INTEGRAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING

PROGRAMME: M.TECH STRUCTURAL ENGINEERING
PROGRAM SPECIFIC OUTCOMES (PSO):

PSO-1: Orientation of graduate students to have high research value in Structural Engineering to pursue research through lifelong learning, enhancing society and sustainable development.

PSO-2: Developing Analytical and Ethical Designing Skills among students to make them capable to have a career as an entrepreneur, design engineer and quality control engineer.

PROGRAM EDUCATIONAL OBJECTIVES (PEO):

PEO-1: Enabling the learners to apply advance structural analysis, design, and quality control methods using latest national design codes in civil engineering works.

PEO-2: Developing the skill to follow the latest research trend to have high research value for better contributing to society and environment.

PEO-3: Promoting lifelong learning to meet the ever evolving professional demands by developing ethical, IT, inter personal and team skills.

PROGRAM OUTCOMES (PO):

PO1- **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2- **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3- **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4- **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5- **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6- **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7- **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10- **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11- **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12- **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

COURSE: THEORY OF ELASTICITY & PLASTICITY
COURSE CODE: CE501/CEE501

COURSE OBJECTIVES:
- To make learner understand the concept of Elasticity & Plasticity of material.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Knowing the basics of elastic theory, learner will understand the concept of stress tensor & stress Invariants and be able to perform axis transformation in Cartesian coordinates.
CO2	In two dimensional Cartesian coordinate system, learner will understand about bi-harmonic equation for plane stress and be able perform elastic calculation of stress and strain.
CO3	In two dimensional Polar coordinate system, learner will understand equilibrium and compatibility equations and be able perform elastic calculation of stress and strain.
CO4	Knowing the plastic behavior, learner will understand analysis principle and be able to establish failure criteria.
CO5	To make learner understand bending behavior of beam in plastic torsion and able to perform deformation analysis of it.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Knowing the basics of elastic theory, learner will understand the concept of stress tensor & stress Invariants and be able to perform axis transformation in Cartesian coordinates.	2	3	3	0	1	0	0	0	0	2	0	0
CO2	In two dimensional Cartesian coordinate system, learner will understand about bi-harmonic equation for plane stress and be able perform elastic calculation of stress and strain.	0	0	0	0	0	0	0	0	0	0	0	0
CO3	In two dimensional Polar coordinate system, learner will understand equilibrium and compatibility equations and be able perform elastic calculation of stress and strain.	0	0	0	0	0	0	0	0	0	0	0	0
CO4	Knowing the plastic behavior, learner will understand analysis principle and be able to establish failure criteria.	2	3	3	0	1	0	0	0	0	2	0	0
CO5	To make learner understand bending behavior of beam in plastic torsion and able to perform deformation analysis of it.	0	0	0	0	0	0	0	0	0	0	0	0
	3: Strong contribution, 2: average contribution, 1: Low contribution												

COURSE: ADVANCED STRUCTURAL ANALYSIS (MATRIX APPROACH)
COURSE CODE: CE502/CEE502

COURSE OBJECTIVES:
- To developed understanding of structural analysis by matrix approach.
- To analyze the structures using displacement methods and force methods.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To understand the basis methods of structural analysis and basic concepts of matrix approach.
CO2	Learner will be able to formulate displacement matrix and analyses continuous beams, rigid & pin jointed plane frames by displacement method.
CO3	Learner will be able to formulate flexibility matrix and analyze rigid jointed plane frames by force method.
CO4	Learner will be able to analyze rigid & pin jointed space frames & space using displacement method.
CO5	Learner is familiarized with static condensation procedure and will be able to analyses large structures using sub structuring technique.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	To understand the basis methods of structural analysis and basic concepts of matrix approach.	3	3	1	1	1	0	0	0	1	1	0	1
CO2	Learner will be able to formulate displacement matrix and analyses continuous beams, rigid & pin jointed plane frames by displacement method.	3	3	1	1	2	0	0	0	1	1	0	1
CO3	Learner will be able to formulate flexibility matrix and analyze rigid jointed plane frames by force method.	3	3	1	1	1	0	0	0	1	1	0	1
CO4	Learner will be able to analyze rigid & pin jointed space frames & space using displacement method.	3	3	1	1	2	0	0	0	1	1	0	1
CO5	Learner is familiarized with static condensation procedure and will be able to analyses large structures using sub structuring technique.	3	3	1	2	2	0	0	0	1	1	0	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: ADVANCED CONCRETE DESIGN
COURSE CODE: CE503/CEE503

