Course Structure

for Degree Program

M. Tech. in Civil Engineering

with Specialization in

Computer Aided Structural Engineering

In line with National Education Policy 2020

(Effective from AY 2024-25)

Dr. BabasahebAmbedkar Technological University

Lonere 402 103, Dist- Raigad, Maharashtra, INDIA

Established vide Maharashtra Act No. XXII of 1989 and Act. No. XXIX of 2014
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Course Structure, Guidelines, Rules and Regulations

Preamble

Economic advancement of a country is closely tied to the quality of technical education it offers. Engineering education is reaching new heights and plays a significant role in the overall education system. The preparation of engineering graduates should focus on enhancing their employability and sustainability in response to evolving industry and societal needs. As technology advances and expectations change rapidly, updating the curriculum to be contemporary and relevant is imperative.

In order to align our technical education system with global standards and practices based on performance and assessment system was implemented earlier for all Undergraduate Programs (UG). Now as per National

Education Policy-2020 framework we are incorporating project-based learning. The realm of engineering and technology, characterized by its interdisciplinary nature, demands the synthesis of knowledge from a wide array of domains including humanities, arts, and advanced technologies. However, what distinguishes technologists is their proficiency in design and their ability to adeptly apply this knowledge across diverse disciplines to achieve effective problem solving.

In response to these needs, aspiring engineers need thorough preparation and a deep understanding of the latest technological trends and industrial requirements. This calls for studying under a modern and adaptable curriculum that mirrors the global environment. As part of this initiative, there is a push to integrate recent advancements and enrich course content with pertinent and up-to-date subjects. Consequently, a revised structure and curriculum will debut from the academic year 2023-24 for First Year Civil Engineering, with intentions to progressively implement these updates across second, third- and fourth-year engineering programs.

Project-based learning has been introduced alongside traditional classroom teaching and laboratory-based learning to enhance the overall learning experience. The objective is to encourage students to learn collaboratively in groups of 3 to 4, focusing on solving meaningful problems. These problems can be theoretical, practical, social, and technical, symbolic, cultural, or scientific, arising from students' curiosity across various disciplines and professional contexts. The selected problems should be exemplary and may require an interdisciplinary approach for both analysis and resolution. This approach aims to develop students' capacity for learning through shared cognition.

- Laboratory Course:

This is focused on completing experiments and assignments related to the courses of the Semester.

- Seminar: This aspect will revolve around state-of-the-art topics selected by students and approved by the authority. Students are required to submit a certified seminar report in a standard format, evaluated

by their assigned guide and the department/institute head for satisfactory completion of the work.

- Project Work in Final Year: Project work in the seventh Semester is integral to the curriculum. It involves applying knowledge gained throughout the graduation program, ideally addressing societal needs. The project provides an opportunity for students to design and construct complete systems or subsystems, specializing in areas of their interest. Students must prepare a certified final project report in standard format, evaluated by their guide and the department/institute head for satisfactory completion of the work.
- Internship: Internships are crucial for educational and career development, offering practical experience in field of discipline. It plays a significant role as employers seek well-trained employees. The primary objective is to expose technical students to real-world industrial environments, providing insights into the social, economic, and administrative factors influencing organizational operations. Students may choose internships in industries, government agencies, NGOs, MSMEs, rural settings, innovation hubs, intellectual property rights (IPR), or entrepreneurship initiatives. They can opt to focus on innovation, leading to start-up's, or gain experience in industry/NGO/government/MSME settings to prepare for professional roles. The conduction, monitoring, assessment, and evaluation of internships follow guidelines provided by AICTE.

Definition of Credit **

1 Hour Lecture (L) per week	1 credit for 1 Hour
Tutorial (T) per week	1 credit for 1 Hour
Practical(P) per week 2 Hours Practical (Lab)/week	1 credit for 2 Hours

** The head of Tutorial and Practical (as a special case) may be merged for common credit with the permission of authority.

Rule No. 1: Eligibility for Admission

Eligibility Criteria

Students seeking admission to the first year of the Bachelor's degree course in Engineering and Technology must fulfil the eligibility criteria as laid down from time to time by the following authorities:

- **Dr.BabasahebAmbedkar Technological University (DBATU)**
- **Government of Maharashtra**
- **All India Council for Technical Education (AICTE)**

Rule No. 2: Scheme of Assessment

Eligibility for the Degree of Bachelor of Engineering and Technology

To be eligible for the degree of Bachelor of Engineering and Technology, a candidate must:

1. **Appearing for Examinations**:
    - A candidate is required to appear for all prescribed examinations during the course of study. This includes theory exams, practical exams, term-work assessments, project evaluations, and any other form of examination as specified in the syllabus.
2. **Passing of Examinations**:
    - A candidate must pass all the prescribed examinations. The passing criteria, including minimum marks required in theory, practical, term-work, and other components, will be as per the rules laid down by the university.

Components of Assessment

The scheme of assessment typically includes the following components:

1. **Theory Examinations**:
    - Conducted at the end of each Semester.
    - Assess the theoretical understanding of the subjects.
2. **Practical Examinations**:
    - Conducted to assess the practical skills and application of knowledge.
    - Includes laboratory work, experiments, and practical assignments.
3. **Term-Work Assessments**:
    - Continuous assessment of assignments, tutorials, and project work throughout the Semester.
    - Includes the evaluation of written assignments, presentations, and project reports.
4. **Project Work**:
    - Assessment of project-based learning and final year projects.
    - Includes continuous assessment by the faculty and final evaluation through project reports, presentations, and viva-voce.
5. **Internal Continuous Assessment**:
    - Regular assessments conducted throughout the Semester.
    - Includes quizzes, class tests, mid-term exams, and participation in class activities.

Program Objectives

Goal of the Civil engineering with a specialization in Computer Aided Structural Engineering (CASE) at Dr. BabasahebAmbedkar technological University, Lonere (BATU) is to provide students with preparation to become worthy of professional careers in the field and to be motivated for lifelong learning. All prescribed courses have definite objectives and outcomes. Program objectives are expected qualities of engineers as under:

a) Preparation: To prepare students to excel in various educational program to succeed in industry / technical profession through further education/training;

b) Core Competence: To provide students with a solid foundation in mathematical, scientific fundamentals required to solve E&T related problems;

c) Breadth: To train students with a breadth of scientific knowledge to comprehend, analyze, design & create novel products and solutions for real life problems;

d) Professionalism: To inculcate in students professional/ethical attitude, effective teamwork skills, multidisciplinary approach and to relate engineering issues to a broader context;

e) Learning Environment: To provide students with academic environment of excellence, leadership, ethical guidelines and life-long learning needed for along/productive career.

In addition to above, DBATU graduate is expected to be

1. Taking pride in their profession and have commitment to highest standards of ethical practices,
2. Able to design structural system that is safe, economical and efficient.
3. Capable of using modern tools efficiently in all aspects of professional practices.
4. Dealing successfully with real life civil engineering problems and achieve practical solutions based on a sound science and engineering knowledge.
5. Shall represent the highest standards of Structural engineering and related technical disciplines.
6. Shall be engage in continuous research, development and exchange of knowledge for professional development.
7. Be honest in their control and performing their duties and promote effective use of resources through open, honest and impartial services to the public.
8. Act in such a manner, which will uphold the honor, integrity, or dignity of the engineering profession, and avoid knowingly engaging in business or professional practices of a fraudulent, dishonest or unethical nature.
9. Recognize that the lives, safety, health and welfare of the public are dependent upon engineering, decision and practices.
10. Continue their professional development throughout their careers and provide opportunities for the professional development.

Table A: Credit Structure for PG program in Engineering

Course Category	Provided
Program Core Course (PCC)	15
Program Elective Course (PEC)	12
Experiential Learning Courses (ELC)	42
Humanities Social Science and Management (HSSM-IKS/VEC/AEC)	7
Open Elective (OE) Other than a particular program	3
Multidisciplinary Minor (MDM)	3
TOTAL	**82**

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for M. Tech. in Civil Engineering with Specialization in Computer Aided Structural Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	ISE	MSE	ESE	Total	
Semester- I										
1	MCVCASEPCT 101	Theory of Elasticity and Plasticity	3	--	--	20	20	60	100	3
2	MCVCASEPCT 102	Matrix Methods of Structural Analysis	3	--	--	20	20	60	100	3
3	MCVCASEPCT 103	Structural Dynamics	3	--	--	20	20	60	100	3
4	MCVCASEPET 104	Program Elective-I	3	--	--	20	20	60	100	3
5	MCVCASEPET 105	Program Elective-II	3	--	--	20	20	60	100	3
6	MCVCASEELL 106	CASE-I Laboratory	--	--	4	25	--	25	50	2
7	MCVCASEELL 107	CASE-II Laboratory	--	--	4	25	--	25	50	2
8	MCVCASEHMT 108	Communication Skills	2	--	--	25	--	25	50	2
9	MCVCASEAUP 109	YOGA for Stress Management	--	--	2	--	AU	AU	AU	AU
		Total	**17**	**0**	**10**	**175**	**100**	**375**	**650**	**21**
Semester- II										
1	MCVCASEPCT 201	Theory of Plates and Shells	3	--	--	20	20	60	100	3
2	MCVCASEPCT 202	Finite Element Analysis	3	--	--	20	20	60	100	3
3	MCVCASEPET 203	Program Elective- III	3	--	--	20	20	60	100	3
4	MCVCASEPET 204	Program Elective- IV	3	--	--	20	20	60	100	3
5	MCVCASEOET 205	Open Elective-V	3	--	--	20	20	60	100	3
6	MCVCASEELL 206	CASE-III Laboratory	--	--	4	25	-	25	50	2
7	MCVCASEELL 207	Mini Project	--	--	4	25	-	25	50	2
8	MCVCASEHMT 208	Indian Knowledge System	2	--	--	20	20	60	100	2
		Total	**17**	**0**	**12**	**170**	**120**	**410**	**700**	**23**

Type of course:

Program Core: **PC**	Program Elective: **PE**
Open Elective: **OE** (Other than particular program)	Ability Enhancement Course: **AE**
Modern Indian Language: **MIL**	Humanities, Management, language and Commerce: **HM**
Experiential Learning Courses: **EL**	Multidisciplinary Minor Courses: **MD**
ABBRIVATIONS: **ISE**-INSEMESTER EVALUATION, **MSE**-MID SEMESTER EVLUATION, **ESE** -END SEMESTER EVALUATION	

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Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	ISE	MSE	ESE	Total	
Semester-III										
1	MCVCASEMDT 301	MOOC/SWAYAM/ NPTEL PLATFORM COURSES/Self Study. (It is desirable to choose one course from each of PE,OE &AE)	3	--	--	20	20	60	100	3
2	MCVCASEMDT 302		3	--	--	20	20	60	100	3
3	MCVCASEHMT 303		3	--	--	20	20	60	100	3
4	MCVCASEELP 304	Seminar-I	--	--	4	25	--	25	50	2
5	MCVCASEELP 305	Dissertation Stage -I	--	--	20	50	--	50	100	10
		TOTAL	**09**	**--**	**24**	**135**	**60**	**255**	**450**	**21**
Semester-IV										
1	MCVCASEELP 401	Dissertation Stage-II	--	--	40	100	--	100	200	20
		TOTAL	**--**	**--**	**20**	**100**	**--**	**100**	**200**	**20**

Dissertation Stage –I /Internship
Students can take Industry Internship along with Dissertation Stage –I. Students must maintain regular reporting with Dissertation supervisor regarding status of Dissertation **Dissertation Stage I and Synopsis Approval :** It is a course requirement under the guidance of faculty Supervisor. PG student from second year is required to do innovative and research oriented applied work related to various theory and laboratory courses. Dissertation work may cover analytical formulation, experimentation or survey based project or combination of these. Student are encouraged to undertake an interdisciplinary type project. Students should be encouraged to publish a paper on Stage –I work in Journals/conferences.

Sr.No.	Multidisciplinary Minor Courses
A	MOOC/SWAYAM/ NPTEL -Project Management and Intellectual Property Rights (Self Study) Student may select this course either from MOOC/SWAYAM/ NPTEL pool or any other approved reputed source. The submission of course completion certificate is mandatory. **MCVCASEMDT301/302, MCVCASEHMT 303 -** Institute has to take care of registration of subjects with detailed syllabus in first two weeks of beginning of the semester with exam department of DABATU.

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Teaching & Evaluation Scheme for M. Tech. in Civil Engineering with Specialization in Computer Aided Structural Engineering

Sr.No.	Program Elective-I	Program Elective-II
A	Advance Structural Analysis	Advanced Pre-stressed Concrete
B	Numerical Methods	Design of Masonry Structures
C	Design of Steel Concrete Composite Structures	Offshore Structures
D	Design of Bridges	Structural Stability

Sr. No.	Program Elective-III	Program Elective-IV	Open Elective
A	Design of Cold Formed Steel Structures	Design of Tall Structures	Research Methodology
B	Retrofitting of Structures	Design of Foundation	Soil Dynamics & Machine Foundations
C	Design of Shells & Folded Plates	Structural Audits	Advance Concrete Technology
D	Earthquake Engineering & Design of Earthquake Resistant Structures	Optimization in Structural Design	Glass in Buildings: Design and Applications
E	Design of advanced steel structure	Structural Health Monitoring	Solution Procedures in Civil Engineering

Sr.No.	Multidisciplinary Minor	Indian Knowledge System
A	MOOC/SWAYAM/ NPTEL	Concepts and Applications in Engineering
B	Project Management and Intellectual Property	Humanities and Social Sciences

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SUBJECT CODE	Theory of Elasticity and Plasticity	CREDITS
MCVCASEPCT 101		3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand concept of stress and strain at a point, Stress equilibrium, Strain compatibility, and analyse. Stress and Strain at a point with various perspectives, etc. under in three-dimensional state of stress.
CO2	Establish relation between stress and strain for various materials, Elastic constants, and reduce 3D
CO3	Formulate and analyse stress concentration problems due to various complex situations.
CO4	Formulate and analyse members subjected to Torsion using various classical approaches.
CO5	Able to understand different post yielding behaviour of materials and Plasticity theories.

