Curriculum of M.Tech Program in Structural Engineering

Semester wise distribution of the courses

Semester I (M1)

Slot	Course Type	Course	Marks		Hours	Credits
			CIA	ESE	L - T - P	
A	DCC	Discipline Core 1	40	60	3 – 0 - 0	3
B	PCC	Program Core 1	40	60	3 – 0 - 0	3
C	PCC	Program Core 2	40	60	3 – 0 - 0	3
D	PEC	Program Elective 1	40	60	3 – 0 - 0	3
E	PEC	Program Elective 2	40	60	3 – 0 - 0	3
S	RM	Research Methodology & IPR	40	60	2 – 0 - 0	2
T	LBC	Laboratory 1	100	-	0 – 0 - 2	1
Total			**340**	**360**	**19**	**18**

Teaching Assistance: 6 hours

Semester II (M2)

Slot	Course Type	Course	Marks		Hours	Credits
			CIA	ESE	L - T - P	
A	DCC	Discipline Core 2	40	60	3 – 0 - 0	3
B	PCC	Program Core 3	40	60	3 – 0 - 0	3
C	PEC	Program Elective 3	40	60	3 – 0 - 0	3
D	PEC	Program Elective 4	40	60	3 – 0 - 0	3
E	IEC	Industry/Interdisciplinary Elective	40	60	3 – 0 - 0	3
S	PR	Mini project	100	-	0 – 0 - 4	2
T	LBC	Laboratory 2	100	-	0 – 0 - 2	1
Total			**400**	**300**	**21**	**18**

Teaching Assistance: 6 hours

Semester III (M3)

Slot	Course Type	Course	Marks		Hours	Credits
			CIA	ESE	L - T - P	
TRACK 1						
A*	MOOC	MOOC	To be successfully completed		-	2
B	AC	Audit Course	40	60	3 – 0 - 0	-

C	PR	Internship	50	50	-	3
D	PR	DissertationPhase I	100	-	0 – 0 - 17	11
TRACK 2						
A*	MOOC	MOOC	To be successfully completed		-	2
B	AC	Audit Course	40	60	3 – 0 - 0	-
C	PR	Internship	50	50	-	3
D	PR	Research project Phase I	100	-	0 – 0 - 17	11
Total			**190**	**110**	**20**	**16**

Teaching Assistance: 6 hours

*MOOC must be successfully completed before the commencement of fourth semester. This course can be carried out at any time from M1 to M3.

Semester IV (M4)

Slot	Course Type	Course	Marks		Hours	Credits
			CIA	ESE	L - T - P	
TRACK 1						
D	PR	Dissertation Phase II	100	100	0 – 0 - 24	16
TRACK 2						
D	PR	Research project Phase II	100	100	0 – 0 - 24	16
Total			**100**	**100**	**24**	**16**

Teaching Assistance: 5 hours

Syllabus for the theory courses

1)   Core courses in M1

#	Course category	Course code	Course Name	Credits
1	DCC	1CE160A	Advanced Numerical Methods and Optimization	3
2	PCC	1CE161A	Advanced Solid Mechanics	3
3	PCC	1CE161B	Advanced Theory and Design of RCC Structures	3
4	PEC	1CE16XX	Program Elective 1	3
5	PEC	1CE16XX	Program Elective 2	3

#	Course code	Course Name
1	1CE160A	Advanced Numerical Methods and Optimisation

Brief syllabus

Introduction to numerical methods- errors in numerical methods; System of linear algebraic equations; Systems of non-linear equations. Quadratic and Cubic splines; Data smoothing by least squares criterion -Non-polynomial models like exponential model and power equation; Multiple linear regression; Numerical integration- Newton – Cotes open quadrature.

Ordinary differential equations of the boundary value type - Finite difference solution; Partial differential equations - Parabolic equations - Explicit finite difference method,

Crank-Nicholson implicit method; Ellipse equations.

