JSPM's
RAJARSHI SHAHU COLLEGE OF ENGINEERING
TATHAWADE, PUNE-33
(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

Department of Civil Engineering

Structure & Syllabi

F. Y. M. Tech (2019 Pattern)

w.e.f. Academic Year 2021-2022

Index

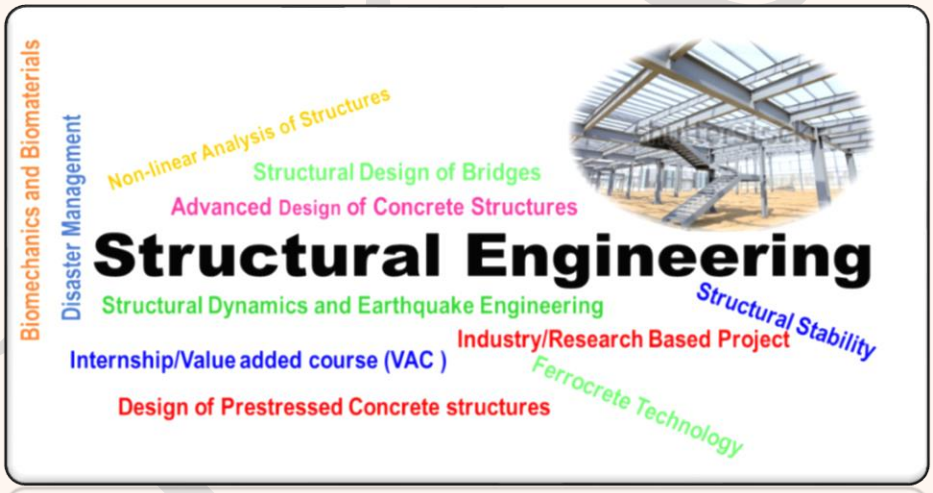
Department of Civil Engineering

Vision

"To provide an excellent academic environment for students to become competent Civil Engineer."

Mission

- To reinforce the students with fundamentals in Civil Engineering by providing scholarly and vibrant environment for successful careers.
- To explore and develop innovations that contributes to higher education, research and entrepreneurship development in applied domains of Civil Engineering.
- To serve society through knowledge and expertise in Civil Engineering.



Structural Engineers: Adding Value in Every Building.

- ***Structural engineers*** design the ***'bones and muscles'*** that create the form and shape of man-made structures
- ***Structural engineers*** concerned with the ***design and physical integrity*** of buildings and other large structures, like tunnels and bridges.
- ***Structural engineers*** understand and calculate the ***stability, strength and rigidity and earthquake evaluation*** of built structures for buildings and non-building structures.
- ***Unlike architects***, who must focus on the appearance, shape, size and use of the building, ***structural engineers*** must ***solve technical problems*** - and help the architect achieve his or her vision for the project.

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Department of Civil Engineering

Program Outcomes (POs)

Engineering Graduates will be able to:

1. Independently carry out research /investigation and development work to solve practical problems.
2. Write and present a substantial technical report/document.
3. Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
4. Graduates of the program will develop technical skills along with entrepreneurship attitude to develop strategic and effective personality
5. Graduates will develop confidence to pursue lifelong learning for pr advancement with professional values and develop the spirit of working in team for common objectives.

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Highlights of the Syllabus

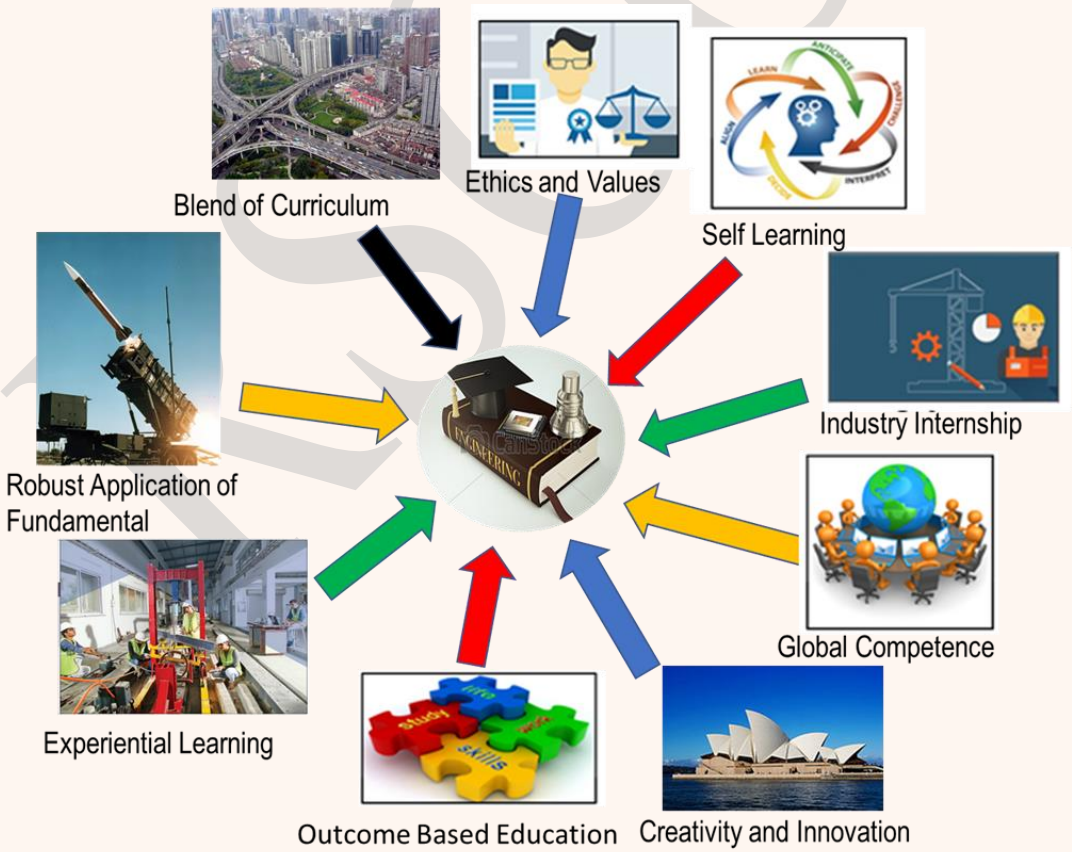
Curriculum of MTech in Structural Engineering Department is designed in consultation with:

Academic Experts

Distinguished Alumni

Industry/Corporate Experts

The curriculum of the PG Program of Civil Engineering designed in association with the Bentley Systems; Construction Diagnostic Centre, Pune; G A Bhilare Consultants Private Limited, Pune; L&T Construction Ltd. Mumbai; Tata Consultancy Services Limited, Pune; Mercedes-Benz India Pvt Ltd, Pune.



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Unique features of the curriculum

1. **Curriculum centered at Outcome Based Education:**
   The new Curriculum is based on student-centered instruction models that focus on measuring student performance through outcomes. The outcomes include subject knowledge, industry required skills and aptitude development of students.
2. **Robust application of Fundamentals:**
   The nature of the new curriculum is rigorous and well prescribed so that the students can spend more time on preparation and self-study. The students have to apply knowledge of core subjects, solve practical based assignments and must attempt periodical quizzes. This will benefit them to utilize and keep a strong hold on fundamentals of applied Engineering in the most effective way.
3. **Experiential Learning:**
   The curriculum emphasizes on hands-on sessions along with theoretical information. The new curriculum considers Problem Based Experiential Learning (PBL) as a teaching pedagogy and includes different subjects that encourage the students for hands on learning through virtual labs, mini-projects, literature and field surveys. Accordingly, the curriculum maintains good balance between theory and laboratory credits.
4. **Promote Creativity and Innovation:**
   Along with experiential learning, the curriculum also motivates the students to inculcate creativity and innovation. Apart from conventional lab, the curriculum provides a freedom for students to perform industry assignments, pilot projects, innovative self-development by patenting their creativity.
5. **Inculcating Ethics and Values:**
   To improvise student's behaviour, the curriculum has included systematic courses on ethics and values. The moral principles can help students to make right decisions, lead their professional lives and become ethical citizen.
6. **Blend of Curricular and Noncurricular Activities**
   The curriculum also gives importance of different activities like co-curricular, extra-curricular, sports, culture, etc. This will help to do all round development of students in all possible ways.
7. **Flexibility**
   The curriculum provides flexibility by offering various courses/electives in choosing mentorship to work in specialized field in the curriculum as, Capstone Projects, Entrepreneurship, Persuing Research and higher studies and industry internships.
8. **Global Competence:**
   The curriculum provides a unique opportunity for students to learn and engage in open and effective interaction with people from diverse and interconnected world. The provision of international internships in the curriculum helps the students to build a capacity to examine global and intercultural issues and to propose perspectives and views.
9. **Industry Induced Internship Program**
   To support ever demanding industry requirements, the curriculum has included an industry internship with an objective to learn technologies pertaining to their discipline and enhance their technical knowledge with a support of the live platform of Industry.
10. **Motivation for Self-Learning:**
    The curriculum also offers a freedom to students to take the initiatives in their learning needs and set the goals with the help of online learning platforms like MOOCs, NPTEL, Swayam, etc.

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F. Y. M. Tech (Civil Structural Engineering)
Academic Year – 2020-2021 Semester -I

Course Code	Course	Teaching Scheme			Examination Schemes						Credits
		TH	Tut	Lab	Theory			TW	Lab	Total	
					ISE (15)	MSE (25)	ESE (60)				
ES5101	Numerical Methods in Civil Engineering	03	-	-	15	25	60	-	-	100	03
CE5101	Theory of Elasticity	03	-	-	15	25	60	-	-	100	03
CE5102	Structural Dynamics and Earthquake Engineering	03	-	02	15	25	60	-	-	100	04
CE5103	Elective-I	03	-	-	15	25	60	-	-	100	03
CE5104	Elective-II	03	-	-	15	25	60	-	-	100	03
CE5105	Lab Practice I	-	-	04	-	-	-	50	50	100	02
CE5106	Online course/certification	-	-	04	-	-	-	50	50	100	02
CE5107	Audit Course	Non-Credit									
Total		**15**	**-**	**10**	**75**	**125**	**300**	**100**	**100**	**700**	**20**

**Audit Course Code	Audit Course Title
EC5108	Technical Paper writing
CE5107	Disaster Management
ME5107	Value Education in Engineering
CS5108	Constitution of India

Elective I		Elective II	
Code No.	**Title**	**Code No.**	**Title**
CE5103A	Advanced Concrete Technology	**CE5104A**	Ferrocrete Technology I
CE5103B	Structural Design of Concrete Bridges	**CE5104B**	Advanced Design of Concrete Structures
CE5103C	Design of Prestressed Concrete structures	**CE5104C**	Design of Precast Concrete structures
CE5103D	Mechanics of Modern Materials	**CE5104D**	Structural Stability

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S. Y. B. Tech (Civil Engineering)
Academic Year – 2020-2021 Semester -II

Course Code	Course	Teaching Scheme			Examination Schemes						Credits
					Theory			TW	Lab	Total	
		TH	Tut	Lab	ISE (15)	MSE (25)	ESE (60)				
CE5108	Finite Element Method	03	01	-	15	25	60	-	-	100	04
CE5109	Theory of Plates and Shells	03	-	-	15	25	60	-	-	100	03
CE5110	Research Methodology + IPR	03	-	-	15	25	60	-	-	100	03
CE5111	Elective-III	03	-	-	15	25	60	-	-	100	03
CE5112	Elective-IV	03	-	-	15	25	60	-	-	100	03
CE5113	Lab Practice II	-	-	04	-	-	-	50	50	100	02
Total		**15**	**01**	**04**	**75**	**125**	**300**	**50**	**50**	**600**	**18**

Elective III		Elective IV	
Code No.	**Title**	**Code No.**	**Title**
CE5111A	Structural Design of Steel Bridges	**CE5112A**	Sub Sea Engineering
CE5111B	Plastic Analysis of Steel Structures	**CE5112B**	Biomechanics and Biomaterials
CE5111C	Ferrocrete Technology II	**CE5112C**	Retrofitting and strengthening of RC Structures
CE5111D	Design of Pre-engineered Buildings	**CE5112D**	Advanced Design of Steel Structures

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First Year M. Tech Civil (Structural Engineering)

Academic Year – 2020-2021 Semester - I

[ES5101]: Numerical Methods in Structural Engineering

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Basic concept of differentiation and integration, differential equations, system of linear equations.

