(DEEMED TO BE UNIVERSITY)

CIVIL ENGINEERING

M.Tech Structural Engineering

2020 & 2021 Admitted Students

CURRICULUM & SYLLABUS

Vision of University

To be a globally renowned university.

Mission of University

To impart quality higher education and to undertake research and extension with emphasis on application and innovation that cater to the emerging societal needs through all-round development of students of all sections enabling them to be globally competitive and socially responsible citizens with intrinsic values.

Vision of Department

To impart knowledge and excellence in Civil Engineering with global perspectives to the student community and to make them ethically strong engineers to build our nation.

Mission of Department

M1: To provide holistic development of student

M2: To meet the ever-changing needs of civil engineering industry

M3: To be involved in forward looking research

M4: To be involved in consultancy useful to society

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

- **PEO1:** Demonstrate knowledge in broad areas of Structural Engineering
- **PEO2:** Demonstrate a depth of knowledge in a chosen/focus area of Structural Engineering
- **PEO3:** Demonstrate knowledge of contemporary issues in their chosen/ focused area
- **PEO4:** Demonstrate the ability to complete a technical project independently

PROGRAMME OUTCOMES (POs):

On completing the B. Tech. – Civil Engineering Programme successfully the students will exhibit the following capabilities:

- **PO1:** Knowledge of a broad range of structural methodologies and underlying civil engineering, commonly used in the development and analysis of Structural Engineering systems.
- **PO2:** Knowledge of fundamental design issues relevant to Structural Engineering and an understanding of how to formulate and analyse design solutions in various engineering contexts.
- **PO3:** In-depth knowledge of one or more of the following (depending of selection of option modules and project area): specific engineering systems, design methods, modeling techniques.
- **PO4:** Knowledge of basic research and development principles and practices relevant to main stream engineering industry.
- **PO5:** Knowledge of key professional, safety and ethical issues arising in modern engineering industry.
- **PO6:** Knowledge of time management and work planning issues related to the organization implementation and successful completion, including reporting, of an individual, masters level, Engineering based projects.

MAPPING OF PEO's WITH MISSION STATEMENTS

S.No	Description of PEOs	Key Components of Mission			
		M 1	M 2	M 3	M 4
		To provide holistic development of student	To meet the ever changing needs of civil engineering industry	To be involved in forward looking research	To be involved in consultancy useful to society
PEO 1	Demonstrate knowledge in broad areas of Structural Engineering	√	√	√	√
PEO 2	Demonstrate a depth of knowledge in a chosen/focus area of Structural Engineering	√	√	√	√
PEO 3	Demonstrate knowledge of contemporary issues in their chosen/ focused area	√	√	√	√
PEO 4	Demonstrate the ability to complete a technical project independently	√	√	√	√

MAPPING OF POs/PSOs with PEOs:

S. No.	Key Components of POs andPSOs	PEO			
		PEO 1	PEO 2	PEO 3	PEO 4
PO1	Knowledge of a broad range of Construction Technology methodologies and underlying civil engineering, commonly used in the development and analysis of Construction Technology and Management systems	√		√	
PO2	Knowledge of fundamental design issues relevant to Construction Engineering and an understanding of how to formulate and analyse design solutions in various engineering contexts	√			
PO3	In-depth knowledge of one or more of the following (depending of selection of option modules and project area): specific engineering systems, design methods, modeling techniques	√	√		
PO4	Knowledge of basic research and development principles and practices relevant to main stream engineering industry	√			
PO5	Knowledge of key professional, safety and ethical issues arising in modern engineering industry	√	√		
PO6	Knowledge of time management and work planning issues related to the organization implementation and successful completion, including reporting, of an individual, masters level, Engineering based projects	√		√	√

ACADEMIC REGULATIONS

This document supplements the KLEF rules and regulations to aid all students. It is required that every individual must abide by these regulations.

Note: The regulations stated in this document are subject to change or can be relaxed / modified without prior notice at the discretion of the Hon'ble Vice Chancellor.

Terminology

Academic Council: The Academic Council is the highest academic body of the University and is responsible for the maintenance of standards of instruction, education and examination within the University. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises of two consecutive semesters i.e., Even and Odd semester.

Y20 Audited Course: It is a course of study which has zero credits and has a "Satisfactory" or an "Unsatisfactory" grade.

Backlog Course: A course is considered to be a backlog course if the student has obtained a failure grade (F).

Basic Sciences: The courses of foundational nature in the areas of Mathematics, Physics, Chemistry, Biology etc., are offered in this category.

Betterment: Betterment is a way that contributes towards improving the students' grade in any course(s). It can be done by either (a) re-appearing or (b) re-registering for the course.

Board of Studies: Board of Studies (BOS) is an authority as defined in UGC regulations, constituted by Vice Chancellor for each of the department separately. They are responsible for curriculum design and update in respect of all the programs offered by a department.

Branch of Study: It is a branch of knowledge, an area of study or a specific program (like Civil Engineering, Mechanical Engineering, Electrical and Electronics Engineering etc.)

Certificate course: It is a course that makes a student gain hands-on expertise and skills required for holistic development. It is a mandatory, non-credited course for the award of degree.

Change of Branch: Change of branch means transfer from one's branch of study to other.

Compulsory course: Course required to be undertaken for the award of the degree as per the program.

Course: A course is a subject offered by the University for learning in a particular semester.

Course Handout: Course Handout is a document, which gives complete plan of the course. It contains the details of the course viz. Course title, Course code, Pre-requisite, Credit structure, team of instructors, Course objectives, Course rationale, Course Outcomes and the relevant syllabus, textbook(s) and reference books, Course delivery plan and session plan, evaluation method, chamber consultation hour, course notices and other course related aspects. In essence, course handout is an agreement between students (learners) and the instructor.

Course Outcomes: The essential skills that need to be acquired by every student through a course.

Credit: A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture hour per week or two hours per week of tutorials/ self- learning/ practical/ field work during a semester.

Credit point: It is the product of grade point and number of credits for a course.

Credit Transfer: The procedure of granting credit(s) to a student for course(s) undertaken at another institution.

Cumulative Grade Point Average (CGPA): It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

Curriculum: Curriculum incorporates the planned interaction of students with instructional content, materials, resources, and processes for evaluating the attainment of Program Educational Objectives.

Degree: A student who fulfills all the Program requirements is eligible to receive a degree.

Degree with Specialization: A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of Professional elective courses in a specialized area is eligible to receive a degree with specialization.

Department: An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff and other resources.

Y20 Detention in a course: Student who does not obtain minimum prescribed marks in continuous in-semester evaluation and /or minimum prescribed attendance in a course shall be detained in that particular course.

Dropping from the Semester: A student who doesn't want to register for the semester should do so in writing in a prescribed format before commencement of the semester.

Elective Course: A course that can be chosen from a set of courses. An elective can be Professional Elective, Open Elective, Management Elective and Humanities Elective.

Engineering Sciences: The courses belonging to basic evolutionary aspects of engineering from Mechanical Sciences, Electrical Sciences and Computing like Engineering Mechanics, Data structures, Network Theory, Signal Analysis etc...

Evaluation: Evaluation is the process of judging the academic work done by the student in her/his courses. It is done through a combination of continuous in-semester assessment and semester end examinations.

Grade: It is an index of the performance of the students in a said course. Grades are denoted by alphabets.

Grade Point: It is a numerical weight allotted to each letter grade on a 10 - point scale.

Honors Degree: A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of additional courses within the same program is eligible to receive an Honors degree.

Humanities Elective: A course offered in the area of Liberal Arts.

Industrial Training: Training program undergone by the student as per the academic requirement in any company/firm. It is a credited course.

Industrial Visit: Visit to accompany/firm as per the academic requirement.

Y20: Summative assessments used to evaluate student learning, acquired skills, and academic attainment during a course.

Y20 Make-up Test: An additional test scheduled on a date other than the originally scheduled date. (Describe elaborately)

Y20: An additional test scheduled on a date other than the originally scheduled date.

Management elective: A course that develops managerial skills and inculcates entrepreneurial skills.