Introduction to structural optimisation; Unconstrained and constrained optimization problems ; Linear Programming - Simplex method, Two phase solution, Duality of linear programming. Non- Linear Programming problems, Unconstrained optimisation Techniques, Formulation of geometric programming.

Analysis of stress in 3D - Analysis of strain in 3D - Stress Strain relations - Two dimensional problems in Rectangular coordinates - Two dimensional problems in polar coordinates - Torsion of prismatic bars.

#	Course code	Course Name
2	1CE161A	Advanced Solid Mechanics

Brief syllabus

Basic theory and design philosophies-Advanced theory in Stress-strain characteristics of concrete, Design concepts-Limit state method-Estimation of deflection and control of cracking, - Design of special RC member, Strut and Tie Models- Development, RCC beam – column joints, different types of walls and their applications in structural systems

#	Course category	Course code	Course Name	Credits
1	RM	1MC061A	Research Methodology & IPR	2
2	LBC	1CE169A	Structural Engineering and Design Lab	1

#	Course code	Course Name
1	1MC061A	Research Methodology & IPR

Brief syllabus

Introduction to Research Methodology- motivation for research, types of research, ethical issues. Identifying a research area and collecting related literature. Research problem- scope- objectives, literature review, identifying research gaps, and formulate the research problem. Research design and methods, data collection and analysis. Copy right – royalty - IPR and patent law. Process of patenting and development, Procedure for grant of patents. Copy left- open access, citation, plagiarism, iImpact factor. Writing a technical paper.

#	Course code	Course Name
2	1CE169A	Structural Engineering and Design Lab

Brief syllabus

Material properties -Design of concrete mix– Hardened property of concrete-Durability test and NDT- Bond strength test–Test on RC members-Design of RCC members–Design of RCC structure.

2)   Core courses in M2

#	Course category	Course code	Course Name	Credits
1	DCC	1CE160B	Finite Element Methods in Engineering	3
2	PCC	1CE161C	Structural Dynamics	3
3	PEC	1CE16XX	Program Elective 3	3
4	PEC	1CE16XX	Program Elective 4	3

#	Course code	Course Name
1	1CE160B	Finite Element Methods in Engineering

Brief syllabus

Review of theory of elasticity- Equations of equilibrium, Strain-displacement relation, compatibility conditions, constitutive relation; Energy principles; Introduction to weighted residual methods; Evolution of FEM, Review of direct stiffness method, Outline of the FE procedure; Element properties, convergence requirements, equilibrium and compatibility in the solution; Types of finite elements; Plane stress and plane strain problems; Stiffness matrix for

truss and beam elements, Development of consistent nodal load vector; Concept of iso parametric formulation- Line element, Plane bilinear element, Sub parametric and super parametric elements; Assembly procedure and storage techniques of stiffness matrix, Application of boundary Conditions, Solution techniques; Computer Implementation of FEM procedure.

#	Course code	Course Name
2	1CE161C	Structural Dynamics

Brief syllabus

Importance of vibration studies. Systems with single degree of freedom - Free and forced vibration with and without damping -Response to support motion. Multi-degree of freedom systems (Lumped mass) - Evaluation of natural frequencies and mode shapes - Co-ordinate coupling - Orthogonality of normal modes - Forced vibration analysis of multi-degree of freedom systems - Mode superposition method. Numerical solution of single degree of freedom systems. Distributed mass (continuous) systems - Axial vibration of rods - Flexural vibration of single span beams - Evaluation of frequencies and mode shapes- Random Vibration- random variables- random processes- power spectra- noise, extreme values fatigue application to wind, wave, and earthquake loading- Vibration isolation- Vibration measuring instruments - Methods of vibration control.

