of properties of flow through pipes and calibration of few flow rate measuring instruments. • CO3: Use modern instruments and tools to determine the properties of harden concrete and other civil engineering materials and work in a group. • CO4: Prepare the report on experimental results.
Topics Covered (Hrs)	Determination of compressive strength, split tensile strength & flexural strength of concrete. 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 apply torsional load on circular rods and to determine the value of modulus of rigidity by measuring the angle of twist. Experiment on Rockwell Hardness Test. Determination of coefficient of bend loss in flow through pipes. Experiment on friction loss in flow through pipes. Calibration of Venturimeter. Calibration of V-notch. Calibration of Orifice meter. Experiment on impact of jet.
Text Books and/or reference material(s)	***Text Books:*** 1. Concrete Technology by M. S. Shetty, S. Chand & Co 2. Concrete Technology by M. L. Gambhir, Tata McGraw Hill 3. Elements of Strength of Material by S. P. Timoshenko, and D. H. Young, Affiliated East-West Press. ***Reference Books:*** 3. Fluid Mechanics by M White Frank, Tata McGraw-Hill 4. Introduction to Fluid Mechanics by W Fox Robert & T Alan McDonald, WILEY 5. Fluid Mechanics by V. L. Streeter, & E B, Wylie, McGraw-Hill.

Mapping of Course Outcomes COs→POs

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

Department of Mathematics							
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-requisites		Basic knowledge of topics included in MAC01 & MAC02					
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

Mapping of CO (Course outcome) and PO (Programme Outcome)

Course	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MAC331	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

<table>
<tr><td colspan="8">Department of Earth and Environmental Studies</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Title of the course</td><td rowspan="2">Program Core (PCR) / Electives (PEL)</td><td colspan="4">Total Number of contact hours</td><td rowspan="2">Credit</td></tr>
<tr><td>Lecture (L)</td><td>Tutorial (T)</td><td>Practical (P)#</td><td>Total Hours</td></tr>
<tr><td>ESC331</td><td>Enginnering Geology for Civil Engineering</td><td>PCR</td><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td colspan="3">Pre-requisites</td><td colspan="5">Course Assessment methods (Continuous (CT) and end assessment (EA))</td></tr>
<tr><td colspan="3"></td><td colspan="5">CT+EA</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">• Assimilation of Geological knowledge with Civil Engineering for better design of Engineering Structures (Dam, Tunnels etc.).
• Enhancing skill of problem solving in dam, tunnel and landslide etc.
• Better understanding of groundwater as a vital resource in Water Resource Engineering.</td></tr>
<tr><td>Topics Covered</td><td colspan="7">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 and classification of faults; Joints – Definition, types and classification of joints; Cleavage and Schistosity – 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, perched water table, Coefficient of storage, Natural springs & seepages, Recharge and Discharge area criteria, Geological Control on groundwater movement – Darcy's law, Fluctuation of water table in unconfined aquifer, Cone of depression, Groundwater exploration, Effects of excessive trapping, Water logging, Water well. [8]
Engineering Geology: Engineering properties of rocks – drifted rocks, in situ rocks, Building materials, 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]</td></tr>
<tr><td>Text Books, and/or reference material</td><td colspan="7">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</td></tr>
</table>

<table>
<tr><td colspan="8">Department of Earth and Environmental Studies</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Title of the course</td><td rowspan="2">Program Core (PCR) / Electives (PEL)</td><td colspan="4">Total Number of contact hours</td><td rowspan="2">Credit</td></tr>
<tr><td>Lecture (L)</td><td>Tutorial (T)</td><td>Practical (P)#</td><td>Total Hours</td></tr>
<tr><td>ESS381</td><td>Geology Laboratory For Civil Engineers</td><td>PCR</td><td>0</td><td>0</td><td>3</td><td>3</td><td>1.5</td></tr>
<tr><td colspan="2">Pre-requisites</td><td colspan="6">Course Assessment methods (Continuous (CT) assessment)</td></tr>
<tr><td colspan="2"></td><td colspan="6">CT</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">● Students will be able to know the characters of the minerals and rocks on which the Civil structures to be constructed.
● The students will learn to solve geological problems associated with selection of construction site.
● The students will have firsthand knowledge of geophysical exploration for groundwater.</td></tr>
<tr><td>Topics Covered</td><td colspan="7">Experiment 1: To study the physical properties of minerals in hand specimens. [3]
Experiment 2: Identification of minerals in hand specimens on the basis of physical properties. [3]
Experiment 3: Study of rocks in hand specimens. [3]
Experiment 4: Determination of apparent dips in given directions from true dip. [3]
Experiment 5: Determination of true dip from given apparent dips. [3]
Experiment 6: Determination of orientation of inclined plane from drill hole data. [3]
Experiment 7: Study of a geological map. [3]
Experiment 8: Resistivity survey for subsurface water (Part 1). [3]
Experiment 9: Resistivity survey for subsurface water (Part 2). [3]</td></tr>
</table>

FOURTH SEMESTER

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	
CEC401	**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: Able to computethe internal forces in cable, arch, trusses, beams and frames • CO3: Achieved the idea to applygeometric methods to obtain slope and deflections • CO4: Gain the idea to apply Energy methods to obtain slope and deflections • CO5: Evaluate & draw the influence lines for reactions, shears, & bending moments in beams & girders due to moving load.
Topics Covered (Hrs)	**Introduction:** Structural system, support condition different load and system**(2)** **Shear force and bending moment:**Recapitulation of bending moment and shear force of determinate structures.**(4)** **Slopes and deflections:** Slopes and deflections in beams and frames, elastic curve, application of elastic beam theory with Maculay's notation, moment area method, conjugate beam method. **(14)** **Energy methods:**Strain energy, complementary energy, real work, virtual work, applicationofCastigliano's Theorems & virtual work methods to beams, frames, trusses, Maxwell's Reciprocal theorem, Betti's Law **(18)** **Static and kinematic indeterminacy:**Application on different type of structures**(4)** **Influence Lines:** Application of influence lines & rolling loads for determinate beams / girders**(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. Elements of structural analysis by N. C. Sinha, New Central book agency pvt. Ltd. 4. Structural Analysis by R. C. Hibbeler, Pearson Education ***Reference Books:*** 5. Structural Analysis by G. S. Pandit& S. P. Gupta, Tata McGraw Hill 6. Theory of structures by S. P. Timoshenko and D. H. Young, Mc. Graw Hill book Co

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	-	-	-	-	-	1	-	-	-	-	-
CO3	3	-	-	-	2	-	-	-	-	-	-	-
CO4	3	-	-	-	2	-	-	-	-	-	-	-
CO5	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	
CEC402	**Design of Concrete Structures**	**PCR**	**3**	**1**	**0**	**1**	**4**
Pre-requisite(s)		Course Assessment methods					
Solid Mechanics		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs) :	• CO1: Apply knowledge of solid mechanics for design solutions. • CO2: Understand basic design philosophies applicable to concrete structures. • CO3: Formulate, analyze, and designbasic components of Civil Engineering Reinforced Concrete structures.
Topics Covered (Hrs)	**Properties** of concrete and reinforcing steel, Characteristic strengths, Stress strain curves, Shrinkage and creep phenomenon, I.S. specification **(4)** **Design philosophies** – working stress method and limit state method of design. **(8)** **Analysis and design** of sections in flexure by working stress and limit state method, Single and doubly reinforced sections, T and L sections **(8)** **Behaviour of beams** in shear and bond, Design for shear, Anchorage and curtailment of reinforcement, Detailing of reinforcement. **(4)** **Serviceability**, Limit states of deflection and cracking, Calculation of deflections. **(4)** **Design of columns**: Short and long columns, Eccentrically loaded columns **(8)** **Design of one-way and two-way slabs, Staircases. (6)** **Isolated and combined footings (6)** **Design of cantilever type retaining walls(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. IS 456: 2000,Indian Standard Plain and Reinforced Concrete – Code of Practice (4th Revision), BIS, New Delhi. 3. SP-16, Design Aids for Reinforced Concrete to IS: 456 – 1978, BIS, New Delhi 4. www.nptel.iitm.ac.in/courses/ ***Reference Books:*** 5. Reinforced Concrete, 6th Edition, by S.K. Mallick and A.P. Gupta, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, 1996. 6. Reinforced Concrete Design, 1st Revised Edition, by S.N. Sinha, Tata McGraw-Hill Publishing Company. New Delhi, 1990.

Mapping of Course Outcomes COs→POs

	Engineering knowledge	Problem analysis	Design/development of solutions	investigations of complex	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	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	3	-	-	-	1	-	-	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	
CEC 403	**Surveying**	**PCR**	**3**	**0**	**0**	**3**	**3**
Pre-requisites		Course Assessment methods					
None		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes	• CO1: Learn basic principles of surveying and handling of various surveying instruments. • CO2: Learn toconduct engineering surveys. • CO3: Data entry in field books and level books. • CO4: Make and interpret maps. • CO5: Compute area and volumes.
Topics Covered (Hrs)	**Introduction:** Definition, primary division,classification and Principles of surveying, Basic measurements. **(2)** **Linear measurements:** Instruments, Ranging, Chaining, Tape corrections. **(3)** **Chain surveying:** Principles, Basic definitions, Equipment, Field work, Obstacles, Plotting & accuracy. **(3)** **Compass surveying:** Instruments, Traverse, Bearings and their designations, Magnetic declination, 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. **(5)** **Measurement of areas:** Area of a tract with irregular boundaries, Different methods, Planimeter and its uses. **(5)** **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. Surveying and Levelling Part I& II by T. P. Kanetkar and S. V. Kulkarni, Pune VidyarthiGrihaPrakashan Pune – 30, 1979 2. Surveying Vol. I& II. by, B. C. Punmia, A. K. Jain and A. K. Jain A.K., Laxmi Publications (P) Ltd., 2005 ***Reference Books:*** ***3.*** Surveying Vol. I.& II by K. R. Arora, Standard Book House, P.B.-1074, Delhi ***4.*** Surveying courses available in http://nptel.iitm.ac.in/

Mapping of Course Outcomes COs→POs

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

CO3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	-	-	-	-	-	-	-	-	3	-
CO5	-	-	-	-	-	-	-	-	-	-	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	
CES451	**Structural Analysis Sessional-I**	**PS**	**0**	**0**	**3**	**3**	**1.5**

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: Able to computethe internal forces in cable, arch, trusses, beams and frames • CO3: Achieved the idea to applygeometric methods to obtain slope and deflections • CO4: Gain the idea to apply Energy methods to obtain slope and deflections • CO5: Evaluate & draw the influence lines for reactions, shears, & bending moments in beams / girders due to moving load.
Topics Covered (Hrs)	**Introduction:** Structural system, support condition different load and system**(1)** **Shear force and bending moment:**Recapitulation of bending moment and shear force of determinate structures.**(2)** **Slopes and deflections:** Slopes and deflections in beams and frames, elastic curve, application of elastic beam theory with Maculay's notation, moment area method, conjugate beam method. **(12)** **Energy methods:**Strain energy, complementary energy, real work, virtual work, applicationofCastigliano's Theorems & virtual work methods to beams, frames, trusses, Maxwell's Reciprocal theorem, Betti's Law **(12)** **Static and kinematic indeterminacy:**Application on different type of structures**(3)** **Influence Lines:** Application of influence lines & rolling loads for determinate beams / girders**(9)**
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Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	-	-	-	-	-	1	-	-	-	-	-
CO3	3	-	-	-	2	-	-	-	-	-	-	-
CO4	3	-	-	-	2	-	-	-	-	-	-	-
CO4	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	
CES452	**Design of Concrete Structures sessional**	**PS**	**0**	**0**	**3**	**3**	**1.5**
Pre-requisite(s)		Course Assessment methods					
Solid Mechanics		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs) :	• CO1: Apply knowledge of solid mechanics for design solutions. • CO2: Understand basic design philosophies applicable to concrete structures. • CO3: Formulate, analyze, and design basic components of Civil Engineering Reinforced Concrete structures.
Topics Covered (Hrs)	**Properties** of concrete and reinforcing steel, Characteristic strengths, Stress strain curves, Shrinkage and creep phenomenon, I.S. specification **(4)** **Design philosophies** – working stress method and limit state method of design. **(8)** **Analysis and design** of sections in flexure by working stress and limit state method, Single and doubly reinforced sections, T and L sections **(8)** **Behaviour of beams** in shear and bond, Design for shear, Anchorage and curtailment of reinforcement, Detailing of reinforcement. **(4)** **Serviceability**, Limit states of deflection and cracking, Calculation of deflections. **(4)** **Design of columns**: Short and long columns, eccentrically loaded columns **(8)** **Design of one-way and two-way slabs, Staircases. (6)** **Isolated and combined footings (6)** **Design of cantilever type retaining walls (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. IS 456: 2000, Indian Standard Plain and Reinforced Concrete – Code of Practice (4th Revision), BIS, New Delhi. 3. SP-16, Design Aids for Reinforced Concrete to IS: 456 – 1978, BIS, New Delhi 4. www.nptel.iitm.ac.in/courses/ ***Reference Books:*** 5. Reinforced Concrete, 6th Edition, by S. K. Mallick and A.P. Gupta, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, 1996. 6. Reinforced Concrete Design, 1st Revised Edition, by S.N. Sinha, Tata McGraw-Hill Publishing Company. New Delhi, 1990.