Mini project: Mini Project is a credit-based course that a student has to undergo during his/her academic term, which involves the student to explore in a discipline belonging to their research interest within their program area.

Minor Degree: A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of courses from another discipline is eligible to receive a minor degree in that discipline.

Multi- Section Course: Course taught for more than one section.

Open Elective: This is a course of interdisciplinary nature. It is offered across the University for all programs.

Over loading: Registering for more number of credits than normally prescribed by the Program in a semester.

Practice School: It is a part of the total program and takes one full semester in a professional location, where the students and the faculty get involved in finding solutions to real-world problems. A student can choose Project/Practice School during his/her 7th or 8th semester of his/her Academic Year to meet the final requirements for a degree.

Pre-requisite: A course, the knowledge of which is required for registration into higher level course.

Professional Core: The courses that are essential constituents of each engineering discipline are categorized as Professional Core courses for that discipline.

Professional Elective: A course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: A set of courses offered by the Department. A student can opt and complete the stipulated minimum credits to qualify for the award of a degree in that Program.

Program Educational Objectives: The broad career, professional, personal goals that every student will achieve through a strategic and sequential action plan.

Project: Course that a student has to undergo during his/her final year which involves the student to undertake a research or design, which is carefully planned to achieve a particular aim. It is a credit based course.

Project based laboratory: Project Based Laboratory is a student-centric learning methodology that involve students in design, problem-solving, decision making, and investigative activities;

gives students the opportunity to work in teams, over extended periods of time; and culminate in realistic products or presentations

Re-Appearing: A student can reappear only in the semester end examination for the Theory component of a course, subject to the regulations contained herein.

Registration: Process of enrolling into a set of courses in a semester/ term of the Program.

Re-Registering: A student desiring to repeat a course is permitted to do so, subject to the regulations contained herein.

Semester: It is a period of study consisting of 15 to 18 weeks of academic work equivalent to normally 90 working days including examination and preparation holidays. The odd Semester starts normally in July and even semester in December.

Semester End Examinations: It is an examination conducted at the end of a course of study.

Single Section Course: Course taught for a single section.

Social Service: An activity designed to promote social awareness and generate well-being; to improve the life and living conditions of the society.

Student Outcomes: The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioural.

Substitution of Elective course: Replacing an elective course with another elective course as opted by the student.

Summer term: The term during which courses are offered from May to July. Summer term is not a student right and will be offered at the discretion of the University.

Term Paper: A 'term paper' is a research report written by students that evolves their course-based knowledge, accounting for a grade. Term paper is a written original research work discussing a topic in detail. It is a credit-based course.

Under-loading: Registering for lesser number of credits than normally prescribed by the Program in a semester.

Withdraw from a Course: Withdrawing from a Course means that a student can drop from a course within the first two weeks of the odd or even Semester (deadlines are different for summer sessions). However s/he can choose a substitute course in place of it by exercising the option within 5 working days from the date of withdrawal.

CURRICULUM STRUCTURE

SEMESTER-1								
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**S**	**Cr**	**CH**
1	20CE5101	Advanced Mechanics of Solids	3	1	0	0	4	4
2	20CE5102	Advanced Prestressed Concrete Design	3	1	0	0	4	4
3	20CE5103	Advanced Concrete Technology	3	0	2	0	4	5
4	20CE5104	Structural Dynamics	3	0	2	0	4	5
5	20CE51A1	Pre Engineered Structures (PE 1)	3	0	0	0	3	3
	20CE51A2	Design of Offshore Structures (PE 1)						
6	20CE51B1	Design and Detailing of Structures (PE 2)	3	0	0	0	3	0
	20CE51B2	Repair and Rehabilitation of Structures (PE 2)						
7	20IE5149	Seminar	0	0	4	0	2	4
		Total	**18**	**2**	**8**	**0**	**24**	**25**
SEMESTER-2								
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**S**	**Cr**	**CH**
1	20CE5205	Theory of Plates and Shells	3	1	0	0	4	4
2	20CE5206	Finite Element Analysis	3	0	2	0	4	5
3	20CE5207	Bridge Engineering	3	1	0	0	4	4
4	20CE5208	Earthquake resistant design of structures	3	0	2	0	4	5
5	20CE52C1	Fracture Mechanics (PE 3)	3	0	0	0	3	3
	20CE52C2	Design of Tall Structures (PE 3)						
6	20CE52D1	Green Buildings (PE 4)	3	0	0	0	3	3
	20CE52D2	Stability of structures (PE 4)						
7	20IE5250	Term Paper	0	0	4	0	2	4
		Total	**18**	**2**	**8**	**0**	**24**	**28**
SEMESTER-3								
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**S**	**Cr**	**CH**
1	20IE6050	Project	0	0	36	0	18	36
SEMESTER-4								
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**S**	**Cr**	**CH**
1	20IE6050	Project	0	0	36	0	18	36
		GRAND TOTAL	**36**	**4**	**88**	**0**	**84**	**125**

Course Wise CO – PO Mapping

Course Code	Course Title	Description of the Course Outcome	1	2	3	4	5	6
20CE5101	Advanced Mechanics of Solids	Interpret the theory of elasticity including strain/displacement and Hooke's law relationships in two dimensional planes	3		2	2	2	2
		Able to analyse the two-dimensional problems in polar coordinates	3	2		2	2	2
		Able to analyse the Three-dimensional problems in polar coordinates	3	2		2	2	2
		Able to analyse the Plasticity deformations of stress and strain.	3	2		2	2	2
20CE5102	Advanced Prestressed Concrete Design	Understand the concepts of prestressed concrete and analyze the prestressed concrete beams.	2		1	2	2	
		Analyze losses in prestressed concrete and deflection of the prestressed concrete members	2	3		2	2	
		Design reinforcement for Ultimate shear, torsion and bending of prestressed concrete members.	3		3	2		1
		Design end blocks as per IS 1343 recommendations.	3		3	2		
		Design of prestressed members, composite sections, continuous prestressed beams	3		3	2		
20CE5103	Advanced Concrete Technology	Understanding about Fly Ash, Ground Granulated Blast Furnace Slag, Silica Fume, Metakaolin, Red mud, Bentonite, Concrete Mix Design.	3	2	3	1	3	3

		Understanding about Nano Materials in Concrete, Water Proofing, Chemical Admixture in Concrete (Super Plasticizers, Retarders, & Accelerators), Fibers, Polymers	3	2	3	1	3	3
		Understanding about Mass Concreting, Roller Compacted Concreting, Pumped Concreting, Sprayed Concreting, Self-Compacted Concreting, Re-Cycled Aggregate Concreting	3	2	3	1	3	3
		Understanding about Corrosion of Reinforcing Steel, Chloride Ion Penetration, Carbonation, Service Life of RC Structures, Sulphate Attack, Alkali Silica Reaction, Acid Attack.	3	2	3	1	3	3
20CE5104	Structural Dynamics	Solve response of free and forced vibrations	2	2				
		Solve response to Arbitrary, Step and Pulse Excitations (SDOF)			2	2		
		Solve Earthquake Response of Linear Systems (SDOF)			2	2		
		Build Generalized Single Degree of Freedom Systems		2		2	1	
20CE5205	Theory of Plates and Shells	Derive the pure bending and curvature of plates	2	2		2		1
		Derive the differential equation for laterally loaded rectangular plates		3		2		2
		Derive the deformation of shells without bending	1					
		Understand the general theory of Cylindrical shells	2				2	
		Derive the pure bending and curvature of plates	2	2		2		1
20CE5206	Finite Element Analysis	Understand the Basic Finite Element Concepts	2	2		2		
		Analysis of Trusses, Beam Bending, Structural Frames and Column buckling using Finite Element Methods	2	2	1	2		