COURSE OBJECTIVES:
- To develop the knowledge of checking of deflection and crack width.
- To develop the knowledge of designing of deep beam and grid floor.
- To develop the knowledge of designing of flat slabs.
- To develop the knowledge of ductile detailing.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Understand the background of structural concrete and behavior of beam and slab.
CO2	Able to design structure for serviceability condition (Deflection and Crack width).
CO3	Able to design deep beam and Grid floor.
CO4	Able to design flat slab with different support conditions.
CO5	Understand the method of field control of concrete and concepts of detailing for ductility.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Understand the background of structural concrete and behavior of beam and slab.	2	3	0	2	0	0	0	0	0	0	0	2
CO2	Able to design structure for serviceability condition (Deflection and Crack width).	2	3	2	2	0	0	0	0	0	0	0	2
CO3	Able to design deep beam and Grid floor.	3	2	2	1	0	0	0	0	0	0	0	2
CO4	Able to design flat slab with different support conditions.	3	2	2	1	0	0	0	0	0	0	0	2
CO5	Understand the method of field control of concrete and concepts of detailing for ductility.	2	3	1	2	0	0	0	0	0	0	0	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: CONCRETE TECHNOLOGY
COURSE CODE: CE504/CEE504

COURSE OBJECTIVES:
- To understand the types and roles of concrete materials with in depth understanding of manufacturing and hydration of cement.
- To develop the ability to recognize the properties fresh and hardened concrete and to perform nondestructive tests.
- To perform Mix Proportioning as per IS 10262-2016.
- To familiarize with special types of concrete and quality control procedures.

COURSE OUTCOMES (CO):
After the successful course completion, a learner will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Capability to perform tests on concrete materials in order to accept or reject based on the results as per Indian Standard.
CO2	Skill to manage the manufacturing of cement with in-depth knowledge of process, reaction and hydration of cement.
CO3	Quality check of fresh and hardened concrete by performing the required tests according to the pre-requisite as per Indian Standard.
CO4	Capability to perform Mix proportioning as per IS10262-2016 using the materials available near the concerned site and demand.
CO5	Ability to perform the quality checks on concrete structures with the knowledge of special types of concretes.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Capability to perform tests on concrete materials in order to accept or reject based on the results as per Indian Standard.	3	0	0	3	0	0	0	3	0	0	0	3
CO2	Skill to manage the manufacturing of cement with in-depth knowledge of process, reaction and hydration of cement.	3	0	0	3	0	0	0	0	0	0	0	3
CO3	Quality check of fresh and hardened concrete by performing the required tests according to the pre-requisite as per Indian Standard.	3	0	0	3	0	0	0	3	0	0	0	3
CO4	Capability to perform Mix proportioning as per IS10262-2016 using the materials available near the concerned site and demand. .	3	0	3	1	0	0	2	3	0	0	0	3
CO5	Ability to perform the quality checks on concrete structures with the knowledge of special types of concretes.	3	0	0	3	0	0	0	3	0	0	0	3
	3: Strong contribution, 2: average contribution, 1: Low contribution												

COURSE: DESIGN OF FOUNDATION STRUCTURES
COURSE CODE: CE505/CEE505

COURSE OBJECTIVES:
- To share the importance of soil investigation.
- To Share the stability of suitable foundation for structures.
- To impart the basics of shallow and deep foundation.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Lerner will be made aware about soil investigation process and the design principles of reinforced concrete foundation.
CO2	Lerner will be able to design shallow foundation and deep foundation as per codal provision.
CO3	Lerner will be able to design pile foundation as per codal provision.
CO4	Lerner will be able to design well foundation as per codal provision.
CO5	Lerner will be able to design tower foundation as per codal provision.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Lerner will be made aware about soil investigation process and the design principles of reinforced concrete foundation.	3	3	1	1	1	0	0	1	0	0	0	1
CO2	Lerner will be able to design shallow foundation and deep foundation as per codal provision.	2	2	3	1	1	0	0	1	0	0	0	1
CO3	Lerner will be able to design pile foundation as per codal provision.	2	1	3	1	1	0	0	1	0	0	0	1
CO4	Lerner will be able to design well foundation as per codal provision.	2	1	3	1	1	0	0	1	0	0	0	1
CO5	Lerner will be able to design tower foundation as per codal provision.	2	1	3	1	1	0	0	1	0	0	0	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES
COURSE CODE: CE506/CEE506