Mapping of Course Outcomes COs→POs

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

Course Code	Title of the course	Program Core (PCR) / Electives (PCR)	Total Number of contact hours				Credit
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
CSC432	**Data Structure**	**PCR**	**3**	**0**	**0**	**3**	**3**
Pre-requisites		Course Assessment methods: (Continuous (CT), Mid-Term (MT) and End Assessment (EA)					
CSC 01 in 1st year		CT+MT+EA					
Course Outcomes	At the end of the course, a student will be able to: CO1.Describe linear data structures using array and linked list CO2. Apply data structures like stacks, queues in linear data structure. CO3. Discuss non-linear data structures tree and its application. CO4. Apply various algorithms in graph. CO5. Solve searching, sorting and hashing techniques in data structures CO6. Interpret sorting algorithms for a given problem.						
Topics Covered	**Fundamentals of Python:** Basic Python programming, Data types, while & for loops, if-else statements, function, List, Tuples and Dictionary, file handling, Object & Classes.[10] **Searching Techniques:** Linear search, Binary search, Fibonacci search. [4] **Sorting Techniques:** Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort. [5] **Single Linked List:** Implementation of Single Linked List and different operation like (i) Creation (ii) insertion (iii) deletion (iv)traversal. Implementation of Circular Linked List using single linked list.[4] **Double Linked List:** Implementation of Single Linked List and different operation like (i) Creation (ii) insertion (iii) deletion (iv)traversal. [3] **Stack and Queue:** Design and Implementation of Stack and Queue and different operation on them, Stack operations to convert infix expression into postfixexpression, Stack operations for evaluating the postfixexpression. [8] **Graph:** Implementation of Graph, Depth first search, Breadth first search. [5] **Binary Search Tree:** Design and Implementation of Binary search tree, Traverse the above binary search tree recursively in pre-order, post-order andin-order. Count the number of nodes in the binary searchtree. [6]						
Text Books, and/or reference material	**Text Books** 1. Rance D. Necaise, "Data Structures and Algorithms using Python", Wiley StudentEdition. 2. Michael T. Goodrich, Robert Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley. **References:** 3. https://docs.python.org/3/tutorial/datastructures.html 4. http://www.tutorialspoint.com/data_structures_algorithms						

Mapping of CO (Course outcome) and PO (Programme Outcome)

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	1	2	1		1	1	1				2	-	-	1
CO2	3	2	1	1	1	1	1	1	1	1		2	1	1	1
CO3	3	3	2	1	1	1	1	1	1	1	1	1	2	2	1

<table>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Title of the course</td><td rowspan="2">Program Core (PCR) / Electives (PCR)</td><td colspan="4">Total Number of contact hours</td><td rowspan="2">Credit</td></tr>
<tr><td>Lecture (L)</td><td>Tutorial (T)</td><td>Practical (P)</td><td>Total Hours</td></tr>
<tr><td>CSS482</td><td>Data Structure Sessional</td><td>PCR</td><td>0</td><td>0</td><td>3</td><td>3</td><td>1.5</td></tr>
<tr><td colspan="2">Pre-requisites</td><td colspan="6">Course Assessment methods: (Continuous evaluation (CE) and End Assessment (EA))</td></tr>
<tr><td colspan="2">CSS 51 in 1st year.</td><td colspan="6">CE+EA</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">At the end of the course, a student will be able to:
CO1. Understand various data representation techniques in the realworld.
CO2. Implement linear and non-linear datastructures.
CO3. Analyze various algorithms based on their time and spacecomplexity.
CO4. Develop real-time applications using suitable datastructure.
CO5. Identify suitable data structure to solve various computingproblems.</td></tr>
<tr><td>Topics Covered</td><td colspan="7">List of Experiments:
Week1: Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order
a. Linearsearch
b. Binary search
c. Fibonaccisearch
Week2: Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order.
a. Bubblesort
b. Insertionsort
c. Selectionsort
Week3: Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order.
a. Quicksort
b. Mergesort
Week4: Write Python programs to
a. Design and implement Stack and its operations using List.
b. Design and implement Queue and its operations using List.
Week5: Write Python programs for the following:
a. Uses Stack operations to convert infix expression into postfix expression.
b. Uses Stack operations for evaluating the postfix expression.
Week6: Write Python programs for the following operations on Single Linked List.
a. (i) Creation (ii) insertion (iii) deletion (iv) traversal
b. To store a polynomial expression in memory using single linked list.
Week7: Write Python programs for the following operations on Circular Linked List.
(i) Creation (ii) insertion (iii) deletion (iv) traversal
Week8: Write Python programs for the following:
Uses functions to perform the following operations on Double Linked List.
(i) Creation (ii) insertion (iii) deletion (iv) traversal in both ways.
Week9: Write a Python program to implement Stack using linked list.
Week10: Write a Python program to implement Linear Queue using linked list.
Week11: Write Python programs to implement the following graph traversal algorithms:
a. Depth first search.
b. Breadth first search.
Week12: Write a Python program to perform the following:</td></tr>
</table>

	a. Create a binary search tree. b. Traverse the above binary search tree recursively in pre-order, post-order and in-order. c. Count the number of nodes in the binary search tree.
Text Books, and/or reference material	**Text Books** 1. Y Daniel Liang, "Introduction to Programming using Python",Pearson. 2. Rance D. Necaise, "Data Structures and Algorithms using Python", Wiley StudentEdition. 3. Michael T. Goodrich, Robert Tamassia, Michael h. Goldwasser, "Data Structures and Algorithms in Python", Wiley. **References:** 1. https://docs.python.org/3/tutorial/datastructures.html 2. http://interactivepython.org/runestone/static/pythonds/index.html 3. http://www.tutorialspoint.com/data_structures_algorithms 4. http://www.geeksforgeeks.org/data-structures/

Mapping of CO (Course outcome) and PO (Programme Outcome)

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1					1	1	1		2	1		1
CO2	3	2	1					1	1	1		2	1		1
CO3	3	2	1		1	1	1	1	1	1		2	2		1

FIFTH SEMESTER

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	
CEC501	**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: Analyse indeterminate beams and frames by displacement methods (Slope deflection method, Moment distribution method, Kane's method) • CO2: Analyse indeterminate beams and frames by force methods (Three moment Equation, column Analogy method, consistent deformation method) • CO3: Apply matrix analysis using stiffness and flexibility methods- computer-based analysis of structure. • CO4: Evaluate and draw the influence lines for reactions, shears, and bending moments in indeterminate beams / girders and frames. • CO5: Apply approximate methods (Substitute Frame method, Portal and cantilever methods) to solve multi-storeyed building frames
Topics Covered (Hrs)	**Displacement methods**: Application of Slope deflection, Moment distribution &Kani's method to indeterminate beams, frames & portals**(16)** **Force methods**: Application of Three moment equations to continuous beam, executionof Column analogy &Consistent deformation method to beams & frames **(12)** **Influence lines:**Indeterminate structures, Muller Breslau principle with application to redundant beams**(8)** **Matrix Method:** Matrix formulationof flexibility & stiffness methods of structures-application for simple loading cases **(10)** **Approximate methods:** Substitute frames, Portal & Cantilever methods on multi-storeyed building frames **(6)**
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 L. S. Negi & R. S. Jangid, Tata McGraw Hill 4. Structural Analysis by R. C. Hibbeler, Pearson Education ***Reference Books:*** 5. Structural Analysis by G. S. Pandit& S. P. Gupta, Tata McGraw Hill 6. Intermediate structure analysis by C K Wang Mc. Graw Hill

Mapping of Course Outcomes COs→POs

	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	-	-	-	2	-	-	-	-	-	-	-
CO2	3	-	-	-	2	-	-	-	-	-	-	-
CO3	3	-	-	-	2	-	-	-	-	1	-	-
CO4	3	-	-	-	2	-	-	-	-	-	-	-
CO5	3	-	1	-	-	-	-	-	-	-	-	-

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	
CEC502	**Design of Steel Structures**	**PCR**	**3**	**1**	**0**	**4**	**4**
Pre-requisite(s)		Course Assessment methods					
Solid Mechanics		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: Apply knowledge of solid mechanics for design solutions. • CO2: Understand basic design philosophy applicable to steel structures. • CO3: Formulate, analyze, and designbasic components of Civil Engineering Steel structures.						
Topics Covered (Hrs)	**Introduction**, Properties of structural steel, I.S. rolled sections, I.S. specifications **(2)** **Design philosophy** of Limit State method for Steel Structures**(6)** **Design of Tension members**, Compression members in truss**(6)** **Design of Beams** (laterally supported /unsupported) : Simple beam using rolled sections, Built up sections /compound beams **(6)** **Design of Gantry girders(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)** **Design of Struts and columns** including built-up columns under axial and eccentric loadings, Lacing and battens, Column splicing. **(6)** **Design of Column bases** – slab base, Gusseted base. **(4)**						
Text Books, and/or reference material(s)	***Text Books:*** 1. Design of steel Structures by N. Subrhamanium (Oxford publications) 2. IS 800-2007: General Construction in Steel-Code of Practice 3. IS 808-1989: Dimensions of Hot Rolled Steel beam, column, channel and angle sections 4. www.nptel.iitm.ac.in/courses/ ***Reference Books:*** 5. Limit State Design of Steel Structures by S.K. Duggal (McGraw Hill publications) 6. Limit State Design of Steel structures by VirendraGehlot&Dr. Ram Chandra (Scientific publisher) 7. Design of steel Structures by S. S. Bhavikatti (IK Intl Publishing House, N Delhi)						

Mapping of Course Outcomes COs→POs

	Engineering knowledge	Problem analysis	Design/development of solutions	investigations of complex	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	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	3	-	-	-	1	-	-	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	
CEC503	**Soil Mechanics**	**PCR**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Engineering and Fluid Mechanics		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs) :	• CO1: Acquire knowledge of classifying the soil from Civil Engg. Aspect • CO2: Ability to conduct Experiment and Analyze the data with interpretation • CO3: Ability to analyze Soil for Soil-Structure like Dams (Earthen/Rigid) • CO4: Ability to Design Soil related Civil Engg. Structure • CO5: Understanding need of the Professional 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 **(4)** **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. **(5)** **Consolidation:**One-dimensional Consolidation theory, Oedometer test, e-$\log_{10}$P curve, settlement&its time required, determination of C_v, m_v, C_c. Definition of Normally &Overconsolidated soils. Problems. **(7)** **Compaction:**Compaction, Standard Proctor Test, Modified Proctor Test, γ_d vs ω curve. Field compaction tests and Field compaction. Problems. **(3)**
Text Books, and/or reference material (s)	***Text Books:*** 1. Soil Mechanics and Foundation Engineering by V N S Murthy,CBS publisher and Distributor 2. Soil Mechanics and Foundation Engineering by S.K. Garg, Khanna Publishers 3. Basic and Applied Soil Mechanics by Gopal Ranjan& A.S.R. Rao, New Age International ***Reference Books:*** 4. Advanced Soil Mechanics by B.M. Das, McGraw Hills Publishers

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	3	-	-	-	-	-	-	-	-
CO3	1	3	3	-	-	-	-	-	-	-	1	-
CO4	-	2	3	2	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	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	
CEC504	**Transportation Engineering**	**PCR**	**3**	**1**	**0**	**4**	**4**
Pre-requisite(s)		Course Assessment methods					
None		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: Apply knowledge of transportation engineering for planning & design solutions. • CO2: Understand basic design philosophy applicable to components of transportation engineering. • CO3: Formulate, analyze, & design basic components of transportation engineering.						
Topics Covered (Hrs)	**Highway planning**, Geometric Design of elements. **(6)** **Highway construction:** Materials - desirable properties and quality control tests; Design of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible pavement using IRC: 37-2012; Design of rigid pavements using IRC: 58-2011; Distresses in concrete pavements; Environmental impact, Highway maintenance. **(12)** **Principle of Transportation**, Different modes of transportation and their characteristics, Scope and limitations. Traffic Engineering, Traffic studies on flow, speed, travel time - delay and O-D study, PCU, peak hour factor, parking study, accident study and analysis, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Control devices, signal design by Webster's method; Types of intersections and channelization; Highway capacity and level of service of rural highways and urban roads. **(12)** **Airport planning**, Site selection, Obstructions and zoning laws, Geometric standards of landing area, Runway orientations, Airport runway length, taxiway and exit taxiway design, Visual aids, Introduction to air-traffic control**. (10)** **Development of railways** in India, Track components and materials, Geometric design elements, Tractive resistances, Layout of points and crossings, High speed track, Marshalling yards, Signaling and interlocking, Track materials and maintenance. **(10)** **Requirements of good docks and harbours**, Types of docks, Whaff-walls, Lock-gates, Wave action, Littoral drift, Breakwaters, Jetties, Dredging. **(6)**						
Text Books, and/or reference material(s)	***Text Books:*** 1. Highway, Railway, Airport and Harbour Engg.by K.P. Subramanian, Scitech Publication 2. Airport Engineering by Rangwala, Chrotar Publishing 3. Railway Engineering by Saxena and Arora, Dhanapat Rai Publication ***Reference Books:*** 4. Highway Engineering by S. K. Khanna, C.E.G. Justo and A. Veeraraghavan, Nemchand& Bros. 5. Harbour, Dock and Tunnel Engineering by R. Srinivasan, Charotar Publishing						