		Analysis of Higher order elements for one dimensional problems and Isometric quadrilateral elements and triangular elements	2	2		2		1
		Analyse the applications based on general two-dimensional boundary value problem	2	2		2		
		Demonstrate the ANSYS software to develop the models using Finite element method				2		2
20CE5207	Bridge Engineering	Introduction to different types of bridges and codal provisions for designing the bridge components.	1				1	
		Analysis and Design of slab Culvert.	2	3	1		2	
		Analysis and Design of T-Beam, sub-structure components and bearings	2				2	
		Understanding the designing of cable supported bridges.	2				2	
20CE5208	Earthquake Resistant Design of Structures	Understanding the designing of cable supported bridges.	1					
		Understand the system of base isolation in structures for resistance towards earthquakes and general detailing requirements of ductile structure.	1		2		1	
		Analyze a structure for earthquake forces onto the structure under static and dynamic behavior.		2	1			1
		Design the structure for earthquake forces on 2 –storey building		2				

20CE51A1	Pre-Engineered structures	Application of the prefabrication techniques and methodology	2					2
		Application of the knowledge of the construction methods Involved in these elements	2					2
		Analyse the prefabricated units	2					2
		Application of the concept of various joints for the connections	2		1			2
20CE51A2	Design of offshore structures	Analysis of Wave theories	2					2
		Analysis Forces of offshore structures	2					2
		Design of offshore structure & Analysis of offshore structures	2	3				2
		Design of offshore structures	2					2
20CE51B1	Design and detailing of RC Structures	Design of RC members	2	2	2	2	2	2
		Analysis, design and detailing of flat slab, grid slab	2	2	2	2	2	2
		Design and detailing of Elevated water tanks, cantilever and counterfort retaining walls	2	2	2	2	2	2
		Earthquake resistant design, Ductile detailing	2	2	2	2	2	2
20CE51B2	Repair and Rehabilitation of structures	Understand the Basic Parameters of Detoriation and Maintenance of Structures	1		1			
		Apply various tests on material for better improvement of retrofitting of structures	1	1			1	
		Understand the basic blended concrete materials	2	2	1			1
		Understand the retrofitting methodology and procedure	2	2				
20CE52C1	Fracture Mechanics	Understanding the basic concepts of Fracture and Linear Elastic Fracture Mechanics (LEFM)	1					1

		Understanding the concept of Crack Tip Plasticity	1		1			
		Understanding the concept Elastic Plastic Fracture Mechanics (EPFM)		2				
		Understanding the concept of Fatigue Crack Growth and practical problems of fracture mechanics		2	1			
20CE52C2	Design of Tall Structures	Understanding the design criteria of Tall structures	1		1			
		Understanding the Loadings On Tall Structures	2				2	
		Understanding the behaviour of Rigid-Frame Structures and Shear Wall Structures		2				
		Understanding the behaviour of Tubular Structures		2			1	
20CE52D1	Green Buildings	Understand Necessity and Role of Green Buildings & Regarding Indian Green Building Council; Grasp the construction practices of a Green Buildings.	1		2			
		Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Opportunities of Green Building, Green Building Features, Material and Resources, Green Building Design	1		2			
		Air Conditioning, Material Conservation	1		2			
		Indoor Environment Quality and Occupational Health	1		2			
20CE52D2	Stability of Structures	Introduction to buckling of columns	2		1		1	
		Analysis of lateral buckling of beams	2	3	1			
		Analysis of lateral buckling of plates and shells	2					1
		Understanding the Mathematical treatment of stability problems	2					
20 CE 5149	Seminar						2	2
20 IE 5250	Term Paper						2	2
20 IE 6050	Dissertation						2	2

Advanced Mechanics of Solids

Course Code :20CE5101 **L-T-P-S : 3-1-0-0**

Pre-requisite: NIL **Credits: 4**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Interpret the theory of elasticity including strain/displacement and Hooke's law relationships in two dimensional planes	**PO1, PO5**	**4**
CO 2	Able to analyse the two-dimensional problems in polar coordinates	**PO1, PO5**	**4**
CO 3	Able to analyse the Three-dimensional problems in polar coordinates	**PO1, PO5**	**4**
CO 4	Able to analyse the Plasticity deformations of stress and strain.	**PO1, PO5**	**4**

Two-dimensional problems in rectangular coordinates

Plane stress; Plane strain; Differential equations of equilibrium; Boundary conditions; Compatibility equations; Stress function; Governing differential equation; Solution by Polynomials; End effects – Saint-Venant's Principle; Determination of displacements; Bending of a cantilever loaded at the end; Bending of a beam by uniform load

Two-dimensional problems in polar coordinates

General equations in polar coordinates; Stress distribution symmetrical about an axis; Effect of circular holes on stress distribution in plates; Concentrated force at a point of a straight boundary; Concentrated force acting on a beam; Stresses in a circular disc, general solutions of the two-dimensional problem in polar coordinates, applications of the general solutions in polar coordinates.

Strain energy methods

Total strain energy; Principle of virtual work; Griffith's theory of rupture; Castigliano's theorem; Principle of least work (Stationary potential energy), applications of the principle of least work rectangular plates, shear lag

Analysis of stress and strain in three dimensions

Stress at a point – components of stress; Principal stresses; Stress ellipsoid and stress director surface; Determination of principal stresses; Stress invariants; Determination of maximum shear

stresses; Octahedral shear stress; strain at a point – Components of strain; differential equations of equilibrium, the principle of superposition

Torsion

Torsion of straight bars – Saint Venant's theory; Elliptic cross section; Membrane analogy; Torsion of a bar of narrow rectangular cross-section; Torsion of rolled profile sections; Torsion of thin tubes

Plasticity

Plastic Deformation: Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.

Text Books:

1. Advanced Mechanics of Solids, Srinath L.S., Tata McGraw Hill,2000.
2. Theory of Elasticity, Timoshenko S. and Goodier J. N., McGraw Hill, 1961.
3. Solid Mechanics, Kazimi S. M. A., Tata McGraw Hill,1994.
4. Theory of Elasticity, Sadhu Singh, Khanna Publishers, 2003.

Reference Books:

1. Elasticity, Sadd M.H., Elsevier, 2005.
2. Engineering Solid Mechanics, Ragab A.R., Bayoumi S.E., CRC Press,1999.
3. Computational Elasticity, Ameen M., Narosa, 2005.

Advanced Prestressed Concrete Design

Course Code : 20CE5102 **L-T-P-S : 3-1-0-0**

Pre-requisite: NIL **Credits: 4**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Understand the concepts of prestressed concrete and analyze the prestressed concrete beams.	**PO1, PO6**	**2**
CO 2	Analyze losses in prestressed concrete and deflection of the prestressed concrete members	**PO1, PO4, PO6**	**4**
CO 3	Design reinforcement for Ultimate shear, torsion and bending of prestressed concrete members.	**PO1, PO4, PO5, PO6**	**3**
CO 4	Design end blocks as per IS 1343 recommendations.	**PO1, PO2, PO3, PO4, PO6**	**3**

Introduction, Prestressing Systems and Material Properties

Basic concepts of pre-stressing; Historical development; Advantages and Types of Pre-stressing, Pre-tensioning Systems and Devices, Post-tensioning Systems and Devices, Need for High strength steel and High strength concrete

Losses of Prestress: Nature of losses of pre-stress; Loss due to elastic deformation of concrete, shrinkage of concrete, creep of concrete, relaxation of stress in steel, friction and anchorage slip; Total losses allowed for in design.

Analysis of Prestressed Member

Analysis of Members under Axial Load: Analysis at Transfer, Analysis at Service, Analysis for Ultimate Strength, Analysis of Member under Flexure:, Analysis at Transfer and at Service, Cracking Moment, Kern Point, Pressure Line, Analysis for Ultimate Strength, design loads and strength, Calculation of Crack Width, Variation of Stress in Steel, Analysis of a Rectangular Section, Analysis of a Flanged Section.

Deflections of Prestressed Concrete Members: Importance of control of deflections; Factors influencing deflections; Short term deflections of un-cracked members. Long term deflection of cracked member

Transmission of Pre-Stress: Transmission of Pre-stressing force by bond; Transmission length; Bond stresses; Transverse tensile stresses; End zone reinforcement; Flexural bond stresses in pre

tensioned and post-tensioned grouted beams, stress distribution in end block, Anchorage zone reinforcements.