Course Objective:
To make the students familiarize with various Numerical methods which will be useful in finding approximate solution of complex Civil Engineering Problems where analytical methods failed. Also identify the difference between analytical and Numerical methods.

Course Outcome:
On completion of the course, student will be able to–
CO1: Understand numerical methods for approximate solution of algebraic and transcendental equations.
CO2: Learn solution of simultaneous linear equation and Eigen value problem using numerical methods.
CO3: Apply finite difference method and curve fitting to experimental data.
CO4: Understand differentiation and integration of complex function in civil engineering problems using numerical techniques.
CO5: Apply Numerical methods to find approximate solution ordinary differential equation occurring in Indeterminate Beams, Columns.
CO6: Apply Numerical methods to find approximate solution partial differential equation occurring in problems of Plate.

Course Contents

UNIT-I	Solution of algebraic and transcendental equations	06 Hours
Bisection method, Newton–Raphson method, Modified Newton–Raphson method, Successive approximation, Muller's method, Bairstow's method, Convergence and stability.		
UNIT-II	**System of linear equations and Eigen values**	**06 Hours**
Gauss elimination method, Choleski's factorization method, Jacobi's method and Gauss–Seidel method. Numerical computation of Eigen values and Eigen vector by Power method, Householder method and Given's method.		
UNIT-III	**Interpolation and Curve fitting**	**08 Hours**
Interpolation: Finite Differences, Newton's forward and backward interpolation formulae, Lagrange's method, Newton's divided difference Interpolation formulae, curve fitting, least square method, curve fitting by straight line, parabola and related curves.		
UNIT-IV	**Numerical differentiation and integration**	**08 Hours**
Numerical Differentiation by finite difference method. Numerical integration by Trapezoidal and Simpson's methods, Gauss Guadrature method, Newton's–Cotes method.		

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UNIT-V	Solution of Ordinary differential equations	08 Hours
Review of Taylor's series, Euler's method, Modified Euler method, Runge–Kutta fourth order method, predictor– corrector method, Adams–Bashforth method. Applications of finite difference approximation of derivative to Indeterminate Beams, Columns.		
UNIT-VI	**Solution of Partial differential equations**	**06 Hours**
Finite difference analysis, Explicit and Implicit finite difference scheme, Stability of finite difference method, Applications of finite difference analysis applied to boundary value problems, one dimensional diffusion equation, Wave equation, Laplace equation. Applications of finite difference approximation of derivative to problems of Plates		

Reference Books:

R1: S. C. Chapraand R. P. Canale, "Numerical Methods for Engineering", TMHPublications.
R2: E. Balgurusamy, "Numerical Methods", TMHPublications.
R3: M.K. Jain, S.R.K. Iyengar, R.K. Jain "Numerical Methods: Problems and Solutions", 2nd Edition, Wiley Eastern.
R4: S. S. Sastry, "Introductory Methods of Numerical Analysis", Prentice Hall of India.
R5: N. KrishnaRaju, "Numerical Methods in Civil Engineering", CBS Publications.
R6: C. F. Gerald and O. Patrick, "Applied Numerical Analysis", Wheatley, Pearson Education, Inc..

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - I
[CE5101]: Theory of Elasticity

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Basics of stress and strain, deflection of body under various load, boundary conditions, shear force and bending moment diagram

Course Objective:
The Objective of this course is to impart knowledge of theory of elasticity to analyse civil engineering problems with parameters such as geometry, material properties and boundary conditions.

Course Outcome:
On completion of the course, student will be able to–
CO1: Analyze stress strain in Cartesian coordinate system and to apply equilibrium and compatibility conditions.
CO2: Comprehend the boundary value problems (2D and 3D) in Cartesian Coordinate System.
CO3: Apply the boundary conditions in Polar Coordinate System.
CO4: Utilize the concept of failure criteria for effect of stress concentration due to circular hole in a stressed plate.
CO5: Apply the state of stress and strains for plates.
CO6: Quantify the practice problems related to rectangular plates.

Course Contents

UNIT-I	Analysis of Stresses and Strain	06 Hours

Concept of stress at a point, stress tensor, stress on inclined plane, stress components on a Rectangular parallel piped in Cartesian coordinate system, derivation of stress equilibrium equations, transformation of stresses, stress invariants. The state of strain at a point, strain displacement relations, strain compatibility condition and stress compatibility conditions.
Hands on Self-pressure test, Drawing Sketches, Demonstrations.

UNIT-II	Analysis of Stresses and Strain	06 Hours

Relations between Elastic Constants, Problems on Navier Lame's Equilibrium Equations, Problems on Beltrami-Michell compatibility equations, Boundary value problems in Elasticity. Generalized Hook's law for Isotropic, Orthotropic, plane stress, plane strain and axisymmetric problems, Problems in 2D and 3D Cartesian coordinate system, Airy's stress function, bending of beams.
Hands on Drawing Sketches, Discussion based on technical video / documentaries, Failure case studies, Mini experiments.

UNIT-III	Polar Coordinate System	08 Hours

Relationship between Cartesian and Polar coordinate system, Equilibrium equations, Strain displacement relations, Stress-strain relationship, Strain-displacement relationship for plane stress and plane strain conditions.
Hands on Drawing Sketches, Demonstrations, Model making.

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UNIT-IV	Stress Concentration Problems	08 Hours
Stress concentration problems such as stress concentration due to circular hole in stressed plate (Kirsch's Problem), failure criterion- von mises. **Hands on** Discussion based on technical video/documentaries, Drawing Sketches, Failure case studies, Mini experiments.		
UNIT-V	**Plates**	**08 Hours**
Introduction: Thin and thick plates, small and large deflections. Small deflection theory of thin plates: Assumptions, Moment Curvature relations. Stress resultants. Governing differential equation in Cartesian co-ordinates, various boundary conditions. Pure bending of Plates. **Hands on** Discussion based on technical video / documentaries, Drawing Sketches, Application Case studies.		
UNIT-VI	**Analysis of Rectangular Plate**	**06 Hours**
Analysis of Rectangular Plates: Navier solution for plates with all edges simply supported. **Hands on** Discussion based on technical video / documentaries, Application Case studies, Mini experiments		
Reference Books: **R1**: Timoshenko and Goodier, "Theory of Elasticity", McGraw-Hill Publications. **R2:** C. Wang, "Applied Elasticity", Dover Publications. **R3:** Enrico Volterra and J. H. Gaines, "Advanced Strength of Materials", Prentice Hall. **R4:** S. M. Akazimi, "Solid Mechanics", Tata McGraw-Hill Publications.		

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First Year M. Tech Civil (Structural Engineering)

Academic Year – 2020-2021 Semester - I

[CE5102]: Structural Dynamics and Earthquake Engineering

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Basics structural analysis, basics of mathematics, matrix method of analysis.

Course Objective:
The Objective of this course is to realize the seismic hazards and identify structural dynamic methods for safety and stability of civil engineering structures.

Course Outcome:
On completion of the course, student will be able to–
CO1: Analyze degrees of freedom and analyse forced & free vibrations.
CO2: Identify the clauses from I.S. 1893, and distinguish between E.S.L. method & R.S. method.
CO3: Utilize the T.H. method apply capacity-based design method w.r.to 13920.
CO4: Assess the harmonic excitations and apply Duhamel's integral.
CO5: Apply forced vibration & free vibration to multistorey building.
CO6: Execute nonlinear analysis & interpret the results.

Course Contents

UNIT-I	**Basics of structural Dynamics**	**06 Hours**
Degrees of freedom & mathematical modelling of dynamic systems. SDOF An undamped& damped free vibration, viscosity & coulomb's damping.		
UNIT-II	**Seismic analysis Methods**	**06 Hours**
Design of multi-storey RC Structure with I.S. 1893, by equivalent static lateral load method& R.S. method		
UNIT-III	**Shear wall and Ductile detailing**	**08 Hours**
Introduction to time history method, capacity-based design of soft story RC Buildings, Design of shear wall, Ductile detailing as per I.S. 13920		
UNIT-IV	**SDOF System**	**08 Hours**
SDOF System: Undamped & damped forced vibrations to harmonic excitations. Response to until impulse and arbitrary loading by Duhamel's integral and analyses for Nonlinear analysis.		
UNIT-V	**MDOF System**	**08 Hours**
MDOF System: Forced vibrations and free vibrations of shear building orthogonally of mode shapes &concept & T.M.D.		
UNIT-VI	**Non-Linear Analysis**	**06 Hours**
Non-Linear Analysis, free vibration of cantilever beam by Rayleigh Ritz method.		

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Reference Books:

R1: S.N. Poultre "Dynamics of structures", Wiley India
R2: M. Paz, "Structural Dynamics Theory and Computation", CBS Publications
R3: A. K. Chopra, "Dynamics of Structures Theory and Applications to Earthquake Engineering", Prentice-Hall Publications
R4: R.W. Clough and J. Penzin, "Dynamics of Structures", McGraw Hill Publications
R5: R.C. Roy, "Structural Dynamics an Introduction to Computer Methods", John Wiley & Sons Publications.
R6: P. Agarwal and M. Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall Publications.
R7: Hosure, "Earthquake resistant design of building structures building", Wiley India.
R8: IS 13920, "Indian Standard Criteria for Ductile Detailing of RC Structure", Bureau of Indian Standards, New Delhi.
R9: IS: 1893, "Indian Standard Criteria for Earthquake Resistant Design of Structures", Bureau of Indian Standards, New Delhi.
R10: IS: 13935, "Repair and Seismic Strengthening of Buildings", Guidelines, 1993.
R11: IS: 4326, "Earthquake Resistant Design and Construction of Buildings" Code of practices.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - I
[CE5103A]: Advanced Concrete Technology

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Behaviour of reinforced concrete structure, limit state method, working stress method, design of basic reinforced concrete structural elements.

Course Objective:
To apply advanced design concept to special structures, ESR, Bunkers, Silos, raft foundation and utilize the knowledge of analysis and design of these different concrete structures in practical life.

Course Outcome:
On completion of the course, student will be able to–
CO1: Produce and test Fabre reinforced concrete, Ferro cement, silica fume & polymer concrete.
CO2: Understand the various properties of special concrete.
CO3: Understand the Mix design by different methods.
CO4: Know the different procedures for testing concrete.
CO5: Understand the concept of durability and cracking in concrete.

Course Contents

UNIT-I	Concrete Composites	06 Hours

Fiber Reinforced Concrete - Introduction, properties of constituent materials, Mix proportion, mixing, casting methods, properties of freshly mixed concrete (Fiber reinforced concrete), workability tests, mechanical properties, Behavior of Fiber reinforced concrete under Compression, tensile, flexure, research findings, application of Fiber Reinforced Concrete
Ferro cement - Introduction, materials used, mechanical properties, construction techniques, and design in direct tension, applications, and merits as structural materials.
Silica Fume Concrete - Introduction, physical and chemical properties of silica Fume, reaction mechanism of silica fume, properties of silica fume concrete in fresh state, mechanical properties and durability of silica fume concrete.
Polymer concrete - Introduction, classification, properties of constituent materials, polymer impregnated concrete, polymer concrete, application.

UNIT-II	Special concrete	06 Hours

Special Concrete: Light weight concrete, ultra-light weight concrete, vacuum concrete, mass concrete, waste material-based concrete, sulphur concrete and sulphur infiltrated concrete, gap graded concrete, no fines concrete, high strength concrete, high performance concrete.

UNIT-III	Concrete Mix Design	08 Hours

Design of high strength concrete mixes, design of light weight aggregate concrete mixes, design of fly-ash cement concrete mixes, design of high-density concrete mixes.