Course Contents

Module 1	**Analysis of Stresses and Strains**	**Hrs. 8**

Concept of Stress at a Point, Stress Tensor, State of Stress at a Point in Cartesian Coordinate System, Derivation of Stress Equilibrium Equations in Cartesian and Polar Coordinate System, Cauchy's Formula, Normal Stress, Shear Stress and Resultant Stress on any Inclined Plane, Transformation of Stresses, Stress Invariants, State of Pure Shear, Principal Stresses, Maximum Shear Stresses, Octahedral Stresses, Decomposition of State of Stress into Pure Shear and Hydrostatic Stress, Mohr's Circles/ Spheres for Various States of Stress, The State of Strain at a Point, Strain Displacement Relations, Strain Compatibility Condition, Volumetric Strain, Problems on Navier Lame's Equilibrium Equations, Problems on Beltrami - Michell Compatibility Equations, Boundary Value Problems in Elasticity.

Module 2	**Stress-Strain Relationship**	**Hrs. 8**

Generalized Hooke's Law, Hooke's Law for Isotropic, Orthotropic, Plane Stress, Plane Strain and Axi-Symmetric Problems, Relations between Elastic Constants, Problems in 2D and 3D Cartesian Coordinate System, Airy's Stress Function, Bending of Beams, Straight Beams & Asymmetrical Bending, Euler Bernoulli Hypothesis, Shear Center or Center of Flexure, Shear Center in Thin Walled Open Sections and Other Sections

Module 3	**Stress Concentration Problems**	**Hrs. 6**

Stress Concentration Problems such as Stress Concentration due to Circular Hole in Stressed Plate (Kirsch's Problem), Stresses under Concentrated Load such as Concentrated Load acting on the Vertex of a Wedge (Michell's Problem) and Concentrated Load Acting on the Free Surface of a Plate (Flamant's Problem), Axi-symmetric Problems such as Stresses in Thick Cylinders Subjected to Internal and External Uniformly Distributed Pressures (Lame's Problem).

Module 4	**Torsion**	**Hrs. 6**

Assumptions and Torsion Equation for General Prismatic Solid Bars, Warping of Non-Circular Sections and St. Venant's Theory, Prandtle's Stress Function Approach, Torsion of Circular, Elliptical and Triangular Cross-Section, Torsion of Thin-Walled Structures by Membrane Analogy, Torsion of Rolled Sections and Shear Flow.		
Module 5	**Plasticity**	**Hrs.7**
Basic Equations, Similarities and Differences when Compared with Elasticity, Idealized Material Behaviour, Mechanical Models, Neck Formation, Failure Theories, Modes of Failure, Failure under Static Equilibrium, Buckling, Vibrations, Yielding, Fracture, Ductile and Brittle Failure, Yield Criteria, Rankine's Theory, Saint Venant's Theory, Tresca Criteria, Beltrami's Energy Criteria, Von Mises and Hencky & Huber's Theory, Comparison of Different Theories under Axial Tension and Torsion, Various Empirical Stress-Strain Relationships		

Text Books:	
1	L. S. Shrinath, Advanced Solid Mechanics, Tata-McGraw Hill Publications.
2	Timoshenko & Goddier, Theory of Elasticity & Plasticity, Mc-Graw Hill Publications.
3	Martin Sadd, Elasticity Theory, Applications & Numerics, Academic Press.
4	M A Kazami, Solid Mechanics, Tata -McGraw Hill Publications.
5	Sadhu Singh, Theory of Elasticity, Khanna Publishers, New Delhi

Reference Books:	
1	Irving Shames, Mechanics of Deformable Solids, Prantice Hall.
2	N K Bairagi, Advanced Solid Mechanics, Khanna Publishers, New Delhi.
3	Wang, Applied Elasticity, Dover Publications.
4	N Dahl and T Lardner, S Crandall, Mechanics of Solids, McGraw Hill Publications.
5	Scholer, Elasticity in Engineering, McGraw Hill Publications.

SUBJECT CODE	Matrix Methods of Structural Analysis	CREDITS
MCVCASEPCT 102		3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Draw deflected shapes of various structures for different loading and boundary conditions.
CO2	Understand difference in force approach and displacement approach in structural analysis.
CO3	Analyze various plane structural systems using direct and generalized flexibility approach.
CO4	Analyze various plane structural systems using direct and generalized stiffness approach.
CO5	Develop codes for computer based analysis of plane structures

Course Contents

Module 1	Introduction & Direct Flexibility Matrix Method	Hrs. 8
Introduction and Review of Various Methods for Finding Slopes and Deflections at a Point in Statically Determinate and Indeterminate Structures, Assessment of Deflected Shape of Structures for Different Loading & Support Conditions. Direct Flexibility Matrix Method, Applications to Continuous Beams, Pin Jointed Frames, Rigid Jointed Frames		
Module 2	**Generalised Flexibility Matrix Method**	**Hrs. 8**
Generalised Flexibility Matrix Method, Applications to Continuous Beams, Pin Jointed Frames, Rigid Jointed Frames.		
Module 3	**Direct Stiffness Matrix Method**	**Hrs. 6**
Direct Stiffness Matrix Method, Applications to Continuous Beams, Pin Jointed Frames, Rigid Jointed Frames.		
Module 4	**Generalised Stiffness Matrix Method**	**Hrs.10**
Generalised Stiffness Matrix Method, Applications to Continuous Beams, Pin Jointed Frames, Rigid Jointed Frames.		
Module 5	**Nonlinear Analysis**	**Hrs.6**
Material and Geometric Non-Linearity, Stiffness Method with Material Non-Linearity and Geometric Non-Linearity.		

Text Books:	
1	Weaver W, Gere G. M., Matrix Analysis of Framed Structures, Van Nostrand Reinhold, New York.
2	Hibbler R. C., Structural Analysis,
3	Reddy C. S., Basic Structural Analysis, Tata Mc Graw Hill Publications.
4	G. S. Pandit, S. P. Gupta, Structural Analysis – A Matrix Approach, Tata Mc Graw Hill Publications.
5	Devdas Menon, Structural Analysis, Alpha Science.

Reference Books:	
1	A. S. Meghare, S. K. Deshmukh, Matrix Methods of Structural Analysis, Charotor Publishing House.
2	B. N. Thadani, J. P. Desai, Structural Analysis – A Matrix Approach, Ueinall Publications, Mumbai

SUBJECT CODE	Structural Dynamics			CREDITS			
MCVCASEPCT 103				3			
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand basics of response of structures to forced vibrations and free vibrations.
CO2	Analyse response of SDoF systems to general loading and understand various methods of evaluation
CO3	Analyse response of structures to ground excitations, support excitations and torsional excitations.
CO4	Understand and Analyse structures for natural frequency and modal analysis.
CO5	Analyse response of structural system by numerical evaluation using various classical approaches.

Course Contents

Module 1	SDoF Systems	Hrs. 6
Simple Structures, SDoF System, Force -Displacement Relation, Damping Force, Equation of Motion, External Force, Mass Spring Damper System, Equation of Motion: Earthquake Excitation, Combining Static & Dynamic Responses, Methods of Solution of the Differential Equation, Free Vibration: Un-damped & Viscously Damped Free Vibration, Energy in Free Vibration, Coulomb Damped Free Vibration, Response to Harmonic & Periodic Excitations, Viscously Damped Systems, Systems with Non Viscous Damping.		
Module 2	**SDoF System under General Loading**	**Hrs. 8**
Response to Unit Impulse, Arbitrary Time Varying Force, Response to Step and Ramp Forces, Response to Pulse Excitations, Rectangular Pulse, Half Sine Wave Pulse, Triangular Pulse, Response to Ground Motion, Numerical Evaluation of Dynamic Responses, Time Stepping Methods, Interpolation Methods, Newmark's Beta Method.		
Module 3	**Generalized SDoF System**	**Hrs. 6**
Generalized SDF Systems, Rigid Body Assemblages, Systems with Distributed Mass & Elasticity, Lumped Mass System, Natural Vibration Frequency by Rayleigh's method, Shape Functions		
Module 4	**MDoF Systems**	**Hrs.10**
Simple Systems, Two Storey Shear Buildings, General Approach for Linear Systems, Static Condensation, Symmetric and Asymmetric systems subjected to Ground Motion, Symmetric Systems subjected to Torsional Excitations, Multiple Support Excitations, Methods for Solving Equations of Motion.		
Module 5	**Dynamic Analysis and Response of Linear Systems**	**Hrs.6**
Systems without Damping, Natural Vibration Frequencies and Modes, Modal & Spectral Matrices, Orthogonality of Modes, Normalization of Modes, Modal Expansion of Displacements, Free Vibration Response of Damped and Undamped and Classically Damped Systems, Damping in Structures, Classical Damping Matrix, Non Classical Damping Matrix, Two DoF Systems, Modal Analysis, Modal Response Contributions.		

Text Books:	
1	R. W. Clough & Joseph Penziene, Dynamics of Structures, Mc-Grew Hill Publications.
2	A. K. Chopra, Dynamics of Structures: Theory & Application to Earthquake Engineering, Prentice Hall Publications.
3	Mario Paz, Structural Dynamics, CBS Publication.
4	Roy Craig, Structural Dynamics, John-Wiley & Sons.
5	Jagmohan L. Humar, Dynamics of Structures, Swets and Zeitlinger, Netharlands.

Reference Books:	
1	Jaikrisna, A. R. Chandrashekharan, Elements of earthquake Engineering, South Asian Publishers.
2	Mukhopadhayay Madhujit, Structural Dynamics: Vibration and systems, Ane Books India Publisher.
3	Patrick Paultre, Dynamics of Structures, Wiley India

SUBJECT CODE	(Program Elective-I)						CREDITS
MCVCASEPET 104A	Advanced Structural Analysis						3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Draw ILD for indeterminate structures.
CO2	Analyze the beams curved in plan.
CO3	Analyze the structure resting on elastic foundation.
CO4	Analyze the skeleton structures using stiffness method.
CO5	Analyze the suspension bridges.

Course Contents

Module 1	Influence Line Diagrams for Indeterminate Structures	Hrs. 6
Continuous beams, portal frames and two hinged arches. Muller- Breslau's Principle and Moment Distribution Method.		
Module 2	**Beams**	**Hrs. 8**
Beams curved in plan**:** Determinate and indeterminate beams curved in plan. Beams on elastic foundations: Analysis of infinite, Semi- infinite and finite beams.		
Module 3	**Beam columns**	**Hrs. 6**
Concept of geometric and material non linearity, Governing differential equation, Analysis of beam columns subjected to different loadings and support conditions, Stiffness and carry-over factors for beam-columns, fixed end actions due to various loads.		

Module 4	Shear center and Unsymmetrical bending.	Hrs.10
Position of shear center, shear flow, shear center of various sections, unsymmetrical bending, Z polygon, combined stresses.		
Module 5	**Cables and suppression bridges**	**Hrs.10**
Shape of cable, anchor cable, temperature stresses, moving loads, two hinged and three hinged stiffened bridges.		

Text Books:	
1	Structural Analysis by Negi and Jangid.
2	Analysis of structure by Vazirani and Ratwani, Vol. II
3	Advanced Theory of Structures by Vazirani and Ratwani.
4	Theory of Elastic Stability by Timoshenko and Gere.
5	Matrix Analysis of Framed structures by Gere and Weaver.

Reference Books:	
1	Structural Analysis – A Matrix approach by Pandit and Gupta.
2	Mechanics of Structures Vol. I, II and III by Junnarkar and Shah.
3	Basic structural Analysis by C. S. Reddy.

SUBJECT CODE	(Program Elective-I)						CREDITS
MCVCASEPET 104B	Numerical Methods						3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Formulate mathematical models of various engineering problems.
CO2	Demonstrate understanding of common numerical methods and how they are used to obtain
CO3	Solve non-linear equations, simultaneous linear algebraic equations, Eigen value problems, using
CO4	Perform numerical differentiation and integration and analyze the errors.
CO5	Apply curve fitting techniques to experimental data

Course Contents

Module 1	Introduction	Hrs. 6
Introduction and Necessity of Numerical Methods, Number representation and errors, Number in different bases, Non integer & Fraction, mantissa, exponent, normalized scientific notations, Errors in representing numbers, Inverse error analysis, Loss of Significance.		