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	3	-	-	-	1	-	-	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	
CES551	**Structural Analysis Sessional-II**	**PS**	**0**	**0**	**3**	**3**	**1.5**

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

Course Outcomes (COs) :	• CO1: Analyse indeterminate beams and frames by displacement methods (Slope deflection method, Moment distribution method, Kane's method) • CO2: Analyse indeterminate beams and frames by force methods (Three moment Equation, column Analogy method, consistent deformation method) • CO3: Apply matrix analysis using stiffness and flexibility methods- computer-based analysis of structure. • CO4: Evaluate and draw the influence lines for reactions, shears, and bending moments in indeterminate beams / girders and frames. • CO5: Apply approximate methods (Substitute Frame method, Portal and cantilever methods) to solve multi-storeyed building frames
Topics Covered (Hrs)	**Displacement methods**: Application of Slope deflection, Moment distribution &Kani's method to indeterminate beams, frames & portals**(12)** **Force methods**: Application of Three moment equations to continuous beam, executionof Column analogy &Consistent deformation method to beams & frames **(9)** **Influence lines:**Indeterminate structures, Muller Breslau principle with application to redundant beams**(6)** **Matrix Method:** Matrix formulationof flexibility & stiffness methods of structures-application for simple loading cases **(6)** **Approximate methods:** Substitute frames, Portal & Cantilever methods on multi-storeyed building frames **(6)**
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 L. S. Negi & R. S. Jangid, Tata McGraw Hill 4. Structural Analysis by R. C. Hibbeler, Pearson Education ***Reference Books:*** 5. Structural Analysis by G. S. Pandit& S. P. Gupta, Tata McGraw Hill 6. Intermediate structure analysis by C K Wang Mc. Graw Hill

Mapping of Course Outcomes COs→POs

	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	-	-	-	-	-	-	-
CO5	3	-	1	-	-	-	-	-	-	-	-	-

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	
CES552	**Design of Steel Structures Sessional**	**PS**	**0**	**0**	**3**	**3**	**1.5**
Pre-requisite(s)		Course Assessment methods					
Solid Mechanics		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: Apply knowledge of solid mechanics for design solutions. • CO2: Understand basic design philosophy applicable to steel structures. • CO3: Formulate, analyze, and designbasic components of Civil Engineering Steel structures.						
Topics Covered (Hrs)	**Introduction**, Properties of structural steel, I.S. rolled sections, I.S. specifications **(2)** **Design philosophy** of Limit State method for Steel Structures**(6)** **Design of Tension members**, Compression members in truss**(6)** **Design of Beams** (laterally supported /unsupported) : Simple beam using rolled sections, Built up sections /compound beams **(6)** **Design of Gantry girders(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)** **Design of Struts and columns** including built-up columns under axial and eccentric loadings, Lacing and battens, Column splicing. **(6)** **Design of Column bases** – slab base, Gusseted base. **(4)**						
Text Books, and/or reference material(s)	***Text Books:*** 1. Design of steel Structures by N. Subrhamanium, Oxford publications 2. IS 800-2007: General Construction in Steel-Code of Practice 3. IS 808-1989: Dimensions of Hot Rolled Steel beam, column, channel and angle sections 4. www.nptel.iitm.ac.in/courses/ ***Reference Books:*** 5. Limit State Design of Steel Structures by S.K. Duggal, McGraw Hill publications 6. Limit State Design of Steel structures by VirendraGehlot&Dr. Ram Chandra, Scientific publisher 7. Design of steel Structures by S. S. Bhavikatti, IK Intl Publishing House, N Delhi						

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	3	-	-	-	1	-	-	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	
CES553	**Transportation Engineering& Soil Mechanics Lab**	**PS**	**0**	**0**	**3**	**3**	**1.5**
Pre-requisite(s)		Course Assessment methods					
Transportation&Foundation Engineering		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs) :	• CO1: Achieve Knowledge of Design and development of experimental skills. • CO2: Understand the principles of design of experiments on materials • CO3: Understand the principles of design of experiments on soil
Topics Covered (Hrs)	**A). Transportation Engineering** 1. Aggregate grading analysis. 2. Determination of flakiness index. 3. Determination of aggregate impact value. 4. Aggregate crushing value test. 5. Determination of softening point. 6. Determination of penetration value. 7. Ductility test. 8. Determination of consistency properties of soil **B). Engineering Foundation** 1).Determination of specific gravity of soil 2). Mechanical analysis of soil (Fine fraction- Hydrometer method) 3). Mechanical analysis of soil (Sieve analysis) 4). Light compaction test (Proctor test) 5). Direct shear test 6). Los Angeles abrasion test.
Text Books, and/or reference material(s)	***Text Books:*** 1. Highway Engineering by S. K. Khanna, C.E.G. Justo and A. Veeraraghavan, Nemchand& Bros. 2. Engineering Soil Testing by Shamsher Prakash, (1979), Nemichand, New Delhi 3. Soil Tsting for Engineers by William Lambe, (2003), MIT. ***Reference Books:*** 4. Relevant IRC/IS codes. 5. Engineering Properties of soil and their measurements by Joesph E Bowles, McGraw hill 6. Geotechnical Laboratory Measurements by John T. Germaine, Amy V. Germaine, (2009), John Wiely

Mapping of Course Outcomes Cos→Pos

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

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	
CES554	**Surveying laboratory and Estimation sessional**	**PCR**	**1**	**0**	**3**	**4**	**2.5**
Pre-requisites:		Course Assessment methods:					
CEC 303 & CEC403		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes	• CO1: learn the basic surveying techniques and the use of basic surveying instruments. • CO2: learn the art of quantity estimation, preparation of Bill of Quantities, and writing specification. • CO3: Learn rate analysis						
	A). Surveying Fieldwork 1). Chain Survey. 2). Compass traverse work. 3). Uses of dumpy level, Profile levelling and cross-sectioning.						

Topics Covered	4). Plane table surveying work – using radiation and intersection methods. 5). Contouring by any method (Optional subject to availability of time). 6). Study of theodolite,function of its different parts, Measurement of horizontal and vertical angle **(7 laboratory classes)** **B). Estimation** Introduction to quantity surveying, Methods of measurement and units of measurement for various items of work, Procedures of computation, Use of proforma. **(2)** Types of estimates, Data required for estimation. **(2)** Preparing detailed estimates for various types of Civil Engineering works. **(7) + 5 sessional classes)** Specifications of different items of work. **(1 hr. theory class lectures)** Analysis of rates of different items of work, Schedule of rates, Cost of works, Overhead charges, Contingencies, Contractors' profit margin etc. **(2 + 1 sessional)** Practical work on estimation as assigned by the teacher. Total: (**14 hrs of theory classes + 7 sessional classes)**
Text Books, and/or reference material	***Text Books:*** 1. Surveying and Levelling Part I by T. P. Kanetkar, and S. V. Kulkarni, Pune VidyarthiGrihaPrakashan Pune – 30, 1979, 2. Engineering Materials by S. C. RangwalaCharotar Pub. House, Anand, 3. Building Construction by S. C. Rangwala, Charotar Pub. House, Anand, 4. Estimating and costing in civil engineering – theory and practice, 23rd edition by B. N. Dutta, UBPSD, New Delhi, 1991. 5. Estimating, costing and specification in civil engineering, 6th edition by M. Chakraborty, Kolkata, 1979. ***Reference Books:*** 6. Text book of estimating and costing (civil engineering) by G. S. Birdie, Dhanpat Rai & Sons, Delhi, 1986. 7. Civil engineering Contracts and Estimates by B. S. Patil, Orient Longman, New Delhi, 1981.

Mapping of Course Outcomes COs→POs

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

SIXTH SEMESTER

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	
CEC601	**Water Resource Engineering**	**PCR**	**3**	**1**	**0**	**4**	**4**
Pre-requisite(s)		Course Assessment methods					
Fluid mechanics		Continuous (CT) and end assessment (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: Understanding of tempo-spatial collection of data and preparation of hydro-meteorological information system. • CO3: learning importance, requirement, method & infrastructure for imparting irrigation water to crop, development & conservation of water for its economic & efficient use						
Topics Covered (Hrs)	**Hydrology:** Hydrologic cycle&system model, Hydro-meteorological Information Systemand 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, formula consumptive use **(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 **(3)** **Run-off:** Factors, Yield, Flow-duration curve, Flow mass curve. **(3)** **Hydrograph**: Base flow separation, Unit hydrograph, Synthetic hydrograph **(3)** **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, Reclamation of saline and alkaline lands, 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,selection of site, Storage zones, Fixation of capacity, regulation.**(3)** **Dam:**Earthen and concrete dam, selection criteria,design**(4)** **Spillways and energy dissipaters:** Location, types, energy dissipation, stilling basin & spillway gate **(4)** **Flood Forecasting:** Estimation, forecasting & mitigation, flood land management **(4)** **Flood routing:** Reservoir & Channel routing (hydrological method only) **(2)**						
Text Books, and/or reference material(s)	***Text Books:*** 1. Engineering Hydrology by K. Subramanya, Fourth Edition, McGraw Hills Education (India) 2.Irrigation Engineering and Hydraulic Structures by S. K. Garg, Khanna Publishers, New Delhi ***Reference Books:*** 3.Irrigation and Water Power Engineering by B. C. Punmia, B. B. Pande, A. K. Jain, A. Kumar,, 16th Edition, Laxmi Publications (P) Limited, New Delhi						

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3		3		-	3	-	-	-	-	-
CO3	-	-	3	-	3	3	-	3	3	2	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	
CEC602	**Foundation Engineering**	**PCR**	**3**	**0**	**0**	**3**	**3**

Pre-requisite(s)	Course Assessment methods
Soil Mechanics	Continuous (CT) and end assessment (EA). CT+EA

Course Outcomes (COs) :	• CO1: Calculate shear strength of soil • CO2: Determine the earth pressures on foundations and retaining structures • CO3: Analyse stability of finite and infinite soil & rock slopes • CO4: Calculate the bearing capacity of soils and foundation 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 group of piles, Problem. **(6)** **Well foundation**: Elements of wells, Types. **(2)**
Text Books, and/or reference material(s)	***Text Books:*** 1. Geotechnical Engineering: Principal and Practices of Soil Mechanics and foundation Engineering by V N S Murthy. 2. Basic and Applied Soil Mechanics by G.Ranjan and A.S.Rao ***Reference Books:*** 3. Foundation analysis and Design by J.E.Bowles 4. Soil Mechanics and Foundation Engineering by S.K. Garg, Khanna Publishers 5. Advanced Soil Mechanics by B.M. Das, McGraw Hills Publishers

Mapping of Course Outcomes COs→

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

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	
CEC603	**Environmental Engineering**	**PCR**	**3**	**1**	**0**	**4**	**4**
Pre-requisite(s)		Course Assessment methods					
None		Continuous (CT) and end assessment (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, analyze, 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:*** 1. Environmental Engineering (Vol. I & II) by Punmia, Jain & Jain, Laxmi Publications (P) Ltd, New Delhi 2. Environmental Engineering (Vol. I & II) by S. K. Garg, Khanna Publishers, Delhi ***Reference Book:*** 3. Environmental Engineering by H.S. Peavy, D. R. Rowe & G. Tchobanoglous, McGraw Hill Education (India) Private Limited, New Delhi 4. Wastewater Engineering, Treatment & Reuse (4th Ed) by Metcalf & Eddy, Inc. (Revised by G. Tchobanoglous, F. L. Burton & H. D. Stensel, Tata McGraw Hill Education Private Limited, New Delhi						