3) Elective courses

a) Program Elective courses

List of Program Elective courses

#	Course code	Course Name
1	1CE162A	Advanced Metal Structures
2	1CE162B	Behaviour of Structural Materials and Instrumentation
3	1CE162C	Forensic Engineering and Rehabilitation
4	1CE162D	Theory and Design of Plates and Shells
5	1CE162E	Composite Structures
6	1CE162F	Fracture Mechanics
7	1CE162G	Advanced Prestressed Concrete Design
8	1CE162H	High Rise Structures
9	1CE162I	Design of Bridges
10	1CE162J	Structural Reliability
11	1CE162K	Stability of structures

12	1CE162L	Random Vibration
13	1CE162M	Structural Health Monitoring
14	1CE162N	Design of offshore structures
15	1CE162O	Theory of Plasticity
16	1CE162P	Soil Structure Interaction

Syllabus of Program Elective courses

#	Course code	Course Name
1	1CE162A	Advanced Metal Structures

Brief syllabus

Design Philosophies, Connections, Beam to column connections, Splices, Tubular connections, Industrial buildings, Steel-Concrete Composite structures, Light gauge steel structures

#	Course code	Course Name
2	1CE162B	Behaviour of Structural Material and Instrumentation

Brief **syllabus**

Components of concrete, special concrete, mix design of various types of concrete, properties of hardened concrete, durability test, non-destructive testing, instrumentation and testing of reinforced concrete members.

#	Course code	Course Name
3	1CE162C	Forensic Engineering and Rehabilitation

Brief syllabus

Failure of structures: Review of the construction theory- Performance problems-Causes of deterioration in concrete and steel structures. Diagnosis and Assessment of Distress: visual inspection-non destructive tests. Fibre optic method for prediction of structural weakness, Effect of environmental problems and natural hazards. Methods of repair of concrete and steel structures, Modern techniques of retrofitting-case studies.

#	Course code	Course Name
4	1CE162D	Theory and Design of plates and shells

Brief syllabus

Introduction to plates, Pure bending of plates, Deflections of laterally loaded plates, Simply supported rectangular plates, Classical Plate theory, Circular plates, Annular plates, Introduction to shells, General theories of cylindrical shells, Theory of folded plates, Special forms of shells

#	Course code	Course Name
5	1CE162E	Composite Structures

Brief syllabus

Introduction to composites - Composite Fundamentals, Structural applications of Composite Materials, Manufacturing Processes. Mechanics of Composite Lamina, Failure theories. Micro Mechanical Behaviour of Composite Laminates - Classical Lamination Theory, stress-strain variation, In-plane forces, bending and twisting moments, special cases of laminate stiffness. Laminate strength analysis procedure, Failure envelopes,. Free-Edge Interlaminar Effects, Analysis of free edge interlaminar stresses, Effects of stacking sequence- Bending and Buckling of Laminated Beams and Plates.

#	Course code	Course Name
6	1CE162F	Fracture Mechanics

Brief syllabus

Significance of fracture mechanics, Griffith energy balance approach, Irwin's modification to the Griffith theory, Stress intensity approach, Cack tip plasticity, Fracture toughness, sub-critical crack growth, Linear Elastic Fracture Mechanics (LEFM), Cack Tip Plasticity, LEFM Testing, Plane strain and plane stress fracture toughness testing, Elastic Plastic Fracture Mechanics (EPFM), Fatigue Cack Growth, Sustained Load Fracture, Experimental and Modelling tools, Numerical Simulation of plain concrete fracture experiments.

#	Course code	Course Name
7	1CE162G	Advanced Prestressed Concrete Design

Brief syllabus

Basic concept and principles of pre-stressed concrete systems, Analysis for flexure, Loss Of pre-stress, Design philosophy and design for flexure, shear and torsion, Codal provisions, Calculation of deflection (short & long term), Design of PSC slabs, Design of compression members, prestressing of statically indeterminate structures, Transfer of prestress, Design of End block.

#	Course code	Course Name
8	1CE162H	High Rise Structures

Brief syllabus

Tall structures, Structural systems, design considerations of Transmission tower, Mast and trestles, Cooling towers, RC and Steel Chimney and their foundations, effects of wind on tall structures, application of software in analysis and design of high rise structures.