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UNIT-IV	Testing of Concrete	08 Hours
a) Tests to Verify Admixture Requirements. b) Advanced non-destructive testing methods: ground penetration radar, probe penetration, pull out test, break off maturity method, stress wave propagation method, electrical/ magnetic methods, nuclear methods and infrared thermography, core test.		
UNIT-V	**Durability of Concrete**	**08 Hours**
Durability of Concrete: Durability, Transport mechanism of fluids and gases in concrete, cracking in concrete – corrosion and carbonation induced cracking, Alkali Aggregate Reaction, degradation by freeze and thaw, chloride attack, sulphate and sea water attack (marine conditions).		
UNIT-VI	**Advanced Materials for Concrete Protection**	**06 Hours**
Corrosion Inhibitor, Coating of Steel Reinforcement by Epoxy, Galvanized Steel Bars, Stainless Steel, Fiber Reinforcement Bars, Cathodic Protection by Surface Painting		

Reference Books:

R1: M.S. Shetty, "Concrete Technology", S. Chand Publications.
R2: A R Santhakumar, "Concrete Technology" Oxford University Press.
R3: M. L. Gambhir, "Concrete technology", Tata McGraw Hill Publications.
R4: P.N. Balguru and P. N. Shah, "Fiber Reinforced Cement Composite", Mc Graw Hill, New York
R5: P. Kumar Mehta and P. S. M. Monteiro, "Concrete: Microstructure, Properties and Materials", Tata Mc-Graw Hill Education Pvt. Ltd.
R6: N V Nayak and A. K. Jain, "Handbook on Advanced concrete Technology", Narosa Publishing House.
R7: A. M. Neville, "Properties of concrete", Longman Publishers.
R8: R.S. Varshney, "Concrete Technology", Oxford and IBH.
R9: Dr. D.B. Divekar, "Ferrocement Construction Manual -1030".
R10: A. P. Remideos, "Concrete Mix Design", Himalaya Publishing House ISBN-978-81-8318-996-5.
R11: Short &Kenniburg, "Light Weight Concrete", Asia Publishing House, Bombay
R12: IS: 456:2000, "Indian Standard Code of Practice for Plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi.
R13: IS: 383: 2019 "Indian Standard Code of Practice for Coarse and Fine Aggregate for Concrete - Specification", Bureau of Indian Standards, New Delhi.
R14: IS: 10262:2009, "Indian Standard Code of Practice for Concrete Mix Proportioning", Bureau of Indian Standards, New Delhi.
R15: IS: 9103:2020, "Indian Standard Code of Practice for Specification for Concrete Admixtures", Bureau of Indian Standards, New Delhi.

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First Year M. Tech Civil (Structural Engineering)

Academic Year – 2020-2021 Semester - I

[CE5103B]: Structural Design of Concrete Bridges

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
IRC provisions, loading standards, IS Codes, Different Loadings, Types of Bearings and Expansion Joints, Pier, Abutment, Wing walls, Importance of Soil-Structure Interaction; Types of foundations.

Course Objective:
To design concrete bridge components and provide cost-effective solutions for bridge construction.

Course Outcome:
On completion of the course, student will be able to–
CO1: Analyse, design and detailing of orthotopically reinforced slab.
CO2: Analysis of load distribution on deck slabs using different methods.
CO3: Design of T-beam deck slab bridge and different types of girders.
CO4: Analysis and design of rigid frame bridges.
CO5: Design of abutments and piers
CO6: Analysis and design of various types of bearings

Course Contents

UNIT-I	Introduction	06 Hours
Classification of concrete bridges, components of bridge and related structures, economic spans. Factors affecting the selection of site, hydrological data, waterway, scour depth. IRC provisions, loading standards.		
UNIT-II	**Analysis of Deck Slab**	**06 Hours**
Load distribution on deck slabs, isotropic plate, grillage analysis, distribution of loads to longitudinal girders, Little-Morrice-Rowe method, Courbon's method, Guy on Massenet method and Hendry Jaegar method, Design of slab and box culverts for highway loadings.		
UNIT-III	**Design of Deck Slab & Girders**	**08 Hours**
Design of T-beam deck slab bridge: design of RC deck slab, design of post- tensioned longitudinal girder and cross girders.		
UNIT-IV	**Design of Rigid Frame Bridges**	**08 Hours**
Analysis and design of rigid frame bridges		
UNIT-V	**Design of Abutments & Piers**	**08 Hours**
Types of abutments, piers, loads acting on pier and abutments, design of abutments, piers		
UNIT-VI	**Design of Bearings**	**06 Hours**
Functions of bearings, types, design of elastomeric bearings, design of PTFE-pot bearings.		

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Reference Books:

R1: N. Rajagopalan, “Bridge Superstructure”, Alpha Science International, Technology & Engineering 2006.
R2: D.J. Victor, "Essentials of Bridge Engineering", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.
R3: N. Krishna Raju. "Design of Bridges", fourth edition Oxford & IBM Publishing Co, Bombay,2009.
R4: V.K. Raina, "Concrete Bridge Practice", Tata McGraw Hill Publishing Co., New Delhi 1991
R5: F.W Taylor, S.E. Thomson and E. Smulski, "Reinforced Concrete Bridges", John Wiley & Sons, New York 1955.

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First Year M. Tech Civil (Structural Engineering)

Academic Year – 2020-2021 Semester -I

[CE5103C]: Design of Pre-stressed Concrete Structures

Teaching Scheme: TH: - 03 Hours/Week	Credit 03	Examination Scheme: In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Behaviour of prestressed concrete, methods of prestressing, loss and stress calculation in prestressed members

Course Objective:
To analyse the behaviour of different prestressed concrete element, enable to detail different prestressed concrete elements and composite sections.

Course Outcome:
On completion of the course, student will be able to–
CO1: Analyze and design of pre tensioned flexural members.
CO2: Analyze and design of post tensioned flexural member.
CO3: Analyze and design of post tensioned slab.
CO4: Design composite sections.
CO5: Analyse and design of statically indeterminate prestressed members like continuous beam and frame.
CO6: Analyze and design of prestressed pipes and circular tanks.

Course Contents

UNIT-I	Pre-tensioned Flexural members	06 Hours
Design of Pre-tensioned Flexural members: Design of pole, sleepers, pipes, cylinders and lintels.		
UNIT-II	**Post tensioned Flexural members**	**06 Hours**
Design of Post tensioned Flexural members: Design Tee, Iand box section girders.		
UNIT-III	**Post tensioned Prestressed Concrete Slabs**	**08 Hours**
Design of Post tensioned Prestressed Concrete Slabs: Introduction, Design of one way, two way and flat slabs.		
UNIT-IV	**Composite Beams**	**08 Hours**
Composite Beams: Composite sections of Prestressed concrete beam and cast in-situ RC slab Analysis of stress, Differential shrinkage, Deflections, Flexural and Shear strength of composite sections, Design of composite sections.		
UNIT-V	**Statically Indeterminate Structures**	**08 Hours**
Statically Indeterminate Structures: Analysis and Design of continuous beams and Frames including choice of cable profile, linear transformations, concordance of cable and shift calculations.		
UNIT-VI	**Prestressed Concrete Pipes and Tanks**	**06 Hours**
Prestressed Concrete Pipes and Tanks: Circular prestressing, types of Prestressed concrete pipes. Prestressed Concrete tanks: General features, Analysis and design of circular tanks.		

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Reference Books:

R1: N. Krishna Raju, "Prestressed Concrete", Tata McGraw Hill Publication Co.
R2: B. C. Punmia, A. K. Jain and Arun K. Jain, "Reinforced Concrete Structures Vol. II", Laxmi Publications, New Delhi.
R3: T. Y. Lin & N. H. Burns, "Design of Prestressed Concrete Structures", John Wiley.
R4: E. G. Nawy, "Prestressed Concrete- A Fundamental Approach", Practice Hall International.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - I
[CE5103D]: Mechanics of Modern Materials

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Types of conventional material, elastic properties of materials.

Course Objective:
To have an overview of Material Science and Engineering as a basis for understanding how structure/property/processing relationships are developed and used for different types of materials. Illustrates the role of materials in modern society of advances in new materials and processes to apply them for the advanced manufacturing processing for various structural engineering applications.

Course Outcome:
On completion of the course, student will be able to–
CO1: Explain classification and applications of modern materials.
CO2: Understand the engineering properties of modern materials
CO3: Determine the failure theories.
CO4: Identify the behaviour of Composite Laminates.
CO5: Analyze and design of Composite Structures.
CO6: Experimental analysis of various modern materials.

Course Contents

UNIT-I	Introduction to Modern Materials	06 Hours

Fiber-Reinforced Polymer Composite (FRPC) Materials: definition, historical development, applications. Fibers and Matrix: types and their properties, manufacturing process and methods for composites. Types and classification of composite materials, properties, advantages over conventional materials. Piezoelectric Materials: History, crystal structure, applications. Shape Memory Alloys (SMA), Functionally Graded Materials (FGM): definition and applications.

UNIT-II	Engineering Properties of Modern Materials	06 Hours

FRPC Composite Lamina: Micromechanics approach, methods. Longitudinal and transverse elastic properties of composite lamina, in- plane shear modulus for continuous fibres. Stress-strain relationship, compliance and stiffness matrices for generally anisotropic, especially orthotropic material, transversely isotropic material, orthotropic, isotropic materials, Plane stress condition for thin lamina, transformation of stress and elastic properties. Three dimensional transformations. Stiffness matrix for Functionally Graded Materials.

UNIT-III	Strength of Composite Lamina	08 Hours

Introduction. Failure theories, Maximum stress theory, Maximum strain theory, Energy based interaction theory (Tsai-Hill), Interactive tensor polynomial theory (Tsai-Wu), Failure mode-based theory (Hasin-Rotem). Computation of lamina strength by Tsai-Wu theory for plane stress condition. Comparison of various failure theories.

UNIT-IV	Elastic behaviour of Composite Laminate	08 Hours

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Basic assumptions, Laminate configurations, Strain-displacement relationship, Stress-strain relationship, Force and moment resultants, Laminate Compliances and stiffness matrices, Transformation of matrices. Load deformation relationship for symmetric laminates, symmetric cross-ply, symmetric angle-ply, balanced, anti-symmetric cross-ply and angle ply, orthotropic, quasi-isotropic laminates.		
UNIT-V	**Design of Composite Structures**	**08 Hours**
Coefficients of thermal and moisture expansion of various unidirectional lamina, load deformation relationship, residual stresses for cross ply symmetric laminates. Design methodology, design of pressure vessel for various laminate configurations.		
UNIT-VI	**Experimental Methods of Testing of Composite Materials**	**06 Hours**
Characterization of constituent materials, fibre, matrix, thermal fibre, interface/interphase characterization, Fibre volume ratio, void volume ratio. Determination of hydrothermal expansion coefficients, tensile, compressive and shear properties of unidirectional laminates. Testing of inter laminar fracture toughness, Biaxial testing, Introduction to stress concentration in laminates.		

Reference Books:

R1: I. M. Daniel and O. Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press, Second Edition, New Delhi.
R2: M. W. Hyer, "Stress Analysis of Fiber-Reinforced Composite Materials", WCB/McGraw-Hill, Singapore.
R3: R. M. Jones, "Mechanics of Composite Materials", McGraw-Hill, New York.
R4: R. F. Gibbson, "Mechanics of Fiber Reinforced composites". McGraw-Hill.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - I
[CE5104A]: Ferrocrete Technology I

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Basic properties of concrete ingredients, Analysis methods for structural members.

Course Objective:
To have an overview of Ferrocrete material as structural smart material for innovative constructions and infrastructural developments.

