

गोंय विद्यापीठ

ताळगांव पठार,

गोंय - ४०३ २०६

फोन : + ९१ - ८६६९६०९०४८



Goa University

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(Accredited by NAAC with Grade A+)

GU/Acad –PG/BoS -NEP Engg. /2025-26/549

Date: 14/11/2025

CIRCULAR

Ref. No.: GU/Acad –PG/BoS -NEP Engg. /2024-25/790 dated 28/01/2025

In supersession to the above referred Circular, the Syllabus of Semester III & IV of the **Master of Engineering (Structural Engineering)** Programme approved by the Standing Committee of the Academic Council in its meeting held on 24th & 25th July 2025 is attached. The syllabus of Semester II approved earlier by the Academic Council in its meeting held on 06th December 2024 and syllabus of Semester I approved by the Academic Council in its meeting held on 22nd August 2024 is also attached.

The Dean, Faculty of Engineering and Principals of affiliated Colleges offering the **Master of Engineering (Structural Engineering)** Programme are requested to take note of the above and bring the contents of the Circular to the notice of all concerned.

(Ashwin V. Lawande)

Deputy Registrar – Academic

To,

1. The Dean, Faculty of Engineering, Goa University.
2. The Principals of affiliated Engineering Colleges.

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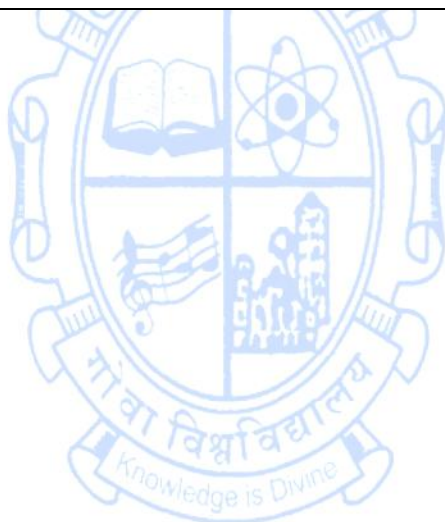
1. The Director, Directorate of Technical Education, Govt. of Goa
2. The Chairperson, BoS in Civil Engineering.
3. The Controller of Examinations, Goa University.
4. The Assistant Registrar Examinations (Prof.), Goa University.
5. Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

MASTER OF ENGINEERING (STRUCTURAL ENGINEERING) RC 2024-25

TWO YEAR PROGRAMME STRUCTURE							
Semester - I							
Sr. No.	Course Code	Title of the Course	L	T	P	Credits	
Programme Specific Core (PSC) Courses							
1	STE-500	Analytical and Numerical Methods for Structural Engineering	3	0	0	3	
2	STE-501	FEM in Structural Engineering	3	0	0	3	
3	STE-502	Advanced Structural Analysis	3	1	0	4	
4	STE-503	Structural Engineering Lab - 1	0	0	1	1	
5	STE-504	Structural Engineering Lab - 2	0	0	1	1	
Programme Specific Elective (PSE) Courses							
6	STE-531	Theory of Elasticity	3	1	0	4	
OR							
7	STE-532	Repair & Rehabilitation of Structures	3	1	0	4	
Research Specific Elective (RSE) Courses							
8	REC-561	Engineering Research & Publications	3	1	0	4	
OR							
9	REC-562	Literature Review & Technical Writing for Engineers	3	1	0	4	
TOTAL			15	3	2	20	
Semester II							
Sr. No.	Course Code	Title of the Course	L	T	P	Credits	
Programme Specific Core (PSC) Courses							
1	COS-505	Advanced Design of Reinforced Concrete and Prestressed Structures	3	0	0	3	
2	STE-506	Structural Engineering Lab - 3	0	0	1	1	
3	COS-507	Theory of Thin Plates & Shells	3	0	0	3	
4	COS-508	Computational Structural Dynamics	3	0	0	3	
5	STE-509	Structural Engineering Lab - 4	0	0	2	2	
Programme Specific Elective (PSE) Courses							
6	COS-533	Structural Health Monitoring	3	0	0	3	
7	COS-534	Structural Health Monitoring - Lab	0	0	1	1	
OR							
8	STE-533	Design of Industrial Structures	3	0	0	3	
9	STE-534	Design of Industrial Structures Lab	0	0	1	1	
Research Specific Elective (RSE) Courses							
10	REC-563	Statistics and Data Analysis for Engineering Research	2	0	0	2	
11	REC-564	Statistics and Data Analysis Lab	0	0	2	2	
OR							
12	REC-565	Statistical Techniques for Engineering Research	2	0	0	2	
13	REC-566	Probability and Statistical analysis lab	0	0	2	2	
TOTAL			14	0	6	20	