#	Course code	Course Name
9	1CE162I	Design of Bridges

Brief syllabus

Introduction to Bridge Engineering: types of bridges, forces and design criteria, IRC loads, Bridge Deck Analysis - Design of RCC deck slab, T-beam and slab, box girder, balanced cantilever bridge - Analysis and design of Prestressed concrete bridge - Design of substructure and foundation, bearings.

#	Course code	Course Name
10	1CE162J	Structural Reliability

Brief syllabus

Fundamentals of probability theory, resistance distributions and parameters, probabilistic analysis for loads, basic structural reliability, level 2 reliability methods, Monte Carlo study of structural safety, reliability of structural system, reliability-based design.

#	Course code	Course Name
11	1CE162K	Stability of Structures

Brief syllabus

Buckling of Columns -Methods of Neutral Equilibrium, Large Deformation Theory for Columns, Energy method for calculating critical loads, Buckling of Beam Columns, Torsional Buckling, Buckling of Frames, Stability of a frame by Matrix Analysis, Buckling of Plates, Instability of shells

#	Course code	Course Name
12	1CE162L	Random Vibrations

Brief syllabus

Basic concepts in Probability theory- Random process- Spectral density functions- Properties of various random processes- Random Vibration-response of linear SDOF, MDOF and continuous systems- Basics of nonlinear random vibration

#	Course code	Course Name
13	1CE162M	Structural Health Monitoring

Brief syllabus

Review of Structural Modelling and Finite Element Models - Review of Signals, Systems and Data Acquisition Systems - Sensors for Health Monitoring Systems - Health Monitoring/Diagnostic Techniques- Health Monitoring/Diagnostic Techniques -Integrated Health Monitoring Systems - Information Technology for Health Monitoring -Project Based Health Monitoring Techniques

#	Course code	Course Name
14	1CE162N	Design of Offshore Structures

Brief syllabus

Offshore structures – types-conceptual development - Basics of wave motion-wave theories-wave kinematics-random waves-wave spectrum-wave breaking - Loads on offshore structures- operational Loads - environmental loads – Morison equation- Wave forces on large structures-Linear diffraction theory - materials-allowable stresses-design methods and code provisions of API and, DNV- Principles of static and dynamic analysis of jacket platforms- Analytical modeling of jacket platforms- Design principles of Concrete offshore platforms-Jack up platforms -Compliant platforms- Tension Leg Platforms and Spar platforms- -Design of tubular members and joints – simple design problems- Fatigue analysis-Submarine pipelines-design procedure-thickness calculations.

#	Course code	Course Name
15	1CE162O	Theory of Plasticity

Brief syllabus

Basic equation of theory of elasticity, frame work of plastic constitutive relations, plastic behavior in simple tension, generalisation of result in simple tension, initial yield surfaces for poly crystalline metals, the Von Mises initial yield condition, the Tresca's initial yield conditions, plastic behavior of bar structures, the theorem of limit analysis, limit analysis in plane stresses and plane strain.

#	Course code	Course Name
16	1CE162P	Soil Structure Interaction

Brief syllabus

Soil-Foundation Interaction - Soil response model - Elasto-plastic behaviour, Beams on Elastic Foundations- Analysis of beams of finite and infinite length -Time dependent behaviour, Plates on Elastic medium-thin and thick plates, Elastic analysis of piles- Analysis of pile groups, Interaction analysis, Load deflection prediction for laterally loaded piles.

b)   Industry Elective courses

#	Course code	Course Name
1	1CE166A	Wind Analysis of Structure and Cladding Components
2	1CE166B	Soil Investigation and Design of Substructures
3	1CE166C	Design of Infrastructure services
4	1CE166D	Advanced Finite Element Methods

c) **Interdisciplinary courses**

List of Interdisciplinary courses

#	Course code	Course Name	Offering Department
1	1CE165A	Mechanics of composite materials	CE
2	1CE165B	Random Vibrations	CE
3	1CE165C	Project Management	CE