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	3	-	-	-	1	-	-	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	
CES651	**Environmental Engineering Laboratory & Computational Laboratory- I**	**PCR**	**0**	**0**	**3**	**3**	**1.5**
Pre-requisite(s)		Course Assessment methods					
Environmental Engineering		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: Achieve Knowledge of design & development of experimental skills • CO2: Understand the principles of design of experiments. • CO3: To learn step by step procedure for modelling technique & analysis of civil engineering problems by finite element based software • CO4:Analyse & solve for forces and deflection in trusses, beams and frames under static loading • CO5: Analyse & solve for responses in trusses, beams and frames under dynamic loading						
Topics Covered (Hrs)	**A). Environmental Engineering** 1. pH and temperature. 2. Turbidity. 3. Conductivity. 4. Total solids, Settle able solids and suspended solids. 5. Chloride. 6. Acidity. 7. Alkalinity. 8. Residual chlorine. 9. Dissolved oxygen. 10. Colony count of bacteria. **B). Computational Laboratory- I** Introduction of computer aided design and drafting, Solution of structural problems using commercial software						
Text Books, and/or reference material (s)	***Text Book:*** 1. Chemistry for Environmental Engineering and Science, 5th edition by C. N Sawyer, P. L.McCarty and G.F. Perkin, McGraw-Hill Inc., 2002 2. Numerical Methods for Scientists and Engineers byR. W. Hamming, Dover Publications ***Reference Book:*** 3. Standard methods for the examination of water and wastewater. (2012). 21st Edition, Washington: APHA. 4. Applied Numerical Methods for Engineers Using Matlab and C byRobert J. Schilling, Sandra L. Harris, Nelson Engineering; Har/Cdr edition						

Mapping of Course Outcomes COs→POs

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

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	
CES652	**Concrete Technology Laboratory**	**PS**	**0**	**0**	**3**	**3**	**1.5**
Pre-requisite(s)		Course Assessment methods					
Building Construction & Concrete Technology		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs)	• CO1: Conduct experiments for determining the properties of different engineering materials like cement, fine &coarse aggregates, concrete etc. and work in a group. • CO2: Design concrete mix proportion based on the properties of concrete ingredients. • CO3: Use modern instruments & tools for conducting the experiment on different engineering materials. • CO4: Prepare the report on experimental results.						
Topics Covered (Hrs)	To determine the (a) fineness of cement by sieving, (b) standard consistency of cement and (c) setting time of cement. **(6)** To determine the (a) specific gravity of cement (b) compressive strength of cement and (c) soundness of cement. **(6)** To determine the (a) particle size distribution, (b) specific gravity and water absorption and (c) bulk density and voids in coarse aggregate**. (6)** To determine the (a) particle size distribution, (b) specific gravity and water absorption and (c) bulk density and voids in fine aggregate. **(6)** Concrete mix design by I.S Method**. (6)** (a) Preparation of concrete specimens to determine the compressive strength flexural strength and split tensile strength of concrete of a given mix proportions**.(6)** (i) Compressive strength at 07 days - 3 nos cube + 3 nos cylinder (ii) Compressive strength at 28 days - 3 nos cube + 3 nos cylinder (iii) Split tensile strength at 28 days - 3 nos cylinder (iv) Flexural strength at 28 days - 3 nos prism (b) Test above specimen according to the proper testing day (7 days and 28 days) **(3)** (c) To determine the consistency and workability of freshly mixed concrete by i) Slump test and ii) Compacting factor test						
Text Books, and/or reference material(s)	***Text Books:*** 1. Concrete Technology by A. M. Nevilleand J. J. Brooks, Pearson Edu. Publication. 2. Concrete Technology by M. S. Shetty, S. Chand Publication. ***Reference Books:*** 3. Concrete Technology by M. L. Gambhir, Tata McGraw Hill. 4. IS code of practice: 383-2016, 10262-2019, 456-2000 etc.						

Mapping of Course Outcomes COs→POs

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

<table>
<tr><td colspan="8">Department of Humanities and Social Sciences</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Title of the course</td><td rowspan="2">Program Core (PCR) / Electives (PEL)</td><td colspan="4">Total Number of contact hours</td><td rowspan="2">Credit</td></tr>
<tr><td>Lecture (L)</td><td>Tutorial (T)</td><td>Practical (P)</td><td>Total Hours</td></tr>
<tr><td>HSC631</td><td>Economics and Management Accountancy</td><td>PCR</td><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisites</td><td colspan="6">Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA))</td></tr>
<tr><td colspan="2">NIL</td><td colspan="6">CT+MT+EA</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">• To review basic economic principles with students;
• To introduce students basic capital appraisal methods used for carrying out economic analysis of different alternatives of engineering projects or works;
• To educate the students on how to evaluate systematically the various cost elements of a typical manufactured product, an engineering project or service, with a view to determining the price offer.</td></tr>
<tr><td>Topics Covered</td><td colspan="7">
PART 1: Economics
Group A: Microeconomics
<table>
<tr><th>Sl. No.</th><th>Name</th><th>L</th><th>T</th><th>P</th><th>Cr</th><th>H</th></tr>
<tr><td>Unit 1:</td><td>Economics: Basic Concepts</td><td>2</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Unit 2:</td><td>Theory of Consumer Behaviour</td><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td>Unit 3:</td><td>Theory of Production, Cost and Firms</td><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td>Unit 4:</td><td>Analyses of Market Structures: Perfect Competition</td><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td>Unit 5:</td><td>Monopoly Market</td><td>2</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Unit 6:</td><td>General Equilibrium & Welfare Economics</td><td>2</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td></td><td>TOTAL</td><td>15</td><td>0</td><td>0</td><td>15</td><td>15</td></tr>
</table>
Group B: Macroeconomics
<table>
<tr><th>Sl. No.</th><th>Name</th><th>L</th><th>T</th><th>P</th><th>Cr</th><th>H</th></tr>
<tr><td>Unit 1:</td><td>Introduction to Macroeconomic Theory</td><td>2</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Unit 2:</td><td>National Income Accounting</td><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td>Unit 3:</td><td>Determination of Equilibrium Level of Income</td><td>4</td><td>0</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td>Unit 4:</td><td>Money, Interest and Income</td><td>2</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Unit 5:</td><td>Inflation and Unemployment</td><td>2</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Unit 6:</td><td>Output, Price and Employment</td><td>2</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td></td><td>TOTAL</td><td>15</td><td>0</td><td>0</td><td>15</td><td>15</td></tr>
</table>
PART 2: Accountancy
<table>
<tr><th>Sl. No.</th><th>Name</th><th>L</th><th>T</th><th>P</th><th>Cr</th><th>H</th></tr>
<tr><td>Unit 1:</td><td>Introduction to Accounting</td><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td>Unit 2:</td><td>Financial Statement Preparation and Analysis</td><td>5</td><td>0</td><td>0</td><td>5</td><td>5</td></tr>
<tr><td>Unit 3:</td><td>Financial Ratio Analysis</td><td>4</td><td>0</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td></td><td>TOTAL</td><td>12</td><td>0</td><td>0</td><td>12</td><td>12</td></tr>
</table>
</td></tr>
<tr><td>Text Books, and/or reference material</td><td colspan="7">PART 1: Economics
Group A: Microeconomics
1. Koutsoyiannis: Modern Microeconomics
2. Maddala and Miller: Microeconomics
3. AnindyaSen: Microeconomics: Theory and Applications</td></tr>
</table>

	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. SoumyenSikder: Principles of Macroeconomics **PART 2: 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.

CO-PO MAPPING of Economics and Management Accountancy (HSC631)

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

SEVENTH SEMESTER

<table>
<tr><td colspan="8">Department of Management Studies</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Title of the course</td><td rowspan="2">Program Core (PCR) / Electives (PEL)</td><td colspan="4">Total Number of contact hours</td><td rowspan="2">Credit</td></tr>
<tr><td>Lecture (L)</td><td>Tutorial (T)</td><td>Practical (P)</td><td>Total Hours</td></tr>
<tr><td>MSC731</td><td>PRINCIPLES OF MANAGEMENT</td><td>PCR</td><td>3</td><td>0</td><td>0</td><td>3</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisites</td><td colspan="6">Course Assessment methods (Continuous (CT), mid-term (MT) and end assessment (EA))</td></tr>
<tr><td colspan="2"></td><td colspan="6">CT+MT+EA</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">• CO1:To make budding engineers aware of various management functions required for any organization
• CO2:To impart knowledge on various tools and techniques applied by the executives of an organization
• CO3:To make potential engineers aware of managerial function so that 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 and Quantitative Techniques and decision science</td></tr>
<tr><td>Topics Covered</td><td colspan="7">UNIT I: Management Functions and Business Environment: Business environment-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(8)
UNIT II: Quantitative tools and techniques used in management: Forecasting techniques, Decision analysis, PERT & CPM as controlling technique (7)
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)
UNIT V: Finance and Accounting: Basics of Financial management of an organization, Preparation of Final Accounts, Analysis of Financial statements, Cost Volume Profit (CVP) Analysis, An overview of financial market with special reference to India. (12)</td></tr>
<tr><td>Text Books, and/or reference material</td><td colspan="7"><u>Suggested Text Books</u>:
1. Financial Management, 11th Edition, I M Pandey, Vikas Publishing House.
2. Marketing Management 15th Edition, Philip Kotler and Kelvin Keller, Pearson India
3. Management Principles, Processes and practice, first edition, Anil Bhat and Arya Kumar, Oxford Higher education
4. Organizational Behavior,13 th edition, Stephen P Robbins, Pearson Prentice hall India
5. Operations Management, 7th edition (Quality control, Forecasting), Buffa&Sarin, Willey
<u>Suggested Reference Books:</u></td></tr>
</table>

Mapping of CO (Course Outcome) and PO (Programme Outcome):

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									3	2	2	
CO2				2					2	2		
CO3				2					3	2		
CO4							1		3			
CO5				2					2	2	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	
CES752	**Structural Engineering & Computational Lab-II**	**PS**	**0**	**0**	**3**	**3**	**1.5**
Pre-requisite(s)		Course Assessment methods					
Design of Concrete Structuresalong with Concrete Technology Laboratory		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs) :	• CO1: Design concrete mix proportion based on the properties of concrete ingredients and design and detailing of reinforced concrete beam under given conditions and work in a group. • CO2: Use modern instruments and tools for experimenting on different engineering materials in a group. • CO3: Prepare the report on experimental results. • CO4: Ability to apply computational software to analyse and design of different civil engineering problems and apply in industries
Topics Covered (Hrs)	1. Concrete mix design for different grades of concrete (as per Indian Standard guidelines). 2. Design, detailing and bar bending schedule for R.C. beam under given conditions. 3. Casting and study on the strength and deflection behavior of R.C. beams. 4. Application of commercial software for solving Civil Engineering problems
Text Books, and/or reference material(s)	***Text Books:*** 1. Limit State Design of Reinforced Concrete by P. C. Varghese, Prentice Hall, Inc. 2. Concrete Technology by M. S. Shetty, S. Chand Publication. 3. Concrete Technology y M. L. Gambhir, Tata McGraw Hill. 4. IS code of practice: 383-2016, 10262-2019, 456-2000 etc. ***Reference Books:*** 5. Manuals of Commercial /Open source software related to Civil Engineering Applications (Eg. SAP, STAAD, ABAQUS,ETAB, LS DYNA, Plaxis, Geomedia, ERDAS …etc)

Mapping of Course Outcomes COs→POs

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

DEPTH ELECTIVES OFFER BY CE DEPARTMENT

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	
CEE610	**Advanced Design of Concrete Structures**	**PCL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Design of Concrete Structures		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs)	• CO1: Acquire knowledge of engineering design of different Member • CO2: Ability to analyze the Utility Structures: Bunker, Silo, Water Tank, Shell etc • CO4: Ability for understanding the need of future studies						
Topics Covered (Hrs)	**Combined footing:** Types, design of rectangular slab, trapezoidal, strip and raft type **(6)** **Portal and multi-storied building frame:** Design of continuous beam, earthquake resistance design & detailing, codal provisions **(6)** **Bunkers&silo:**Analysis& Design bunker & silo **(6)** **Shell and folded plate:** Design of shell and folded plate **(4)** **Serviceability Limit State:** Deflection and cracking **(4)** **Deep and curve Beam:** Design of deep & curve beam **(4)** **Tension Members:**Design under axial, bending and combination of both**(4)** **Flat Slab:** Design of flat slab and associated Column **(4)** **Water Tanks:** Different types tank **(6)**						
Text Books, and/or reference material (s)	***Text Books:*** 1. Ad. R. C. C Design Vol-II, by S.S. Bhavikatti, New Age International (P) Limited, New Delhi 2. Ad. R. C. C Design, by N.K. Raju, CBS Publishers & Distributor, New Delhi 3. IS 456: 2000, Indian Standard Plain and Reinforced Concrete – Code of Practice (4th Revision), BIS, New Delhi. 4. IS 3370 (I, II, IV): 2009 & 1965, Concrete structures for storage of Liquids- Code of practice (1st Revision), BIS, New Delhi. 5. IS 1893 (I): 2016, Criteria for earthquake resistance design of Structures-General provisions and building (6th Revision), BIS, New Delhi. 6. IS 13920: 2016, Ductile design & detailing of R. C. structures subjected to seismic forces-code of practice (1st Revision), BIS, New Delhi 7. www.nptel.ac.in ***Reference Books:*** 8. Reinforced Concrete, 6th Edition, by S.K. Mallick and A.P. Gupta, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, 1996. 9. Reinforced Concrete Design, 2nd Edition, by S. Unnikrishna Pillai and DevdasMenon, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003						