Shear and Torsion Resistance of Prestressed Concrete Member: Shear and Principal stresses; Ultimate shear resistance of pre-stressed concrete members; Design of shear reinforcement, pre-stressed concrete members in torsion, Design of reinforcements for torsion, shear and bending.

Design of Pre-Stressed Members: Design of sections for flexure, Design of Sections for Axial Tension, Design of Sections for compression and bending, design of pre-stressed section for shear and torsion, design of pre-stressed member for bond. Dimensioning of flexural member, design for pre-tensioning member, design of post-tensioning members.

Composite Construction of Prestressed Concrete: Composite structural member, types of composite construction, analysis of stresses, differential shrinkages, deflection of composite member, flexural strength of composite sections, shear strength of composite section;

Design of Continuous Prestressed Concrete Member: Advantages of continuous members, ultimate load analysis of continuous pre-stressed member, design of continuous pre-stressed concrete beams.

Text Books :

1. Prestressed Concrete by N. Krishna Raju; Mc Graw - Hill Publishing Company Limited, New Delhi.6th Edition

Reference Books :

1. Prestressed concrete by N. Rajagopalan; Narosa Publishing House.2nd edition, 2005
2. Design of Prestressed Concrete by A. Nilson; John Willey & Sons.2nd edition, 1987
3. B. S. Taranath, Tall Buildings – Steel, Concrete, and Composite Design of Tall Buildings, TMH publications, 1997. 4. Design of Prestressed Concrete Structures by T.Y. Lin & Ned H. Burns; John Wiley & Sons,3rd edition, 1981.

Advanced Concrete Technology

Course Code : 20CE5103 **L-T-P-S : 3-0-2-0**

Pre-requisite: NIL **Credits: 4**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Understanding about Fly Ash, Ground Granulated Blast Furnace Slag, Silica Fume, Metakaolin, Red mud, Bentonite, Concrete Mix Design.	**PO, PO**	
CO 2	Understanding about Nano Materials in Concrete, Water Proofing, Chemical Admixture in Concrete (Super Plasticizers, Retarders, & Accelerators), Fibers, Polymers	**PO, PO**	
CO 3	Understanding about Mass Concreting, Roller Compacted Concreting, Pumped Concreting, Sprayed Concreting, Self-Compacted Concreting, Re-Cycled Aggregate Concreting	**PO, PO**	
CO 4	Understanding about Corrosion of Reinforcing Steel, Chloride Ion Penetration, Carbonation, Service Life of RC Structures, Sulphate Attack, Alkali Silica Reaction, Acid Attack.	**PO, PO**	

Syllabus:

CONCRETE INGREDIENTS: Composition of OPC – Manufacture – Modified Portland Cements – Hydration Process of Portland Cements – Structure of Hydrated Cement Pastes Mineral Admixtures – Slags – Pozzolanas and Fillers – Chemical Admixtures –Solutes – Retarders – Air Entraining Agents – Water Proofing Compounds –Plasticizers and Super Plasticizers Aggregates – Properties and testing of fine and course aggregates – combining of aggregates – Substitute material for aggregates – recent advancements.

SPECIAL CONCRETES: Fibre Reinforced Concrete – Self Compacting Concrete – Polymer Concrete – High performance concrete – Sulphur concrete – pervious Concrete.

CONCRETE MIX DESIGN: Mix Proportioning – Mixes incorporating Fly ash, Silica fume, GGBS – Mixes for High Performance Concrete – High strength concrete – variations in concrete strength.

MECHANICAL PROPERTIES OF CONCRETE: Interfacial Transition Zone – Fracture Strength – Compressive strength – Tensile strength - Impact strength - Bond strength.

DURABILITY OF CONCRETE: Factors affecting durability – Chemical Attack – Permeability – chloride penetration –water absorption – creep – Shrinkage.

Text Books:

1. Santhakumar.A.R., Concrete Technology, Oxford University press, New Delhi. 2007.
2. Gambhir.M.L., Concrete Technology – Tata McGraw Hill Book Co. Ltd.,Delhi, 2004.
3. Neville, A.M., Properties of Concrete, Longman, 1995.
4. MethaP.K.andMontreio P.J.M., Concrete Structure Properties and Materials, Prentice Hall, 1998.
5. Gupta.B.L. and Amit Gupta, Concrete Technology, Standard Publishers Distributer, New Delhi, 2004

Structural Dynamics

Course Code :20CE5104 **L-T-P-S : 3-0-2-0**

Pre-requisite: NIL **Credits: 4**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Solve response of free and forced vibrations	**PO2**	**3**
CO 2	Solve response to Arbitrary, Step and Pulse Excitations (SDOF)	**PO2**	**3**
CO 3	Solve Earthquake Response of Linear Systems (SDOF)	**PO2**	**3**
CO 4	Build Generalized Multi Degree of Freedom Systems	**PO3**	**3**
CO5	Solve response of Multi Degree Freedom System	**PO3**	**3**

Equation of Motions, Problem Statement, Solution Methods of Single Degree of Freedom Systems (SDOF): Basic concepts of structural dynamics; single degree of freedom system, force displacement relationship, damping force, equation of motion, mass-spring-damper system, methods of solution of differential equation. Free Vibration (SDoF): Undamped free vibration, viscously damped free vibration, energy in free vibration. Response to Harmonic and Periodic Excitations (SDoF): Harmonic vibration of undamped systems, Harmonic vibration with viscous damping, response to vibration generator, natural frequency and damping from harmonic test, force transmission and vibration isolation, vibration measuring instruments, energy dissipated in viscous damping. Response to periodic force.

Response to Arbitrary, Step and Pulse Excitations (SDoF): Response to unit impulse, response to arbitrary force, step force, ramp force, response to pulse excitations, solution methods, effects of viscous damping. Numerical Evaluation of Dynamic Response (SDoF): Time stepping methods, methods based on interpolation of excitation, central difference method, Newmark's method, stability and computational error, analysis of nonlinear response by Newmark's method.

Earthquake Response to Linear Systems (SDoF) Earthquake excitation, equation of motion, response quantities, response history, response spectrum concept, deformation, pseudo-velocity and pseudo acceleration response spectra, peak structural response from the response spectrum, response spectrum characteristics, elastic design spectrum, comparison and distinction between design and response spectra.

Generalized Single Degree of Freedom Systems: Generalized SDoF systems, rigid body assemblages, systems with distributed mass and elasticity, lumped mass system-shear building, natural vibration frequency by Rayleigh's method.

Multi -degree of freedom systems (MDoF): Equation of motions: simple system-two storey shear building, general approach for linear systems, static condensation, and symmetric plan systems: ground motion. Multiple support excitation, methods of solving the equation of motions. Free Vibration (MDoF): Natural frequencies and modes: systems without damping, modal and spectral matrices, orthogonality of modes, normalization of modes. Solution of undamped free vibration systems, solution methods for eigenvalue problem.

Text Books:

1. Dynamics of structures by Anil K Chopra; Prentice-Hall of India Limited, New Delhi.3rd edition 2006.

2. Dynamics of Structures by R.W. Clough and P.E. Penzien, McGraw-Hill. 1st edition 1975

Reference books:

1. Structural Dynamics for Structural Engineers by G. C. Hart & K. Wang; John Wiley & Sons. 1st edition 1991

2. Structural Dynamics by Mario Paz, CBS Publishers, 1st edition 1991.

PRE-ENGINEERED STRUCTURES

Course Code :20CE51A1 **L-T-P-S : 3-0-0-0**

Pre-requisite: NIL **Credits: 4**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Application of the prefabrication techniques and methodology	PO1, PO6	3
CO 2	Application of the knowledge of the construction methods Involved in these elements	PO1, PO2, PO6	3
CO 3	Analyse the prefabricated units	PO1, PO2, PO6	4
CO 4	Application of the concept of various joints for the connections	PO1, PO6	3

Introduction

Prefabricates classification, foundation, columns, beams, roof and floor panels, wall panels, clay units, box prefabricates, erection and assembly. Design of prefabricated elements, Lift points beams, slabs, columns, wall panels, footings, design of joints to transfer axial forces, moments and shear forces

Design Of Industrial Buildings And Shell Roofs

Components of single-storey industrial sheds with crane gantry systems, Design of R.C. Roof Trusses, Roof Panels, Design of R.C. crane-gantry girders, corbels and columns, wind bracing design. Cylindrical, Folded plate and hyper-prefabricated shells, Erection and jointing, joint design, hand book based design

Design Of Pre-Engineered Structures

Introduction-section specification-Types of assemblies –analysis and design of pre-engineered structure connection details

Applications & Practical Orientation

Designing and detailing of precast unit for factory structures, purlins, principal rafters, roof trusses, lattice girders, gable frames, singe span single storied simple frames, single storied buildings, slabs, beams and columns.