Module 2	Solution of Linear and Non-Linear Algebraic Equations	Hrs. 8
Systems of Linear Algebraic Equations, Introduction, ill Conditioning, Methods of Solution (Gauss Elimination Method, LU Decomposition Method, Doolittle Decomposition Method, Gauss-Jordon Elimination Method, Gauss Seidel Method), Symmetric& Banded Coefficient Matrices, Pivoting, Diagonal Dominance, Gauss Elimination with scaled row Pivoting, Roots of Algebraic & Transcendental Equations, Fixed point iteration method, Iterative Search Method, Bisection Method, Geometrical Approach to Root Finding, Convergence towards Roots of Equation, Secant Method, False Secant/ Regula-Falsi Method, Ridder's Method, Newton Raphson Method, System of Non-Linear equations (Newton Raphson Method).		
Module 3	**Regression Analysis**	**Hrs. 6**
Interpolation and Curve Fitting, Discrete Data, Lagrange's Interpolating Polynomial, Newton's Polynomial Method, Limitations of Interpolation with Polynomials, Spline Interpolation, Curve Fitting, Least Square Fit, Fitting with straight Line, Polynomial Fit, Weighted Linear Regression, Fitting Exponential Function.		
Module 4	**Numerical Integration Methods**	**Hrs.8**
Numerical Differentiation and Integration, Taylor's Series, Finite Difference Method, Error in Finite Difference Approximation, Richardson Extrapolation, Derivatives by Interpolation, Cubic Spline Interpolant, Numerical Integration or Quadrature, Newton Cotes Formula, Trapezoidal & Composite Trapezoidal Rule, Simpson Rule, Recursive Trapezoidal Rule, Romberg Integration, Gaussian Integration, Orthogonal Polynomial, Abscissas and Weights for Gaussian Quadrature, Gauss Legendre Quadrature, Gauss Laguerre & Gauss Hermite Method, Gauss-Chebyshev Quadrature, Gauss Quadrature with Logarithmic Singularity		
Module 5	**Solution of Differential Equations**	**Hrs.8**
Initial Value Problem, Taylor series approach, Euler"s Method, Runge-Kutta Method, Second Order Runge-Kutta Method, Forth order Runge-Kutta Method, Stability of Euler"s Method, Stiffness, Adaptive Runge-Kutta Method, Bulrisch Stoer Method, Numerical Methods in Structural Dynamics, Implicit and Explicit Method, Central Difference Method, Newmark-Beta Method, Wilson-Theta Method.Boundary Value Problem, Eigenvalue Problem in Structural Dynamics, Inverse vector iteration method.		

Guidelines for Assignments:
The candidate shall perform minimum six assignments consisting theoretical as well as numerical aspects of the Course. Assignments covering programming in C or MATLAB for all methods is desirable.

Text Books:	
1	L. Ridgway Scott., Numerical Analysis, Princeton University Press
2	S. D. Conte, Carl de Boor, Elementary Numerical Analysis: An Algorithmic Approach, Mc Graw Hill Publications
3	S. R. Otto, J. P. Deneir, An introduction to Programming and Numerical methods in MATLAB, Springer

4	Jaan Kiusalaas, Numerical Methods in Engineering with MATLAB, Cambridge University Press.
5	William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, Numerical Recipes in C, Cambridge University Press.

SUBJECT CODE	(Program Elective-I)	CREDITS
MCVCASEPET 104C	Design of Steel Concrete Composite Structures	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand about steel composite structures.
CO2	Learn to design steel composite structures.
CO3	Learn to design connections in steel composite structures
CO4	Understand about box girder bridges.
CO5	Analyze seismic behavior of steel composite structures.

Course Contents

Module 1	**Introduction**	**Hrs. 6**
Introduction to steel - Concrete composite construction - Theory of composite structures - Introduction to steel - Concrete - Steel sandwich construction.		
Module 2	**Design of Composite Members**	**Hrs. 8**
Behavior of composite beams - Columns - Design of composite beams - Steel – Concrete composite columns - Design of composite trusses.		
Module 3	**Design of Connections**	**Hrs. 6**
Types of connections - Design of connections in the composite structures – Shear connections -Design of connections in composite trusses.		
Module 4	**Composite Box Girder Bridges**	**Hrs.8**
Introduction - Behavior of box girder bridges - Design concepts.		
Module 5	**General**	**Hrs.8**
Case studies on steel - Concrete composite construction in buildings - Seismic behaviour of composite structures.		

Text Books:	
1	Johnson R.P., Composite structures of steel and concrete, Blackwell Scientific Publications (Second Edition), UK, 1994.
2	Owens, G.W. and Knowels. P. Steel Designers manual (Fifth edition), Steel Concrete Institute (UK), Oxford Blackwell Scientific Publications, 1992.

3	Workshop on Steel Concrete Composite Structures, conducted at Anna University, 2000

SUBJECT CODE	(Program Elective-I)	CREDITS
MCVCASEPET 104D	Design of Bridges	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand the preliminary concepts, development, various types of bridges and it's conceptual
CO2	Study various types of loadings coming on road and railway bridges.
CO3	Study the behaviour of various types of bridges under different loadings.
CO4	Design of slab decks of various types of RC and PSC bridges.
CO5	Perform the design of substructure components like piers, abutments, wing walls and it's foundation

Course Contents

Module 1	**Introduction to Bridge Engineering**	**Hrs. 8**
Historical Perspective, Introduction, Layout and Planning, Investigations for Bridges, Classification and Components of Bridges, Choice of Type of Bridges and Choice of Materials. General Arrangement of Various Types of Bridges including Arch Type, Slab Type, Slab and Beam Type, Plate Girder Type, Open Web Girder, Cable Stayed Type, etc., Conceptual Bridge Design. Modern Methods of Construction of Concrete, Steel and Composite Bridges, their Impact on Analysis and Design, Study of various types of Joints to be provided during Construction.		
Module 2	**Loading on Bridges**	**Hrs. 8**
Loading Standards for Roads and Railway Bridges as per IRC Standards and IRS Standards, Analysis of other Loads Like Impact Factor, Centrifugal Forces, Wind Load, Earthquake Load, Hydraulic Forces, Longitudinal Forces, Earth Pressure, Buoyancy Effects, etc. Analysis by Pieguad's and Courbon's Theory.		
Module 3	**Structural Behavior of Various Bridges**	**Hrs. 6**
Structural behavior of Box Girder Bridges, Arch Bridges, Suspension Bridges, Skew Bridges and Cable Stayed Bridges under various loads.		
Module 4	**Design of Bridge Decks**	**Hrs.10**
Load Distribution in Slab and Bridge, Behavior, Analysis and Design RC and Prestressed Deck Slab, Longitudinal and Cross Girders, Design of Long Span Bridge, Slab Culvert and Box Culvert.		
Module 5	**Design of Sub structure and Foundation**	**Hrs.10**
Design of Bearings, Design of Sub Structure and Foundations, Piers and Abutments of Different Types and		

Shapes, Shallow and Deep Foundation, Wing Walls .

Text Books:	
1	Dr.V.K.Raina, Concrete Bridge Practice: Analysis, Design and Economics, Shroff Publishers & Distributors Pvt Ltd.,
2	Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Reinforced Concrete Structures, Vol. II, Laxmi Publications**.**
3	Jagadish & Jayaram, Design of Concrete Bridges, Tata McGraw Hill.
4	Victor, Design of Concrete Bridges, Tata McGraw Hill.
5	N. Krishnaraju, Prestressed Concrete Bridges, CBS Publishers & Distributors Pvt. Ltd.

Reference Books:	
1	Ponnuswamy S., Bridge Engineering, Tata McGraw Hill.
2	Dr. V. K. Raina., Concrete Bridge Practice: Construction, Maintenance & Rehabilitation, Shroff Publishers & Distrib. Pvt Ltd.
3	Dr.V.K.Raina, Field Manual for Highway & Bridge Engineers, Shroff Publishers & Distributors Pvt Ltd.
4	Dr.V.K.Raina, Handbook for Concrete Bridges, Shroff Publishers & Distributors Pvt Ltd.
5	Victor D. J., Essentials of Bridge Engineering, Oxford & IDH

SUBJECT CODE	(Program Elective-II)	CREDITS
MCVCASEPET 105A	Advanced Prestressed Concrete	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand the preliminary concept, terminologies and methodologies related to prestressed concrete.
CO2	Analyse and design of the anchor blocks.
CO3	Analyse the PSC member for flexural, shear strength and deflection.
CO4	Design the simple and indeterminate structures like continuous beams and portal frames.
CO5	Analyse and design composite section and various slabs

Course Contents

Module 1	**Introduction to Prestressed Concrete**	**Hrs. 6**
Basic Principle of Prestressing, Methods and Systems of Prestressing, Material Requirements, Losses of Prestressing, Analysis of Rectangular, Symmetrical and Unsymmetrical, Flanged Beams, Concept of Cable Profile, Pressure Line, Thrust Lines, etc.		
Module 2	**Design of Anchor Blocks**	**Hrs. 6**

Design of Anchor Blocks using Magnel's Method, Guyon's Method and IS Code Method		
Module 3	**Analysis and Design of PSC Members**	**Hrs.8**
Analysis of PSC section for Flexural Strength, Shear Strength and Deflection, Design of Prestressed Concrete section for Flexural Strength by Analytical procedure and Magnel's Graphical method, Shear Strength and Deflection, Design of Statically Indeterminate Beams and Single Story Portal Frame, Concordant Cable Profile		
Module 4	**Composite Section**	**Hrs.8**
Analysis and Design of Composite Construction of Prestressed and in-situ Concrete Structures, Design of One way and Two-way Slab, Grid Slab. Design of Various PSC Structures- Design of Cylindrical and Non-cylindrical Pipes, Design of Poles, Circular Prestressing for Water Tanks, Design of Sleepers.		
Module 5	**Causes and Remedies of Various Defects in PSC**	**Hrs.8**
Causes of various Defects in Prestressed Concrete like Cracking, Buckling, Deflection, Deterioration, Corrosion of Prestressing Steel, Concrete Crushing at End Anchorages, Grouting of Post Tensioned Tendons, Congested Connections, Dimensional Tolerances etc. and Remedial Measures.		

Guidelines for Assignments:	
1	The candidate shall perform minimum Six assignments consisting theoretical as well as numerical aspects of the Course.
2	One assignment based on visit to any of the prestressed concrete plant or ongoing site involving prestressed concrete activities is desirable.
3	Use of IS 456-2000 and IS 1343 is allowed in the theory examination.
4	The necessary charts for design of anchor blocks by various methods shall be provided in the question paper.

Text Books:	
1	N. Krishnaraju, Prestressed Concrete, Tata Mc Graw-Hill Publishing Company.
2	T. Y. Lin & Nedbhurns, Design of Prestressed Concrete Structures, John Wiley & Sons
3	S.Ramamruthm, Pretsressed Concrete, Dhanpat Rai and Sons.
4	Sinha and Roy, Fundamentals of Prestressed Concrete, S. Chand Ltd.
5	N. Rajagopalan, Prestressed Concrete, Narosa Publishing House

Reference Books:	
1	James R. Libby, Modern Prestressed Concrete, CBS Publishers & Distributors Pvt. Ltd.
2	IS 1343: 2012, Indian Standard Code of Practice for Prestressed Concrete.
3	IS 784: 2001, Indian Standard Code for Circular Prestressing in prestressed concrete pipes

SUBJECT CODE	(Program Elective-II)	CREDITS
MCVCASEPET 105B	Design of Masonry Structures	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand the preliminary information of various masonry structures including materials of construction, basic properties and parameters.
CO2	Understand the compressive strength of masonry structures under various conditions and situation.
CO3	Determine strength of masonry structure in flexure, shear, bond and factors affecting.
CO4	Design the load bearing masonry buildings.
CO5	Design the earthquake resistant masonry structures.

Course Contents

Module 1	**Introduction**	**Hrs. 6**

Masonry units, Materials and Types, History of Masonry Characteristics of Brick, Stone, Clay Block, Concrete Block, Stabilized Mud Block Masonry units – Strength, Modulus of Elasticity and Water Absorption. Masonry materials, Classification and Properties of Mortars, Selection of Mortar.

Module 2	**Strength of Masonry in Compression**	**Hrs. 8**

Behaviour of Masonry under Compression, Strength and Elastic Properties, Influence of Masonry unit and Mortar Characteristics, Effect of Masonry unit Height on Compressive Strength, Influence of Masonry Bonding Patterns on Strength, Prediction of Strength of Masonry in Indian Context, Failure Theories of Masonry under Compression. Effects of Slenderness and Eccentricity, Effect of Rate of Absorption, Effect of Curing, Effect of Ageing, Effect of Workmanship on Compressive Strength.

Module 3	**Flexural, Shear and Bond Strength**	**Hrs.8**

Flexural Strength and Shear Strength of Masonry, Bond between Masonry unit and Mortar, Tests for determining Flexural, Shear and Bond strengths, Factors affecting Bond Strength, Effect of Bond Strength on Compressive Strength, Orthotropic Strength Properties of Masonry in Flexure, Shear Strength of Masonry.

Module 4	**Design of Load Bearing Masonry Buildings**	**Hrs.8**

Permissible Compressive Stress, Stress Reduction and Shape Reduction Factors, Increase in Permissible Stresses for Eccentric Vertical and Lateral Loads, Permissible Tensile and Shear Stresses, Effective Height of Walls and Columns, Opening in Walls, Effective Length, Effective Thickness, Slenderness Ratio, Eccentricity, Load Dispersion, Arching action, Lintels, Wall Carrying Axial Load, Eccentric Load with Different Eccentricity Ratios, Wall with Openings, Free standing Wall, Design of Load Bearing Masonry for Buildings up to 3 to 8 Storey's using BIS Codal Provisions.

Module 5	Earthquake Resistant Masonry Buildings	Hrs.8
Behaviour of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIS Codal provisions. Masonry arches, domes and vaults: Components and classification of masonry arches, domes and vaults, historical buildings, construction procedure. Structural Aspects of Monuments & Ancient Structures- Evolution of Construction Practices, Materials of Construction, Choice of Structural Framing, Form Design, Geometric Proportions, Choice of Foundations, Footprint Ratio, Study of any Four Historical Monuments from Structural point of view.		