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	1
CO2	-	-	3	-	2	-	1	-	-	-	-	1
CO3	-	-	-	-	-	-	-	-	-	-	-	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	
CEE611	**Advanced Structural Analysis**	**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 basic understanding of the fundamental concepts and theorems of the advanced topics in analysis of structures. • CO2: Model and analyze different structural systems by matrix method of analysis using element approach of force/ flexibility method. • CO3: Model and analyze different structural systems by matrix 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: Ability to write the governing equations for stability&analysis of structures.						
Topics Covered (Hrs)	**Recapitulation** of basic concepts of structural analysis, force & displacement methods, statical& kinematic indeterminacies of pure truss, pure frame & generalized structures**(2)** **Stiffness/ Displacement Method**: System approach of solution, global and local coordinate systems, element stiffness matrices for truss and frame elements, displacement and force transformation matrices, connectivity arrays, global stiffness matrix, global load vector, assembling of stiffness matrix and load vector, solution of stiffness equation, output of global displacements and local member end forces, introduction to warping torsion and shear deformation, three dimensional element stiffness matrix and transformation matrix, analysis of grids, different types of example problems. (10) **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. (8) **Elastic Stability Analysis** of beam, column and frames. (10)						
Text Books, and/or reference material(s)	***Text Books:*** 1. Structural Analysis by L.S. Negi & R.S. Jangid, Tata McGraw-Hill Publishing Company Limited 2. Structural Analysis: A Unified Classical and Matrix Approach, Amin Ghali, Adam M. Neville by E& FN SPON 4th Ed. 3. Stability Analysis and Design of Structureby M. L. Gambhir, Springer 2004 edition ***Reference Books:*** 4. Structural Analysis: A Matrix Approachby G.S. Pandit& S.P. Gupta, Tata McGraw-Hill Publishing Company Limited						

Mapping of Course Outcomes COs→POs

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

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	
CEE612	**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 reference material(s)	***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 Books:*** 3. Mechanics of Composite Materials and Structures by MadhujitMukhopadhyay, University Press (2004)						

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	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	
CEE613	**Material Technology**	**Program Elective (PEL)**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Engineering Mechanics and Mathematics		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs) :	• CO1: Development of skills for predicting structural behaviour of different materials under different loads • CO2: Knowledge of basics of analysis and design of structural components, made of 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)	**Material and Material Defects**: Metallic materials, Polymeric Materials, Ceramics and Composites, elastic and plastic deformation, Mechanism of deformation and its significance in design and shaping **(8)** **Failure mechanisms of Materials**:**Fracture:** Definition and types of facture, Brittle fracture: Critical stress and crack propagation velocity for brittle fracture. Ductile fracture: Notch effect on fracture. Fracture toughness. Ductility transition. Definition and signification. Conditions of ductility transition factors affecting it. **(6)** **Fatigue Failure:** Definition of fatigue and significance of cyclic stress. Mechanism of fatigue and theories of fatigue failure, Fatigue testing. Test data presentation and statistical evolution. S-N Curve and its interpretation. Influence of important factors on fatigue. Notch effect, surface effect, Effect of pre-stressing, corrosion fatigue, Thermal fatigue. **(5)** **Creep:** Definition and significance of creep. Effect of temperature and creep on mechanical behaviors of materials. Creep testing and data presentation. **(6)** **Introduction to New Materials**: **Composites:** Basic concepts of composites, Processing of composites, advantages over metallic materials, various types of composites and their applications. Nano Materials: Introduction, Concepts, synthesis of nano materials, examples, applications and nano-composites. Polymers: Basic concepts, Processing methods, advantages and disadvantages over metallic materials, examples and applications. **(10)** **Strength Analysis of materials under different loading:** Stress, strain due to normal, shear, flexure, impact, torsion loads. Analysis by energy method. **(7)**
Text Books, and/or reference material(s)	***Text Books:*** 1. A Text Book of Strength of Materials by Ghosh &Datta, 2ed, New Age International Publication Pvt. Ltd, New Delhi 2. Engineering Materials Technology by W. Bolton, 3ed,Taylor & Francis Ltd ***Reference Books:*** 3. Engineering Materials: An Introduction to Properties, Applications and Design by David R.H. Jones, Michael F. Ashby, 4ed, Elsevier (BH)

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	3	-	-	-	1	-	-	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	
CEE614	**Applied Numerical Methods**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Engineering Mathematics		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes	• CO1: Assess the error involved in a numerical method • CO2: Solve problems in engineering and science with a required accuracy using appropriate						

(COs) :	numerical methods • CO3:Write algorithm for the numerical methods for efficient coding of program • CO4:Understand the mathematics concepts underlying the numerical methods
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, stability and their convergence. Boundary value problems: functional approximation, finite difference method.**(08)**
Text Books, and/or reference material(s)	***Text Books:*** 1. Numerical Methods for Scientists and Engineers byR. W. Hamming, Dover Publications; 2 edition 2. Numerical Methods: Problems and Solutions byMahinder Kumar Jain (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. ***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

Mapping of Course Outcomes COs→POs

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

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	
CEE615	**Bridge Engineering**	**PCL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Survey, Water Resource Engineering,analysis and design of structures		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes	• CO1: Acquire knowledge to select different type bridges by assessing their material, capacity, quality & suitability						

(COs)	• CO2: Ability to make a bridge plan and design following requisite criteria • CO3: Supervise the construction procedure of different components of a bridge • CO4: Assess the quality and roles of various components of bridge
Topics Covered (Hrs)	**Hydraulic design:**Survey,Catchment, Site selection, Hydraulic geometry, Linear waterways, Economic span, Afflux and Scour. **(4)** **Loads onbridge:** Different types of load acting on bridge along with numerical**(6)** **Slab andboxculvert:**Analysis of deck slab - effective width & length method and numerical example with different type of live load. **(4)** **R.C. beam-slab and steel composite bridges:**R.C. T-beam bridgeand steel composite bridge design using Pigeaud's method and Courbon's method **(6)** **Dynamic response of bridge deck:** General features, factor affecting vibration, practical approach for vibration analysis and numerical examples.**(2)** **Prestressed concrete bridge:** General features, advantage of P.S.C. Bridge, design details of pre-tensioned and post–tensioned bridge and numerical (**6**) **Bridge bearing:** Introduction, types of bearing, design principles of different bearing and numerical examples **(4)** **Substructure:** Introduction, type of piers, forces acting on piers, stability analysis of abutment, types of wing wall and numerical examples of Pier and Abutment. **(4)** **Bridge foundation:** General aspect, types of foundations, design aspect of pile and well foundations and numerical examples of pile and well foundations.**(4**)
Text Books, and/or reference material(s)	***Text Books:*** 1. Bridge Engineering by S. Ponnuswamy, Tata McGraw-Hill Publishing Company Limited, New Delhi. 2. IRC:6-2017 Standard Specifications and Code of Practice for Road Bridges 3. www.nptel.ac.in ***Reference Books:*** 4. Design and construction of Highway Bridges by K. S. Rakshit, New Central Book Agency (P) Ltd

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	2	-	3	-	1	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	3	2	-	1
CO4	-	-	-	-	-	-	-	-	-	-	-	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	
CEE620	**Analysis and Design of Pavements**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Transportation Engineering		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO 1: Understanding of material characteristics for transfer of load • CO 2: Understanding of mechanics of transfer of vehicular load to pavement • CO 3: Development of ability to understand vehicle pavement interaction • CO 4: Ability to determine stresses in different type of pavements • CO 5: Development of expertise in design of pavement of different types of roads, highway, airport pavement						

Topics Covered (Hrs)	**Characterization of Sub-Grade Soil and Mineral Aggregates:** Introduction, particle size analysis, gradation, moisture content, consistency, test, classification, composition, compaction, strength determination, strength properties of mineral aggregates**(8)** **Bituminous Materials:** Introduction, desirable properties, tests, other binders, engineering properties and mix design **(8)** **Design of Cement Concrete Mixes for Pavements:** Introduction, cement, properties, mineral aggregates, water, admixtures, properties of fresh concrete, test on hardened concrete, factors for durability, design of cement by BS (10262), IRC (44), Dry Lean Cement Concrete (MORTH 201), Mix Design for Rural Roads (IRC :SP:62) **(8)** **Factors Affecting Pavement Design:** Types of pavements, factors affecting design of pavements**(4)** **Analysis and Design of Flexible Pavements:** Stress analysis, design methods, benefits of M-E method, test roads**(4)** **Structural Evaluation of Pavements:** Purpose, types, and methods of structural evaluation, structural evaluation by static loading, steady – state Vibratory Loading, impulse lading, Models of Falling Weight Deflectometer, FWD, back calculation of Layer Moduli from FWD Test data, uses of Back-calculated Pavement Layer Moduli, Structural Evaluation of Rigid Pavement using FWD.(**6)** **Structural Evaluation of Unbound Granular and Sub-Grade Layers:** Using Dynamic Cone Penetrometer (DCP) – Development of DCP Test, The Dynamic Cone Penetrometer, material testing with DCP, determination of DCP index values, factors affecting DCP test results, correlation of DCP index values with other standard test values, application of DCP test data, limitation of DCP**(6)**
Text Books and/or reference material(s)	***Text Books:*** 1. Highway Engineering by R. Srinivas Kumar. ***Reference Books:*** 2. Principles of Pavement Engineering by Nick Tom

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	3	-	-
CO2	-	-	3	4	-	-	-	-	-	-	-	-
CO3	-	-	-	-	3	-	-	-	2	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	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	
CEE621	**Finite Element Method**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Solid Mechanics, Structural Engineering &Engg. Mathematics		Continuous (CT) and end assessment (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: Skill to simulate simple engineering structures through FE modellling and interpret data from the FE analysis to ascertain their reliability and applicability in light of physical constraints of the system and common engineering sense. • CO3: Ability to use computational tools for solving Civil Engineering problems. • 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**: Engineering Problems, Different numerical methods, History of Finite Element Method (FEM), Steps in FEM, Areas of Application, Verification problems, implementation of Engineering Problems in FEM**. (10)** **Solution of Engineering Problems using Matrix operation**: Importance, Matrix Manipulation Techniques, Solution of Simultaneous Linear Equations, Inverse of Matrix, Computer Implementation. **(6)** **Spring Element:** General, Implementation in FEM, Applications in civil engineering, Problems. **(6)** **Bar Elements**: Definition, Stiffness Matrix, Load vector and displacement vector, Implementation in FEM, Problems and Validation. **(6)** **FE Modelling of Engineering Problems:** Trusses, beams, Frames etc. **(14)** **Computer Programs**/ SOFTWARES based on FEM: Use in solution of Engineering Problems. **(3)**
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. An Introduction to the Finite Element Method by Reddy, J. N., 2005. 3. Fundamentals of Finite Element Analysis by David V. Hutton Publisher: Tata Mcgraw Hill Education Private Limited (2005) ***Reference Books:*** 4. Finite Element Procedures by Klaus-Jurgen Bathe Publisher: Prentice-Hall (2009)

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	2	-	-	-	-	-	-	-	-
CO3	-	-	-	-	3	-	-	-	-	-	-	-
CO4	-	2	-	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	**Ground Improvement**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Soil Mechanics&Foundation Engineering		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: understand how to improve the geotechnical properties of soft soil by different techniques. • CO2: identify ground conditions and suggest method of improvement • CO3: understand the principles of soil reinforcement and confinement in engineering constructions.						
Topics Covered (Hrs)	**Introduction:** Formation of soil, major soil type, collapsible soil, expansive soil, ground improvements; objective, potential. **(8)** **Ground Improvement in Granular Soil**: In place densification by (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, vertical and radial consolidation, preloading methods. Types of Drains, Design of vertical Drains, construction techniques. Stone Column: Function Design principles, load carrying capacity, construction techniques, settlement of stone column foundation.**(22)**						

Text Books, and/or reference material (s)	***Text Books:*** 1. Ground Improvement by M.P. Moseley and K. Krisch, (2006)–II edition, Taylor and Francis 2. Designing with Geosynthetics by Koerner, R. M (1994), Prentice Hall, New Jersey 3. Engineering Principles of Ground Modifications by Hausmann, M. R. (1990),McGraw Hill publications ***Reference Books:*** 4. Earth Reinforcement and soil structures by Jones C. J. F. P. (1985), Butterworths, London. 5. Ground Control and ImprovementbyXianthakos, Abreimson and Bruce 6. Ground Control and Improvement by K. Krisch&F.Krisch (2010), John Wiley & Sons, 1994. 7. Foundation Design principles and Practices by Donald P Coduto, 2nd edition, Pearson, Indian edition, 2012

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	3	-	2	-	-	-	-	-	-	-	-
CO2	-	2	3	2	-	-	1	-	-	-	-	-
CO3	-	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	
CEE623	**Remote Sensing and GIS**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
None		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	CO1: Learn about basic items, parameters & concepts related with remote sensing. CO2: Apply techniques of visual image interpretation and digital image processing. CO3: Use GIS and its components for basic applications in civil 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 – Image enhancement, Image transformation, Image classification & analysis. **(10)** **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. (5)						
Text Books, and/or reference material (s)	***Text Books:*** 1. Remote Sensing & GIS (2nd Ed.) by B. Bhatta (Oxford University Press, New Delhi) 2. Textbook of Remote Sensing & Geographical Information Systems (3rd Ed.) by M. Anji Reddy (BS Publications, Hyderabad) ***Reference Books:*** 3. Remote sensing &Image Interpretation (6th Ed.) by T.M. Lillesand, R.W. Kiefer & J.W. Chipman (Wiley India (P) Ltd., New Delhi) 4. Geographical Information Systems (2nd Ed.) by P.A. Longley, M.F. Goodchild, D.J. Maguire & D.W. Rhind (John Wiley & Sons, Inc.)						