Text book (s) :

1. Gerostiza. C.Z., Hendrikson, C., Rehat D.R., “Knowledge Based Process Planning for Construction and Manufacturing”, Academic Press, Inc., 2002.

Reference(s) :

1. Lewicki B., “Building with Large Prefabricates”, Elsevier Publishing Company, Amsterdam / London / Newyork, 1966.
2. Koncz.T. “Manual of Precast Concrete Construction”, Vol.I II, III and IV, Berlin, 1971.
3. Mokk L., “Prefabricated Concrete for Industrial and Public Structures”, Publishing house of Hungarian Academy of sciences, Budapest, 1964

Design of offshore Structures

Course Code : 20CE51A2 **L-T-P-S : 3-0-0-0**

Pre-requisite: NIL **Credits: 3**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Analysis of Wave theories	**PO1, PO3**	**2**
CO 2	Analysis Forces of offshore structures	**PO1, PO3**	**2**
CO 3	Design of offshore structure & Analysis of offshore structures	**PO2, PO3**	**3**
CO 4	Design of offshore structures	**PO1, PO3**	**3**

Wave Theories: Wave generation process, small and finite amplitude wave theories.

Forces of Offshore Structures: Wind forces, wave forces on vertical, inclined cylinders, structures - current forces and use of Morison equation.

Offshore Soil and Structure Modelling: Different types of offshore structures, foundation modelling, structural modelling.

Analysis of Offshore Structures: Static method of analysis, foundation analysis and dynamics of offshore structures.

Design of Offshore Structures: Design of platforms, helipads, Jacket tower and mooring cables and pipelines.

Text Books:

1. Dawson.T.H., "Offshore Structural Engineering", Prentice Hall Inc Englewood Cliffs, N.J. 1983

Reference Books:

1. Chakrabarti, S.K. "Hydrodynamics of Offshore Structures", Computational Mechanics Publications, 1987.

2. Brebia, C.A and Walker, S., "Dynamic Analysis of Offshore Structures", New Butterworths, U.K. 1979.

3. API, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms, American Petroleum Institute Publication, RP2A, Dalls, Tex, 2000.

4. Reddy, D.V. and Arockiasamy, M., "Offshore Structures", Vol.1 and Vol.2, Krieger Publishing Company, Florida, 1991.

Design & Detailing of RC Structures

Course Code : 20CE51B1 **L-T-P-S : 3-0-0-0**

Pre-requisite: NIL **Credits: 3**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Design of RC members	**PO1, PO3**	**4**
CO 2	Analysis, design and detailing of flat slab, grid slab	**PO1, PO3**	**4**
CO 3	Design and detailing of Elevated water tanks, cantilever and counterfort retaining walls	**PO1, PO3**	**4**
CO 4	Earthquake resistant design, Ductile detailing	**PO1, PO3**	**2**

Introduction: Design and detailing of Continuous beam, slab, column and footing as per IS code provisions**.** Detailed design and drawing of portal frames, Design example for hinged and fixed frame.

Elevated water tanks: Introduction, Analysis & Design and detailing of INTZ Tanks including staging and continuous deep beams.

Analysis, design and detailing of flat slab, grid slab as per IS code provisions, cantilever and counterfort retaining walls as per IS code provisions.

Earthquake resistant design: Concept of Earthquake resistant design, provisions of seismic code IS 1893 (Part-I), Design of buildings, Reinforcement detailing, Provisions of IS 13920 for ductile detailing

Repair and Rehabilitation of structures

Course Code : 20CE51B2 **L-T-P-S : 3-0-0-0**

Pre-requisite: NIL **Credits: 3**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Understand the Basic Parameters of Detoriation and Maintenance of Structures	**PO1, PO6**	**2**
CO 2	Apply various tests on material for better improvement of retrofitting of structures	**PO1, PO6**	**3**
CO 3	Understand the basic blended concrete materials	**PO1, PO6**	**2**
CO 4	Apply Various methods to give strength & stabilization of structures	**PO1, PO6**	**3**

Syllabus:

MAINTENANCE AND REPAIR STRATEGIES: Introduction, significance of corrosion, and corrosion mechanisms, Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

STRENGTH AND DURABILITY OF CONCRETE: Embedded metal corrosion, Deterioration of cementitious systems – Sulphate and Acid attack, Deterioration of cementitious systems – Alkali Silica Reaction (ASR), Shrinkage, and others, Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete – Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion – Effects of cover thickness, Concrete assessment using non-destructive tests (NDT), : Concrete assessment and load effects

SPECIAL CONCRETES: Surface repair – Condition assessment Analysis, strategy, and design, Material requirement, surface preparation, placement of repair material ,Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes.

STRENGHTENING & STABILIZATION: Introduction and beam hear capacity strengthening, Column strengthening, Flexural strengthening

Textbooks:

1. Diagnosis and treatment of structures in distress by RN Raikar, Published by R&D Centre of Structural Designers & Consultants Pvt.Ltd., Mumbai, 1994.
2. Handbook on Repair and Rehabilitation of RCC buildings, Published by CPWD, Delhi, 2002.
3. Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande, Prentice-Hall of India, 2006.

THEORY OF PLATES AND SHELLS

Course Code :20CE5205 **L-T-P-S: 3-1-0-0**

Pre-requisite: NIL **Credits: 4**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Derive the pure bending and curvature of plates	**PO2, PO4**	**4**
CO 2	Derive the differential equation for laterally loaded rectangular plates	**PO2, PO4**	**4**
CO 3	Derive the deformation of shells without bending	**PO2, PO4**	**4**
CO 4	Understand the general theory of Cylindrical shells	**PO2, PO4**	**4**

Syllabus:

Introduction: Assumptions in the theory of thin plates – Pure bending of Plates – Relations between bending moments and curvature - Cases of pure bending of rectangular plates, Cylindrical bending - immovable simply supported edges – Synclastic bending and Anticlastic bending – Strain energy in pure bending of plates in Cartesian and polar co-ordinates – Limitations.

Laterally Loaded Circular Plates: Differential equation of equilibrium – Uniformly loaded circular plates with simply supported and fixed boundary conditions – Annular plate with uniform moment and shear force along the boundaries.

Laterally Loaded Rectangular Plates: Differential equation of plates – Boundary conditions – Navier solution for simply supported plates subjected to uniformly distributed load and point load – Levy's method of solution for plates having two opposite edges simply supported with various symmetrical boundary conditions along the other two edges loaded with u. d. l. – Simply supported plates with moments distributed along the edges - Approximate Methods. Effect of transverse shear deformation - plates of variable thickness – Anisotropic plates-thick plates-orthotropic plates and grids - Large Deflection theory.

Deformation of Shells without Bending: Definitions and notation, shells in the form of a surface of revolution, displacements, unsymmetrical loading, spherical shell supported at isolated points, membrane theory of cylindrical shells, the use of stress function in calculating membrane forces of shells.

General Theory of Cylindrical Shells: A circular cylindrical shell loaded symmetrically with respect to its axis, symmetrical deformation, pressure vessels, cylindrical tanks, thermal stresses, in extensional deformation, general case of deformation, cylindrical shells with supported edges, approximate investigation of the bending of cylindrical shells, the use of a strain and stress

function, stress analysis of cylindrical roof shells.