Guidelines for Assignments:	
1	The candidate shall perform minimum Six assignments consisting theoretical as well as numerical aspects of the Course.

Text Books:	
1	Hendry A.W., "Structural masonry", Macmillan Education Ltd., 2nd edition
2	Sinha B.P & Davis S.R., "Design of Masonry structures", E & FN Spon
3	Dayaratnam P, "Brick and Reinforced Brick Structures", Oxford & IBH
4	Curtin, "Design of Reinforced and Prestressed Masonry", Thomas Telford
5	Sven Sahlin, "Structural Masonry", Prentice Hall

Reference Books:	
1	Jagadish K S, Venkatarama Reddy B V and Nanjunda Rao K S, "Alternative Building Materials and Technologies", New Age International, New Delhi & Bangalore
2	IS 1905: 1987 Indian Standard Code of Practice for Structural Use of Unreinforced Masonry, Bureau of Indian Standards, New Delhi.
3	SP20 (S&T): 1991, Handbook on Masonry Design and Construction

SUBJECT CODE	(Program Elective-II)	CREDITS
MCVCASEPET 105C	Offshore Structures	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand the preliminary information of various masonry structures including materials of construction, basic properties and parameters.
CO2	Understand the compressive strength of masonry structures under various conditions andsituation.
CO3	Determine strength of masonry structure in flexure, shear, bond and factors affecting.
CO4	Design the load bearing masonry buildings.
CO5	Design the earthquake resistant masonry structures.

Course Contents

Module 1	Wave Theories	Hrs. 6
Wave generation process, small and finite amplitude wave theories.		
Module 2	**Forces of Offshore Structures**	**Hrs. 6**
Wind forces, wave forces on vertical, inclined cylinders, structures - current forces and use of Morison equation.		
Module 3	**Offshore Soil and Structure Modeling**	**Hrs. 6**
Different types of offshore structures, foundation modeling, and structural modeling.		
Module 4	**Analysis of Offshore Structures**	**Hrs. 6**
Static method of analysis, foundation analysis and dynamics of offshore structures.		
Module 5	**Design of Offshore Structures**	**Hrs. 6**
Design of platforms, helipads, Jacket tower and mooring cables and pipe lines		

Guidelines for Assignments:	
1	The candidate shall perform minimum Six assignments consisting theoretical as well as numerical aspects of the Course.

Text Books:	
1	Chakrabarti, S.K. Hydrodynamics of Offshore Structures, Computational MechanicsPublications, 1987.
2	Thomas H. Dawson, Offshore Structural Engineering, Prentice Hall Inc Englewood Cliffs, N.J. 1983
3	API, Recommended Practice for Planning, Designing and Constructing Fixed OffshorePlatforms, American Petroleum Institute Publication, RP2A, Dalls, Tex.
4	Wiegel, R.L., Oceanographical Engineering, Prentice Hall Inc, Englewood Cliffs, N.J. 1964.
5	Brebia, C.A.Walker, S., Dynamic Analysis of Offshore Structures, New-nes Butterworths, U.K. 1979.

Reference Books:	
1	Reddy, D.V. and Arockiasamy, M., Offshore Structures, Vol.1, Krieger Publishing Company,Malabar, Florida, 1991

SUBJECT CODE	(Program Elective-II)	CREDITS
MCVCASEPET 105D	Structural Stability	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Determine stability of columns and frames

CO2	Determine stability of beams and plates
CO3	Use stability criteria and concepts for analyzing discrete and continuous system.
CO4	Learn the inelasticity of beams and frames.
CO5	Understand the dynamic stability of structures.

Course Contents

Module 1	**Introduction**	**Hrs. 6**
Concept of stability, Static, dynamic and energy criterion of stability. Flexibility and stiffness criteria, Snap-through & post buckling behavior.		
Module 2	**Stability of columns**	**Hrs. 6**
Critical load for standard boundary conditions, elastically restrained perfect Columns, effect of transverse shear in buckling, columns with geometric imperfections, eccentrically loaded columns. Orthogonality of buckling modes. Large deformation theory for columns.		
Module 3	**Stability of continuous Beams and Frames**	**Hrs. 6**
Moment distribution and stiffness methods for stability analysis of continuous beam & frames. Differential equations for lateral bucking, lateral buckling of beams in pure bending, lateralbuckling of beams subjected to concentrated and uniformly distributed forces.		
Module 4	**In-elastic stability of Columns**	**Hrs. 6**
In-elastic buckling, double modulus theory, tangent modulus theory, Shanleys theory of in-elastic buckling, eccentrically loaded in-elastic columns.		
Module 5	**Dynamic Stability of Structure**	**Hrs. 6**
Discrete systems, Lagrange-Hamilton formulation for continuous systems, Stability of continuous system, general method for conservative and non-conservative systems		

Guidelines for Assignments:	
1	The candidate shall perform minimum Six assignments consisting theoretical as well as numerical aspects of the Course.

Text Books:	
1	Concrete Technology & Design by R. N. Swamy, Surrey University Press.
2	Special Structural Concrete by Rafat Siddique, Galgotia pub. Pvt. Ltd.
3	Fiber Reinforced Cement Composites by P.N.Balaguru, S.P.Shah, Mc-Graw Gill
4	Fiber Cement and Fiber Concrete by John Wiley and sons.
5	Fracture Mechanics and Structural Concrete by Bhushan L. Karihal Longman Scientific and Technical Wiley and sons.

SUBJECT CODE	CASE-I Laboratory						CREDITS
MCVCASEELL 106							2
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	4	2	25	--	25	50

Course Contents

Students are expected to develop small programs for Analysis & Design of Various Structural Elements by using excel spread sheets or any programming language (minimum 10 Programs)

SUBJECT CODE	CASE-II Laboratory						CREDITS
MCVCASEELL 107							2
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	4	2	25	--	25	50

Course Contents

Students are expected to Analysis and Design 3D Multistory RCC Structure by using any Software with Modeling of Shear wall**.**

SUBJECT CODE	Communication Skill						CREDITS
MCVCASEHMT 108							2
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
2	0	0	2	25	--	25	50

Course Outcomes: Students will be able to	
CO1	Understand the preliminary information of various masonry structures including materials of construction, basic properties and parameters.
CO2	Understand the compressive strength of masonry structures under various conditions and situation.
CO3	Determine strength of masonry structure in flexure, shear, bond and factors affecting.
CO4	Design the load bearing masonry buildings.
CO5	Design the earthquake resistant masonry structures.

Course Contents

Module 1	Language for Technical Purpose and Presentation Tools	Hrs.6
Technical vocabulary, Sentence structures, Microsoft office, Graphical presentations, Preparation, Understanding audience, Use of presentation tools, Presentation, nonverbal techniques, handling questions, Demo presentations		
Module 2	**Formal Written Communication**	**Hrs. 3**
Drafting Letters, e-Mails, Memos, Notices, Circulars, Schedules.		
Module 3	**Project Research Proposals and Reports**	**Hrs.6**
Research Proposal: Essentials, Abstract, Aims, Background & significance, Design & methods, Writing a sample proposal.Project Report: Types of reports, Planning a report, Collection & organization of information, Structure & style, Proofreading etc. Writing a sample report.		
Module 4	**Project Research Proposals and Reports**	**Hrs.6**
Research Proposal: Essentials, Abstract, Aims, Background & significance, Design & methods, Writing a sample proposal.Project Report: Types of reports, Planning a report, Collection & organization of information, Structure & style, Proofreading etc. Writing a sample report.		
Module 5	**Business Meetings**	**Hrs.6**
Understanding role of meetings, planning meetings, developing meeting agendas, scheduling meetings, conducting meetings effectively, Taking notes and publishing minutes and concluding meetings, action plans, Demo meetings.		

Text Books:	
1	S. Hariharan, et.al. Soft Skills; MJP Publishers, 2010.
2	John Seely, Oxford Guide to Effective Writing and Speaking; Oxford University Press, 2009.
3	Thomas N. Huckin and Leslie A. Olsen, Technical Writing and Professional Communication
4	for Nonnative Speakers of English; Tata McGraw Hills, International Edition, 1991.
5	Jeff Butterfield,Soft Skills for Everyone,cengage Learning India Private Limited,2010

Reference Books:	
1	L. Ann Masters & Harold R. Wallace, Personal Development for Life & Work,10e,Cengage
2	Learning India Private Limited,2011.

SUBJECT CODE	YOGA for Stress Management	CREDITS
MCVCASEAUP 109		AUDIT

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	2	2	AU	AU	AU	AU

Course Objectives	
CO1	Understand the physiological and psychological aspects of stress and its impact on overall well-being.
CO2	Learn and practice specific yoga postures, breathing exercises, and relaxation techniques to alleviate stress.
CO3	Explore the connection between mindfulness, meditation, and stress reduction, fostering mental clarity.
CO4	Discover holistic practices that promote better sleep, nutrition, and overall lifestyle habits for stress management.
CO5	Develop practical skills to manage stress in daily life, enhancing resilience and promoting emotional balance.

Course Outcomes: Students will be able to	
CO1	Recognize the signs and sources of stress, understanding its effects on mental and physical well-being.
CO2	Master a variety of yoga techniques, including postures, breathing, and meditation, to effectively manage stress.
CO3	Acquire relaxation strategies that promote calmness, reduce anxiety, and enhance overall mental clarity.
CO4	Incorporate healthy habits inspired by yoga principles to foster better sleep, nutrition, and self-care routines.
CO5	Develop practical skills to navigate and cope with stress, enhancing emotional balance and promoting a more harmonious life.

Course Contents

Module 1	**Introduction to Yoga for Stress Management**	**Hrs. 6**
Stress according to Western perspective Stress Eastern Perspective Developmental process: Western and Eastern Perspective Stress Hazards and Yoga		
Module 2	**Meeting the challenges of Stress**	**Hrs. 6**
Introduction to Stress Physiology Stress, Appetite and Dietary management- Modern and Yogic perspective Sleep and Stress: understanding the relationship for effective management of stress		
Module 3	**Stress Assessment methods**	**Hrs. 6**
A valuable tool toward stress management Role of Yoga in prevention and management of stress related disorders – a summary of research evidence Concept of stress and its management - perspectives from Patanjali Yoga Sutra - Part 1/Part 2/ Part 3		
Module 4	**Stress Management**	**Hrs.6**

Concept of stress and its management - perspectives from Bhagavad Gita - Part 1 / Part 2 / Part 3		
Module 5	**Yoga practices for Stress Management**	**Hrs. 8**
Bio-Psycho-Socio-Spiritual model of stress management Yoga practices for Stress Management Breathing practices , Asana practices- Tadasana, Ardhakati Chakrasana, Ardha Chakrasana, Trikonasana, Vrikshasana, Vakarasana, Janu Sirshasana, Ushtrasana, Sashankasana, Ardhamatseyndrasana, Paschimottanasana, Poorvottanasana, Gomukhasana, Makarasana, Bhujangasana, Salambha Shalabahasana, Dhanurasana, Setubandhasana, Sarvangasana, Mastyasana, Deep Relaxation Technique (DRT),etc.		

Text Books:	
1	H R Nagendra and R Nagarathna. Yoga for Promotion of Positive Health. Swami Vivekananda Yoga Prakashana. 2011.
2	Contrada, R., & Baum, A. (Eds.). The handbook of stress science: Biology, psychology, and health. Springer Publishing Company. 2010
3	Al'Absi, M. (Ed.). Stress and addiction: Biological and psychological mechanisms. Elsevier. 2011.
4	Van den Bergh, O. Principles, and practice of stress management. Guilford Publications. 2021.
5	Swami Muktibodhananda, Hatha Yoga Pradipika, Bihar Scool of Yoga, 1998

Reference Books:	
1	Swami Satyananda Saraswati, Four Chapters on Freedom, Bihar Scool of Yoga, 1975
2	Swami Tapasyananda, Srimad Bhagavat Gita, Sri Ramakrishna Math, 2012
3	**NPTEL Course-**Yoga for Stress Management-Dr H R Nagendra, Dr Mithila M V, Dr Rajesh Nair,Swami Vivekananda Yoga Anusandhana Samsthana https://onlinecourses.swayam2. ac.in/aic23_ge10/preview#:~:te xt=In%20this%20course%20we %20intend,meeting%20the%20 challenges%20of%20stress

SUBJECT CODE	Mini Project			CREDITS			
MCVCASEELP 207				4			
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	8	4	25	--	25	50

Course Contents

Guidelines for Mini Project
Mini project shall be based on one of the topic chosen in consultation with the supervisor. Mini project may be interdisciplinary nature. Areas of recent techno-management development shall be explored. Research innovations may be considered as prospective areas. Mini project may be related with main project to explore possibilities of continuation further and to study the pre-requisites.

SUBJECT CODE	History of Structural Engineering In India	CREDITS
MCVCASEHMT 208		2

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
2	0	0	2	20	20	60	100

Course Contents

Course Outcomes: Students will be able to	
CO1	Understand the foundational techniques of urban planning, masonry, and drainage systems in ancient Indian civilizations.
CO2	Analyze temple architecture styles and Islamic engineering techniques, focusing on load-bearing elements and material usage.
CO3	Evaluate structural innovations during the Mughal and early European colonial periods, including dome construction and advanced masonry.
CO4	Examine the impact of British engineering on Indian infrastructure, including bridge and dam construction techniques.
CO5	Assess modern advancements in high-rise construction, sustainable practices, and adherence to Indian structural codes.