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	1	-	-	-
CO2	3	2	-	2	2	-	1	-	1	1	-	3
CO3	3	2	3	-	2	-	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	
CEE624	**Traffic Engineering and Management**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Transportation Engineering		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs):	• CO1: Apply knowledge of traffic study & analysis for design solutions. • CO2: Understand basic design philosophy applicable to traffic flow & highway intersections. • CO3: Formulate, analyze, and design basic components of highway intersections.						
Topics Covered (Hrs)	**Traffic characteristics**, Traffic engineering studies and analysis: 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. (20) **Impact of highway traffic** on environment. (4)						
Text Books, and/or reference material(s)	***Text Books:*** 1. Traffic Engineering by R.P. Roess, W.R. McShane and E.S. Prassas, Prentice Hall. ***Reference Books:*** 2. Transportation Engineering and Planning, C.S. Papacostas, and P. D. Prevedouros, Prentice Hall India 3. Principles of Transportation Engineering, P. Chakroborty and A. Das, Prentice Hall India.						

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	3	-	-	-	1	-	-	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	
CEE625	**Systems approach to Civil Engineering design**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisites:		Course Assessment methods					
No pre-requisites		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes	• CO1: Develop system approach based models of Civil Engineering systems. • CO2: Solve optimization problems. • CO3: Learn decision theory and its application to CE problems						
	Introduction: System concept for engineering design, System classification, system modeling, Methodology of system design.**(4)** **Optimization Techniques:**Linear Programming- Simplex Method Duality Theory, Dual Simplex,						

Topics Covered	Sensitivity analysus, Integer programming **(8)** **Network analysis:** Transportation problems, Assignment problems, Maximal flow, Project management **(8)** **Non-Linear programming:** Basic concept, Introduction to Lagrange multipliers, Kuhn-Tucker conditions **(4)** **Common Probabilistic models(8)** **Decision theory:** Decision problems, Decision criteria, Maximax, Equally likely, Minimax, Maximum likelihood, Bays' decision rule, Application to civil engineering systems design. **(10)**
Text Books, and/or reference material	***Text Books:*** 1. Engineering Hydrology by R. S. Varshney, Nem Chand & 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. Introduction to Operations Research – A computer oriented Algorithmic Approach by B. 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 Book Co. Singapore, 1989. 7. Engineering Optimization – methods and Applications by G. V. Reklaitis, A. Ravindran,and K. M. Ragsdell, John Wiley & Sons, New York, 1983.

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	3	3	-	-	-	-	2	2	-	-	-
CO2	-	3	3	-	-	-	1	-	-	3	-	2
CO3	-	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	
CEE710	**Structural Dynamics**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Solid Mechanics		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: Develop &analyze damped & un-damped SDOF systems for free & forced vibration. • CO2: Develop and analyze the MDOF systems for free & forced vibration. • CO3: Model civil engineering structures & derive the dynamic properties of structures • CO4: Calculate natural frequencies, mode shapes& structural responses numerically • CO5: Apply the concepts & principles of structural dynamics for earthquake analysis of civil engineering structures & evaluate their seismic performance						
Topics Covered (Hrs)	**Introduction:** D'Alembert's principle, dynamic loads, definition of degrees of freedom **(1)** **SDOF system:** Equations of motion, undamped and damped SDOF systems, viscous damping, critically damped, over-damped and under-damped system, damping coefficient determination, dynamic magnification factor and transmissibility. **(7)** **Forced vibration ofSDOF systems:** Vibrationunder sinusoidal loads, response to general dynamic loading - Duhamel's integral: impulse, rectangular, triangular loading problems. **(5)** **Fourier analysis and response in the frequency domain** theory, problems **(2)** **MDOF system:** Development and solution of equations of motion, problems **(2)**						

	Free vibration ofMDOF systems: Eigen values and vectors, natural frequencies and modes, orthogonality of modes, normalization of modes, modal expansion, concept of normal/generalized coordinates, problems **(5)** **Free vibration response**: Free vibration of un-damped systems, modal analysis. **(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. Dynamics of Structures by Anil K. Chopra, PHI 2. Earthquake Resistant Design of structure by Pankaj Agarwal and Manish Shrikhande. 3. Structural Dynamics: Theory and Computation by Mario Paz, Kluwer Academic Publishers ***Reference Books:*** 4. Elements of Earthquake Engineering, Jai Krishna, A.R. Chandrasekaran, B. Chandra. South Asian Publishers. 5. Theory of Vibration with Applications, W.T. Thomson, PHI

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	-	-	-	-	-	-	-	-	-
CO2	2	3	3	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	1	-	-	-	-	-	-	2
CO4	3	3	3	3	2	-	-	-	-	-	1	2
CO5	3	2	-	2	1	1	-	1	-	-	1	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	
CEE711	**Advanced Design of Steel Structures**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Design of Steel Structures		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: Understand the design aspects, principles of few steel structures as a whole. • CO2: Apply basic knowledge of steel design of components for design solutions of whole structure. • CO3: Formulate, analyze, and design of various Civil Engineering Steel 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. **(10)** **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 **(8)**
Text Books, and/or reference material(s)	***Text Books:*** 1. Design of steel Structures by N. Subrhamanium (Oxford publications) 2. IS 800-2007: General Construction in Steel-Code of Practice 3. IS 808-1989: Dimensions of Hot Rolled Steel beam, column, channel and angle sections 4. SP 6(1)-1964: Handbook for Structural Engineers. 5. IS 3370-1965 code for concrete structures for he storage of liquids 6. IS 805: 1968 Code of Practice for Use of Steel in Gravity Water Tanks 7. IRC:6-2017 Standard Specifications and Code of Practice for Road Bridges 8. www.nptel.iitm.ac.in/courses/ ***Reference Books:*** 9. Limit State Design of Steel Structures by S.K. Duggal (McGraw Hill publications) 10. Design of steel Structures by S. S. Bhavikatti (IK Intl Publishing House, N Delhi)

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	3	-	-	-	-	2	2	-	-	-
CO2	3	-	3	-	-	-	1	-	-	3	-	2
CO3	-	3	3	-	1	-	-	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	
CEE712	**Theory of Plates and Shells**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Solid Mechanics, Structural Analysis		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs):	• CO1: Derive the expressions of the curvature and displacement relationships of plates subjected to bending moments, twisting moments and shear force. • CO2:Analyse the simply supported plates and solve them by using Navier's and Levy's Methods. • CO3: Analyse the thin shell structures using membrane theory. • CO4: Design the cylinder shell and review the IS codal provisions of it.						
Topics Covered (Hrs	**Basic curvature and displacement relationships**. Expressions for bending, moment, twisting moments, shear forces. **(4)** **Plate equation**, Edge conditions. Solution of simply supported plates by Navier's and Levy's methods. Introduction to anisotropic plates. **(10)** **Plate subjected to in plane forces**, Buckling of plates. Numerical analysis of plates. Design of plates. **(6)** **Shell structures** Classification, Differential geometry, Curvature, Strain, Displacement relations. **(4)** **Membrane theory of thin shells** and design of cylindrical shells of double curvature (Synclastic and anticlastic), Shells of revolution, North light shell. **(10)** **Design of shell** and review of IS code provisions, Introduction to bending theories: Application to cylindrical shells and design.**(6)**						
Text Books,	***Text Book (s):*** 1. Theory of Plates and Shells by Timoshenko and Krieger, McGraw Hill 2. Theory and Analysis of Plates by Classic and Numerical Methods, Rudolph Szilard,						

and/or reference material(s)	Prentice Hall Inc. New Jersey ***Reference Book:*** 3. Design and Construction of Concrete Shell Roofs by G.S. Ramaswamy, CBS Publisher & Distributors (2005)

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-
CO4	-	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	
CEE713	**Theory of Elasticity and Plasticity**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Engineering & Solid Mechanics		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes	• CO1: To develop basic understanding of the behaviour of materials. • CO2: To define the stress and strain behaviour of structural elements. • CO3: To apply theory of elasticity in bending and torsion problems. • CO4: To apply theory of plasticity in failures 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's stress function, Principal Stresses and strains, stress & strain invariants, numerical problems. **(15)** **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	***Text Books:*** 1. Theory of Elasticity and Plasticity by S. Timoshenko, MC Graw Hill Book company. 2. Theory of Elasticity and Plasticity by Sadhu Singh, Khanna Publishers. ***Reference Books:*** 3. Advanced Strength of materials by Papov, MC Graw Hill Book Company. 4. Plasticity for structural Engineers by Chen, W.F. and Han, D.J, Springer-Verlag, New York.						

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-
CO4	3	3	2	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	
CEE714	**Structural Health Monitoring**	**PEL**	**3**	**0**	**0**	**3**	**3**

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

Course Outcomes (COs) :	• CO1: Knowledge of assessment and monitoring of existing structures as well as for newly constructed structures. • CO2: Exposure and skill to use relevant NDT equipment for research and industrial applications. • CO3: Knowledge on instrumentations in structures, their use and interpret the collected data from instrumentations. • CO4: Based on the above, the students are expected to suggest remedial measures for 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:** What is structural health and SHM, importance, application and present scenario of SHM in India and abroad, parameter related to structural health. **(4)** **Types of SHM:** Periodic and continuous, methods for implementation of each. **(6)** **Measurement techniques**: Destructive and non-destructive **(6)** **Equipment:** For non-destructive testing, working principles of this equipment and use **(8)** **Health monitoring in dynamic condition:** Basics of structural dynamics, sensing technologies, data collection and analysis, basic concept of signal processing, identification of structural health using modal parameters. **(14)** **Field visit:** Visitto the site(s) of old structure(s) for assessing their existing condition for SHM purpose. **(3)**
Text Books, and/or reference material(s)	***Text Books:*** 1. Structural Health Monitoring by Victor Giurgiutiu 2. New trends in Structural Health Monitoring by Ostachowich, Witslaw, Guemes, Alfredo. 3. Dynamics of structures by A K Chopra, Pearson/Prentice Hall. ***Reference Books:*** 4. Non-destructive Testing of Materials and structures by Buyukozturk and Tasdemir: Springer

Mapping of Course Outcomes COs→POs

	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	2	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	2	-	-	-	-	-	-	-
CO3	-	-	-	2	3	-	-	-	-	-	-	-
CO4	-	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	
CEE720	**Soil Dynamics**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Soil Mechanics		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes	• CO1: develop a mechanism to design the foundations for resisting vibrations and achieve static equilibrium conditions of structures. • CO2: understand the classical geotechnical failures due to liquefaction and mitigate the same. • CO3: design of foundations in large structures like power plants, other industrial buildings etc., for analysing the vibrating waves which can be isolated and measures for achieving safety of the adjacent foundations.						
Topics Covered (Hrs)	Vibration of elementary system, Single degree and two-degree freedom systems, Wave propagation in an elastic, homogeneous, isotropic medium. **(10)** Propagation of waves in saturated media, Behaviour of dynamically loaded soils, Evaluation of dynamic properties of soil. **(10)** Theories for vibration of foundations in elastic media, Design procedures for dynamically loaded foundations for vertical and rocking vibrations. **(14)** Foundations under reciprocating engines, Foundations for forge hammers, motor generators, turbo-generators and crushers. **(10)**						
Text Books, and/or reference material (s)	***Text Books:*** 1. Soil Dynamics and Machine Foundation by Swami Saran, GalgotiaPublicaions 2. Vibrations Vibration Analysis and Foundation Dynamics by NSV Kameswara Rao, Wheeler Publishing, New Delhi. 3. Fundamentals of Soil Dynamics by B M Das ***Reference Books:*** 4. Vibrations of Soils and Foundations by Richart Hall and Woods 5. Foundations of Machines-Analysis and Design by Prakash and Puri. 6. Analysis and design of Foundations for Vibrations by P J Moore 7. Dynamics of bases and Foundations by D DBarkar						

Mapping of Course Outcomes COs→POs

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

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	
CEE721	**Environmental Pollution & Control**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
None		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: Apply knowledge of different types of environmental affecting the community life pollutants (air, solid wastes and noise) for design solutions. • CO2: Understand basic design philosophies applicable to control and safe disposal of different types of environmental pollutants.						