Text Books:

1. S.P Timoshenko and S.W Krieger, Theory of Plates and Shells, McGraw Hill, 1989.

Reference Books:

1. R. Szilard, Theory and Analysis of Plates – Classical Numerical Methods', Prentice Hall inc, 1974.
2. P.L Gould, Analysis of Shells and Plates, Springer-Verlag, New York, 1988.

Finite Element Analysis

Course Code :20CE5206 **L-T-P-S : 3-0-2-0**

Pre-requisite: NIL **Credits: 4**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Understand the Basic Finite Element Concepts	PO1, PO4	4
CO 2	Analysis of Trusses, Beam Bending, Structural Frames and Column buckling using Finite Element Methods	PO1, PO4	4
CO 3	Analysis of Higher order elements for one dimensional problems and Isometric quadrilateral elements and triangular elements	PO1, PO4	3
CO 4	Analyse the applications based on general two-dimensional boundary value problem	PO1, PO4	4
CO 5	Demonstrate the ANSYS software to develop the models using Finite element method	PO1, PO4, PO5	4

Basic Finite Element Concepts, Approximate solution of boundary value problems- Methods of weighted residuals, Modified Galerkin method, Boundary conditions and general comments, Two dimensional example, Basic ideas in a finite element solution, General finite element solution procedure, Finite element equations using modified Galerkin method, Application: Axial deformation of bars.

Analysis of Trusses, Beam Bending, Analysis of Structural Frames, Two dimensional truss element, three dimensional space truss element, Governing differential equation for beam bending, two node beam element, exact solution of uniform beams subjected to distributed loads using superposition, Calculation of stresses in beams, Plane frame element, Thermal stresses in frames, three dimensional space frame element.

Higher order elements for one dimensional problems, Shape functions for second order problems, Iso parametric mapping concept, Quadratic Iso parametric element for general one dimensional boundary value problem, one dimensional numerical integration, Two dimensional boundary value problems using triangular elements, A triangular element for general 2D BVP, Numerical Examples

Isometric quadrilateral elements and triangular elements, Shape functions for rectangular elements, Iso parametric mapping for quadrilateral elements, and Numerical integration for quadrilateral elements, four node quadrilateral element for 2D BVP, and Eight node serendipity

element for 2D BVP, Natural (or Area) coordinates for triangles, Numerical integration for triangles, Six node triangular element for general 2D BVP

Applications based on general two dimensional boundary value problem, Torsion of 2 prismatic bars, Two dimensional elasticity, Governing differential equations, Constant strain triangular element, Four node quadrilateral element, Eight node Iso parametric element.

Axisymmetric Solids, Three-Dimensional Solids

Textbooks:

1. Introduction to Finite Elements in Engineering by R.T. Chandrupatla and A.D. Belegundu, Prentice Hall of India, 1997.

Reference Books:

1. Bhatti, M.A., Fundamental Finite Element Analysis and Applications: With Mathematica and MATLAB Computations, John Wiley & Sons, 2005.
2. Bhatti, M.A., Advanced Topics in Finite Element Analysis of Structures: With Mathematica and MATLAB Computations, John Wiley & Sons, 2006.
3. Finite Element Analysis by Abel and Desai, New Age Publishers, 2007.
4. Finite Element Analysis: Theory and Programming by C. S. Krishnamoorthy, Tata McGraw-Hill, 1995.
5. Finite Element Procedures in Engineering Analysis by K. J. Bathe, Prentice Hall Inc.,1996.
6. The Finite Element Method by O.C. Zienkiewicz, and R.L.Taylor, McGraw – Hill, 1987.

(DEEMED TO BE UNIVERSITY)

Bridge Engineering

Course Code :20CE5207 **L-T-P-S : 3-1-0-0**

Pre-requisite: NIL **Credits: 4**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Introduction to different types of bridges and codal provisions for designing the bridge components.	PO1, PO2	4
CO 2	Analysis and Design of slab Culvert.	PO1, PO2	4
CO 3	Analysis and Design of T-Beam, sub-structure components and bearings	PO1, PO2	4
CO 4	Understanding the designing of cable supported bridges.	PO1, PO2	4

Syllabus:

Components of Bridges: Sub structure, super structure, IRC Loading: Different types of bridges; IRC Specifications for road bridges; Design of Culverts: Loads, Types of culverts, Design of box culverts.

Design of T–Beam Bridge: Pigeaud's method for computation of slab moments; courbon's method for computation of moments in girders; Design of simply supported T-beam Bridge.

Design of Sub Structures: Pier and abutment caps; Materials for piers and abutments' Design of pier; Design of abutment; Backfill behind abutment; approach slab.

Design of Bearings: Importance of bearings; bearings for slab bridge; bearings for girder bridges; Expansion bearings; Fixed bearings; Design of elastomeric pad bearing;

Bridge Foundations: Scour depth; Grip length; Types of foundations; Design of well foundation.

Special Bridges: Different types of cable supported bridge, difference between suspension bridge and cable stayed bridge. Different components and factors considered for design of a) suspension bridge, b) cable stayed bridge.

Text Books :

1. Essentials of Bridge Engineering by Dr. Johnson Victor; Oxford & IBH publishing Co. Pvt. Ltd (6th Edition)

2. Cable supported bridges, concepts and design by N J Gimsing. John Willey and Sons(3rd Edition)
3. R. Rajagopalan, "Bridge Superstructure", Tata McGraw- Hills Publishing Company Limited.(2nd Edition)
5. Essentials of Bridge Engineering by S.Ponnu swamy(3rd edtion), Tata McGraw- Hills Publishing Company Limited

Reference Books :

1. Design of Bridge Structures by T. R Jagadeesh, M.A Jayaram, Prentice Hall of India Pvt. Ltd

(DEEMED TO BE UNIVERSITY)

Earthquake resistance design of structures

Course Code :20CE5208 **L-T-P-S : 3-0-2-0**

Pre-requisite: NIL **Credits: 4**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Understand the building categories, seismic behavior and dynamics of structures earthquake causes, ground motion behavior, Seismic resistant building architecture	PO1	2
CO 2	Analyze of single degree of freedom and Compute equivalent lateral seismic loads and carryout a seismic design as per IS codal provisions	PO2, PO4	4
CO 3	Assessment of ductile Members and design for earthquake loads. Design the 2 storey building with Linear static analysis and non linear dynamic analysis	PO2, PO4	4
CO 4	Analyze the concept of base Isolation and design principles	PO2, PO4	4
CO 5	ETABS software to develop the models, analyze and design the structures under linear and non-linear static and dynamic conditions	PO4	4

Seismic-resistant buildings: Introduction; Lateral load resisting systems- moment resisting frame, building with shear wall or bearing wall system, building with dual system; Building configuration – Problems and solutions; Building characteristics – Mode shape and fundamental period, building frequency and ground period, damping, ductility, seismic weight, hyper stativity/redundancy,

Design forces for buildings: Introduction, Equivalent static method; Mode superposition technique; Dynamic inelastic-time history analysis; Response Spectrum Analysis, Pushover analysis, advantages and disadvantages of these methods; Determination of lateral forces on an intermediate plane frame using Equivalent static method and Model analysis using response spectrum; Analysis of the intermediate frame for various load combinations as per IS1893(Part 1); Identification of design forces and moments in the members

Ductility considerations in earthquake resistant design of RCC buildings: Introduction; Impact of ductility; Requirements for ductility; Assessment of ductility– Member/element ductility, Structural ductility; Factor affecting ductility; Ductility factors; Ductility considerations as per IS13920. Design and detailing of typical flexural member, typical column as per IS13920.

Shear Wall Design: Introduction to Shear Walls, Types of shear walls, Design of shear wall for a Lateral Load resisting frame, Design of shear wall for multi storied structure.

Base isolation of structures: Introduction; Considerations for seismic isolation; Basic elements of seismic isolation; seismic-isolation design principle; Feasibility of seismic isolation; Seismic-isolation configurations.

Text Books:

1. Earthquake Resistant Design of Building Structures by Dr. Vinod Hosur, Wiley Corporation, 2012
2. Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande, Prentice-Hall of India, 2006

Reference Books:

1. Basics of structural dynamics and aseismic design by Damodaraswamy S.R and S. Kavitha, Prentice Hall India Learning Private Limited; 5th Edition (2009)
2. Seismic design of reinforced concrete and masonry buildings by T. Paulay and M.J.N. Priestley, John Wiley & Sons, 1991.