COURSE OBJECTIVES:
- To get knowledge about composite section of steel-concrete.
- To understand the steel sandwich construction.
- To study the behaviour and to design the composite beam and column sections and composite trusses.
- To know about different types of connections in composite structures and to design it.
- To understand the behaviour of box girder bridges and its design concept.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	With given problem learner will get knowledge about composite section of steel-concrete.
CO2	Learner will understand the steel sandwich construction.
CO3	Learner will understand the behavior of composite section and will learn how to design composite trusses.
CO4	Learner will get knowledge about different types of connections in composite structures.
CO5	With given problem learner will be able to understand the behavior of box girder bridges and learn how to design it.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	With given problem learner will get knowledge about composite section of steel-concrete.	3	2	1	0	0	0	0	0	0	0	0	2
CO2	Learner will understand the steel sandwich construction.	3	2	1	0	0	0	0	0	0	0	0	2
CO3	Learner will understand the behavior of composite section and will learn how to design composite trusses.	3	2	3	1	0	0	0	0	0	0	0	2
CO4	Learner will get knowledge about different types of connections in composite structures.	2	2	2	1	0	0	0	0	0	0	0	2
CO5	With given problem learner will be able to understand the behavior of box girder bridges and learn how to design it.	3	2	3	1	0	0	0	0	0	0	0	2
	3: Strong contribution, 2: average contribution, 1: Low contribution												

COURSE: THEORY OF PLATES AND SHELLS
COURSE CODE: CE513/CEE513

COURSE OBJECTIVES:
- To learn about the behaviour of plates, various boundary conditions and solution of rectangular and Circular plates.
- To analyse plates of various shape and to design them.
- To analyse the cylindrical shells and to get numerical solutions.
- To know about approximate design methods for doubly curved shells, Design criteria, code specification and stability consideration.
- To study the structural behaviour of folded plates, method of analysis of folded plates and its design considerations.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Learner will learn about the behaviour of plates, various boundary conditions and solution of rectangular and Circular plates.
CO2	One will be able to analyse plates of various shape and can design it.
CO3	Learner will be able to analyse the cylindrical shells and can get numerical solutions.
CO4	One will get knowledge about design methods for doubly curved shells, Design criteria and stability consideration.
CO5	Learner will learn structural behaviour, method of analysis of folded plates and its design considerations.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Learner will learn about the behaviour of plates, various boundary conditions and solution of rectangular and Circular plates.	3	3	2	1	0	0	0	0	0	0	0	2
CO2	One will be able to analyse plates of various shape and can design it.	2	3	3	1	0	0	0	0	0	0	0	2
CO3	Learner will be able to analyse the cylindrical shells and can get numerical solutions.	2	2	1	3	0	0	0	0	0	0	0	2
CO4	One will get knowledge about design methods for doubly curved shells, Design criteria and stability consideration.	3	3	3	3	0	0	0	0	0	0	0	2
CO5	Learner will learn structural behaviour, method of analysis of folded plates and its design considerations.	2	3	2	2	0	0	0	0	0	0	0	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: STRUCTURAL ENGINEERING LABORATORY
COURSE CODE: CE509/CEE509

COURSE OBJECTIVES:
- To understand and perform the pre-requisite tests on materials before mix proportioning.
- To perform Mix Proportioning as per IS 10262 using the properties obtained from pre-requisite tests and clients requirements.
- To check the properties of fresh and hardened concrete to validate mix proportioning.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Capability to perform tests on concrete materials as per Indian Standard to retrieve data for mix proportioning.
CO2	Capability to perform Mix proportioning as per IS10262 to meet concrete performance.
CO3	Quality assessment of mix proportioning by performing the required tests on fresh and hardened concrete as per Indian Standard.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Capability to perform tests on concrete materials as per Indian Standard to retrieve data for mix proportioning.	0	0	0	3	3	2	0	0	3	3	0	3
CO2	Capability to perform Mix proportioning as per IS10262 to meet concrete performance.	0	0	0	3	3	2	0	0	3	3	0	3
CO3	Quality assessment of mix proportioning by performing the required tests on fresh and hardened concrete as per Indian Standard.	0	0	0	3	3	2	0	0	3	3	0	3
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: STRUCTURAL DYNAMICS
COURSE CODE: CE510/CEE510