Course Contents

Module 1	**Ancient Structural Engineering**	**Hrs. 6**

Indus Valley Civilization: Urban planning, drainage systems, brick masonry, load-bearing walls, and water management.

Vedic and Early Iron Age: Early wooden structures, iron usage in tools and construction, and references in Vedic texts to materials and methods.

Mauryan Period: Pillar construction techniques, stone masonry, Mauryan stupas (e.g., Sanchi Stupa), and rock-cut structures.

Material Analysis: Baked bricks, mud mortar, wood, and early stone carving.

Module 2	**Medieval Structural Engineering**	**Hrs. 6**

Temple Architecture (South and North India):

- **Dravidian Style**: Structural design of temples (e.g., Brihadeeswara Temple), granite usage, and techniques in constructing gopurams.
- **Nagara Style**: Stonework, shikhara structures, load transfer methods, and buttress walls.

Early Islamic Architecture: Introduction of arches, domes, vaulting techniques, and lime mortar (e.g., Qutb Minar, Delhi).

Material Analysis: Advanced stone masonry, use of lime, brick, and mortars

Module 3	**Early Modern Period Engineering**	**Hrs. 6**

Mughal Structural Engineering:

- Structural features of the Taj Mahal: symmetrical dome construction, load distribution, and marble

inlay techniques.

- Forts and Palaces: Large-scale stone masonry, multi-story structures, and integration of gardens and water channels.

European Influence: Early European fortifications, use of brickwork, lime mortar, and stone foundations.

Material and Structural Analysis: Sandstone, marble, brick masonry, and techniques for stability in large structures.

Module 4	**Colonial Period and Early Modern Structural Practices**	**Hrs.6**

Railway Bridges and Infrastructure: Design and engineering of iron and steel railway bridges (e.g., Pamban Bridge), cantilever and truss systems.

Hydraulic Structures: Dams and canals (e.g., Mullaperiyar Dam), early concrete use, gravity dam design principles.

Educational Institutions: Role of engineering colleges (e.g., Thomason College), influence of British standards and codes.

Material and Structural Analysis: Iron, steel, concrete, brick, and foundations for industrial architecture.

Module 5	**Post-Independence Structural Engineering Developments**	**Hrs.10**

National Infrastructure Projects: Large dams (e.g., Bhakra Nangal), concrete technology advancements, reinforced concrete (RC) design.

Urbanization and High-rise Structures: Evolution of high-rise buildings, metro structures, and earthquake-resistant design.

Sustainable Building Practices: Modern materials, green construction techniques, sustainable structural engineering in urban projects.

Standards and Professional Bodies: Overview of IS codes, development of seismic and wind load standards, and role of organizations (e.g., Institution of Engineers).

Guidelines for Assignments:
The candidate shall perform minimum six assignments consisting theoretical as well as numerical aspects of the Course.

Text Books:	
1	Indian Architecture (Buddhist and Hindu Periods)" by Percy Brown
2	Temples of South India by K.R. Srinivasan
3	The Art and Architecture of India by Benjamin Rowland
4	Engineering the Pyramids of India: Ancient to Modern by Nitin Kanwar
5	Mughal Architecture: An Outline of Its History and Development (1526-1858)" by Catherine B. Asher

Reference Books:	
1	Building Jaipur: The Making of an Indian City by Vibhuti Sachdev and Giles Tillotson
2	Bridge Engineering by S.P. Bindra
3	A History of Architecture on the Comparative Method, by Banister Fletcher
4	Concrete Technology: Theory and Practice by M.S. Shetty
5	Indian Dams and Irrigation Engineering by K.C. Jain and P.L. Shah

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for M. Tech. in Civil Engineering with Specialization in Computer Aided Structural Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	ISE	MSE	ESE	Total	
Semester- II										
1	MCVCASEPCT 201	Theory of Plates and Shells	3	--	--	20	20	60	100	3
2	MCVCASEPCT 202	Finite Element Analysis	3	--	--	20	20	60	100	3
3	MCVCASEPET 203	Program Elective- III	3	--	--	20	20	60	100	3
4	MCVCASEPET 204	Program Elective- IV	3	--	--	20	20	60	100	3
5	MCVCASEOET 205	Open Elective-V	3	--	--	20	20	60	100	3
6	MCVCASEELL 206	CASE-III Laboratory	--	--	4	25	-	25	50	2
7	MCVCASEELL 207	Mini Project	--	--	4	25	-	25	50	2
8	MCVCASEHMT 208	Indian Knowledge System	2	--	--	20	20	60	100	2
		Total	**17**	**0**	**12**	**170**	**120**	**410**	**700**	**23**

Type of course:

Program Core: **PC**	Program Elective: **PE**
Open Elective: **OE** (Other than particular program)	Ability Enhancement Course: **AE**
Modern Indian Language: **MIL**	Humanities, Management, language and Commerce: **HM**
Experiential Learning Courses: **EL**	Multidisciplinary Minor Courses: **MD**
ABBRIVATIONS: **ISE**-INSEMESTER EVALUATION, **MSE**-MID SEMESTER EVLUATION, **ESE** -END SEMESTER EVALUATION	

SUBJECT CODE	Theory of Plates & Shells						CREDITS
MCVCASEPCT 201							3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand and derive governing differential equation for deflected shape of rectangular plates.
CO2	Solve governing differential equation of deflected shape of rectangular plate for various loading and
CO3	Understand and derive governing differential equation for deflected shape of circular plates.
CO4	Solve governing differential equation of deflected shape of circular plate for various loading and
CO5	Understand membrane theory for internal forces in different shells.

Course Contents

Module 1	**Introduction to Plate Theory**	**Hrs. 8**
Thin and Thick Plates, Small and Large Deflection Theory of Thin Plate, Assumptions in Analysis of Thin Plates, Slope Curvature Relations, Moment - Curvature Relations, Stress Resultants, Governing Differential Equations for Bending of Plates, Various Boundary Conditions.		
Module 2	**Navier's and Levy's Solution**	**Hrs. 6**
Rectangular Plates Subjected to Uniformly Distributed Load, Sinusoidal Load for Different Boundary Conditions.		
Module 3	**Circular Plates**	**Hrs.8**
Analysis of Circular Plates under Axis-Symmetric Loading, Moment Curvature Relations, Governing Differential Equation in Polar Co-Ordinates, Simply Supported and Fixed Edges, Distributed Load, Ring Load, a Plate with Hole at Center.		
Module 4	**Introduction to Shell Structures**	**Hrs.8**
Classification of Shells on basis of Geometry, Thin Shell Theory, Equation of Shell Surfaces, Stress Resultants, Stress- Displacement Relations, Compatibility and Equilibrium Equations		
Module 5	**Membrane Analysis**	**Hrs.12**
Equation of Equilibrium for Synclastic Shells, Solution for Shells Subjected to Self-Weight and Live Load, Cylindrical Shells -Equation of Equilibrium, Open Shells with Parabolic, Circular, Elliptical Directrix, Simple Problems, Shells with Closed Directrix-Circular, Elliptical-Simple Problems, Problems on Pipes Carrying Fluid/Liquid Under Pressure, Just Filled & Partly Filled. Symmetrically Loaded Circular Cylindrical Shells, Beam Theory, Finsterwalder's Theory, D.K.J. Theory- Donnell's Equation, Characteristic Equation, Schorer's Theory.		

Guidelines for Assignments:
The candidate shall perform minimum six assignments consisting of theoretical as well as numerical aspects of the course.

Text Books:	
1	Theory of Plates and Shells by S. S. Bhavikatti, New Age International Publishers Limited.
2	Design of Reinforced Concrete Shells and Folded plates by P.C. Varghese, PHI Learning Private Limited, New Delhi (2010).
3	Design and Construction of Concrete Shell Roofs by G.S. Rama Swamy – CBS Publishers & Distributors, Delhi
4	S. Timoshenko and W. Krieger, Theory of Plates and Shells, Mc Grew Hill.
5	Ansel C. Ugural, Stresses in Plates and Shells, Mc Graw Hill.

Reference Books:	
1	Reddy, J. N.; Theory and Analysis of Elastic Plates and Shells, Taylor & Francis
2	G. S Ramaswamy, Design and Construction of Concrete Shell Roofs, CBS Publications.
3	Chandrashekhara K., Analysis of Concrete Shells, New Age International Edition.
4	Chandrashekhara K., Analysis of Plates, New Age International Edition.
5	ASCE Manual of Engineering practice No. 31, Design of cylindrical concrete shell roofs ASC, New York

SUBJECT CODE	Finite Element Method						CREDITS
MCVCASEPCT 202							3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand the different energy methods in structural analysis and basic concepts of finite element method.
CO2	Analyse 1-D problems related to structural analysis like Bars, Trusses, Beams and Frames using finite element approach.
CO3	Find solution to problems using direct approach methods like Rayleigh – Ritz or Galerkin's Method.
CO4	Solve 2-D problems using knowledge of theory of elasticity.
CO5	Students will be able to implement the knowledge of numerical methods in FEM to find the solution to the various problems in statics and dynamics, Analyse 1D, 2D, and 3D structures using different

Course Contents

Module 1	Introduction to FEM & Approximate Methods	Hrs. 8
Introduction, Overview of Various Methods to Solve Integral & Differential Equations (Point Collocation Method, Method of Least Square, Weighted Residual Method, Galerkin's Method), Variational Calculus (Hamilton's Variational Principle, Minimum Potential Energy Principle, Euler Lagrange Equation), Partial FEM (Kentorvich Method/ Finite Strip Method/ Semi-Analytical Method), Local & Global Finite Element Methods (Rayleigh-Ritz Method), Stepwise Procedure in FEM		
Module 2	**One Dimensional FE Analysis**	**Hrs. 10**
Application of FEM to Solve various 1-D problems (Shape Functions for 1-D Elements, Properties of Shape Functions, Lagrange Interpolating Polynomials), C0 Continuity, 1-D FE Analysis (Discretization, Selection of Shape Function, Defining Gradients of Primary Unknowns & Constitutive Equations, Derivation of Element Equations, Assembly & Application of Boundary Conditions, Computation of Primary and Secondary Unknowns), Direct Approach for Assembly, Boundary Conditions (Geometric, Natural), Concept of Sub-Structuring (Static Condensation), Stiffness Matrix for Basic Bar & Beam Element, Representation of Distributed Loading, The Assembly Process within the PMPE Approach, Element Stresses), FE Analysis of 1-D Non-Prismatic Members, Solution of Differential Equation using FEM, Solution of BIVP using Galerkin's MWR (1-D Transient Analysis).		
Module 3	**FE Analysis by Direct Approach**	**Hrs.6**
C1 Continuity, Formulation of 1-D Beam Element, Classical Beam Theory, Element Equation Formulation (Galerkin's Approach, Rayleigh-Ritz Approach), Derivation of Scalar Functional from Differential Equation and Vice Versa, Application to Fixed and Continuous Beams.		
Module 4	**Two Dimensional FE Analysis**	**Hrs.10**
Conditions of Symmetry & Anti Symmetry (Applications), 2-D FE Analysis, Review of Theory of Elasticity, CST Element (3- Node Triangular Element), Pascal's Triangle and Pyramid, Area Co-ordinate, Stepwise Formulation, Equivalent Load Vector, Plane Stress Problems using CST Elements, 2-D Stress Analysis using 4-noded Rectangular Element, Stepwise Formulation, Effect of Aspect Ratio, Explicit & Implicit Iso-parametric Formulation, Iso-parametric Elements for Plane Problems (Quadrilateral Element, Bilinear Element, Para-linear Element, Bi-Quadrilateral Element, Serendipity Elements, Lagrange Element), Numerical Integration, (1-D Domain, 2-D Domain, n-point Gauss Rule), Formulation of Transition Element		
Module 5	**Three Dimensional FE Analysis & Computer Implementation of FEM**	**Hrs.12**
3-D Stress Analysis using FEM, Iso-parametric Formulation, 3-D Brick Element, Application to 3-D Analysis, FEA of Axi- symmetric Solids Subjected to Axi-symmetric and Asymmetric Loads (Application of Partial FEM). Computer Implementation of FEM, Application of FEM to Time Dependent Problems, Partial FEM,		

h-version of FEM, p-version of FEM, Adaptive Meshing, Exposure to Hybrid FEM (Mixed/ Hybrid Formulation, Unidirectional Composites), Introduction to ANSYS, Static & Dynamic Analysis of 1-D, 2-D and 3-D structures using ANSYS.

Guidelines for Assignments:
The candidate shall perform minimum six assignments consisting theoretical as well as numerical aspects of the course.

Text Books:	
1	M. Mukhopdhyay, Concept and Application of Finite Element Analysis, Oxford and IBH Publishing Co. Pvt. Ltd.
2	O.C.Zienkiewicz & R.L.Taylor, The Finite Element Method Vol .I & II, Tata McGraw Hill
3	J.N.Reddy, An introduction to the Finite Element Method, Tata McGraw Hill Pub.
4	R. D. Cook, Concept and Application of Finite Element Analysis, John Wiley & sons
5	Hutton D.V., Fundamentals of Finite Element Analysis, Tata McGraw Hill Pub.