	• CO3: Formulate, analyze, and design basic control and disposal systems of different types of environmental pollutants.
Topics Covered (Hrs)	**Natural & man made sources of pollution**, types of pollutants. **(2)** **Air pollution**: Its effects, measurement, methods of control, air pollution control equipment. **(16)** **Community Solid wastes** – quantity & characteristics, methods of collection, disposal & reuse. **(16)** **Noise pollution** - Its effects, noise measurement, methods of control of environmental noise. **(6)** **Legal aspects** of environmental pollution & control. **(2)**
Text Books, and/or reference material (s)	***Text Books:*** 1. Introduction to Environmental Engineering byM.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 [McGraw Hill Education (India) Private Limited, New Delhi] ***Reference Books:*** 3. Environmental Engineering – A Design Approach by A.P. Sincero& G.A. Sincero (Prentice – Hall of India Private Limited, New Delhi)

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	3	-	-	-	1	-	-	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	
CEE722	**Construction Planning and Management**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisites:		Course Assessment methods					
CEC303 + CES544		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs)	• CO1: Learn preliminaries of construction planning and management. • CO2: Learn construction safety aspects. • CO3: Learn contract management. Get exposed to tendering and contracting. • CO4: Learn about the running &operation of government–run–engineering depart., elements of project financing, project selection& use of construction equipment.						
Topics Covered	**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.**(8)** **Organizing construction:** Principles of organization, Types of organization, Site organisation, Temporary services, Job layout. **(6)** **Safety in construction:** Importance of safety& its measures in construction activities.**(3)** **Construction labour:**Welfare facilities, Labour laws. **(3)** **Contract management:** Different types of contracts, Notice inviting tender, Contract documents, Condition of contract, Earnest money, Security money, Termination of contract, Arbitration, Specification – different types. **(8)** **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. **(7)**						

	Construction practices: Various construction equipment, Factors affecting selection of equipment, Output of various equipment, Time value of money, Investment and operating cost, Depreciation. **(7)**
Text Books, and/or reference material	***Text Books:*** 1. Estimating and costing in civil engineering by B. N. Dutta,theory and practice 2. Estimating, costing and specification in civil engineering by M. Chakraborty 3. Text book of estimating and costing (civil engineering) by G. S. Birdie, Dhanpat Rai & Sons 4. Civil engineering Contracts and Estimates by B. S. Patil, Orient Longman, New Delhi, 1981. 5. PERT & CPM principles and applications by L. S. Srinath, Affiliated East-West Press Pvt. 6. Construction Management and Accounts by V. N. Vazirani, and S. P. Chandola, Khanna Publishers, Delhi-6, 1978. ***Reference Books:*** 7. Management in Construction Industry by P. P. Dharwadker, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, 1992. 8. Building Construction by S. C. Rangawala, Charotar Book Stall, Anand, 1980. 9. Construction equipment and its planning & application by M. Verma, Metropolitan book co. (p) Ltd. New Delhi, 1979

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	-	-	-	-	3	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	-	-	-	-	-	-	-	-	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	
CEE723	**Open channel Hydraulics**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Fluid Mechanics		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• **CO1:** Understanding mechanics of flow, energy & momentum in an open channel • **CO2:** Computation of different components of flow in an open stream. • **CO3:** Capability for design of different type of open channel for operationalization of water-resources systems						
Topics Covered (Hrs)	**Introduction:** Descriptions, types of flow, state of flow, regime of flow **(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.**(8)** **Energy and Momentum Principles:** Energy, specific energy, criterion for a critical state of flow, interpretation of local phenomena, energy in non-prismatic channels, momentum in open-channel flow, specific force, momentum principle applied to non-prismatic channels. **(6)** **Critical flowcomputations and Applications:** Critical flow, factors, flow computation, 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'sresistance,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 of Channels for Uniform Flow: (6)** **(a) Non-erodible channels:** Non-erodible channel, non-erodible material and lining, minimum permissible velocity, channel slopes, freeboard, best hydraulic section, determination of section dimensions **(b) Erodible channels with scour not silt:** Method of approach, maximum permissible velocity, method of permissible velocity, tractive force, tractive-force ratio, permissible tractive force, method of tractive force, stable hydraulic section **(c)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. Open Channel Hydraulics by K. Subramanya, Fourth Edition, McGraw Hills Education (India) Private Limited, New Delhi. ***Reference Books:*** 2. Open-Channel Hydraulics by V. T. Chow, McGraw-Hill Book Company, Inc., New York

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	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	
CEE724	**Ground Water**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Fluid Mechanics and Water Resources Engineering		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs) :	• CO1: Understanding of occurrence, distribution, storage and transmission of water below the ground level. • CO2: Understanding of mechanics of flow of water under the ground • CO3: Techniques for exploitation of ground water on sustainable basis. • CO4: Ability to develop models for storage and transmission of ground water. • CO5: Development of capabilities in recharging, management & conjunctive use of ground water
Topics Covered (Hrs)	**Fundamentals of ground water:** Introduction – Characteristic of Ground water – Distribution of water - ground water column –Permeability - Darcy's Law - Types of aquifers - Hydrogeological Cycle – water level fluctuations. **(6)** **Hydraulics of flow:**Storage coefficient - Specific field - Heterogeneity and Anisotropy - Transmissivity– Governingequations of ground water flow - Steady state flow – DupuitForchheimer assumptions – Velocity potential - Flow nets**(6)** **Estimation of parameters:**Transmissivity and Storativity – Pumping test - Unsteady state flow - Thiess method – Jacobmethod - Image well theory – Effect of partial penetrations of wells - Collectors wells. **(6)** **Ground water development:** Infiltration gallery - Conjunctive use - Artificial recharge

	Rainwater harvesting - Safe yield –Yield test – Geophysical methods – Selection of pumps. **(6)** **Water quality:** Ground water chemistry - Origin, movement and quality - Water quality standards – Saltwater intrusion –Environmental concern**(6)** **Artificial recharge:** Artificial recharge of ground water; concept of artificial recharge – recharge methods, relative merits, Application of GIS and Remote Sensing in Artificial Recharge of Ground Water **(3)** **Groundwater management:** Ground water basin management; concepts of conjunction use**(3)**
Text Books, and/or reference material(s)	***Text Books:*** 1. Ground Water Hydrology by H.M. Raghunath, Wiley Eastern Ltd., 2000. 2. Ground Water Hydrology by D. K. Todd, John Wiley and Sons, 2000. 3. Ground Water by Bawvwr, John Wiley & Sons 4. Groundwater System Planning & Management by R. Willes & W.W.G. Yeh, Printice Hall. 5. Applied Hydrogeology by C.W. Fetta, CBS Publishers & Distributers. ***Reference Books:*** 6. Principles of Pavement Engineering by Nick Tom

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-
CO3	-	3	3	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	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	
CEE725	**Hydrology and Irrigation Engineering**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Physics and Fluid Mechanics		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: Understanding of occurrence, distribution, storage & transmission of water in different form in space, over& below surface of earth, data collection & processing • CO2: Understanding flow generation, occurrence of flood, drought, environmental flow requirement. • CO3: Realizing need for food sufficiency, crop water, irrigation requirement, method & design of infrastructures for irrigation requirement.						
Topics	**Introduction**: Brief introduction to Hydrology and Irrigation system **(7)** **Diversion head-works**: Definition of weirs and barrages and their classification, Layout of 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)** **Hydraulic power:** Thermal-water power, 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						

Covered (Hrs)	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 **(6)** **Planning for water resources development:** Level, Phases, objectives, formulation, evaluation, Environmental issues, Systems analysis, multiply purpose projects. **(2)** **Engineering economy in water resources planning:** Social importance, Annual cost comparisons, Interest and taxes, Frequency and economy, Economy studies for public works, Cost allocation. **(4)** **Planning for water resources development:** Level of planning, Phases, Objectives, Data requirements, Project formulation and evaluation, Environmental considerations, Systems analysis, Multiple purpose projects. **(4)**
Text Books, and/or reference material(s)	***Text Books:*** 1. Engineering Hydrology by K. Subramanya, Fourth Edition, McGraw Hills Education (India) Private Limited, New Delhi 2. Irrigation and Water Power Engineering by B. C. Punmia, B. B. Pande, A. K. Jain & A. Kumar, 16th Edition, Laxmi Publications (P) Limited, new Delhi. ***Reference Books:*** 3. Hydrology by V. T. Chow, McGraw-Hill Book Company, Inc., New York

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	3	3	-	-	-	-	-	-	-	-
CO3	-	-	-	-	3	3	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	
CEE730	**Principles of Reliability**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)			Course Assessment methods				
Engineering Mathematics and Design of Concrete Structures			Continuous (CT) and end assessment (EA). CT+EA				
Course Outcomes (COs) :	• CO1: Understand of reliability theory based on knowledge of fundamentals of probability and statistics. • CO2: Apply Monte carlo simulation technique to solve different civil engineering problems. • CO3: Understand the different reliability analysis methods. • CO4: To design the elements of civil engineering structures by using reliability methods.						
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 continuous random variables, Multiple random variables, probability distribution of random variables (Bernoulli and Binomial distribution, Poisson, geometric, hypergeometric, uniform, normal, lognormal, gamma). **(10)** **Simulation technique:** Monte Carlo method, theory and applications. **(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, Calibration of partial safety factors for a level I code, Applications to solve design problems. **(10)**
Text Books, and/or reference material(s)	***Text Books:*** 1. Structural Reliability Analysis and Design by Ranganathan, Jaico Publishing House 2. Probability, Reliability and Statistical Methods in Engineering Design by A. Halder and S. Mahadevan, John Wiley and Sons. New York. ***Reference Books:*** 3. Probability Concepts in Engineering and Design by Ang and Tang, John Wiley. 4. Structural Reliability Analysis and Prediction by R. E. Melchers and A. T. Beck, John Wiley.

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	1	1	-	3	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	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	
CEE731	**Offshore Structural Dynamics**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)			Course Assessment methods				
Solid mechanics & Structural analysis			Continuous (CT) and end assessment (EA). CT+EA				
Course Outcomes (COs) :	• CO1: Identify the types of offshore structures, parameters governing solid-fluid interaction and environmental forces acting on offshore structures. • CO2: Apply static methods of analysis for stresses in Offshore structures • CO3: Solve for response analysis of offshore structures – single and multi-degree of freedom problems, frequency and time domain analyses. • CO4: Evaluate responses under random wanes						
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 under torsion, Beam deflection, Bucklingof beams, Bernoulli-Euler beam theory, Matrix analysis of plane, Space trusses,Plane space frames.**(8)** **Environmental loadings:** Winds forces, Ocean surface waves, Wave loads on offshore structures, Buoyantforces, 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:**Modelling of offshore structures-.Single and multi-degree freedom systems- Dynamic amplification factor- Response of offshore structures- Coupled and uncoupled motions- Frequency domain analysis- Time domain analysis- New Mark-Beta method- Wilson θ method- Response analysis of fixed platforms- Response analysis of compliant platforms. Response in Random Waves**(16)**					

Text Books, and/or reference material(s)	***Text Books:*** 1. Offshore Structural Engineering by Thomas H Dawson, Prentice Hall, 1983 2. Dynamic Analysis and Design of Ocean Structures by Srinivasan Chandrasekaran, Springer, 2015. 3. Dynamics of Offshore Structures by Wilson, J. F., John Wiley, 2002. ***Reference Books:*** 4. Offshore Mechanics by MadjidKarimirad, Constantine Michailides and Ali Nematbakhsh, Wiley, 1 edition 5. Offshore structures – Vol. 1 & 2 by Clauss, G, Lehmann, E &Ostergaard, C., Springer-Verlag, 1992.