COURSE OBJECTIVES:
- To developed the concept of structural dynamics.
- To analysis and design structures subjected to dynamics loading.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Lerner will be able to identify, formulate and solve free response of single degree freedom system.
CO2	Lerner will be able to identify, formulate and solve forced response of single degree freedom system.
CO3	Lerner will be able to determine natural frequencies & modes shapes of multi degree of freedom system by approximate methods
CO4	Lerner will be able to determine response of lumped multi degree of freedom system using normal mode theory & numerical integration scheme
CO5	Learner will be made aware of continues system and analysis of tall structures under dynamics loading.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Lerner will be able to identify, formulate and solve free response of single degree freedom system.	3	2	2	1	1	2	0	0	1	1	0	1
CO2	Lerner will be able to identify, formulate and solve forced response of single degree freedom system.	3	3	2	1	1	1	0	0	1	1	0	1
CO3	Lerner will be able to determine natural frequencies & modes shapes of multi degree of freedom system by approximate methods.	3	2	2	1	1	2	0	1	1	1	0	1
CO4	Lerner will be able to determine response of lumped multi degree of freedom system using normal mode theory & numerical integration scheme	3	3	2	2	1	1	0	0	1	0	0	1
CO5	Learner will be made aware of continues system and analysis tall structures under dynamics loading.	3	2	2	1	1	2	0	1	1	1	0	1
	3: Strong contribution, 2: average contribution, 1: Low contribution												

COURSE: NUMERICAL ANALYSIS & FINITE ELEMENT METHODS
COURSE CODE: CE511/CEE511

COURSE OBJECTIVES:
- To understand the method of applying numerical technique for solving linear and nonlinear equations, interpolation and Eigen values.
- To develop the skill to utilize the numerical technique for solving differential equations, single and multiple integrals.
- To understand the method of applying finite difference method and weighted residual problems (Galerkin's Method).
- To emphasize the Finite Element Method advantage and its broad aspect and to develop ability to solve 1D, 2D problems using FEM.

COURSE OUTCOMES (CO):
After the successful course completion, a learner will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Capability to solve the complex linear and nonlinear equations using various numerical techniques.
CO2	Capability to solve the differential equations, single and multiple integrals using numerical technique.
CO3	Skill to use interpolation and boundary value techniques on problems.
CO4	Competent to analyze 1D elements using Finite Element Methods.
CO5	Competent to analyze beam elements and ability to derive shape function of any 1D and 2D elements.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Capability to solve the complex linear and nonlinear equations using various numerical techniques.	3	3	0	3	0	0	0	0	0	0	0	0
CO2	Capability to solve the differential equations, single and multiple integrals using numerical technique.	3	3	0	3	0	0	0	0	0	0	0	0
CO3	Skill to use interpolation and boundary value techniques on problems.	3	3	0	3	0	0	0	0	0	0	0	0
CO4	Competent to analyze 1D elements using Finite Element Methods.	3	3	0	3	0	0	0	0	0	0	0	3
CO5	Competent to analyze beam elements and ability to derive shape function of any 1D and 2D elements.	3	3	0	3	0	0	0	0	0	0	0	3
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: ADVANCED STEEL STRUCTURE
COURSE CODE: CE512/CEE512

COURSE OBJECTIVES:
1. To impart behavior and design procedures of tension members, compression members and connections.
2. To impart behavior and design procedures of flexural member.
3. To impart requirements and concepts involves in analysis and design of steel chimneys & towers.
4. To study the behavior and design requirements of Industrial building.
5. To impart the concept and application of plastic analysis in steel structures.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Learner should be able to understand the types and design requirement of tension and compression steel members, then they should be able to design them with connections for given conditions by following the guidelines of Indian codes.
CO2	Learner should be able to understand the behavior of steel flexure member, then able to analysis and design them with connections for given conditions by following the guidelines of Indian codes.
CO3	Learner should know the structural behavior of tower and chimney, then should be able to design self supported steel chimney and tower as Indian code provisions.
CO4	Learner should be able to understand the requirement and behavior of Industrial building and also able to design elements of industrial building for given conditions by following guide line of Indian codes.
CO5	Learner should be able to apply concept of plastic analysis to analysed steel structures for given conditions.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Learner should be able to understand the types and design requirement of tension and compression steel members, then they should be able to design them with connections for given conditions by following the guidelines of Indian codes.	2	2	2	0	0	1	0	2	0	1	0	1
CO2	Learner should be able to understand the behavior of steel flexure member, then able to analysis and design them with connections for given conditions by following the guidelines of Indian codes.	2	2	2	0	0	1	0	2	0	1	0	1
CO3	Learner should know the structural behavior of tower and chimney, then should be able to design self supported steel chimney and tower as Indian code provisions.	2	2	2	0	0	1	0	2	0	1	0	1
CO4	Learner should be able to understand the requirement and behavior of Industrial building and also able to design elements of industrial building for given conditions by following guide line of Indian codes.	2	2	2	0	0	1	0	2	0	1	0	1
CO5	Learner should be able to apply concept of plastic analysis to analysed steel structures for given conditions.	2	2	2	0	0	1	0	2	0	1	0	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: RESEARCH METHODOLOGY
COURSE CODE: CE552/CEE552