Reference Books:	
1	C. S. Desai & J. F. Abel, Introduction to the Finite Element Method, CBS Pub.
2	C. S .Krishnamoorthy, Programming in the Finite Element Method, Tata McGraw Hill
3	T.R.Chandrupatla and Belegundu, Introduction to the Finite Element in Engineering Prentice Hall of India, pvt.ltd
4	Bathe K.J., Finite Element Procedures, PHI learning pvt.ltd
5	Y. M. Desai, T.I Eldho, Finite Element Method with application in Engineering, Pearson , Delhi

SUBJECT CODE	(Program Elective-III)	CREDITS
MCVCASEPET 203A	Design of Cold Formed Steel Structures	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand the types of cross sections, mechanical and thermal properties and applications of cold formed steel structures.
CO2	Understand the design criteria and strength of thin elements and analyse various cross section for strength in tension, compression, flexure, etc.
CO3	Design the CFS flexural members.
CO4	Design the CFS compression members.
CO5	Design the CFS members subjected to axial load and bending. Study and design various types of connections in cold formed steel structures.

Course Contents

Module 1	Introduction	Hrs. 8
General, Types of Cold-Formed Steel Sections and Their Applications, Standardized Metal Buildings and Industrialized Housing, Methods of Forming, Research and Design Specifications, General Design Considerations of Cold-Formed Steel Construction, Economic Design and Optimum Properties, Yield Stress, Tensile Strength, and Stress–Strain Curve, Modulus of Elasticity, Tangent Modulus, and Shear Modulus, Ductility, Weld ability, Fatigue Strength and Toughness, Influence of Cold Work on Mechanical Properties of Steel, Utilization of Cold Work of Forming, Effect of Temperature on Mechanical Properties of Steel, Testing of Full Sections and Flat Elements, Residual Stresses Due to Cold Forming, Effect of Strain Rate on Mechanical Properties.		
Module 2	**Strength of Thin Elements & Design Criteria**	**Hrs. 8**
Definitions of Terms, Design Basis, Serviceability, Structural Behaviour of Compression Elements and Design Criteria, Perforated Elements and Members, Plate Buckling of Structural Shapes, Design Examples.		
Module 3	**Design of Axially Loaded Members**	**Hrs. 10**
Design of axially loaded tension members, Flexural Column Buckling, Torsional Buckling and Flexural–Torsional Buckling, Effect of Local Buckling on Column Strength, Distortional Buckling Strength of Compression Members, Effect of Cold Work on Column Buckling, North American Design Formulas for Concentrically Loaded Compression Members, Effective Length Factor *K,* Built-Up Compression Members, Bracing of Axially Loaded Compression Members, Design Examples.		
Module 4	**Design of Flexural Members**	**Hrs.6**
Bending Strength and Deflection, Design of Beam Webs, Bracing Requirements of Beams, Torsional analysis of Beams and Combined Bending and Torsional Loading, Design Examples.		
Module 5	**Design of Members under Combined Axial Load & Bending**	**Hrs.10**
Combined Tensile axial load and Bending, Combined Compressive axial load and Bending (Beam–Columns), North American Design Criteria, Design Examples, Second-Order Analysis. Design of Connections :Types of Connectors, Welded Connections, Bolted Connections, Types of Connectors, Welded Connections, Bolted Connections, Screw Connections, Other Fasteners, Rupture Failure of Connections, I or Box-Shaped Compression Members Made by Connecting Two C-Sections, I-Beams Made by Connecting Two C-Sections, Spacing of Connections in Compression Elements.		

Guidelines for Assignments:
The candidate shall perform minimum Six assignments consisting theoretical as well as numerical aspects of the Course.

Reference Books:	
1	W.W. Yu, "Cold-Formed Steel Design", John Wiley & Sons.
2	IS 801: 1975, Code of Practice for Use of Cold Formed Light Gauge Steel Structural Members in General Building Construction.
3	BS 5950-5:1998, Structural Use of Steelwork in Building: Code of Practice for Design of Cold Formed Thin Gauge Sections.

SUBJECT CODE	(Program Elective-III) Retrofitting of Structures						CREDITS
MCVCASEPET 203B							3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand factors of Serviceability and Durability of Structures.
CO2	Determine crack width, effect of crack on materials, effect of moisture on structures.
CO3	Understand methods for protection of steel structures and masonry structures.
CO4	Understand various materials and methodologies used for repairing of structures.
CO5	Understand and implement techniques used for repairing and maintenance of structure

Course Contents

Module 1	Serviceability and Durability	Hrs. 6

Quality Assurance for Concrete Construction, Permeability, Thermal Properties and Cracking, Distress Monitoring, Causes for Distress, Effects of Climate, Temperature, Chemicals, Wear and Erosion, Design and Construction Errors, Corrosion Mechanism, Effects of Cover Thickness and Cracking,

Non-Destructive Testing: Ultrasonic and Sonic Test, Rebound Hammer Test, Strength Evaluation of Existing Structures.

Module 2	Cracks in Structures	Hrs. 6

Causes, Thermal and Shrinkage cracks, Cracks due to Vegetation and Trees, Foundation Movements, Types and their Fatality, Diagnosis Techniques for Repair.

Moisture Penetration

Sources of Dampness, Moisture Movement from Ground, Reasons for Ineffective Damping, Leakage in Concrete Slabs, Pitched Roofs, Dampness in Solid Walls, Condensation, Remedial treatments, Chemical Coatings.

Module 3	Steel Structures and Masonry	Hrs. 10

Types and Causes of Deterioration, Preventive Measures, Repair Procedure, Brittle Failure, Defects in Connections,

Welded Joints: Test for Defects; Mechanism of Corrosion , Methods of Corrosion Protection, Corrosion Inhibitors, Corrosion Resistant Steels, Coatings, Cathodic Protection. Design and Fabrication Errors, Distress during Erection. Masonry Structures Discoloration and Weakening of Stones, Preservation, Chemical Preservatives, Brick Masonry Structures, Distress and Remedial Measures.

Module 4	**Materials for Repairs**	**Hrs.6**

Essential Parameters for Repair Material, Premixed Cement Concrete and Mortar, Sulphur Infiltrated Concrete, Fiber Reinforced Concrete, Special Elements for Accelerated Strength Gain, Expansive Cement, Polyester Resin.

Polymer Concrete: Physical and Mechanical Properties, General Guidelines and Precautions for Use, Field Application

Polymer Modified Concrete: Physical and Mechanical Properties, General Guidelines and Precautions for Use, Field Application, Epoxy Concrete and Mortar: Epoxies, Physical and Mechanical Properties, General Guidelines and Precautions for Use, Field Application.

Surface Coatings: Essential Parameters, Types, Characteristics.

Module 5	**Maintenance and repair strategies**	**Hrs.6**

Definitions: Maintenance, Repair and Rehabilitation, Facets of Maintenance, Importance of Maintenance, Preventive Measures on Various Aspects Inspection, Assessment Procedure for Evaluating a Damaged Structure, Causes of Deterioration, Testing Techniques. Repairs using Mortars and Dry Packs**,** Concrete Replacement, Surface Impregnation, Rust Eliminators and Polymers Coating for Rebar During Repair Foamed Concrete, Vacuum Concrete, Gunite and Shotcrete, Injection: Epoxy, Resin, Polymer Modified Cement Slurry;Shoring and Underpinning. Strengthening of Super Structures (Beam, Column, Slab including Joints) for Tension, Compression, Flexural, and Shear respectively, Jacketing (RCC, Plate, Fiber, Wrap), Bonded Overlays, Reinforcement Addition, Strengthening the Substructures, Increasing the Load Capacity of Footing, Strengthening of Masonry Structure.

Guidelines for Assignments:

The candidate shall perform minimum six assignments consisting theoretical as well as numerical aspects of the course.

Text Books:

1	Johnson. S.M., “Deterioration, maintenance and repair of structures”, McGraw-Hill book company, New York, 1965.
2	R. T. Allen and S. C. Edwards, “Repair of concrete structures”, Blakie and Sons, UK, 1987.
3	Denison Campbell, Allen and Harold Roper, “Concrete structures”, Materials, Maintenance and Repair, Longman Scientific and technical UK, 1991.
4	SP25-84, “Hand book on causes and prevention of cracks on buildings”, Indian standards.
5	M. S. Shetty, “Concrete Technology- Theory and Practice”, S. Chand and Company, New Delhi, 1992

Reference Books:	
1	Santhakumar, A.R., " Training Course notes on Damage Assessment and repair in Low Cost Housing "," RHDC–NBO " Anna University, July, 1992.
2	Raikar, R.N., "Learning from failures – Deficiencies in Design ", Construction and Service – R & D Centre (SDCPL), Raikar Bhavan, Bombay, 1987

SUBJECT CODE	(Program Elective-III) Glass in Building: Design And Application	CREDITS
MCVCASEPET 203C		3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand Glass as a building material, its various applications and benefits.
CO2	Understand process of selection of glass
CO3	Learn about daylighting in building.
CO4	Analyse the glass processing.
CO5	Design and analyze the suitable façade based on drawings.

Course Contents

Module 1	Introduction	Hrs. 6
Introduction – Glass the Building Material, Float Glass Manufacturing Process, coatings on glass, glass design for coating, sustainability and aesthetics		
Module 2	**Design Tools for Glass Selection**	**Hrs. 6**
Structural Control and Design for Energy efficiency, Design Tools for Glass Selection, Building,Envelope Design, Innovations in Glass Future Facades, Standards Related to Glass		
Module 3	**Useful Daylighting in Building**	**Hrs. 8**
Fundamentals of Daylighting, Daylighting Strategies Techniques, ECBC and Green Building Requirements, Introduction to Daylight Simulation, Daylighting Controls, Achieving Acoustics Through Glass		
Module 4	**Glass Processing**	**Hrs. 6**
Glass Processing Overview, Interior Glazing Program, Interior Glazing Applications Shower Enclosure, Glass in Passive Fire Protection, Glazing Choices for Project Segment, National Building Code 2016		
Module 5	**Applications of Glass**	**Hrs. 10**
Glass in Passive Fire Protection, Glazing Choices for Project Segment Silicone for Structural Glazing, Role of Windows in Building Design, Fire Resistant Glazing, Interior Glazing Applications, Design and application of sealant. Facade Fundamentals, Glass Application on Facades, Energy Efficiency Facade System, Structural		

Design of Facades, Facade Factory Operations, Performance Testing for Facades, Sustainable Building and Facades.

Text Books:	
1	Structural Glass: Hugh Dutton, Peter Rice: 9780419199403
2	Structural Glass Facades and Enclosures, Mic Patterson; ISBN: 978-0-470-93185-1
3	Joseph S. Amstock‟s Glass in Construction (McGraw-Hill, 1997)
4	Envelope Design for Buildings ISBN 0750628545 by William Allen
5	Thomas Herzog, “Facade Construction Manual.” Birkhauser, 2004

Reference Books:	
1	Glass in Architecture ISBN 0714829226 by Michael Wigginton
2	FOSG Architectural Guide
3	Glass Academy Foundation Manual Volume – I
4	Glass Academy Foundation Manual Volume – II
5	Glass Academy Foundation Manual Volume - III

SUBJECT CODE	(Program Elective-III) Earthquake Engineering & Design of Earthquake Resistant Structures			CREDITS			
MCVCASEPET 203 D				3			
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand Engineering Seismology and Seismic zones in India.
CO2	Understand earthquake response of SDoF Linear systems and instrumentation in measurement of
CO3	Understand factors resisting earthquake forces, and earthquake risk analysis.
CO4	Perform Seismic Analysis of buildings as per IS 1893.
CO5	Understand, analyse and Design structural elements and its ductile detailing using IS 13920.

Course Contents

Module 1	**Introduction to Seismology**	**Hrs. 6**
Elements of Seismology, Terminology, structure of Earth, Causes of an earthquake, seismic waves, magnitude and intensity, seismograph, strong motion earthquake, strong motion earthquake, accelerogram, Elastic Rebound Theory, Theory of Plate Tectonics and Movement of Indian Plate, Seismic Zoning Maps of		

India and Comparative Study, Response Spectra, Strong Motion Characteristics.		
Module 2	**Earthquake Response of Systems**	**Hrs. 6**
Structural dynamics: Free and forced vibrations of single degree of freedom systems, un-damped and viscously damped vibrations, equations of motion, Duhamel integral. Response Spectrum Theory: construction of Design Response Spectrum, effect of foundation and structural damping on design spectrum, design spectrum of IS 1893, evaluation of lateral loads.		
Module 3	**Earthquake Risk Analysis**	**Hrs. 6**
Earthquake Effects on the Structures, Classification of Loads, Seismic Methods of Analysis, Seismic Design Methods, Seismic Damages during Past Earthquakes and Effect of Irregularities and Building Architecture on the Performance of RC Structures, Mathematical Modeling of Multi-Storied RC Buildings with Modeling of Floor Diaphragms and Soil-Foundation, Winkler model.		
Module 4	**Analysis of Seismic Forces**	**Hrs.10**
Analysis of Seismic Forces on Building as per latest IS: 1893 by Equivalent Static Lateral Load Method and Response Spectrum Method, Introduction to Time History Method and Performance Based Analysis. Seismic Retrofitting, Sources of Weakness in RC Framed Buildings, Classification of Retrofitting Techniques, Conventional and Non-Conventional Methods, Comparative Study of Various Methods and Case Studies,		
Module 5	**Ductility in Structures**	**Hrs.10**
Introduction to Ductility, Factors Affecting Ductility, Ductility Requirements, Types of Ductility, Provisions as per latest IS 13920, Seismic Design and Ductile Detailing of Beam, Column, Beam Column Joint, Shear Wall, Elevated RC Circular Water Tanks Introduction to Base Isolation Systems, IS Code Provisions for Retrofitting of Masonry Structures, Failure Modes of Masonry Structures and Repairing Techniques		

Guidelines for Assignments:
The candidate shall perform minimum six assignments consisting theoretical as well as numerical aspects of the course.