Course Outcome:
On completion of the course, students will be able to–
CO1: Comprehend different types of Ferrocement concrete, its typical properties and proportion of mortar
CO2: Recognize the mechanical properties and different construction method using ferrocement.
CO3: Design of structure based on form, shape, various structural forms and their behaviour.
CO4: Design the houses with cavity walls, hollow floors and hollow beams.
CO5: Apply the concept of ferrocement to various structural members.
CO6: Apply ferrocement in different space structures and precast products like shells, pyramids, domes etc

Course Contents

UNIT-I	Introduction of concrete in structure	06 Hours

Definition. Basic concept like bond increase. Comparison with concretes like RCC, Prestressed, Asbestos cement, Fiber reinforced, Polymer concretes. Composition of ferrocement. Special types of ferrocement. Ferrocement as substitute for conventional building materials. Typical characteristics and their applications.
Raw materials, skills, tools and plants. Ferrocement as material of construction. Forming a ferrocement structure. Properties and specifications of raw materials. Proportioning of cement mortar. Job requirements of required skills. Tools and plants

UNIT-II	Ferro cementing Method	06 Hours

Mechanical properties and typical features affecting design. Properties under static and dynamic loading. Shrinkage and creep. Testing of ferrocement.
Experimenting the methods of constructing ferrocement structures. Standardizing method of construction. Planning the work. Fabricating skeleton, tying meshes and mortaring. Curing. Maintenance. Protective surface treatments. Damage to ferrocement structures.

UNIT-III	Design methods for various Structure	08 Hours

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Strength through shape. Design of structure based on form and shape. Forms in nature. Various structural forma and their behaviour. Typical strengths of different materials. Comparative study of various forms.

Design of ferrocement structures. Design, analysis and optimization. Special design considerations for ferrocement. Typical features of ferrocement affecting design. Conventional design methods like working stress, load factor, applied to ferrocement. Design based on equivalent area method for compression, tension and flexural members. Specific surface method and crack control method, Design of structures subjected to membrane stresses. Design of shaped structures in ferrocement like stiffened plates, arch faced walls, stiffened cavity walls and hollow floors and beams. Design of forms like 'T', 'U' 'T' '+' 'L'.

UNIT-IV	Cost Analysis	08 Hours

Cost analysis: Factors governing cost analysis. Special considerations for ferrocement structures. Cost comparison with conventional construction. Specifications for ferrocement structures. Quantity analysis of material and labour for ferrocement items. Cost and value of ferrocement construction.

Ferrocement in building construction. Ferrocement in foundations, walls, floors roofs. Ferrocement single wall construction. Design and construction of houses with cavity walls, hollow floors and hollow beams. Staircases and other building accessories. Earthquake resisting structures. Special characteristics of ferrocement to resist shock loading. Design and construction of quake proof structures

UNIT-V	Water and Soil retaining structure	08 Hours

Hydraulic structures. Why ferrocement? Water retaining structures. Storage tanks of various types. Structures across streams. Ferrocement in layered form used for lining, water proofing and surface coating.

Soil retaining structures. Types of retaining walls and their comparison with ferrocement arch faced wall. Design and method of fabrication and casting. ferrocement counter fort retaining wall. Ferrocement containers for storing granular materials.

UNIT-VI	Precast ferrocement products	06 Hours

Ferrocement large size special purpose structures. Space structures like shells, pyramids, domes corrugated catenaries.

Precast ferrocement products: Why ferrocement for precasting? Methods of precasting. Design of precast elements. Ferrocement precast walling and flooring panels. Joints in precast ferrocement elements.

Reference Books:

R1: B. N. Divekar, "Ferrocrete Technology- A Construction Manual".
R2: S. P. Shah and P. N. Balaguru "Concrete Technology and Design Vol. II".
R3: Proceedings of International Symposiums on 'Ferrocement and thin reinforced composites. - Ferro 1 to Ferro 10. International Ferrocement Information Centre, A I T Bangkok, Thailand.
R4: "Construction and Repairs of Ferrocement", ACI committee Report. No ACI549R- 88 and ACI 549.1R.88. Published by American Concrete Institute, Detroit, USA
R5: B. R. Paul and R. P. Pama, "Ferrocement Authors", International Ferrocement Information Centre. A. I. T. Bangkok, Thailand.
R6: A. E. Naaman, "Ferrocement and Laminated Cementitious Composite", Techno-press, Ann Arbor, Michigan, U S A.
R7: "Ferrocement- Materials and applications", SP 61, A C I Detroit. U S A.

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First Year M. Tech Civil (Structural Engineering)

Academic Year – 2020-2021 Semester -I

[CE5104B]: Advanced Design of Concrete Structures

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Behaviour of reinforced concrete structure, limit state method, working stress method, design of basic reinforced concrete structural elements.

Course Objective:
To apply advanced design concept to special structures, ESR, Bunkers, Silos, raft foundation and utilize the knowledge of analysis and design of these different concrete structures in practical life.

Course Outcome:
On completion of the course, student will be able to–
CO1: Analyse, design and detailing of orthotopically reinforced slab.
CO2: Analyse and design of grid and coffered dam.
CO3: Analyse and design of flat slab.
CO4: Analyse, design and detailing of elevated service reservoir.
CO5: Analyze, design and detailing bunkers and Silos
CO6: Analyse, design and detailing Raft and Pile foundation.

Course Contents

UNIT-I	Introduction to yield line theory	06 Hours
Yield line theory for analysis of slabs, various patterns of yield lines, assumptions in yield line theory, characteristics of yield lines, equilibrium and virtual work method of analysis. Design of various slabs such as rectangular, triangular, circular with various edge conditions using yield line theory, Design for limit state of strength and serviceability of orthotopically reinforced slabs.		
UNIT-II	**Design of grid slab**	**06 Hours**
Grid and coffered slabs, general features, rigorous and approximate method of analysis, design of grid floor by approximate method.		
UNIT-III	**Design of flat slab**	**08 Hours**
Flat slabs, types, design methods, column and middle strip, proportioning of flat slab element, total design moment, distribution of moments, effect of pattern loading, design for shear, design of intermediate and end panel by direct methodology		
UNIT-IV	**Elevated service reservoir**	**08 Hours**
Elevated service reservoir: Rectangular and circular type only flat bottom, Design of staging for wind and earthquake forces.		
UNIT-V	**Miscellaneous structures**	**08 Hours**
Design of bunkers, and Silos, square and circular bunkers, silos shallow and deep beams.		
UNIT-VI	**Design of foundation and formwork**	**06 Hours**

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Design of raft foundations, pile foundations, single pile, group of piles, Pile cap, design of form work for slabs, girders and columns.

Reference Books:

R1: H. J. Shah, "Reinforced Concrete design", Charotar publishing house.
R2: B. C. Punmia, A. K. Jain and Arun K. Jain, "Reinforced Concrete Structures Vol. II", Laxmi Publications, New Delhi.
R3: N. C. Sinha, S.K. Roy, "Fundamentals of Reinforced Concrete", S. Chand & Co. Ltd, New Delhi.
R4: S. S. Bhavikatti, "Advance R. C. C. Design", New Age International Publishers.
R5: S. Ramaamruthum, "Design of RCC Structures" Dhanpat Rai publications.
R6:P. C. Varghese, "Advanced Reinforced Concrete Design", Prentice Hall of India Pvt. Ltd., New Delhi.
R7: IS: 456-2000, "Indian Standard Code of Practice for Plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi.
R8: IS: 1893, "Indian Standard Code of practice for criteria for Earthquake resistant design of Structures", Bureau of Indian Standards, New Delhi.
R9: IS: 3370, "Indian Standard Code of Practice for Concrete Structures for Storage of Liquids", Bureau of Indian Standards, New Delhi.

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First Year M. Tech Civil (Structural Engineering)

Academic Year – 2020-2021 Semester - I

[CE5104C]: Advanced Design of Precast concrete Structures

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Properties of hardened concrete, High performance concrete, Concrete Technology, stress stain.

Course Objective:
The Objective of this course is to enable students to design composite and precast components.

Course Outcome:
On completion of the course, student will be able to–
CO1: Identify the materials and precast components.
CO2: Apply concept of Ferrocement to precast concrete structures
CO3: Design different types of precast components - floor slabs, walls, beams and columns
CO4: Analyze and Design of Ferrocrete Structures
CO5: Apply the optimized method for strengthening of joints of precast structures.
CO6: Apply Ferrocrete technology to structures based on the concept of strength through shape.

Course Contents

UNIT-I	Introduction	06 Hours

History and Development of Precast concrete construction, Advantages and disadvantages of precast concrete construction; different types of units involved in general building construction, including residential, factory and industrial framed structure; their general principles of design; mechanical handling of large projects like stadium, bridges etc.
Materials viz. Concrete, Self-Compacting Concrete, Grout, Reinforcement and structural welded wire cages. Requirements of industrialized buildings, standardization of precast elements and unification of building design. Influence of manufacture, transport and erection technologies on design solution (Modular and Tilt-Up); expansion and contraction joints.

UNIT-II	Ferrocement	06 Hours

Definition, basic concept like bond increase, comparison with concretes like RCC, Prestressed, Asbestos cement, Fiber reinforced, Polymer concretes. Composition of ferrocement, special types of ferrocement. Ferrocement as substitute for conventional building materials, typical characteristics and their applications.
Raw materials, skills, tools and plants. Ferrocement as material of construction. Forming ferrocement structure. Properties and specifications of raw materials. Proportioning of cement mortar. Job requirements of required skills. Tools and plants.

UNIT-III	Prefabricated Components and its Behaviour	08 Hours

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Design of precast concrete components and behaviour of structural components, large panel constructions, Construction of roof and floor slabs, Wall panels, Beams, Columns, Shear walls.
Design for Flexure: Strength design (Depth of Stress block, Flanged Elements, Strength reduction factor, Limitations on reinforcement, Critical sections), Service load design. Design for Shear: Horizontal and vertical shear resistance.

UNIT-IV	Design of Ferrocrete Structures	08 Hours

Design, analysis and optimization, Special design considerations, Typical features of Ferrocrete affecting design, Design criteria, Rational method of design ferrocrete structure. Strength through shape, Shape and form of a structure, various structural forms and their behaviour, Comparative study of various forms
Hydraulic structures, Water retaining structures, Storage tanks of various types. Structures across streams. Ferrocement in layered form used for lining, water proofing and surface coating.

UNIT-V	Joints and Connections	08 Hours

Joints and connections in precast construction; classification and their requirements. Design of concrete bracket and corbels, cantilever beam design method, Strut-and-tie method.
Introduction to Hanger Connections. Design of bearing pads, column bases and moment connections. Typical connection designs for lateral load resisting systems

UNIT-VI	Space structures and precast products	06 Hours

Ferrocement large size special purpose structures. Space structures like shells, pyramids, domes corrugated catenaries.
Precast ferrocement products: Why ferrocement for recasting Methods of precasting. Design of precast elements. Ferrocement precast walling and flooring panels. Joints in precast ferrocement elements.

Reference Books:

R1: A. E. Naaman, "Ferrocement and laminated cementations composites", Techno-press Ann Arbor, Michigan, U SA.
R2: "PCI Design Handbook, Precast and Prestressed Concrete", (6thEdition).
R3: Koncz T. "Manual of precast concrete construction, Vols. I, II and III", Bauverlag, GMBH.
R4: D. B. Divekar, "Ferrocement Construction Manual".
R5: "CBRI, Building materials and components", India, 1990.
R6: "Design, Construction and Repairs of Ferrocement", ACI549R- 88 and ACI 549.1R.88. American Concrete Institute, Detroit, USA
R7: B. R. Paul and R. P. Pama, "Ferrocement" International Ferrocement Information Centre. A. I. T. Bangkok, Thailand.
R8: "Ferrocement-Materials and applications", SP 61, A C I Detroit. U S
R9: Ferrocement code -ACI549.1R
R10: C. Z. Gerostiza, C. Hendrikson and D. R. Rehat, "Knowledge Based Process Planning for Construction and Manufacturing", Academic Press Inc., 1994
R11: "Structural design manual, Precast concrete connection details", Society for the studies in the use of precast concrete, Netherland BetorVerlag, 1978.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - I
[CE5104D]: Structural Stability

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Types of conventional material, elastic properties of materials.