Semester III						
Sr. No.	Course Code	Title of the Course	L	T	P	Credits
Programme Specific Core (PSC) Courses						
1	COS-600	Advanced Design of Steel Structures	3	0	0	3
2	COS-601	Advanced Design of Steel Structures LAB	0	0	1	1
3	COS-602	Design of Substructures	3	0	0	3
4	COS-603	Design of Substructures Lab	0	0	1	1
Programme Specific Elective (PSE) Courses						
5	COS-631	Design of High Rise Structures	3	0	0	3
6	COS-632	Design of High Rise Structures Lab	0	0	1	1
OR						
7	COS-633	Design of Earthquake resistant structures	3	0	0	3
8	COS-634	Design of Earthquake resistant structures Lab	0	0	1	1
Research Specific Elective (RSE) Courses						
9	STE-661	Experimental Methods in Structural Engineering	2	0	0	2
10	STE-662	Experimental Methods in Structural Engineering Lab	0	0	2	2
OR						
11	COS-663	Forensic Structural Engineering	2	0	0	2
12	COS-664	Forensic Structural Engineering Lab	0	0	2	2
Generic Elective (GE) Courses						
13	GEC-681	Sustainability - Principles & Practices	3	0	0	3
14	GEC-682	Sustainability - Principles & Practices Lab	0	0	1	1
OR						
15	GEC-683	Project Management	3	0	0	3
16	GEC-684	Project Management Lab	0	0	1	1
TOTAL			14	0	6	20
Semester IV						
Sr. No.	Course Code	Title of the Course	L	T	P	Credits
Generic Elective (GE) Courses						
1	GEC-685	Financial Management	4	0	0	4
OR						
2	GEC-686	Entrepreneurship	4	0	0	4
Programme Specific Dissertation/Internship						
3	STE-698	Dissertation	0	0	0	16
OR						
4	STE-699	Internship	0	0	0	16
TOTAL			4	0	0	20

THREE YEAR PROGRAMME STRUCTURE						
Semester - I						
Sr. No.	Course Code	Title of the Course	L	T	P	Credits
Programme Specific Core (PSC) Courses						
1	STE-500	Analytical and Numerical Methods for Structural Engineering	3	0	0	3
2	STE-503	Structural Engineering Lab - 1	0	0	1	1
Programme Specific Elective (PSE) Courses						
3	STE-531	Theory of Elasticity	3	1	0	4
OR						
4	STE-532	Repair & Rehabilitation of Structures	3	1	0	4
Research Specific Elective (RSE) Courses						
5	REC-561	Engineering Research & Publications	3	1	0	4
OR						
6	REC-562	Literature Review & Technical Writing for Engineers	3	1	0	4
TOTAL			9	2	1	12



SEMESTER – I

Programme Specific Core (PSC) Courses

Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : STE-500
Title of the Course : Analytical And Numerical Methods for Structural Engineering
Number of Credits : 03 (3L)
Effective from AY : 2024-25

Pre-requisites for the Course:	Students should have knowledge of 1. Fundamentals of Matrices 2. Basics of Interpolation 3. Basics of Differentiation and 4. Basics of Integration	
Course Objectives:	The course will enable the students to: 1. Illustrate advanced matrix techniques in the determination of Eigen values and Eigen vectors of square matrix. 2. Solve linear algebraic systems by direct and iteration methods. 3. Analyze the performance of various interpolation technique and perform error analysis and compare various numerical differentiation and integration techniques. 4. Use the software to solve a range of problems	
	Content	No. of hours
Unit - 1	Errors: Error analysis, types of errors, accuracy & precision, stability in numerical analysis Solution of Non-linear Algebraic and Transcendental Equations: Solution by graphical method, bisection method, Newton Raphson iterative method, Regula-Falsi method. Introduction to MATLAB: Basic programming algorithms for Solution of Non-linear Algebraic and Transcendental Equations and their implementation in MATLAB	10
Unit - 2	Interpolation and Curve Fitting: Empirical laws for curve fitting, general interpolation formulae. Linear Interpolation - Higher Order Interpolation - Lagrange Interpolation Interpolating polynomials. Fitting a straight-line, Second-degree curve, Exponential curve, power curve by method of least squares. Application of MATLAB : interpolation and curve fitting to solve engineering problems using MATLAB	10
Unit - 3	Elements of Matrix Algebra: Solution of systems of linear equations, Eigen value problems. Applications to Structural Dynamic problems, stress problems, buckling of columns.	11
Unit - 4	Numerical Differentiation & Integration: Solution of Ordinary and Partial Differential Equations - Numerical Integration – Double integration using Trapezoidal and Simpson's method. Euler's method – Backward Euler method – Midpoint method – single step method, Taylor's series method- R-K Methods. Boundary value problems. Finite Difference Schemes.	14