COURSE OBJECTIVES:
- Think critically and understand the concept of gap identification for research
- Identify appropriate research methods for a specific research problem
- Write a professional research report.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Develop the student's understanding of research methods and applying those methodology to solve complex research problems.
CO2	Develop student's understanding of sampling techniques for research.
CO3	Develop student's understanding of different data collection methods and their suitability.
CO4	Students will gain understanding of analysing the quantitative data.
CO5	Students will gain understanding of analysing the qualitative data and will learn how to write a professional research report.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Develop the student's understanding of research methods and applying those methodology to solve complex research problems.	2	2	3	1	3	3	3	3	1	2	3	3
CO2	Develop student's understanding of sampling techniques for research.	3	3	2	3	2	2	2	3	1	3	2	3
CO3	Develop student's understanding of different data collection methods and their suitability.	3	3	2	3	2	2	2	3	1	3	2	3
CO4	Students will gain understanding of analysing the quantitative data.	3	3	2	3	3	2	3	3	1	3	2	3
CO5	Students will gain understanding of analysing the qualitative data and will learn how to write a professional research report.	2	2	3	1	3	3	3	3	1	2	3	3
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: SEMINAR
COURSE CODE: CE514/CEE514

COURSE OBJECTIVES:
- To understand organization of topic for presentation and research.
- To learn the skill set required to perform research.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Skill to search on any topic to extract the information.
CO2	Ability to organize – deliver presentation and report on any topic.

CO-PO MAPPING:

	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Skill to search on any topic to extract the information.	0	0	0	3	3	1	2	1	3	3	0	3
CO2	Ability to organize – deliver presentation and report on any topic.	0	0	0	0	3	1	2	1	3	3	0	3
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: DESIGN OF BRIDGES
COURSE CODE: CE601/CEE601

COURSE OBJECTIVES:
- To gain knowledge of basic of hydraulics as well as structural design consideration of short span bridge.
- To design of RCC and steel bridges.
- Impart knowledge of relevant bridge foundation and its design.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Lerner is made aware about selection criteria of type of bridge and various geometric & hydraulics design considerations as well as IRC loadings.
CO2	Lerner will be able to design reinforced and prestressed concrete bridges.
CO3	Lerner will be able to design steel bridges.
CO4	Learner will be made aware with seismic consideration in bridge design use of bearing in bridge design.
CO5	Learner will be able to design bridge foundation.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Lerner is made aware about selection criteria of type of bridge and various geometric & hydraulics design considerations as well as IRC loadings.	3	1	2	1	0	1	0	0	0	0	1	1
CO2	Lerner will be able to design reinforced and prestressed concrete bridges.	2	1	3	1	1	1	1	0	0	1	1	1
CO3	Lerner will be able to design steel bridges.	2	1	3	1	1	1	1	0	0	1	1	1
CO4	Learner will be made aware with seismic consideration in bridge design use of bearing in bridge design.	3	1	2	1	1	1	1	1	0	0	0	1
CO5	Learner will be able to design bridge foundation.	2	1	3	0	1	1	1	0	0	0	0	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: STABILITY OF STRUCTURE
COURSE CODE: CE602/CEE602

COURSE OBJECTIVES:
- To understand the buckling behaviour of columns, beams and frames.
- To understand the effect of shear and stability analysis of frame for various boundary conditions.
- To understand the torsion instability and buckling behaviour of thin walled bars of open cross section.
- To understand the buckling of plates and shells, various edge conditions to analyse them by equilibrium approach.
- To understand the post buckling behavior of columns, plates and shells under axial and biaxial loading.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	With given poblem learner will be able to understand the buckling brhaviour of structural members.
CO2	learner will understand the effect of shear and stability analysis of frame for various boundary conditions.
CO3	learner will understand the buckling behaviour of thin walled bars of open cross section with given problems.
CO4	With given poblem learner will be able to analyse the plates and shells by equilibrium approach.
CO5	one will be able to understand the post buckling behavior of columns, pltes and shells under axial and biaxial loading.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	With given poblem learner will be able to understand the buckling brhaviour of structural members.	3	2	1	2	0	1	0	0	0	0	0	2
CO2	learner will understand the effect of shear and stability analysis of frame for various boundary conditions.	3	2	1	2	0	1	0	0	0	0	0	2
CO3	learner will understand the buckling behaviour of thin walled bars of open cross section with given problems.	2	2	0	2	0	0	0	0	0	0	0	2
CO4	With given poblem learner will be able to analyse the plates and shells by equilibrium approach.	2	3	0	1	0	0	0	0	0	0	0	2
CO5	one will be able to understand the post buckling behavior of columns, pltes and shells under axial and biaxial loading.	2	3	1	2	0	0	0	0	0	0	0	2
	3: Strong contribution, 2: average contribution, 1: Low contribution												