Text Books:	
1	P. Agarwal and M. Shrikhande – Earthquake Resistant Design of Structures, Prentice-Hall Publications.
2	Clough and Penzin – Dynamics of Structures, Mc-Graw Hills Publications.
3	Jai Krishna, A.R. Chandrashekharan and B Chandra – Elements of Earthquake Engineering, South Asian Publishers Pvt. Ltd.
4	Joshi P S et al. - Design of Reinforced Concrete Structures for Earthquake
5	Resistance Published by Indian Society of Structural Engineers, 2001.

Reference Books:	
1	IS:13935 – Repair and Seismic Strengthening of Buildings – Guidelines, 1993
2	IS:4326 – Earthquake Resistant Design and Construction of Buildings – Code of Practice, 1993
3	IS:13828 – Improving Earthquake Resistance of Low Strength Masonry Buildings, 1993
4	IS:13827 - Improving Earthquake Resistance of Earthen Buildings, 1993
5	IS:13920 – Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Force,1993

SUBJECT CODE	(Program Elective-IV) Design of Tall Structures						CREDITS
MCVCASEPET 204 A							3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Identify and calculate magnitude of various loads acting on tall buildings.
CO2	Understand various forms of structures, moment and force resisting systems in a structure.
CO3	Identify various factors causing movements /twists in the building and their analysis and design.
CO4	Understand various types of chimneys, their components, Analyse and design of chimneys.
CO5	Understand various types of Cooling Towers, their components & feasibility, analyse and design a Cooling Tower

Course Contents

Module 1	Design Loads	Hrs. 6
Gravity Loads, Dead Load and Live Load Reduction, Construction Loads, Wind Load, Equivalent Lateral Force, Combination of Loadings, Design Philosophy: Working Stress Design and Limit State Design		
Module 2	**Structural Systems and its Behaviour**	**Hrs. 6**
Height and Structural Forms, Rigid Frames, Braced Frames, In-Filled Frames, Shear Walls, Coupled Shear Walls, Tubular Structures, and Hybrid Mega Systems		
Module 3	**Tall Buildings**	**Hrs. 6**
Approximate Analysis, Detail Analysis and Reduction Techniques, Analysis of Member Forces, Drift, and Twist, Buckling Analysis, P-Delta Analysis, Translational and Torsional Instability, Design for Differential Movements, Creep and Shrinkage, Structural Control and Energy Dissipation Devices.		
Module 4	**Chimneys**	**Hrs.6**
Design Factors, Thermal Stresses, Components, Platform and Safety Ladders, Steel Stacks, Refractory Linings, Caps and Foundations.		

Module 5	Cooling & Transmission Towers	Hrs.6
Types, Components, Analysis and Design. Types of Loads, Tower Configuration, Analysis and Design		

Guidelines for Assignments:
The candidate shall perform minimum six assignments consisting theoretical as well as numerical aspects of the course.

Text Books:	
1	B. S. Taranath, Structural Analysis and Design of Tall Building, CRC press, 2011.
2	B. S. Smith and A. Coull, Tall Building Structures: Analysis and Design, Wiley, 1991.
3	S. N. Manohar, Tall Chimneys: Design and Construction, Tata Mcgraw-Hill, 1985.
4	A. R. Shanthakumar and S. S. Murthy, Transmission Line Structures, Tata Mcgraw-Hill, 1990.
5	IS: 6533 (Part 2): 1989, - Code of Practice for Design and Construction of Steel Chimneys IS 4998 (Part 1): 1992, -Criteria for Design of Reinforced Concrete Chimneys.

SUBJECT CODE	(Program Elective-IV)	CREDITS
MCVCASEPET 203B	Design of Foundation	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Compute bearing capacity and settlement of foundation
CO2	Design shallow and deep foundation
CO3	Suggest remedial measure for foundation on expansive soil.
CO4	Analyse and design sheet piles
CO5	Design simple machine foundation by using IS code method

Course Contents

Module 1	Bearing capacity	Hrs. 8
Empirical equations for bearing capacity (Terzaghi, IS code, Skempton‟s Meyerhof, Hansen, Vesic). Bearing capacity of footing with inclined load, eccentric load. Effect of water table on bearing capacity. Bearing capacity of rocks. Settlement - Immediate and consolidation settlements in cohesive soil, settlement prediction in non- cohesive soil. Allowable settlement.		
Module 2	**Shallow Foundation**	**Hrs. 6**
Proportioning of footing (isolated, wall footing, combined rectangular and combined trapezoidal, strap footing) Mat foundation, types of mats, design consideration and various methods of analysis of mat. Floating raft concept and design.		

Module 3	Deep foundation	Hrs. 8
Mechanics of load transfer in piles, determination of capacity of single pile, rock socketing, negative skin friction, design of axially loaded pile, design of pile groups, design of pile group subjected to eccentric load (Axial load and moment) Design of pile cap. Settlement of pile group.		
Module 4	**Sheet piles and braced excavations**	**Hrs.6**
Types and uses of sheet piles, design of cantilever sheet pile walls, design of anchored bulkhead, Anchorage method, Design of Braced sheeting in cuts. Introduction to expansive soil, Types of damage and cracks in buildings on expansive soil. Principles of design of foundations in expansive soil.		
Module 5	**Introduction to Machine Foundation**	**Hrs. 6**
Soil behavior under dynamic loads, Permissible amplitude, criteria for satisfactory machine foundations, introduction to analysis and design of simple machine foundations using I. S. Code method.		

Text Books:	
1	Foundation Engineering by P.C. Varghese (Prentice hall of India)
2	Analysis and Design of Substructures by Swami Saran (Oxford and IBH Publishing)
3	Foundation Analysis and Design Bowles J.E. (McGraw Hill Book Company)
4	Design Aids in Soil Mechanics and Foundation Engineering Shenbage R Kaniraj, TATA Mc-Grawhill
5	Design of Foundation Systems- Nainan P Kurian, Narosa publication house

Reference Books:	
1	Design of Reinforced Concrete Foundations by Varghese P.C (Prentice hall of India)
2	Design of Reinforced Concrete Structures by N Subramanian
3	Limit state theory and Design of Reinforced concrete – Dr. V. L. Shah and Dr. S R Karve (Structures Publications)

SUBJECT CODE	(Program Elective-IV)	CREDITS
MCVCASEPET 203C	Structural audits	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Gain the knowledge of Byelaws, procedure of Structural audit and study the typical problems in
CO2	Aware of causes and types of deterioration in structures.
CO3	Develop skills for use of various Non destructive tests required during auditing of structures.
CO4	Strength evaluation of existing structures.
CO5	Acquire knowledge of legal procedure to conduct structural audits ad report preparation.

Course Contents

Module 1	Introduction to Structural Audit	Hrs. 8
Introduction to Structural Audit, Objectives, Bye-laws, Importance, Various Stages involved, Visual inspection: scope, coverage, limitations, Factors to be keenly observed. Detailed Study of: RC frame and Masonry building: Structural and non structural system, Structural elements concrete and its texture, sag and deflection in members, cracks: types and its fatality, Architectural features like balconies, cornices, etc their vulnerabilities, Probable damages in Structural and non structural walls, Plaster and paint Leakages and seepages, Plinth importance and how it affects suitability of building, Electric wiring: various damages and their fatality.Steel Structures: Corrosion, Connection defects, Connection strength, yielded member		
Module 2	**Causes and types of deterioration in Structures**	**Hrs. 6**
Causes of deterioration in RC frame and Masonry building: Permeability of concrete, capillary porosity, air voids, Micro cracks and macro cracks, corrosion of reinforcing bars, sulphate attack, alkali silica reaction,. Causes of deterioration in Steel Structures: Uniform deterioration, pitting, crevice, galvanic, laminar, Erosion, cavitations, fretting, Exfoliation, Stress, Causes of corrosion in various members, causes of defects in connection (bolted and welded), Cracks.		
Module 3	**Non Destructive Testing**	**Hrs. 8**
Concrete Strength Assessment: Rebound hammer, Ultrasonic Pulse velocity, Penetration resistance, Pull out test, Chemical test: Carbonation test, Chloride test, Corrosion potential assessment: Cover meter survey, half cell potential, resistivity measurement, Fire damage assessment: Differential thermal analysis, X ray diffraction, Structural Integrity and soundness assessment: Radiography, Impact echo test, dynamic testing of structure, Interpretation and evaluation of test results.		
Module 4	**Strength Evaluation of Existing Structure**	**Hrs.6**
Reserve strength, identification of critical sections, structural system and its validation, evaluation of damage in concrete and reinforcement, evaluation of building configuration.		
Module 5	**Approach to conduct Structural Audits & Report preparation**	**Hrs. 10**
Guidelines of Statutory Bodies, Legal aspects, Responsibility of calling Structural Audit, Scope of Investigation, Involvement of Original Consultants & Representatives of Statutory Bodies, Frequency of Structural Audits. Draft Structural audit report for up-gradation of existing building, Audit for continuation of usage of old Buildings, Audit for Buildings damaged due to Flood, Earthquakes, Fire, Storms/cyclones, Landslides, Cloud Burst, Tsunamis and accidental events such as blasts/ wilful damages.		

Reference Books:	
1	Indian Standard codes related with nondestructive testing.
2	Government Resolutions related to Structural Audits (BMC Act, etc.)
3	Field manuals and reports by Expert Consultants.

SUBJECT CODE	(Program Elective-IV)	CREDITS
MCVCASEPET 203D	Optimization in Structural Design	3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Use variational principle for optimization
CO2	Apply optimization techniques to structural steel and concrete members
CO3	Apply Linear optimization technique
CO4	Apply nonlinear optimization technique
CO5	Acquire knowledge of Geometric programming.

Course Contents

Module 1	Introduction	Hrs. 6
Objective optimization, problem formulation, problem types, constrained and unconstrained problems, implications of risk & uncertainly mathematical programming, general problems of linear and nonlinear programming.		
Module 2	**Linear Programming**	**Hrs. 6**
-Standard linear programming form, definitions and theorem, simplex method- Algorithm canonical form, improving the basis, identifying an optimal solution, locating initial basic feasible solution, examples.		
Module 3	**Application of Linear Programming**	**Hrs. 8**
Problems on structural design trusses, plastic analysis of frame, weight minimization, transportation problem, duality, decomposition, parametric linear programming, integer linear programming examples.		
Module 4	**Non-linear optimization**	**Hrs.6**
Classical optimization techniques differential calculus- Language multipliers, Newtons Raphson approximation, Kuhn Tucker conditions, examples**. (06 Lectures)**		
Module 5	**Geometric programming**	**Hrs. 8**
Calculus viewpoint, polynomials, orthogonality conditions, degree of difficulty, geometric inequality, primal-dual relations, inequality constraints, examples. Search techniques- altering, one dimensional or sectioning search, transforming nonlinear problem into linear cutting–plane method, logarithmic transformation,		

graphical optimization, examples. Examples on minimum route problem, minimum cost, minimum weight, optimum design of R.C.C. sections, Structural design-frame, trusses.

Reference Books:	
1	Foundation of Optimization by Wilde & Beighter
2	Optimization Theory & Applications by S.S. Rao
3	Optimization in Structures by Hemp.
4	Mechanical foundation for design by Stark and Nicholls, Mc Graw Hill

SUBJECT CODE	(Open Elective-V) Research Methodology						CREDITS
MCVCASEOET 205 A							3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand concept of research, its types, methods, detailed procedure to identify and solve a
CO2	Understand various mathematical techniques useful in research work.
CO3	Understand various sampling techniques useful in research work.
CO4	Understand various techniques for correlating and predicting different parameters with each other
CO5	Design the experiments for research work.

Course Contents

Module 1	**Introduction to Research methodology**	**Hrs. 6**
Introduction, meaning of research, objectives, types and role of scientific and engineering related research in advancing the knowledge, defining a research problem, formulation of a hypothesis, research design and features of good design, methods of data collection, approaches and techniques for data acquisition, processing, analyses and synthesis, Designing a questionnaire, Interpretation of results, Report Writing, Aspects of literature review, Different ways of communication and dissemination of research results.		
Module 2	**Descriptive Statistics, Probability and Distribution**	**Hrs. 6**
Basic statistical concepts, Measures of central tendency and dispersion, Elements of Probability, Addition and multiplication theorems of probability, Examples, probability distributions, Binomial, Poisson and normal distributions. Sampling Techniques: Random sampling, simple random sampling and stratified random sampling, Non-sampling errors.		
Module 3	**Correlation and Regression**	**Hrs. 6**

Product moment correlation coefficient and its properties. Simple linear regression and multiple linear regressions, Statistical Inference: Statistical hypotheses, Error Types, level of significance, Chi-square Test and F distributions. Central limit theorem, Tests for the mean, equality of two means, variance, large sample tests for proportions, Confidence interval.		
Module 4	**Design of Experiments**	**Hrs.6**
Analysis of variance. Data Classification, Completely randomized, randomized block, Factorial experiments, Yates technique.		
Module 5	**Multivariate Data Analysis**	**Hrs.10**
Multivariate normal distributions. Mean vector, variance, covariance matrix and correlation matrix, Stepwise regression, Selection of best subject of variables, Classification and discrimination problems, Factor analysis, and Principle component analysis. Data analysis using software's.		