Course Objective:
It is a course based on fundamental mechanics that is designed to give the theoretical background to the more practical design-based module

Course Outcome:
On completion of the course, student will be able to–
CO1: Understand the concept of stability for structures
CO2: Apply finite element approach for stability analysis
CO3: Apply differential equation to beam-column joints
CO4: Comprehend buckling loads for optimization of stability
CO5: Apply Energy methods for thin plate problems and beam-column members

Course Contents

UNIT-I	Introduction to structural analysis and significance of stability	06 Hours

Fundamental concepts, elastic structural stability, structural instability, analytical methods for the stability analysis, equilibrium, imperfections and energy methods.

UNIT-II	Elastic Energy Method	06 Hours

Elastic buckling of columns, assumptions, critical load for various boundary conditions, columns with geometric imperfection, large deflection theory of columns, Southwell plot, Orthogonality of buckling modes, eccentrically loaded columns, numerical techniques – Finite difference and Finite element approach.

UNIT-III	Buckling of beam-column	08 Hours

Elastic buckling of beam-column, differential equations of beam-column, beam- column with concentrated point load, several point loads, continuous lateral load, single couple, uniformly distributed load, end couples.

UNIT-IV	Buckling of frames under various loads	08 Hours

Elastic buckling of frames, triangular, partial, multistory portal and box frames with symmetric & anti symmetric buckling, stiffness method approaches, approximate method, buckling of open sections, torsional buckling.

UNIT-V	Elastic buckling of thin plates	08 Hours

Support conditions of thin plates, equilibrium approach, rectangular plate with axial load in one and two directions, various boundary conditions, Energy methods – Rayleigh Ritz and Gelerkin, large deformation theory of plates and effective width concept, post buckling behaviour of plates.

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UNIT-VI	Design methodology for elements	06 Hours
Structural Design for stability of Members, Lateral torsional buckling of beams, lateral torsional buckling of cantilever and S.S. beams, stability design of beam-column member.		

Reference Books:

R1: S. P. Timoshenko. and J. M. Gere, "Theory of Elastic Stability", McGraw Hill, Singapore.
R2: G. George, "Introduction to Structural Stability Theory", McGraw Hill, New York.
R3: N. G. Iyengar., "Elastic Stability of Structural elements", McMillan, India.
R4: A. Kumar, "Stability of Structures", Allied Publishers, New Delhi.
R5: M. L. Gambhir, "Stability Analysis and Design of Structures", Springer-Verlag (2004).

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - I
[CE5105]: Lab Practice I

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	02	Term work :50Marks Oral/ Presentation: 50 Marks Total :100 Marks

Course Prerequisites:
Knowledge of current issues, research & development and failures in the structural engineering field.

Course Objective:
To prepare students for practice and hands on assignments on course works. Introduce the students to independent thinking and exposure to practical considerations.

Course Outcome:
On completion of the course, student will be able to–
CO1: Identify and assess practical parameters in the study domain.
CO2: Criticize and evaluate the research work.

Course Contents

1. Completion of assignments / review of technical documentaries/review of case studies / research paper review/failure case studies/observation and group discussion on case studies.
2. Technical review and critique of a research article/paper on any topic from the refereed journal paper related to the program content.
3. The oral exam for Lab -I should be based on completion of assignments /review of technical documentaries / review of case studies / research paper review / failure case studies / observation and group discussion on case studies / applications confined to the course.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - I
[CE5106]: Online Course/Certification

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	02	Term work : 50 Marks Oral/ Presentation: 50 Marks Total :100 Marks

Prerequisites Courses:
Basics analysis or design concepts of the selected course.

Course Objective:
The Objective of this course is to prepare students to learn the courses using online teaching aids.

Course Outcome:
On completion of the course, student will be able to–
CO1: Use modern ICT tools for self-learning.
CO2: Demonstrate the ability to abreast with advance technologies.
CO3: Apply the analysis/design tools for solving the structural engineering problems.

Course Contents

The students should complete at least one NPTEL Certification course which will be offered by NPTEL Courses during the same semester. The students should select the subjects relevant to MTech. (Structural Engineering) and which should not include in the specified curriculum. Minimum duration of course should be 4 weeks and all assignments should be submitted. Certification done would be appreciated but not mandatory. In case a student does not go for certification, he/she should pass the internal test organized by department for the said course.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - I
[**]: Audit Course - I

The purpose of audit courses is to give general awareness about the social issues to the students. Students are expected to apply the scientific way to analyze the data and make use of their technical expertise to deal with the issues. The basic objective is to give a different learning experience in context with social issues. Assessment of the student's work will be done on the basis of assignments/reports/presentations/oral/exam/test.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has at least 75% or above attendance and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA.

Evaluation Criteria:

Guidelines for Conduction (Any one or more of following but not limited to)

• Lectures/ Guest Lectures • Visits (Social/Field) and reports • Demonstrations	• Surveys • Mini Project • Hands on experience on

Guidelines for Assessment (Any one or more of following but not limited to)

• Written Test • Demonstrations/ Practical Test • Poster presentation	• Presentations • IPR/Publication • Report

Audit Course I

**Audit Course Code	Audit Course Title
EC5108	Technical Paper writing
CE5107	Disaster Management
ME5107	Value Education in Engineering
CS5108	Constitution of India

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - I
[EC5108]: Technical Paper Writing

Course Prerequisites: Nil

Course Outcome:
On completion of the course, student will be able to–
CO1: Write a paper and report.
CO2: Properly present papers in conferences with neat flow.

Course Contents

UNIT-I		**06 Hours**
Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.		
UNIT-II		**06 Hours**
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.		
UNIT-III		**08 Hours**
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.		
UNIT-IV		**08 Hours**
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.		
UNIT-V		**08 Hours**
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.		
UNIT-VI		**06 Hours**
Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.		

Reference Books:
R1: Writing for Science, Goldbort R, Yale University Press
R2: How to Write and Publish a Scientific Paper, Day R, Cambridge University Press
R3: Handbook of Writing for the Mathematical Sciences, Highman N, SIAM. Highman's book
R4: English for Writing Research Papers, Adrian Wallwork, Springer New York Dordrecht Heidelberg London.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - I
[CE5107]: Disaster Management

Course Prerequisites: Nil

Course Objective:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Course Outcome:

On completion of the course, student will be able to–

CO1: Respond in critical Disaster Situation.

CO2: Help in affected areas.

Course Contents

UNIT-I	Understanding Disasters	02 Hours

Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.

UNIT-II	Types, Trends, Causes, Consequences and Control of Disasters	08 Hours

Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.

UNIT-III	Disaster Management Cycle and Framework	08 Hours

Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR,Yokohama Stretegy, Hyogo Framework of Action.

UNIT-IV	Disaster Management in India	07 Hours

Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter Governmental Agencies.

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UNIT-V	Applications of Science and Technology for Disaster Management	07 Hours
Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non-Structural Mitigation of Disasters S&T Institutions for Disaster Management in India.		
UNIT-VI	**Suggested Areas for Project and Assignments**	**07 Hours**
Study of Recent Disasters (at local, state and national level) And Preparation of Disaster Risk Management Plan of an Area or Sector Role of Engineers in Disaster Management.		

Reference Books:

R1: Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.

R2: Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi

R3: An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi

R4: World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland.

R5: Encyclopedia of disaster management, Vol I, II and IIIL Disaster management policy and administration, S L Goyal, Deep & Deep, New Delhi, 2006.

R6: Encyclopedia of Disasters – Environmental Catastrophes and Human Tragedies, Vol. 1 & 2, Angus M. Gunn, Greenwood Press, 2008

R7: Disasters in India Studies of grim reality, Anu Kapur & others, 2005, 283 pages, Rawat Publishers, Jaipur

R8: Management of Natural Disasters in developing countries, H.N. Srivastava & G.D. Gupta, Daya Publishers, Delhi, 2006, 201 pages

R9: Natural Disasters, David Alexander, Kluwer Academic London, 1999, 632 pages

R10: Disaster Management Act 2005, Publisher by Govt. of India

R11: Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management.

R12: NIDM Publications.

R13: High Power Committee Report, 2001, J.C. Pant.

R14: Disaster Mitigation in Asia & Pacific, Asian Development Bank.

R15: National Disaster Management Policy, 2009, Govt. of India.

R16: Disaster Preparedness Kit, American Red Cross.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - I
[ME5107]: Value Education in Engineering

Course Prerequisites: Nil

Course Objective:

1. Understand value of education and self- development.
2. Imbibe good values in students.
3. Let they should know about the importance of character.

Course Outcome:

On completion of the course, student will be able to–

CO1: Knowledge of self-development.
CO2: Learn the importance of Human values.
CO3: Developing the overall personal.

Course Contents

UNIT-I		06 Hours
Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.		
UNIT-II		**06 Hours**
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.		
UNIT-III		**08 Hours**
Personality and Behaviour Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.		
UNIT-IV		**08 Hours**
Character and Competence –Holy books vs Blind faith. Self-management and good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.		

Reference Books:

R1: Values and Ethics for organizations Theory and practice, Chakraborty, S.K. Oxford University Press, New Delhi
R2: Value Education in Engineering, S Chand Publication.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - I
[CS5108]: Constitution of India

Course Prerequisites: Nil

Course Objective:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcome:

On completion of the course, student will be able to–

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3: Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

Course Contents

UNIT-I		**06 Hours**
History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) welfare of SC/ST/OBC and women.		
UNIT-II		**06 Hours**
Philosophy of the Indian Constitution: Preamble, Salient Features.		
UNIT-III		**08 Hours**
Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties		
UNIT-IV		**08 Hours**
Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.		
UNIT-V		**08 Hours**
Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy		

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UNIT-VI		06 Hours
Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women		

Reference Books:

R1: The Constitution of India, 1950 (Bare Act), Government Publication.
R2: Dr. B. R. Ambedkar framing of Indian Constitution, Dr. S. N. Busi, 1st Edition
R3: M. P. Jain, Indian Constitution Law, 7th Edition, Lexis Nexis
R4: Introduction to the Constitution of India, D.D. Basu, Lexis Nexis

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - II
[CE5108]: Finite Element Method

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In Sem. Evaluation: 15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total :100 Marks

Course Prerequisites:
A basic knowledge of Basic Numerical Methods course which focuses on linear systems and ordinary differential equations would suffice. Basic calculus (Differentiation and Integration), Differential Equations (ODEs/PDEs) Linear Algebra, Solid Mechanics, Tensor algebra and calculus Variational principles would be a added advantage.

Course Objective:
This course will enable students to understand the mathematical and physical principles underlying the FEM. & Improvise them to identify and solve relatively complex engineering problems using commercial FEM software's such as STAAD Pro, ETABS etc.

Course Outcome:
On completion of the course, students will be able to–
CO1: To apply the basic knowledge of elasticity to solve continuum mechanics problems, use numerical technique like Rayleigh –Ritz method, Gelrkins method to solve partial differential equations of structural engineering problems.
CO2: To evaluate various methodologies namely polynomial functions, stiffness matrix and degrees of freedom concepts
CO3: To relate the shape functions and its coordinate system & apply the logic to development for shape functions for 1D 2D 3D element.
CO4: To demonstrate the development of Jacobian matrix and its formulation for various elements like beam, truss etc.
CO5: To apply the various theories of plate bending to four and eight noded isoparametric elements.
CO6: To understand stress strain relations & study the Flat and Curved shell

Course Contents

UNIT-I	Introduction to Finite Element	

Background on variational calculus, Galerkin method, collocation method, least squares methods, Variational methods of approximation, Rayleigh-Ritz method, Variational theorem, principle of minimum potential energy, use of polynomial displacement function, variational approach for formulation of element stiffness matrix for truss and beam elements, Strong and Weak formulation.

UNIT-II	Basic Methods of Finite Element	06 Hours

Two dimensional elements in plane stress / plane strain problems. CST, LST and rectangular elements, modeling considerations, aspect ratio, use of polynomial displacement functions, Pascal 's triangle. Requirements for convergence, geometric invariance, grid refinement. Standard stiffness and load vector formulation procedures using variational principle. Condensation of internal degrees of freedom-Summary of analysis procedure.