COURSE: MAINTAINANCE AND REHABILIATION OF STRUCTURES
COURSE CODE: CE603/CEE603

COURSE OBJECTIVES:
- To understand the effect of climate on concrete properties.
- To be aware of construction error, corrosion mechanism and the effect of corrosion on RCC with remedies.
- To develop the skill to inspect quality and maintenance of various concrete.
- To understand the methods and technique to repair the concrete.

COURSE OUTCOMES (CO):
After the successful course completion, a learner will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Capability to understand the effect of weathering and climate on concrete.
CO2	Capability to eliminate construction error and solutions to corrosion problems in steel bars.
CO3	Skill to perform quality control on concrete.
CO4	Awareness of the various materials and techniques used for repairing concrete structures
CO5	Efficient in repairing and retrofitting concrete structures using various techniques.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Capability to understand the effect of weathering and climate on concrete.	3	3	3	3	0	0	0	0	0	0	0	2
CO2	Capability to eliminate construction error and solutions to corrosion problems in steel bars.	3	3	3	3	0	0	0	0	0	0	0	2
CO3	Skill to perform quality control on concrete.	3	3	3	3	0	0	0	0	0	0	0	2
CO4	Awareness of the various materials and techniques used for repairing concrete structures	3	3	3	3	0	0	0	0	0	0	0	2
CO5	Efficient in repairing and retrofitting concrete structures using various techniques.	3	3	3	3	0	0	0	0	0	0	0	2
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: INDUSTRIAL STRUCTURES
COURSE CODE: CE607/CEE607

COURSE OBJECTIVES:
- To impart requirement and design concepts of industrial building.
- To impart design theories of bunkers and silos.
- To introduce learner with classification and design concepts of tower and steel chimneys.
- To impart design concepts large span truss and machine foundation.
- To impart classification, requirement and design concepts of concrete pipes.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Learner should be able to understand the types and behavior of Industrial building and also able to design elements of industrial building for given conditions by following guide line of Indian codes.
CO2	Learner should be able to understand the types and behavior of bunkers and silos and also able to design them as Indian codes provision for given conditions.
CO3	Learner should know the structural behavior of tower and chimney, then should be able to design self supported steel chimney and tower as Indian codes provisions.
CO4	Learner should be able to design large span truss by knowing its requirements and geographical conditions and also able to design machine foundation for given conditions by following guide line of Indian codes.
CO5	By knowing the requirements of pipes learner should able to design aforesaid structures for given conditions by following guide line of Indian codes.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Learner should be able to understand the types and behavior of Industrial building and also able to design elements of industrial building for given conditions by following guide line of Indian codes.	2	2	2	0	0	1	0	2	0	1	0	1
CO2	Learner should be able to understand the types and behavior of bunkers and silos and also able to design them as Indian codes provision for given conditions.	2	2	2	0	0	1	0	2	0	1	0	1
CO3	Learner should know the structural behavior of tower and chimney, then should be able to design self supported steel chimney and tower as Indian codes provisions.	2	2	2	0	0	1	0	2	0	1	0	1
CO4	Learner should be able to design large span truss by knowing its requirements and geographical conditions and also able to design machine foundation for given conditions by following guide line of Indian codes.	2	2	2	0	0	1	0	2	0	1	0	1
CO5	By knowing the requirements of pipes learner should able to design aforesaid structures for given conditions by following guide line of Indian codes.	2	2	2	0	0	1	0	2	0	0	0	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: PREFABRICATED STRUCTURES
COURSE CODE: CE608/CEE608

COURSE OBJECTIVES:
- To get knowledge about various prefabrication systems and structural schemes.
- To know about design consideration, Economy of prefabrication and prefabrication of load bearing members.
- To design the Pre-stressed concrete sections.
- To design for shear, torsion, bend and bearing and application of prestressing of roof members.
- To learn about production, Transportation and erection of Form-work and dimension tolerances of shuttering and mould design