Guidelines for Term Work:
Student shall critically read recent three to four journal articles within the broader field of their prospective specializations to identify research and knowledge gaps and accordingly formulate specific research questions. On the basis of these research questions student will retrieve additional relevant information and prepare well- articulated and content rich introductory problem description as well as proposed research methodology notes. The subject teacher and research guide of the student shall assess this jointly.

Text Books:	
1	Gupta S. C. and Kapoor V. K, "Fundamentals of Mathematical Statistics", Sultan Chand & Company New Delhi.
2	Gupta S. C. and Kapoor V. K, "Fundamentals of Applied Statistics", Sultan Chand & Com. N.Delhi.
3	Montogomery D. C., "Probability and Applied Statistics for Engineers", Wiley Int.Student Edition
4	Walpole Ronald E, Myers Raymond H and Myers Sharon L, "Probability & Statistics for Engineers and Scientists", 6thEdition, Prentice Hall.
5	Ross S. M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edi, Elsevier

Reference Books:	
1	Johnson R. and Wichern, "Applied Multivariate Statistical Analysis", 3rd Edi, Prentice Hall India
2	Douben K. J., "Research Methodologies – Principles and Guidelines of Applied Scientific Research", UNESCO-IHE Lecture Notes LN0317/06/01, Delft, the Netherlands.
3	Holtom D. and E. Fisher, "Enjoy Writing Your Science Thesis - a Step by Step Guide to Planning and Writing Dissertations and Theses for Undergraduate and Graduate Science Students", Imperial College Press. ISBN 1-86094-207-5, London, UK.
4	Kumar R., "Research Methodology- a Step-by-step Guide for Beginners", Sage Publi.. ISBN 0-7619-6213-1. London, UK.
5	Johnson R. and Wichern, "Applied Multivariate Statistical Analysis", 3rd Edi, Prentice Hall India

SUBJECT CODE	(Open Elective-V) Advance concrete Technology						CREDITS
MCVCASEOET 205 B							3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand the testing of concrete materials as per IS code.
CO2	Know the procedure to determine the properties of fresh and hardened of concrete.
CO3	Design the concrete mix using ACI and IS code methods.
CO4	Select and Design special concretes depending on their specific applications.
CO5	Gain ideas on non-destructive testing of concrete.

Course Contents

Module 1	**Ingredients of concrete**	**Hrs. 6**
Aggregates: Review of types; sampling and testing; effects on properties of concrete, production of artificial aggregates. **Cements**: Review of types of cements, chemical composition; properties and tests, chemical and physical process of hydration, Blended cements		
Module 2	**Properties of fresh concrete**	**Hrs. 6**
Basics regarding fresh concrete – mixing, workability, placement, consolidation, and curing, segregation and bleeding Chemical Admixtures: types and classification; actions and interactions; usage; effects on properties of concrete. Mineral Admixtures**:** Fly ash, ground granulated blast furnace slag, metakaolin, rice- husk ash and silica fume; chemical composition; physical characteristics; effects on properties of concrete; advantages and disadvantages. Proportioning of concrete mixtures: Factors considered in the design of mix BIS Method, ACI method		
Module 3	**Properties of hardened concrete**	**Hrs. 6**
Strength- compressive tensile and flexure - Elastic properties - Modulus of elasticity - Creep-factors affecting creep, effect of creep - shrinkage- factors affecting shrinkage, plastic shrinkage, drying shrinkage, autogenous shrinkage, carbonation shrinkage.		
Module 4	**Durability of concrete**	**Hrs.6**
Durability concept; factors affecting, reinforcement corrosion; fire resistance; frost damage; sulfate attack; alkali silica reaction; concrete in seawater, statistical quality control, acceptance criteria as per BIS code. Non-destructive testing of concrete: Surface Hardness, Ultrasonic, Penetration resistance, Pull- out test, chemical testing for chloride and carbonation- core cutting - measuring reinforcement cover.		
Module 5	**Special concretes**	**Hrs.10**

Lightweight concrete- description of various types -High strength concrete - Self compacting concrete -Roller compacted concrete – Ready mixed concrete – Fibre reinforced concrete - polymer concrete Special processes and technology for particular types of structure - Sprayed concrete; underwaterconcrete, mass concrete; slip form construction, Prefabrication technology

Guidelines for Assignments:
The candidate shall perform minimum six assignments consisting theoretical as well as numerical aspects of the Course.

Text Books:	
1	Job Thomas., "Concrete Technology", Cenage learning,
2	R. Santhakumar „ Concrete Technology", Oxford Universities Press, 2006
3	Shetty M. S., Concrete Technology", S. Chand & Co., 2006

Reference Books:	
1	Mehta and Monteiro, „Concrete-Micro structure, Properties and Materials", McGraw Hill Professional
2	Neville A. M. and Brooks J. J., Concrete Technology, Pearson Education, 2010
3	Lea, Chemistry of Cement and Concrete", Butterworth-Heinemann Ltd, 5e, 2017
4	Bungey, Millard, Grantham – Testing of Concrete in Structures- Taylor and Francis, 2006

SUBJECT CODE	(Open Elective-V) Design of Shells & Folded Plates	CREDITS
MCVCASEOET 205 C		3

Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Outcomes: Students will be able to	
CO1	Understand the testing of concrete materials as per IS code.
CO2	Know the procedure to determine the properties of fresh and hardened of concrete.
CO3	Design the concrete mix using ACI and IS code methods.
CO4	Select and Design special concretes depending on their specific applications.
CO5	Gain ideas on non-destructive testing of concrete.

Course Contents

Module 1	Design of Shell Roofs, Spherical Domes and Conical Roofs	Hrs. 6
Introduction, Selection of dimensions of shells, Structural design of shell roofs by Working Stress Method, Detailing of Steel as per IS code, Spherical domes, Design of Ring Beam (Edge Member), Design for Shear between Bottom ring Beam and Dome, Detailing of Steel, Conical Shell, Conical dome roof with ring beams, umbrella roof.		
Module 2	**Detailing of Steel in Cylindrical Shells**	**Hrs. 6**
Introduction, General arrangement of steel, Minimum amount of steel recommended in shells, Longitudinal steel for Tx forces and for edge beams, Transverse steel for TΦ and MΦ Forces, Steel for shear S, Detailing of junction between shell and transverse and edge beam, Consumption of steel.		
Module 3	**Design of Transverse Stiffeners of Cylindrical Shells**	**Hrs. 6**
Introduction, Design of Transverse Stiffeners (Diaphragms) of Long Shells, Supports on Long Shells on T or L Beams Design of Supporting Frames, Detailing Junction of Shell and Transverse.		
Module 4	**Design of Paraboloid Shells**	**Hrs.6**
Introduction, Types of Hyperbolic Paraboloids, Equation of Hypar Shells with Straight Rectangular Edges, Types Of H.P. Shell Roofs with Straight Edges, Shallow and Deep H.P. Shells, Analysis of The Shell Part of Shallow Hypar Shells with Straight Edges, Analysis of The Edge Members, Supporting Dead Weight of Edge Members, Detailing of Steel in Hypar Shells, Oblique Hypar Shells Elliptical and Circular Paraboloids, Action of Elliptical Paraboloids, Shallow Elliptical Paraboloids Curvature and Radius Nature of Variation of Membrane Forces.		
Module 5	**Design of Reinforcements in Folded Plates and Supporting Diaphragms**	**Hrs. 8**
Structural behaviour of trough type folded plate roofs – slab-beam analysis of folded plates – reinforcement in folded plates. Introduction, Shear in Folded Plates, Design of steel for Transverse moments, Design of Longitudinal Steel, Design of Diaphragm, Detailing of Steel.		

Guidelines for Assignments:
The candidate shall perform minimum six assignments consisting theoretical as well as numerical aspects of the Course.

Text Books:	
1	Design of Reinforced Concrete Shells and Folded plates by P.C. Varghese, PHI Learning Private Limited, New Delhi (2010).
2	Design and Construction of Concrete Shell Roofs by G.S. Rama Swamy – CBS Publishers & Distributors, Delhi.
3	Theory and Design of Concrete Shells by B.K. Chatterjee, Chapmann & Hall, New York, 3rd Edition
4	IS 2210 : 1988 (Reaffirmed 2017) Criteria for design of reinforced concrete shell structures and folded

	plates [CED 38: Special Structures]

Reference Books:	
1	Theory and Analysis of Plates by R. Szilard, Prentice Hall-INC, New Jersey, (1974).
2	Analysis of Thin Concrete Shells by K. Chandrasekhara, Oxford and IBH, Kolkata, 1971.
3	Thin Shell Structures by Bandyopadhyay J.N. New Age International Publishers, New Delhi, 1986.
4	ASCE Manual of Engineering practice No. 31, Design of cylindrical concrete shell roofs ASC, New York.
5	https://onlinecourses.nptel.ac.in/noc21_ce59/preview

SUBJECT CODE	CASE-III Laboratory					CREDITS	
MCVCASEELP 206						2	
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	4	2	25	--	25	50

Course Contents

Students are expected to Analysis of Various Structural Elements by using Finite Element Software and Detailing of Structural Elements using various drafting tool

SUBJECT CODE	Mini Project					CREDITS	
MCVCASEELP 207						4	
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	8	4	25	--	25	50

Course Contents

Guidelines for Mini Project
Mini project shall be based on one of the topic chosen in consultation with the supervisor. Mini project may be interdisciplinary nature. Areas of recent techno-management development shall be explored. Research innovations may be considered as prospective areas. Mini project may be related with main project to explore possibilities of continuation further and to study the pre-requisites.

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Teaching & Evaluation Scheme for M. Tech. in Civil Engineering with Specialization in Computer Aided Structural Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	ISE	MSE	ESE	Total	
Semester-III										
1	MCVCASEMDT 301	MOOC/SWAYAM/ NPTEL PLATFORM COURSES/Self Study. (It is desirable to choose one course from each of PE,OE &AE)	3	--	--	20	20	60	100	3
2	MCVCASEMDT 302		3	--	--	20	20	60	100	3
3	MCVCASEHMT 303		3	--	--	20	20	60	100	3
4	MCVCASEELP 304	Seminar-I	--	--	4	25	--	25	50	2
5	MCVCASEELP 305	Dissertation Stage -I	--	--	20	50	--	50	100	10
		TOTAL	**09**	**--**	**24**	**135**	**60**	**255**	**450**	**21**
Semester-IV										
1	MCVCASEELP 401	Dissertation Stage-II	--	--	40	100	--	100	200	20
		TOTAL	**--**	**--**	**20**	**100**	**--**	**100**	**200**	**20**

SUBJECT CODE				Multidisciplinary Minor Courses			CREDITS
MCVCASEMDT 301 MCVCASEMDT 302 MCVCASEHMT 303							3
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
3	0	0	3	20	20	60	100

Course Contents

Multidisciplinary Minor Courses
MOOC/SWAYAM/ NPTEL -Project Management and Intellectual Property Rights (Self Study) Student may select this course either from MOOC/SWAYAM/ NPTEL pool or any other approved reputed source. The submission of course completion certificate is mandatory. **MCVCASEMDT301/302, MCVCASEHMT 303 -** Institute has to take care of registration of subjects with detailed syllabus in first two weeks of beginning of the semester with exam department of DABATU.

SUBJECT CODE	Seminar I						CREDITS
MCVCASEELP 304							2
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	4	2	25	--	25	50

Course Contents

Guidelines for Seminar
Seminar I shall be presented on one of the advanced topics chosen in consultation with the supervisor. Students must study latest literature. The concepts must be clearly understood and presented by the student. The student should use all modern methods of presentation. The student expects minimum 03 presentations within period of semester. A hard copy of the report should be submitted before delivering the seminar. A copy of the report in soft form must be submitted to the Supervisor along with other details, if any.

SUBJECT CODE	Dissertation Stage-I						CREDITS
MCVCASEELP 302							10
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	20	20	50	--	50	100

Course Contents

Dissertation Stage-I
Students can take Industry Internship along with Dissertation Stage –I. Students must maintain regular reporting with Dissertation supervisor regarding status of Dissertation. Dissertation Stage -I is an integral part of the final project work. In this, the student shall complete the partial work of the project which will consist problem statement, literature review, project overview, scheme of implementation that may include mathematical model/block diagram/ PERT chart, and layout and design of the proposed system/work. As a part of the progress report of project-I work; the candidate shall deliver a presentation on progress of the work on the selected dissertation topic. It is desired to publish the paper on the state of the art on the chosen topic in international conference/ journal. The student shall submit the duly certified progress report of project -I in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for M. Tech. in Civil Engineering with Specialization in Computer Aided Structural Engineering

Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	ISE	MSE	ESE	Total	
Semester-IV										
1	MCVCASEELP 401	Dissertation Stage-II	--	--	40	100	--	100	200	20
		TOTAL	**--**	**--**	**20**	**100**	**--**	**100**	**200**	**20**

SUBJECT CODE	Dissertation Stage-II			CREDITS
MCVCASEELP 401				20
Teaching Work Load/week(Hrs.)				Examination Scheme(Marks)			
Theory	Tutorial	Laboratory	Total	ISE	MSE	ESE	Total
0	0	40	40	100	--	100	200

Course Contents

Dissertation Stage-II
In Project Stage - II, the student shall complete the remaining part of the project, which will consist of the simulation/ analysis/ synthesis/ implementation / fabrication of the proposed project work, work station, conducting experiments and taking results, analysis and validation of results and drawing conclusions. It is mandatory to publish the paper on the state of the art on the chosen topic in international conference/ journal. The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.