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UNIT-III	Interpolation Methods	08 Hours
Shape functions in Cartesian and natural coordinate systems, shape functions for one, two- and three-dimensional elements. Higher order elements- Lagrange –Serendipity – Interpolation-formulation of element stiffness.		
UNIT-IV	**Isoperimetric Formulations**	**08 Hours**
Concept of isoperimetric elements and isoperimetric mapping, Jacobean matrix, formulation of two dimensional quadrilateral isoperimetric elements in plane elasticity problem, 3-D isoperimetric elements.		
UNIT-V	**Modeling Methods**	**08 Hours**
Thin Plate bending elements, various triangular and rectangular elements, ACM (Adini, Clough, Melosh) and BFS (Bogner, Fox, Schmidt) elements. Conforming and non- conforming elements, concept of four noded and eight nodded isoparametric elements, Mindlins hypothesis for plate bending element.		
UNIT-VI	**Application of FEM to Formulations**	**06 Hours**
Axisymmetric elements in axisymmetric problems, stress strain relations, triangular and Quadrilateral elements. Flat and curved shell element, elements for cylindered shells, curved solid elements.		

Reference Books:

R1: J. N. Reddy, "An Introduction to the finite element method", Tata McGraw Hill Publishing Co. Ltd.

R2: C. S. Krishna Moorthy, "Finite Element Analysis: Theory & Programming", Tata McGraw Hill Publishing Co. Ltd.

R3: G. R. Buchanan, "Finite Element Analysis Schaum's outlines", Tata McGraw Hill Publishing Co. Ltd.

R4: D. L. Logan, "A First Course in Finite Element Method", Cengage Learning.

R5: S. S. Bhavikatti, "Finite Element Analysis", New Age International Publishers, Delhi.

R6: S. S. Rao, "The Finite Element Method in Engineering" 4th Edition, Elsevier Publication.

R7: O. Zienkiewicz & R. Taylor, "The Finite Element Method" 4th Edition, Vol. I &II, McGraw Hill International Edition.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - II
[CE5109]: Theory of Plates and Shells

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In Sem. Evaluation: 15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total :100 Marks

Course Prerequisites:
Basic concepts of stress – strain relationship for plates. Basic knowledge for analysis of beams and arches, also basic points differential equation

Course Objective:
The objective of this course is to give proper knowledge to explain classifications of plate and shell structures and describe different analysis theories for various types of plates and shells.

Course Outcome:
On completion of the course, student will be able to–
CO1: Classify and describe small deflection theories for thin and thick plates.
CO2: Explain and apply the shear and moment deformation theories for rectangular plates designed for various loading and boundary conditions.
CO3: Analyze circular plates with various loading and boundary conditions.
CO4: Understand shell geometry and analysis theories for thin shells.
CO5: Use membrane theory for analysis of circular cylindrical shells.
CO6: Analyze the cylindrical roof shells.

Course Contents

UNIT-I	Introduction	06 Hours

Introduction: Thin and thick plates, small and large deflections, small deflection theory of thin plates: assumptions, moment curvature relations, stress resultants, governing differential equation in Cartesian co-ordinates, various boundary conditions, pure bending of plates. Analysis of rectangular plates: Navier solution for plates with all edges simply supported, distributed loads, point loads and rectangular patch load

UNIT-II	Methods of analysis	06 Hours

Levy's Method: Distributed load and line load, plates under distributed edge moments. Raleigh- Ritz approach for simple cases in rectangular plates. Introduction to shear deformation theories, Reissener - Mindlin's theory, moment curvature relationship for First order shear deformation theory.

UNIT-III	Circular Plates	08 Hours

Circular Plates: Analysis of circular plates under Axi-symmetric loading, moment curvature relations, governing differential equation in polar co-ordinates. Simply supported and fixed edges, distributed load, ring load, a plate with a central hole.

UNIT-IV	Introduction of shells	08 Hours

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Introduction: Classification of shells on geometry, thin shell theory, equations to shell surfaces, stress resultants, stress- displacement relations, compatibility and equilibrium equations. Shells of revolution: Membrane theory, equilibrium equations, strain displacement relations, boundary conditions, cylindrical, conical and spherical shells.		
UNIT-V	**Analysis of Circular cylindrical shells**	**08 Hours**
Circular cylindrical shells: Membrane theory: Equilibrium equations, strain displacement relations, boundary conditions. Bending Theory: Equilibrium equation, strain displacement relations, governing differential equation, solution for a simply supported cylindrical shell, various boundary conditions and application to pipes and pressure vessels.		
UNIT-VI	**Beam theory**	**06 Hours**
Beam theory of cylindrical shells: Principles of Lundgren's beam theory, beam analysis, arch analysis, and application to cylindrical roof shells.		

Reference Books:

R1: S. Timoshenko and W. Krieger, "Theory of Plates and Shells", McGraw Hill.
R2: A. C. Ugural, "Stresses in Plates and Shells", McGraw Hill
R3: G. S Ramaswamy, "Design and Construction of Concrete Shell Roofs", CBS Publications.
R4: K. Chandrasekhara "Analysis of Concrete Shells", New Age International Edition.
R5: K. Chandrasekhara "Analysis of Plates", New Age International.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - II
[CE5110]: Research Methodology & IPR

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Basic Concepts of Statistics

Course Objective:
The objective of the course is to explain the basic of research, process involved; identify appropriate research topics, sampling techniques and data interpretation. It will create consciousness for Intellectual Property Rights and its constituents. Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad.

Course Outcome:
On completion of the course, student will be able to–
CO1: Demonstrate knowledge of research processes; describe sampling methods, measurement scales and instruments and appropriate uses of each.
CO2: Perform literature reviews using print and online databases and follow research ethics.
CO3: Prepare effective research proposals and reports.
CO4: Identify, apply and assess principles of law relating to each of these areas of intellectual property;
CO5: Demonstrate a capacity to assess ownership rights and marketing protection under intellectual property law as applicable to information, ideas, new products and product marketing;
CO6: Understand current and emerging issues relating to the intellectual

Course Contents

UNIT-I	Meaning of research problem	06 Hours
Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.		
UNIT-II	**Literature review**	**06 Hours**
Effective literature studies approach, analysis Plagiarism and Research ethics.		
UNIT-III	**Effective technical writing**	**08 Hours**
How to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.		
UNIT-IV	**Nature of Intellectual Property**	**08 Hours**
Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.		
UNIT-V	**Patent Rights**	**08 Hours**

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Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.		
UNIT-VI	**New Developments in IPR**	**06 Hours**
Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.		

Reference Books:

R1: Stuart Melville and Wayne Goddard, "Research methodology: An introduction for science & engineering students", Juta& Co. Ltd,1996

R2: Ranjit Kumar, "Research Methodology: A Step-by-Step Guide for beginners", Pearson, 2005

R3: Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

R4: Mayall, "Industrial Design", McGraw Hill, 1992.

R5: Niebel, "Product Design", McGraw Hill, 1974.

R6: Asimov, "Introduction to Design", Prentice Hall, 1962.

R7: R. P. Merges, P. S. Menell, M. A. Lemley, "Intellectual Property in New Technological Age", 2016.

R8: T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - II
[CE5111A]: Structural Design of Steel Bridges

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Standard specifications, IRC loading, loading standards, gussets, cross frame members, steel plates, lateral bracing, expansion joints and hinges, webs, flanges, stiffeners,

Course Objective:
To design different components and apply in steel bridges and design philosophy of steel bridge to control for heavy traffic.

Course Outcome:
On completion of the course, student will be able to–
CO1: Classify different components of bridges and compare with standard specifications.
CO2: Analyse, through type and deck type plate girder bridges.
CO3: Design plate girder bridges.
CO4: Analyse and design truss bridge.
CO5: Analyze and design cable supported steel bridges and box girders.
CO6: Analyze supporting members of box girders.

Course Contents

UNIT-I	Introduction	06 Hours
Introduction to bridge engineering, classification and components of bridges, layout, planning, structural forms of bridge decks, beam and slab decks, cellular decks, standard specification for bridges, IRC loadings for road bridges, loading standards for railway bridges.		
UNIT-II	**Analysis of Different Types of Bridges**	**06 Hours**
Analysis and design of beam and plate girder bridges, analysis of through type and deck type bridges		
UNIT-III	**Effect of Different Buckling**	**08 Hours**
Design of plate girder bridges, main plate girder, shape limitation based on local buckling, lateral torsional buckling, web buckling, shear moment interaction, fatigue effect, Lateral bracing		
UNIT-IV	**Design of Truss Bridges**	**08 Hours**
Design of truss bridges, optimum depth of truss girder, design of compression chord member, design of tension chord member, design of vertical and diagonal member, Lateral bracing		
UNIT-V	**Design of Suspension Bridges**	**08 Hours**
Design of cable supported steel bridges, design of steel box girder, design of suspension cables, Suspension bridges.		
UNIT-VI	**Design of Different types of Boxes**	**06 Hours**
Box section flexural members, diaphragm requirements at support, bearing, top lateral bracing in tube girder, horizontally curved boxes, single boxes, closed boxes, proportioning limits		

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References Books:

R1: G. W Owens, P. R. Knowle, P. J. Dowling, "Steel Designers Manual", Fifth edition, Blackwell Scientific Publications.

R2: S. Chatterjee "The Design of Modern Steel Bridges", First edition, BSP Professional books.

R3: E. T. Demetrios, "Design, Rehabilitation and Maintenance of Modern Highway Bridges", McGraw-Hill Publishers.

R4: D. J. Victor, "Essentials of Bridge Engineering", Oxford and IBH Publishers.

R5: IRC: 6 - 1966 – Section II, "Indian Standard for loads and stresses on Highway Bridges".

R6: Bridge rules - 1982, Specifications for Indian Railway loading.

R7: T. R. Jagadeesh and M. A. Jayaram, "Design of Bridge Structures", Prentice-Hall of India.

R8: N. Krishna Raju, "Design of Bridges", Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

R9: D. J. Lee, "Bridge Bearings and Expansion Joints", E & FN Spon.

R10: V. K. Raina, "Concrete Bridge Practice Analysis, design and Economics", Tata McGraw Hill.

R11: IRC Codes – IRC: 5, IRC: 6, IRC: 18, IRC: 27, IRC: 45, IRC: 78, IRC: 83

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - II
[CE5111B]: Plastic Analysis of Steel Structures

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Structural analysis-I, Structural analysis –II

Course Objective:
To understand the concept of plastic analysis of steel frames, to decide reserve strength of structure after attaining first yield point, to determine shape factor of various cross sections and to design the beam/ frame using plastic method of analysis are main objectives of the course.

Course Outcome:
On completion of the course, student will be able to–
CO1: Demonstrate the behaviour of steel structures in plastic state of deformation.
CO2: Determine collapse load of structure by statical and mechanism method.
CO3: Analyze various steel frames using plastic analysis method.
CO4: Assess the importance of plastic analysis and employ the concept for design of steel structures.
CO5: To identify the effect of additional stresses interacting with bending stresses in steel member.
CO6: To employ the design concepts of steel frames with and without haunches along with connections.

Course Contents

UNIT-I	Introduction to plastic analysis	06 Hours
Plasticity in ductile materials, actual and idealized stress-strain graph for mild steel, elasto-plastic behavior of beam in flexure, shape factor for different cross sections, yield zones, concept of plastic hinge.		
UNIT-II	**Analysis of beams and frames**	**06 Hours**
Plastic collapse loads of determinate and indeterminate structures such as beams and rectangular portal frames, statical and kinematical methods, basic and combined mechanisms. Determination of plastic collapse loads, bending moment diagram at collapse.		
UNIT-III	**Analysis of gable portal frames**	**08 Hours**
Plastic collapse loads of frames with inclined members such as gable portal frames, various mechanisms.		
UNIT-IV	**Limit state design of beams**	**08 Hours**
Requirement of steel for design, Limit State of Strength and Serviceability, partial safety factors, design of laterally supported beams, shear resistance		
UNIT-V	**Design of beams for combined action**	**08 Hours**
Secondary design considerations, design of beams with high shear, interaction of bending and shear, interaction of bending and axial force.		