Mapping of Course Outcomes COs→POs

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

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	
CEE732	**Pre-stressed Concrete**	**PCL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Solid mechanics and Design of Concrete Structures		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs)	• CO1: Apply knowledge of solid mechanics & concrete structures for design solutions. • CO2: Understand basic design philosophies applicable to pre-stressed concrete structures. • CO3: Formulate, analyse, and design basic components of Civil Engineering Pre-stressed Concrete structures.						
Topics Covered (Hrs)	**Introduction:** Basic principles, advantage, Comparison with RC, Types of pre-stressing and Stress analysis **(4)** **Materials:** Specifications and characteristics of concrete and high tensile steel **(2)** **Loss of Prestressed**: Different type of loss with derivation and numerical problems **(4)** **Flexural Analysis:** Derivation of moment of resistance, Pre-stressing force and eccentricity with numerical problems **(6)** **Shear and torsion:** Design of beam for shear and torsion **(5)** **Deflection and Cracking:** Cause and requirement along with numerical problems**(5)** **Design of end blocks:** Transmission length, design of bearing plate and burst reinforcement **(4)** **Member Design:** One way slab and beam design, two-way pre-stressing, Circular pre-stressing, Partial pre-stressing, Composite construction with pre-stressed concrete and reinforced concrete. **(10)**						

Text Books, and/or reference material(s)	***Text Books:*** 1. Prestressed Concrete, 5th Edition by N. Krishna Raju, Tata McGraw-Hill Publishing Company Limited, New Delhi. 2. Prestressed Concrete, 5th Edition, by S.Ramamrutham, DhanpatRai Publishing Co. Pvt. Ltd. New Delhi. 3. IS 1343: 2012, Prestressed Concrete – Code of Practice (2nd Revision), BIS, New Delhi. 4. www.nptel.ac.in ***Reference Books:*** 5. Fundamentals of PrestressedConcreteby N. C. Sinha& S. K. Roy, S.Chand& Company Ltd, New Delhi

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	3	-	-	-	1	-	-	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	
CEE733	**Advanced Concrete Technology**	**PCL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Solid mechanics and Concrete Technology		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs)	• CO1: Acquire knowledge of selection and application of concrete making materials • CO2: Understand the properties of concrete at different stages • CO3: Gain an integrative ideaon different concretes						
Topics Covered (Hrs)	**Introduction:**Brief discussion on concrete making materials, fresh and harden concrete and mix design **(10)** **Elasticity, Creep & Shrinkage:** Definitions and meaning, factors affecting, measurement and types. **(6)** **Durability of Concrete:** Volume change, Permeability, Mass concrete, Freezing & thawing, Sulphate & Acid attack, Alkali-Aggregate reactions, Crack, Cover to Reinforcement **(6)** **Testing of Harden Concrete:** Compression, Flexural, Ring Tension, Core and non-destructive test **(6)** **Special Concrete:** Mass,LightWeight,High Density, Fibre Reinforced, Cold Weather, Hot Weather, Prepacked, Vacuum, Shotcrete, Ferro cement, Self-Compacted, Reinforced, Pre-stressed & etc. Concrete **(14)**						
Text Books, and/or reference material(s)	***Text Books:*** 1. Engineering Materials byS. C. Rangwala, K. S. Rangwala and P. S. Rangwala, Charotar Publishing House, Anand 2. Concrete Technology byM.S. Shetty, S. Chand Publisher, New Delhi 3. IS 10262: 2009, Concrete Mix Proportioning-Guidelines (1st Revision), BIS, New Delhi. 4. IS 383: 1970, Specification for Coarse and Fine aggregates from natural sources for concrete (2nd Revision) BIS, New Delhi. ***Reference Books:*** 1. Concrete Technology by M. L. Gambhir, Tata McGraw Hill and www.nptel.ac.in						

Mapping of Course Outcomes COs→POs

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

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	
CEE734	**Advanced Structural Mechanics**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Solid Mechanics		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs) :	• CO1: To develop basic understanding of the fundamental concepts of the advanced topics. • CO2: To define the stress and strain tensors for structural members and to write the stress-strain relationships. • CO3: To evaluate the state of stress or state of strain with respect to the different theories of failure and compare. • CO4: To apply the principles of structural mechanics to special 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. **(7)** **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-strain constitutive relations:** (4) **Theories of failure:**(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; beams with doubly symmetric cross-sections; beams with arbitrary cross sections. **(4)** **Introduction To Plates** (4)
Text Books, and/or reference material(s)	***Text Books:*** 1. Solid Mechanics by S.M.A. Kazimi, Tata McGraw-Hill Publishing Company Limited 2. Advanced Mechanics of Solids by L.S. Srinath, Tata McGraw-Hill Publishing ***Reference Books:*** 3. Mechanics of Solids by Abdul Mubeen

Mapping of Course Outcomes COs→POs

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

EIGHTH SEMESTER

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	
CEE810	**Sediment Transport**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
CEC 302, CEC 601.		Continuous (CT) and end assessment (EA). CT+EA					

Course Outcomes (COs):	• CO1: Understanding of the origin and mechanism of sediment transport • CO2: Development of capabilities to analyze sediment load. • CO3: Ability to develop model to predict sediment load. • CO4: Capability to design stable channel to carry the predicted sediment load
Topics Covered (Hrs)	**Introduction:(2)** **Sediment properties:** particle size shape and density, fall velocity, viscosity, colloids and flocculation. Introduction **(4)** **Threshold of particle motion**. **(4)** **Sand transport by air:** Surface creep, effects of sand movement on wind, instability of a flat sand surface, ridges and dunes. **(4)** **Sediment movement in water:** bed features and meanders, analytical models, stresses in flow of fluid-solid mixtures. **(4)** **Channel roughness and resistance to 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. **(8)** **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)** **Cohesive sediments: (2)** Erosion, deposition, scour, local scour at different structures. **(2)** Dimensional Analysis and Similitude **(2)**
Text Books, and/or reference material(s)	***Text Books:*** 1. Mechanics of Sediment Transportation and Alluvial Stream Problems by R. J. Garde, K. G. Ranga Raju, Revised Third Edition, New Age International Publishers, and New Delhi. 2. Loose boundary hydraulics by A. J. Raudkivi, 2nd edition Pergamon press ***Reference Books:*** 3. Sediment Transport by V. T. Chow, McGraw-Hill Book Company, Inc., New York

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	3	-	-	-
CO2	-	3	-	-	-	-	-	-	3	-	-	-
CO3	-	-	-	-	3	-	-	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	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	
CEE811	**Slope Stability and Reinforced Earth**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Foundation Engineering		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: learn basic mechanism of reinforced earth. • CO2: design wall with reinforced backfill • CO3: analyze stability of reinforced slopes						
Topics Covered (Hrs)	**Introduction,** Basic mechanism of reinforced earth, Practical application. **(6)** **Basic components of reinforced soil**: Soil or fill matrix, Reinforcements, facing elements. **(6)** **Strength characteristics of reinforced soil**: Basic concept, Sigma and Tau models, 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)** **Methods of Slope Stability**: Taylor Charts, Method of Slices, Effect of Tension Cracks, Vertical Cuts. Bishop's Analysis. Non-circular Failure Surfaces, Stabilization of slopes: Drainage measures, Soil reinforcement (geosynthetics/soil nailing etc). **(15)**						
Text Books, and/or reference material(s)	***Text Books:*** 1. Reinforced Earth & Geotextiles by Koerner 2. Reinforced Earth & Geotextiles by G. V. Rao 3. Earth and Earth-Rock Dams by Sherard, Woodward, Gizienski and Clevenger. John Wiley &. Sons. 1963 4. Earth and RockFill Dams by Bharat Singh and H. D. Sharma, 1999 ***Reference Books:*** 5. Slope Stability and Stabilisation methods by L. W. Abramson, T. S. Lee, and S. Sharma, John Wiley & sons. (2002) 6. The Stability of Slopes by E. N. Bromhead, (1992), Blackie academic and professional, London. 7. Earth &Rockfill Dams, Principles of Design and Construction by Christian, Kutzner Published Oxford and IBH. 8. Handbook of Slope Stabilization by J. A. R. Ortiago, and A. S. F. J. Sayao, 2004.						

Mapping of Course Outcomes COs→POs

	Engineering knowledge	Problem analysis	Design/development of solutions	investigations of complex	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	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	3	-	-	-	-	-	-	-	-	-
CO3	-	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	
CEE812	**Soil Structure Interaction**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)			Course Assessment methods				
Structural Analysis, Soil Mechanics and Foundation Engineering			Continuous (CT) and end assessment (EA). CT+EA				
Course Outcomes (COs) :	• CO1: Understand the basis of soil-structure interaction. • CO2: Understand various soil interaction models like beams on elastic foundation (Winkler beam model), infinite beam, finite beam models. • CO3: Apply soil-structure interaction models to different type of foundations like pile, sheet pile walls (cantilever and anchored sheet pile walls). • CO4: Analyse the foundation of different civil structures with considering soil-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**, Infinite beam, Finite beam, Modulus of subgrade reaction and effecting parameters. **(8)** **Sheet pile wall**, Cantilever and anchored sheet pile wall, Fixed earth support, Free earth support. **(6)** **Retaining walls**, Conduits, Load on different types of conduits, 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**. (8)**						
Text Books, and/or reference material(s)	***Text Books:*** 1. Geotechnical Engineering: Principal and Practices of Soil Mechanics and foundation Engineering by V N.S. Murthy, 2. Foundation analysis and Design by J. E. Bowles. 3. Basic and Applied Soil Mechanics by G.Ranjan and A.S.Rao ***Reference Books:*** 4. Advanced Geotechnical Engineering soil-structure Interaction using Computer and Material Models by C. S. Desai, and M. Zaman 5. Advanced Soil Mechanics by B. M. Das, McGraw Hills Publishers						

Mapping of Course Outcomes COs→POs

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

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	
CEE813	**Industrial Wastes**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Environmental Engineering		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: Apply knowledge of different types of industrial pollutants (air, solid waste and wastewater) for design solutions. • CO2: Understand basic design philosophies applicable for control and safe disposal of different types of industrial pollutants. • CO3: Formulate, analyze, and design basic control and disposal systems of different types of industrial pollutants.						
Topics Covered (Hrs)	**Industrial sources of pollution**, types of pollutants. **(5)** **Air pollution** – Its effects, measurement, methods & equipment of control**. (15)** **Solid wastes** – quantity & characteristics, methods of collection, disposal & reuse**. (12)** **Wastewater** – characteristics, methods of collection, treatment & disposal. **(10)**						
Text Books, and/or reference material (s)	***Text Books:*** 1. Environmental Engineering byH.S. Peavy, D. R. Rowe & G. Tchobanoglous, McGraw Hill Education (India) Private Limited, New Delhi 2. Introduction to Environmental Engineering byM.L. Davis & D.A. Cornwell, Tata McGraw-Hill Education Private Limited, New Delhi ***Reference Books:*** 3. Environmental Engineering – A Design Approach by A.P. Sincero& G.A. Sincero, Prentice – Hall of India Private Limited, New Delhi 4. Industrial Water Pollution Control byW.W. Eckenfelder, Jr. (McGraw-Hill Higher Education)						

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	3	-	-	-	1	-	-	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	
CEE814	**Water resource System Planning and Management**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Fluid Mechanics, Irrigation Engineering, Water Resources Engineering, Economics and Computer Applications		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: Understanding of different aspects of systems of water resources • CO2: Learning of optimization techniques, linear and dynamic Programming. • CO3: Ability to formulate modelsof reservoir systems,size, operation and hydropower production						
	Introduction: Overview and Role of engineers **(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)**						

Topics Covered (Hrs)	**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:** Planning context, Developing the supply, Estimating the demand, 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**. (5)** **Planning for navigation:** Planning context, Developing the supply, Estimating the demand, Project feasibility**. (5)** **Irrigation planning and operation:** Planning context, Developing the supply, Estimating the demand, Project feasibility**. (5)**
Text Books, and/or reference material(s)	***Text Books:*** 1. Water Resources Systems – Modelling Techniques and Analysis by S. Vedula and P. P. Mujumdar, Tata McGraw-Hill Publishing Company Limited, New Delhi. ***Reference Books:*** 2. Irrigation System Design – An Engineering Approach by H. Cuenca, Richard, Prentie Hall, Englewood Cliffs, New Jersey 07632 3. Water Demand Management by Butler, David and Memon, Fayyaz Ali, IWA Publishing, London

Mapping of Course Outcomes COs→POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	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	
CEE815	**MachineFoundation**	**PEL**	**3**	**0**	**0**	**3**	**3**
Pre-requisite(s)		Course Assessment methods					
Mechanics of structures		Continuous (CT) and end assessment (EA). CT+EA					
Course Outcomes (COs) :	• CO1: Acquire knowledge of Machines and its Foundation: Types and Forces acting upon, dynamic analysis • CO2: Ability to conduct Field-Experiment and Analyze the data with interpretation for determining dynamic properties of Soil • CO3: Ability to Design Suitable Foundations based on Soil as a Spring, and as a Half-Space continuum • CO4: Ability for understanding the need of future studies						
Topics Covered	**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:**Free and Forced Vibration of Two Degree Freedom System, Natural frequencies and their arrangement, Eigen value and Eigen vector, normal coordinates,						

(Hrs)	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 modeling as linear un-damped springs. Soil as Half-Space, inclusion of damping, embedment effect. **(6)** **Foundation design:**Foundation analysis and design as linear spring, vertical vibration, pure sliding and rocking vibration. **(6)** **Couple vibration of sliding and rocking. (6)** **Elastic half-space approach of analysis and design(8)**
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. ***Reference Books:*** 2. Design Aids in Soil Mechanics and Foundation Engineering by S.R. Kaniraj, Tata-Mc-Graw-Hill Publishing Company ltd.

Mapping of Course Outcomes COs→POs

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