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	One will get knowledge about various prefabrication systems and structural schemes.
CO2	Learner will learn about design consideration, Economy of prefabrication and prefabrication of load bearing members.
CO3	learner will be able to design the Pre-stressed concrete section.
CO4	Learner will learn about application of prestressing of roof members and able to design for shear, torsion, bend and bearing.
CO5	Learner will learn about production, Transportation and erection of Formwork and dimension tolerances of shuttering and mould design.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	One will get knowledge about various prefabrication systems and structural schemes.	3	2	1	1	1	0	0	0	0	0	0	2
CO2	Learner will learn about dewsign consideration, Economy of prefabrication and prefabrication of load bearing members.	3	2	2	1	1	0	0	0	0	0	0	2
CO3	Learner will be able to design the Pre-stressed concrete section.	2	2	3	1	1	0	0	0	0	0	0	2
CO4	Learner will learn about application of prestressing of roof members and able to design for shear, torsion, bend and bearing.	3	2	3	2	1	0	0	0	0	0	0	2
CO5	Learner will learn about production, Transportation and erection of Formwork and dimension tolerences of shuttering and mould design.	3	3	2	1	2	0	0	0	0	0	0	2
	3: Strong contribution, 2: average contribution, 1: Low contribution												

COURSE: COMPUTER AIDED DESIGN IN STRUCTURAL ENGINEERING
COURSE CODE: CE612/CEE612

COURSE OBJECTIVES:
- To develop the python basic programming skill in order to carry our engineering problems.
- To develop the MATLAB basic programming skill in order to carry our engineering problems.
- To develop the skill in order to work on EXCEL efficiently in order to carry our engineering problems.
- To utilize the programming and excel in order to perform analysis and design in structural engineering.

COURSE OUTCOMES (CO):
After the successful course completion, a learner will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Capability to execute the programming in python language.
CO2	Skill to work on EXCEL and capability to perform statistical analysis on a data efficiently.
CO3	Efficient in structural analysis problems usingpython language.
CO4	Efficient in mix proportioning and structural designing using python language.
CO5	Capability to perform automation using machine learning techniques in structural engineering.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Capability to execute the programming in python language.	2	3	3	1	3	0	0	0	0	0	0	3
CO2	Skill to work on EXCEL and capability to perform statistical analysis on a data efficiently.	2	3	3	0	3	0	0	0	0	0	0	3
CO3	Efficient in structural analysis problems using python language.	2	3	3	3	3	0	0	0	0	0	0	3
CO4	Efficient in mix proportioning and structural designing using python language.	2	3	3	3	3	0	0	0	0	0	0	3
CO5	Capability to perform automation using machine learning techniques in structural engineering.	2	3	3	3	3	0	0	0	0	0	0	3
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: DESIGN OF TALL BUILDINGS
COURSE CODE: CE606/CEE606

COURSE OBJECTIVES:
- To understand the basic concept of tall building.
- Able to analysis and design tall structures under wind and seismic loads.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Learner will develop understanding of tall structures and analysis it for stability.
CO2	Learner will be able to determine the response of tall building under wind loading.
CO3	Learner will be able to determine the response of tall building under earthquake loading.
CO4	Learner will be able to understand the shear wall in tall buildings and its design
CO5	Learner will be made aware of codal provision for dynamic load and design tall structures.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Learner will develop understanding of tall structures and analysis it for stability.	3	2	2	1	2	1	1	1	1	1	0	1
CO2	Learner will be able to determine the response of tall building under wind loading.	3	2	3	1	2	1	1	2	1	1	0	1
CO3	Learner will be able to determine the response of tall building under earthquake loading.	3	2	3	2	3	1	2	1	1	1	0	1
CO4	Learner will be able to understand the shear wall in tall buildings and its design	3	2	2	1	2	1	1	2	1	1	0	1
CO5	Learner will be made aware of codal provision for dynamic load and design tall structures.	3	2	3	1	2	1	1	2	1	1	0	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: ASEISMIC DESIGN OF STRUCTURES
COURSE CODE: CE611/CEE611

COURSE OBJECTIVES:
- To learn basic concept of earthquake
- To develop understanding of structural idealization for dynamic analysis
- To design earthquake resistant structures using codal provisions

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Learner will be made aware about the basic concepts of earthquake.
CO2	Learner will develop understanding of structural dynamics and able to determine free vibration response of structural system
CO3	Learner will gain knowledge of earthquake resistant design and ductility requirements in design
CO4	Learner will be able to design shear wall and gain knowledge of modern techniques in aseismic design
CO5	Learner will gain knowledge of various codal provisions in aseismic design of structures