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UNIT-VI	Design of frames and connections	06 Hours
Design of rectangular and gable portal frames, design of corner connection with and without haunches.		

Reference Books:

R1: A. S. Arya and J. L. Ajmani, "Design of Steel Structures", Nemchand & Bros., Roorkee.
R2: "Teaching Resource for Structural Steel Design", INSDAG Kolkata.
R3: Ramchandra, "Design of Steel Structures" Vol – II, Standard Book House, Delhi
R4: B. G. Neal, "Plastic Method of Structural Analysis", Chapman &Hall.
R5: L. S. Beedle, "Plastic Design of Steel Frames", John Willey &Sons.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - II
[CE5111C]: Ferrocrete Technology II

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Basic properties of all materials which are used in concrete and prestressed members for design.
Basic knowledge of all IS codes required for RCC, prestressed, water structures space structure, soil and water retaining structures.

Course Objective:
The objective of this course is to give proper knowledge to students about various types of RCC, Prestressed, and water retaining and space structure design. Also, they are able to solve design problems of all structures like RCC, Steel, Composite, Water and soil retaining structures.

Course Outcome:
On completion of the course, student will be able to–
CO1: Identify different types of Ferrocement concrete, its typical properties and rational methods of design.
CO2: Design members in compression, tension, flexure and shear
CO3: Design of structures using Fibrocement.
CO4: Analysis of various forms for stress pattern under loading
CO5: Apply ferrocrete techniques in different RCC structures
CO6: Apply ferrocement techniques in different Space structures and precast products

Course Contents

UNIT-I	Design of structure based on Properties	06 Hours

Ferrocement – correct definition, standard method of construction, design for direct field applications, and ferrocement for structural applications, thin layered system changed to solid form. Typical mechanical properties and characteristics, parameter of design, review of present methods of designs based on RCC. Design of ferrocement structure based on its typical properties, like specific surface, crack width control and strength through shapes.
Rational methods of design based on Equivalent area, equivalent strain, Specific surface, volume fraction of steel and wire diameter, Crack width control method Ductility and energy absorbed per unit volume.

UNIT-II	Basic Properties and design based on various theory	06 Hours

Equivalent area and equivalent stress method- "m" value, Moment of Inertia of section, design of compression members, walls, columns, and member subjected to membrane stresses. Equivalent area and equivalent stress method- "m" value, Moment of Inertia of section, design of compression members, walls, columns, and member subjected to membrane stresses.
Equivalent stress and the principle of superimposition applied to stress-strain curves for mortar, meshes, and ferrocement composites. Locate stress at first crack and at yield point on curve based on tensile strength of mortar and yield strength of steel wire. Chord modulus of elasticity for design in multiple cracking zones.

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UNIT-III	Design based on crack width	08 Hours

Design based on crack width- Relationship between crack width -its spacing and stress in steel wire.. Equation establish in relationships between crack width, spacing of cracks, modular ratio, modulus of elasticity and tensile stress of mortar. Crack control method of design- applied to pipes, silos, water tanks and waterproofing systems.

Design of ductility -Strain energy absorbed per unit volume of ferrocement. Its use in design of structures subjected to dynamic loading-earthquake, wind, machine foundations.

UNIT-IV	Design of composite structure	08 Hours

Shaping ferrocement to gain strength, stress pattern changed due to shaping, Different shapes and stress Patterns like flexure to compression, different ways of giving forms, boxing, corrugating, folding, ribbing, stiffening, arching, waffling. Giving shapes in three dimensions. Analysis of various forms for stress pattern under loading- cavity walls, hollow floors, hollow columns and beams, stiffened plates in compression and flexure, built in sections like H, U, T, +, L. Shells of translation and rotation, domes, pyramids, folded plates.

Design of composite structures of ferrocement with RCC, steel and masonry. Precast ferrocement elements with in-built RCC framework. Joints of precast members as structural members their design and construction, Confining and strengthening damaged structures, retrofitting.

UNIT-V	Design of Water and Soil retaining structure	08 Hours

Applications in building construction: Parabolic foundations, under-reamed piles, Panelled cavity walls and box-sectioned hollow floors, hollow beams. Stiffened plates as slabs. Design and construction of multi-storied buildings and mass scale housing using in-situ mortaring method and method of joining precast walling and floor panels.

Water and soil retaining structures: Applications in water treatment and effluent treatment plants and in Irrigation, Highways and Bridges.

UNIT-VI	Various Precast Products	06 Hours

Space structures like shells, pyramids, domes, folded plates. Special purpose Structures subjected to shock loadings like wind, earthquake, Tsunami, blast and fire. Acoustic design in ferrocement buildings.

Standardizing precast ferrocement products like manholes and their covers, chajja and lintels, water tanks, septic tanks, stiffened plates for walling and flooring panels. Lost forms for RCC columns, beams and slabs. Design and casting of ferrocement spun pipes to replace prestressed concrete pipes. Precast parabolic canal sections.

References:

R1: "State-of-the-art report and guide for Design, Construction and Repairs of Ferrocement"; ACI Committee Report. No ACI549R- 88 and ACI 549.1R.88. Published by American Concrete Institute, Detroit, USA

R2: B. R. Paul and R. P. Pama, "Published by International Ferrocement Information" Centre. A. I. T. Bangkok, Thailand.

R3: A. E. Naaman "Ferrocement and laminated Cementitious composite", Publisher: Techno-press, Ann Arbor, Michigan, USA.

R4: "Ferrocement- Materials and applications" SP 61, A C I Detroit. USA.

R5: B. N. Divekar, "Ferrocrete Technology- A Construction Manual".

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - II
[CE5111D]: Subsea Engineering

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Engineering Mechanics, Structural Analysis, Steel Structures, Composites.

Course Objective:
To acquire knowledge of functions, type & loading on different subsea components and undersea construction for extraction of oil and gas.

Course Outcome:
On completion of the course, student will be able to–
CO1: Explain functions of different subsea components, their construction and use.
CO2: Understand the fundamentals of flow management of subsea production system.
CO3: Illustrate installation of subsea plant.
CO4: Enlist and explain inspection methods of risk management.
CO5: Understand the applications of different subsea equipment.
CO6: Design different special subsea components.

Course Contents

UNIT-I	Introduction	06 Hours

Introduction to oil and gas industry: general view of oil and gas industry, technological challenges and future developments. Overview of deep-water developments: introduction, deep water areas and potential, challenges, route for development Metaocean and environmental conditions: Overview of the determination of Metaocean conditions (meteorological and oceanographic) and the influence of wave, wind, tide and current on marine operations. Introduction to marine ecology and its impact on marine operations.

UNIT-II	Infrastructure Development	06 Hours

Infrastructure development: Summarize the current state of the art and highlights the design challenges. Outlines the way in which water depth influences the architecture and technology of Oil and Gas infrastructure. Flow assurance: overview of flow assurance and the fundamentals of flow management for subsea production systems, Introduction to flow assurance issues like paraffin deposition; hydrate formation and blockage; Asphaltene precipitation; emulsions; experimental methods, flow assurance assessment methods; prevention, mitigation and remediation tools for flow assurance issues; thermal management and insulation materials.

UNIT-III	Installation and Intervention	08 Hours

Overview of the installation of subsea plant, risers and pipelines and the main intervention methods including AUVs, ROVs and divers. Subsea operations and control: An overview of the principle methods of subsea control including electrical, acoustic and hydraulic systems. Subsea processing and artificial lift: introduction the analytical and numerical models used to design subsea processing systems for sustained recovery of hydrocarbons.

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UNIT-IV	Reliability And Integrity Management	08 Hours
Introduction to Risk Assessment, FMECA and HAZOPS, Monitoring, Intervention and Inspection Methods, Data Management Construction management of oil field, future challenges.		
UNIT-V	**Subsea Field Equipment**	**08 Hours**
Structures and architectures: scale of operations, environmental factors, A description of each of the pieces of the subsea infrastructure, their use and interconnection including subsea trees, flow lines, umbilical's, risers, moorings and pipelines Materials and corrosion. Types of corrosion found in the oilfield with emphasis on the effects of acid gases		
UNIT-VI	**Pipelines and Design**	**06 Hours**
Introduction to pipeline engineering, the main pipeline design challenge in deep water. Analysis and design methods of pipelines that address stress analysis, buckling and collapse of deep-water pipelines. Limit state-based strength design methods. Geotechnical aspects of pipeline design and its installation. Deepwater risers: different design options available for deep water risers, and defines the key design drivers for each. General principles of stress analysis: An introduction to the principles of stress analysis and the principles of reliability based design, finite element analysis.		

Reference Books:

R1: Petex, "A Primer of Offshore Operations".

R2: Yong Bai and, Qiang Bai, "Subsea Engineering Handbook Hardcover".

Supplementary Reading:

https://nptel.ac.in/courses/114/106/114106011/

Lab Exercises:

I. Assignment on types of subsea structures.
II. Assignment on fundamentals of subsea structures and construction, installation.
III. Assignment on the design of subsea pipeline systems, Numerical, Use of Norsok Codes.
IV. Assignment on oil well caisson foundations, and superstructure construction.
V. A case study of typical subsea structure analysis, design, installation.
VI. Assignment on Use of international standards for subsea system designs.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester -II
[CE5112A]: Pre-Engineered Buildings

Teaching Scheme: TH: - 03 Hours/Week	Credit 03	Examination Scheme: In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Limit State Design of steel structures.

Course Objective:
To understand fabrication aspects, inculcate analytical and design aptitude and be able to prepare fabrication drawing and detailing of Pre-Engineered Buildings.

Course Outcome:
On completion of the course, student will be able to–
CO1: Understand fabrication aspects of pre-engineered buildings.
CO2: Analyze strategies of pre-engineered steel buildings.
CO3: Understand Code provisions of pre-engineered buildings.
CO4: Design strategies of pre-engineered steel buildings.
CO5: Optimize design to have optimum cost of material.
CO6: Produce fabrication drawings of pre-engineered building components.

Course Contents

UNIT-I	Introduction to pre-engineered buildings	06 Hours
History Concept, Difference between Conventional Steel Buildings and Pre-Engineered buildings, components of pre-engineered buildings, material and connections used for manufacturing of PEB, Advantages of PEB, Applications of PEB, Pre-Engineered Building Components.		
UNIT-II	**Analysis of the Pre-Engineered buildings**	**06 Hours**
Plastic analysis, Analysis for wind load, Seismic analysis.		
UNIT-III	**Code stipulations**	**08 Hours**
Code provisions: AISC, AISI, MBMA, ANSI, ASCE, UBC and IS codes, Design for stability, flexure, shear and deflections.		
UNIT-IV	**Design of components**	**08 Hours**
Design of primary frame, Gable end framing, Secondary framing, Bracing systems.		
UNIT-V	**Design optimization**	**08 Hours**
Iterative design procedure to arrive at optimum section sizes.		
UNIT-VI	**Fabrication drawings and detailing**	**06 Hours**
Components of fabrication drawings, Fabrication details of various components of the pre-engineered buildings		

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Reference Books:

R1: A Newman, "Metal Building Systems Design and Specifications", McGraw-Hill publication, ISBN 978-0-07-177664-6
R2: N Subramanian, "Design of Steel Structures", OUP India publication, ISBN 978-0-19- 567681
R3: K. S. Vivek and P. Vaishnavi, "Pre-Engineered Steel Buildings", Lambert Academic Publishing

Supplementary Reading:

http://nptel.ac.in/courses/105106113/3

Lab Exercises:

I. Analysis and design of one of the frames of Pre-Engineered building.
II. Fabrication drawings of the frame with connection details.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - II
[CE5112B]: Bio Mechanics and Bio Materials

Teaching Scheme: TH: - 03 Hours/Week	Credit 03	Examination Scheme: In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam : 60 Marks Total: 100 Marks

Course Prerequisites:
Stress strain Relationship, Material Properties, Composite material properties

Course Objective:
The Objective of this course is to link engineering analogy to biological systems.