Fracture Mechanics

Course Code :20CE52C1 **L-T-P-S : 3-0-0-0**
Pre-requisite: NIL **Credits: 3**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Understanding the basic concepts of Fracture and Linear Elastic Fracture Mechanics (LEFM)	**PO1**	**3**
CO 2	Understanding the concept of Crack Tip Plasticity	**PO1**	**3**
CO 3	Understanding the concept Elastic Plastic Fracture Mechanics (EPFM)	**PO1**	**3**
CO 4	Understanding the concept of Fatigue Crack Growth and practical problems of fracture mechanics	**PO1**	**3**

Introduction to fracture mechanics of concrete Structural failure based on material performance; Concepts of linear elastic fracture mechanics; Fracture mechanics of concrete

Principles of linear elastic fracture mechanics, Airy stress functions for problems in elasticity; Complex stress function; Elastic stress and displacement fields at crack tip; Stress intensity factors and crack opening displacements for useful geometries; Superposition of stress intensity factors; Plastic zone at crack tip; Griffith's fracture theory; Strain energy release rate for crack propagation; Relationship between stress intensity factor and strain energy release rate; Design based on linear elastic fracture mechanics

Principles of non-linear fracture mechanics energy principles for crack propagation in non-linear materials; J-integral for non- linear elastic materials; Fracture resistance (R curve); Crack tip opening displacement;

Structure and fracture process of concrete constituents and microstructure of concrete; Fracture behaviour and strain localization of concrete; Fracture process zone and toughening mechanisms; Experimental determination of fracture zone; Influence of fracture process zone on fracture behaviour of concrete

Non-linear fracture mechanics for Mode I Quasi-Brittle Fracture general description of quasi-brittle fracture; Fictitious approach – Energy dissipation for fictitious crack, Fictitious crack model by Bazant and Oh, Determination and influence of s (w) relationship, Some comments on fictitious crack approach; Effective elastic approach – Energy dissipation for effective-elastic crack, Two- parameter fracture model by Jenq and shah, Size effect model by Bazant and Kazemi, Effective crack model by Karihaloo and Nallathambi, Effective crack model by Refai and Swartz, Some comments on effective-elastic crack approach; Comparison between Fictitious

and effective-elastic crack approaches; Finite element analysis – Discrete crack approach, Smeared crack approach.

Text Books :

1. Fracture Mechanics of Concrete: Applications of Fracture Mechanics to Concrete, Rock and Other Quasi-Brittle Materials by Surendra P. Shah, Stuart E. Swartz, Chengsheng Ouyang, Publisher : Wiley , 1995.
2. Analysis of Concrete Structures by Fracture Mechanics by by L. Elfgren, Publisher: Routledge, 1990.
3. Fracture mechanics – Applications to concrete , Edited by Victor C.Li and Z.P.Bazant, ACI SP118.
4. Elements of fracture mechanics by Prashant Kumar, Wheeler Publishing, 1999.

Design of Tall Structures

Course Code :20CE52C2 **L-T-P-S : 3-0-0-0**

Pre-requisite: NIL **Credits: 3**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Understanding the design criteria of Tall structures	PO1, PO3	2
CO 2	Understanding the Loadings On Tall Structures	PO1, PO3	2
CO 3	Understanding the behaviour of Rigid-Frame Structures and Shear Wall Structures	PO1, PO3	2
CO 4	Understanding the behaviour of Tubular Structures	PO1, PO3	2

INTRODUCTION: Why Tall Buildings, Factors affecting growth, Height and structural form. The Tall Building Structure: Design process, Philosophy, scope and content.

DESIGN CRITERIA: Design philosophy, Loading, Sequential loading, Strength and Stability, Stiffness and drift limitations, Human Comfort criteria, Creep, Shrinkage and temperature effects, Fire, Foundation settlement and soil structure interaction:

LOADING ON TALL STRUCTURES: Gravity loading:-Methods of live load reduction, Impact gravity loading, Construction loading, Wind loading:-Simple static loading, Dynamic loading, Earthquake loading:-Equivalent lateral force procedure, Model analysis procedure, Combination of loading:-Working stress design, Limit Sate design.

STRUCTURAL FORM: Structural form:-Braced frame structures, Rigid Frame structures, In filled-Frame structures, Flat plate- Flat slab structures, Shear wall structures, Wall frame structures, Framed tube structures, Suspended structures, Floor systems :-(Reinforced concrete):-One-way slabs on beams or walls, One-way pan joints and Beams, One-way slab on beams and girders, Two-way Flat plate, Two-way flat slab, Waffle flat slabs, Two-way slab and beam, Floor systems: - (Steel framing):-One-way beam system, Two-way beam system, Three way beam system, Composite Steel-Concrete floor system.

MODELING FOR ANALYSIS: Approaches to analysis:-Preliminary analyses, Intermediate and final analysis, Assumptions:-Materials, Participating components, Floor slabs, Negligible stiffnesses, Negligible deformations, Cracking, High-Rise Behavior, Modeling for Approximate analyses:- Approximate Representation Bents, Approximate modeling of slabs, Modeling for continuum analyses, Modeling for Accurate analyses:-

Plane frames, Plane shear walls, Three dimensional frame and wall structures, P-Delta effects, The assembled model.

BRACED FRAMES: Types of bracings, Behavior of bracings, and Behavior of bracing bents, Methods of analysis:-member force analysis, Drift analysis, Worked example for calculating drift by approximate methods, use large scale bracing.

RIGID-FRAME STRUCTURES: Rigid frame behavior, Approximate determination of member forces caused by Gravity loading:-Girder forces-Code recommended values, two cycle moment distribution, and Column forces, Approximate Analysis of member forces caused by horizontal loading:-Allocation of loading between bents, member force analysis by portal frame method, Approximate method by cantilever method, Approximate analysis of rigid frames with setbacks, Approximate analysis for drift:-Components of drift, correction of excessive drift, Effective shear rigidity (GA), Flat plate structures:-Analogues rigid frame, Worked examples, Computer analysis of rigid frames, Reduction of rigid frames for analysis:-Lumped girder frame, single- bay substite frame

SHEAR WALL STRUCTURES: Behavior of shear wall structures, Analysis of proportionate wall systems:- Proportionate Non twisting structures, Proportionate twisting structures, Non Proportionate structures:-No proportionate Non twisting structures, Non proportionate twisting structures, Behavior of nonproportionate structures, Effects of discontinuities at base, Stress analysis of shear wall:-Membrane finite element analysis, Analogous frame analysis

TUBULAR STRUCTURES: Structural behavior of tabular structures:-Framed- tube structures, Bundled Tube structures, Braced-Tube structures, General three dimensional structural analysis, Simplified Analytical models for symmetrical Tubular structures:-Reduction of three dimensional frame tube to an equivalent plane frame, Bundled-Tube structures, Diagonally braced frame tube structures

DYNAMIC ANALYSIS: Dynamic Response to Wind Loading:-Sensivity of structures wind forces, Dynamic structural response due to wind forces, Along wind response, Cross wind response, worked examples, Dynamic response to Earthquake motions:-Response of Tall buildings to ground accelerations, response spectrum analysis, Empirical relations for fundamental natural frequency, Structural damping ratios, Comfort criteria: Human response to building motions:- Human perception of building motion, Perception thresholds, Use of comfort criteria in design

Text Books:

1. Tall Building Structures Analysis and Design by Bryan Stafford Smith & Alex Coull; A Wiley-Interscience Publications, Newyork,1991

Reference Books:

1. Tall Building Structures on Elastic Subgrade and Research of Semi-Analytical. Method [D] by Gong Yaoqing. Beijing: Tsinghua University, 2006
2. ETABS, Three-Dimensional Analysis of Building Systems. Computers and Structures inc., Berkeley, California, 1989.