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Learner will be made aware about the basic concepts of earthquake.	2	1	1	1	1	0	0	0	0	0	0	1
CO2	Learner will develop understanding of structural dynamics and able to determine free vibration response of structural system.	2	2	2	1	1	0	0	0	0	0	0	1
CO3	Learner will gain knowledge of earthquake resistant design and ductility requirements in design.	2	1	2	1	1	3	1	1	0	1	0	1
CO4	Learner will be able to design shear wall and gain knowledge of modern techniques in aseismic design	2	1	3	1	2	2	1	1	0	1	0	1
CO5	Learner will gain knowledge of various codal provisions in aseismic design of structures	1	1	2	1	0	2	0	2	0	1	0	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: PRESTRESSED CONCRETE
COURSE CODE: CE613/CEE613

COURSE OBJECTIVES:
- To impart concepts of pre-stressing in concrete and their losses.
- To Impart importance's of control deflection.
- To impart behavior and design concept of pre-stressed concrete flexure members.
- To impart concept of shear, bond and bearing stress in prestress concrete member.
- To impart concept and behavior of full and partial prestressed members

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Learner should know the concepts of pre-stressing in concrete structures as well an able to formulate losses in prestressed concrete.
CO2	Learner should know the factors influencing deflection in prestress structures and able to calculate deflection of prestressed concrete member by using code provision for given conditions.
CO3	Learner will be able to understand behavior of prestressed flexure members and able to design flexure member by using code provision for given conditions.
CO4	Learner will be able to understand concepts of transmission length, bond, bearing and shear stress in prestressed members as well as able to design of prestress member for bond, bearing and shear forgiven requirement.
CO5	Learner will be able to understand the behavior and design concept of full and partial prestressed members and able to design member for given requirements by following the guideline of Indian codes.

CO-PO MAPPING:

CO	DESCRIPTION	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Learner should know the concepts of pre-stressing in concrete structures as well an able to formulate losses in prestressed concrete.	2	2	0	0	0	1	0	0	0	0	0	0
CO2	Learner should know the factors influencing deflection in prestress structures and able to calculate deflection of prestressed concrete member by using code provision for given conditions.	2	2	0	0	0	1	0	2	0	0	0	1
CO3	Learner will be able to understand behavior of prestressed flexure members and able to design flexure member by using code provision for given conditions.	2	2	2	0	0	1	0	2	0	1	0	1
CO4	Learner will be able to understand concepts of transmission length, bond, bearing and shear stress in prestressed members as well as able to design of prestress member for bond, bearing and shear forgiven requirement.	2	2	2	0	0	1	0	2	0	1	0	1
CO5	Learner will be able to understand the behavior and design concept of full and partial prestressed members and able to design member for given requirements by following the guideline of Indian codes.	2	2	2	0	0	1	0	2	0	1	0	1
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: DIRECTED STUDY
COURSE CODE: CE616/CEE616

COURSE OBJECTIVES:
- To make learner aware about the latest technology and engineering practices in industries.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Awareness regarding the latest technology, engineering methodology and practices being used in industries.

CO-PO MAPPING:

	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Awareness regarding the latest technology, engineering methodology and practices being used in industries.	3	0	0	2	3	3	0	0	3	3		3
3: Strong contribution, 2: average contribution, 1: Low contribution													

COURSE: M TECH DISSERTATION
COURSE CODE: CE699/CEE699

COURSE OBJECTIVES:
- To develop individuality and problem analysis skill.
- To nurture ability to perform literature review.
- To improve critical thinking ability for formulation of plan.
- To develop skill to use various engineering and technological tools.
- To develop skill to think critically on research results.
- To enhance the writing skill for research paper and dissertation.

COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Capability to work independently on a research-based problem.
CO2	Skill to perform review of available literature effectively to present research gap.
CO3	Aptitude to plan methodology for the attainment of various research objectives.
CO4	Competency to apply of various engineering and technological tools to carry research.
CO5	Ability to conclude work using critical thinking.
CO6	Proficiency in preparing presentation and report.

CO-PO MAPPING:

	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	Capability to work independently on a research-based problem.	0	0	0	3	3	0	0	3	3	3	0	3
CO2	Skill to perform review of available literature effectively to present research gap.	0	0	0	3	3	0	0	3	3	3	0	3
CO3	Aptitude to plan methodology for the attainment of various research objectives.	0	0	0	0	3	0	0	0	3	3	0	3
CO4	Competency to apply of various engineering and technological tools to carry research.	0	0	0	3	3	0	0	0	3	0	0	3
CO5	Ability to conclude work using critical thinking.	0	0	0	3	3	0	0	3	3	3	0	3
CO6	Proficiency in preparing presentation and report.	0	0	0	0	3	0	0	3	3	3	0	3
3: Strong contribution, 2: average contribution, 1: Low contribution													