Course Outcome:
On completion of the course, student will be able to–
CO1: Identify structure of tissue, classification of bio material.
CO2: Differentiate biomaterials composition and fabrication method.
CO3: To analyze biomaterial composite and its structure.
CO4: Inspect and assess Mechanical properties of bone.
CO5: To assess joint mechanism and evaluation of joint forces and moments.
CO6: Identify the different type biomaterials and their suitability.

Course Contents

UNIT-I	Structure of biomaterials and hard tissue	06 Hours

Structure of biomaterials, classification of bio materials, mechanical properties, Hookean elasticity, elasticity of non-Hooke a material. Elasticity models for bio materials. Structure of Hard tissue.

UNIT-II	Composition of Bio materials	06 Hours

Materials for replacements, Metallic Biomaterials and ceramic biomaterials steps involved in the fabrication of metallic implants, stainless steel Co-Cr-alloys Ti& its alloys, medical applications, corrosion of metallic implants**.**

UNIT-III	Types of bio materials	08 Hours

Polymeric Biomaterials and composite biomaterials, Polymerization, polyolefin's, Polyamides, acrylic polymers, high strength thermoplastics for medical applications, deterioration of polymers. Structure, bounds on properties, anisotropy of composites, particulate composite fibrous composites, porous materials. On-absorbable or relatively Bio inert bio-ceramics Bio-degradable or restorable ceramics. Bio active or surface reactive ceramics, deterioration of ceramics

UNIT-IV	Mechanical properties of bone and tissue	08 Hours

Polymeric Biomaterials and composite biomaterials, Polymerization, polyolefin's, Polyamides, acrylic polymers, high strength thermoplastics for medical applications, deterioration of polymers. Structure, bounds on properties, anisotropy of composites, particulate composite fibrous composites, porous materials. On-absorbable or relatively Bio inert bio-ceramics Bio-degradable or restorable ceramics. Bio active or surface reactive ceramics, deterioration of ceramics

UNIT-V	Joint structure	08 Hours

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Mechanical properties of cartilage. Different properties of particular cartilage, mechanical properties of bone. Internal fracture fixation devices, joint replacements, dental implants.		
UNIT-VI	**Artificial fixation devices**	**06 Hours**
Design of artificial fixation devices. Orthopedic fixation devices. Fundamentals of design of joint prosthesis. Mechanical testing of joint prosthesis Principles involved in study of rehabilitation engineering		

Reference Books:

R1: Y. C. Fung, "Bio-mechanics, Mechanical Properties of Living Tissues", Springer New York, Edition 2, 1993.
R2: D. Dowson, V. Wright, "Introduction to Biomechanics of joints and joint replacement", Mechanical Engineering Publication1987.
R3: C. V. Mow, A. Ralcliffe, "Bio-mechanics of Diarthrodial joints", Springer Verlag,1990.
R4: F. H. Silver, "Bio-materials Medical Devices and Tissue Engineering", Chapman & Hall, 1994.
R5: J. B. Park, "Bio-Materials Science & Engineering", Plenum Press,1990.
R6: B. D. Ratner & A. S. Hoffman, Bio-Materials Science an Introduction to Materials in Medicine, Academic Press,1996.
R7: K. Jacob "Hand book of Biomedical Engineering", Academic Press,1988.

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First Year M. Tech Civil (Structural Engineering)

Academic Year – 2020-2021 Semester - II

[CE5112C]: Retrofitting and Strengthening of R C Structures

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Basic knowledge of concrete and Reinforce cement concrete.

Course Objective:
The Objective of this course to create awareness on S.H.M. and enable students to investigate the cause effects and rehabilitation techniques in concrete structure.

Course Outcome:
On completion of the course, student will be able to–
CO1: To understand the cause of deterioration of concrete structures.
CO2: Inspect and assess the structures using techniques of visual inspection, NDT and Semi destructive testing.
CO3: To analyze different Repair system, material and techniques.
CO4: Comprehend the retrofitting and strengthening method of concrete structures.
CO5: Design strengthening of R C members.
CO6: Assess of structural health.

Course Contents

UNIT-I	Introduction	06 Hours

Needs for repair and rehabilitations of RC structure, degradation of reinforced concrete structure, major causes and sign, deterioration of concrete structures, causes of deterioration, cracking-type, causes and characteristics.

UNIT-II	Evaluation of concrete structures	06 Hours

Evaluation of concrete structures: Conditional evaluation- definition, objectives and stages of conditional assessment, preliminary investigation-scope, methodology and output, detailed investigation-scope and methodology, In situ and laboratory testing such as non-destructive, semi destructive, corrosion test, chemical test and NDT for cracks, flaws and voids in concrete.

UNIT-III	Repair system, material and techniques	08 Hours

Repair methodology, compatibility of repair material and concrete, material for repair-cement base, polymer modified, resin base, micro concrete and composite, repair techniques

UNIT-IV	Retrofitting and strengthening of concrete structures	08 Hours

Design philosophy of strengthening, strengthening technique-section enlargement, composite construction, post tensioning, stress reduction, strengthening by reinforcement, strength by FRP.

UNIT-V	Strengthening of RC members	08 Hours

Strengthening of RC members: Strengthening of beams: flexural and shear, slab, columns, footings and seismic retrofitting of R C structures using FRP.

UNIT-VI	Quality control in concrete	06 Hours

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Quality control in concrete construction, maintenance, water leakage-detection and mitigation, fire damage-detection and reparation, corrosion-detection and mitigation, demolition of concrete structures and structural health monitoring.

References Books:

R1: P. H. Emmons and G. M. Sabnis, "Concrete Repair and Maintenance", Galgotia Publication.
R2: Repairs and Rehabilitation – Compilation from Indian Concrete Journals.
R3: G. Somerville, "Management of Deteriorating Concrete Structures", Taylor and Francis, Publication.
R4: Concrete Building Pathology, Susan Macdonald, Blackwell Publication.
R5: C. L. Page, M. M. Page, "Durability of Cement and Cement Composites", Wood Head Publication.
R6: ACI 440.2R-08, Guide for the design and construction of externally bonded FRP systems for strengthening concrete structures, American Concrete Institute.
R7: Xilin Lu, "Retrofitting design of building structures", Science Press, New York, 2010.
R8: L.C. Hollaway and J.G. Teng, "Strengthening and Rehabilitation of Civil Infrastructures Using Fiber-Reinforced Polymer (FRP) Composites", Woodhead Publishing Series in Civil and Structural Engineering.
R9: P. C. Varghese "Maintenance, Repair & Rehabilitation & Minor Works of Building", PHI Publication 2016.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - II
[CE5112D]: Advanced Design of Steel Structures

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Stress stain curve, Knowledge of Design philosophy of steel structure

Course Objective:
The objective of this course is to apply of advanced concepts of design of steel structures to tabular structure, cold form and chimney etc.

Course Outcome:
On completion of the course, student will be able to–
CO1: Demonstrate the use of IS Codes and standards related to design of hoarding structures and analyze and design castellated beams using Indian Standard provisions.
CO2: Analyze and design microwave and transmission tower structures using Indian Standard provisions.
CO3: Analyze and design tubular structures using Indian Standard provisions
CO4: Recognize the behavior of Cold form light gauge section and design of Cold form light gauge section for various loading conditions.
CO5: Design chimneys subjected to various types of loads.
CO6: Design base plate of chimney and design of foundation.

Course Contents

UNIT-I	Hoarding Structures and Castellated beams	06 Hours

) Hoarding Structures: Analysis and design of hoarding structures under dead, live and wind load as per the latest IS: 875 by limit state method.
b) Castellated beams: Concept, fabrication of the castellated beam from rolled steel section, design of castellated beam for bending and shears as per latest code by limit state method.

UNIT-II	Microwave Towers and Tubular Structures	06 Hours

a) Microwave Towers: Introduction, structural configuration, function, analysis and design.
b) Tubular Structures: Design of tubular Trusses and scaffoldings using circular hollow, rectangular hollow sections as per code, detailing of joints

UNIT-III	Transmission Towers	08 Hours

Introduction, structural configuration, bracing systems, analysis and design as per code. Use working stress method

UNIT-IV	Cold form light gauge section	08 Hours

Advantage, type of cross section, stiffened multiple stiffened and un-stiffened element, flat-width ratio, and effective design width, design of light gauge compression, tension and flexural members as per code.

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UNIT-V	Design of chimneys	08 Hours
Introduction, type, joints, lining, ladder, forces acting on chimney, design of thickness of steel plates for self-supporting chimney.		
UNIT-VI	**Design of base plate of chimney**	**06 Hours**
Design of anchor bolt, design of foundation and stability of steel chimneys.		

References Books:

R1: R. Chandra, "Design of steel Structures, Volume II", Standard Book House, New Delhi.
R2: B.C. Punmia and A. K. Jain, "Comprehensive Design of steel structure", Laxmi Publication, New Delhi.
R3: M Raghupathi, "Design of steel structures", Tata McGraw Hill, New Delhi.
R4: S. K. Duggal, "Limit state design of steel structures", Tata McGraw Hill Education.
R5: N. Subramanian, "Design of steel structures", Oxford University Press.
R6: IS: 800 - 2007, "Code of Practice for General Construction in Steel", BIS, New Delhi.
R7: IS: 800 - 1984, "Code of Practice for General Construction in Steel" BIS, New Delhi.
R8: IS: 801 - 1975, "Code of Practice for use of cold formed light gauge steel structural members in general building construction", BIS, New Delhi.
R9: IS: 802(Part I and II)-1978, "Code of practice for use of structural steel in overhead transmission line towers", BIS, New Delhi.
R10: IS:806-1988, "Code of practice for use of steel tubes in general building construction", BIS, New Delhi.
R11: 875 (Part 1, 2and 3) –1987, "Code of practice for design loads for buildings and structures", BIS,
R12: IS: 811-1987, "Specification for cold formed light gauge structural steel sections", BIS, New Delhi.

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First Year M. Tech Civil (Structural Engineering)
Academic Year – 2020-2021 Semester - II
[CE5113]: Lab Practice II

Teaching Scheme:	Credit	Examination Scheme:
TH: - 03 Hours/Week	03	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Total: 100 Marks

Course Prerequisites:
Concepts of structural static and dynamic analysis, finite element analysis.

Course Objective:
To make students to learn principles of Analysis of Stress and Strain, to apply the Finite Element Method for the analysis of one- and two-dimensional problems. To evaluate the stress and strain parameters and their inter relations of the continuum.

Course Outcome:
On completion of the course, student will be able to–
CO1: To make students to learn principles of Analysis of Stress and Strain.
CO2: Demonstrate the knowledge and understanding of principles of dynamic studies.
CO3: Develop skill of results analysis.
CO4: Applying appropriate techniques for the analysis & design of structures.

Course Contents

Experiment -I	Analysis of building structures using software	14 Hours
Static analysis of Building structure using software (ETABS / STAADPRO) Dynamic analysis of Building structure using software (ETABS / STAADPRO)		
Experiment -II	**Analysis and design of special structures using software**	**14 Hours**
Design of RCC frames and multi storied building using software (ETABS / STAADPRO) Steel structure (truss system) using software (ETABS / STAADPRO) Analysis of bridge deck slab; plane frame analysis.		
Experiment -III	**Proof reading and corrections of Software Results**	**14 Hours**
Proof reading of software results. Corrections in results (if any) .		
Experiment-IV	**Programming for design of different structural element**	**14 Hours**
Preparation of program for design of: Slabs, Beams, Columns, Footings. Introduction to Mat Lab.		

References Books:
R1: "National Building Codes", BIS, New Delhi.
R2: IS 456, IS 800, SP-16, SP-34.
R3: M. A. Jayram &D. S. Rajendra Prasad, "Cad in civil engineering", Sapna book house,
R4: S. Timoshenko, "Vibration Problems in Engineering", Van-Nostrand Co, 2009.
R5: T. S. Sarvan, "Staad Pro. V12i for beginners", 2014.

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