Green Buildings

Course Code :20CE52D1 **L-T-P-S : 3-0-0-0**

Pre-requisite: NIL **Credits: 3**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Understand Necessity and Role of Green Buildings & Regarding Indian Green Building Council; Grasp the construction practices of a Green Buildings.	PO1, PO3	2
CO 2	Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Opportunities of Green Building, Green Building Features, Material and Resources, Green Building Design	PO1, PO3	2
CO 3	Air Conditioning, Material Conservation	PO1, PO3	2
CO 4	Indoor Environment Quality and Occupational Health	PO1, PO3	2

Introduction

What is Green Building, why to go for Green Building, Benefits of Green Buildings, Green Building Materials and Equipment in India, what are key Requisites for Constructing a Green Building, Important Sustainable features for Green Building,

Green Building Concepts and Practices

Indian Green Building Council, Green Building Moment in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation;

Green Building Opportunities and Benefits: Opportunities of Green Building, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy Saving Approach in Buildings, LEED India Rating System and Energy Efficiency,

Green Building Design

Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximise System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources. Ecofriendly captive power generation for factory, Building requirement,

Air Conditioning

Introduction, CII Godrej Green business centre, Design philosophy, Design interventions, Energy modeling, HVAC System design, Chiller selection, pump selection, Selection of cooling towers, Selection of air handing units, Precooling of fresh air, Interior lighting system, Key feature of the building. Eco-friendly captive power generation for factory, Building requirement.

Material Conservation

Handling of non-process waste, waste reduction during construction, materials with recycled content, local materials, material reuse, certified wood, Rapidly renewable building materials and furniture;

Indoor Environment Quality and Occupational Health: Air conditioning, Indore air quality, Sick building syndrome, Tobacco smoke control, Minimum fresh air requirements avoid use of asbestos in the building, improved fresh air ventilation, Measure of IAQ, Reasons for poor IAQ, Measures to achieve Acceptable IAQ levels,

Text Books:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air Conditioning Engineers, 2009.
2. Green Building Hand Book by Tomwoolley and Samkimings, 2009.

Reference Books:

1. Complete Guide to Green Buildings by Trish riley
2. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009

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Stability of structures

Course Code :20CE52D2 **L-T-P : 3-0-0-0**

Pre-requisite: NIL **Credits: 4**

Mapping of Course Outcome with Program Outcome:

CO	Course Outcome	PO	BTL
CO 1	Introduction to buckling of columns	PO1, PO6	2
CO 2	Analysis of lateral buckling of beams	PO1, PO6	4
CO 3	Analysis of lateral buckling of plates and shells	PO1, PO6	4
CO 4	Understanding the Mathematical treatment of stability problems	PO1, PO6	2

Syllabus:

Buckling of Columns: Introduction; Methods of finding critical loads; Critical loads for straight columns with different end conditions and loading; Inelastic buckling of axially loaded columns; Energy methods; Prismatic and non-prismatic columns under discrete and distributed loading; General Principles of elastic 0stability of framed structures.

Buckling of thin walled members of open cross section:

Torsion of thin-walled bars; warping; Non-uniform torsion; Torsional buckling under axial loading; Combined bending and torsion buckling.

Lateral Buckling of Beams

Beams under pure bending; Cantilever and simply supported beams of rectangular and I-sections; Beams under transverse loading; Energy methods; Solution of simple problems.

Buckling of Rectangular Plates

Plates simply supported on all edges and subjected to constant compression in one or two directions; Plates simply supported along two opposite sides perpendicular to the direction of compression and having various edge conditions along the other two sides.

Buckling of Shells

Introduction to buckling of axially compressed cylindrical shells.

Mathematical treatment of stability problems

Discrete/Discontinuous systems; Eigen value problem; Converting continuous systems to discrete systems using the finite element method – Buckling of a column with sudden change in cross-section

Textbooks:

1. Theory of elastic stability by Timoshenko & Gere, McGraw Hill, 1961.

Reference Books:

1. Background to buckling by Allen and Bulson, McGraw-Hill, 1980.
2. Elastic stability of structural elements by N.G.R.Iyengar, Macmillan India Ltd., 2007.

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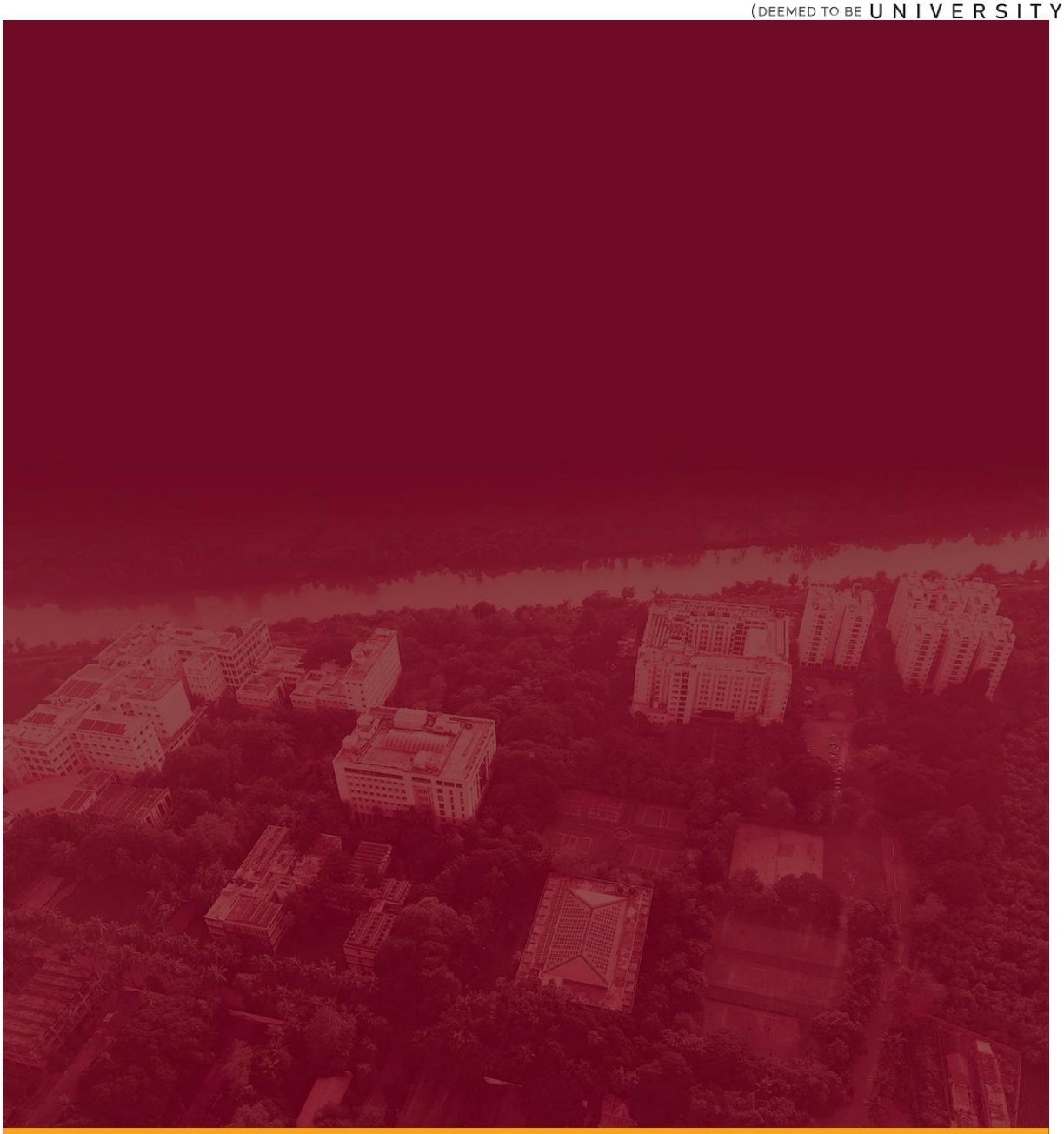

KONERU LAKSHMAIAH EDUCATION FOUNDATION

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(NAAC Accredited "A" Grade University)

Vaddeswaram Guntur District , Andhra Pradesh, India.