	Computer Algorithms: Numerical solutions for different structural problems.	
Pedagogy:	Constructive, Collaborative and Inquiry based learning	
References/ Readings:	1. Chapra, S. C. and Canale, Raymond P. "Numerical methods for Engineers" McGraw Hill book Company, 4th edition, 2002, ISBN: 978-007-119-8522 2. Gerald, Curtis F. and Wheatley, Patrick O., "Applied numerical analysis", Addison Wasley, 7th Edition: ISBN 978-032-113-3045 3. Jain, M.K. Iyengar, S.R.K., Jain, R.K. "Numerical methods for scientific and engineering computations", Willey Eastern Limited, 1987, ISBN-978-812-240-0672 4. Sastry, S.S., Numerical methods, 5TH edition, Prentice-Hall of India, ISBN 978-812-034-5920 5. Shanta Kumar, M. "Computer based numerical analysis", Khanna Book publishers, New Delhi.	
Course Outcomes:	After taking this course, student will be able to: CO 1. Apply numerical methods to find the roots of a Nonlinear Algebraic and Transcendental equations and perform error analysis. CO 2. Solve linear algebraic system by direct and iteration methods and apply the knowledge of Eigen values and Eigen vectors to some contents in engineering. CO 3. Apply the knowledge of interpolation and extrapolation of uniform and non-uniform data to certain contents of Civil Engineering. CO 4. Apply the knowledge of numerical differentiation and integration to some contents of Civil Engineering and Formulate simple problems into programming models.	

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Name of the Programme : Master of Engineering (Structural Engineering)
Course Code : STE-501
Title of the Course : FEM in Structural Engineering
Number of Credits : 03 (3L)
Effective from AY : 2024-25

Pre-requisites for the Course:	Students should have knowledge of 1. Fundamentals of Matrices 2. Structural Analysis 3. Matrix methods of Structural Analysis	
Course Objectives:	The course will enable the students to 1. Formulate boundary value problems of finite element method. 2. Discretize the structure and determine interpolation functions using various elements. 3. Analyze structural problems using iso - parametric formulations. 4. Perform Finite Element Analysis by standard software	
Content:		No. of hours
Unit - 1	Introduction - Finite Element method - History and Applications - Basic steps in finite element analysis - Boundary value problems - Approximate solutions - Variational and weighed residual methods - Ritz and Galerkin formulations - Spring and Bar Elements - Minimum Potential Energy Principle - Weak formulation.	10
Unit - 2	Element Properties - Natural Coordinates - Triangular, rectangular, 3D and axis-symmetric Elements - Lagrange and Serendipity Elements - Solid Elements - Isoparametric Formulation - Stiffness Matrix of Isoparametric Elements Numerical Integration - Gaussian Quadrature - Interpolation Functions	11
Unit - 3	ANALYSIS OF FRAME STRUCTURES - Stiffness of Truss Members-Analysis of Truss-Stiffness of Beam Members-Finite Element Analysis of Continuous Beam-Plane Frame Analysis-Analysis of Grid and Space Frame TWO AND THREE DIMENSIONAL SOLIDS - Constant Strain Triangle - Linear Strain Triangle - Rectangular Elements-Numerical Evaluation of Element Stiffness - Computation of Stresses, Geometric Nonlinearity and Static Condensation - Axisymmetric Element - Finite Element Formulation of Axisymmetric Element - Finite Element Formulation for 3 Dimensional Elements- Problems	12
Unit - 4	COMPUTER IMPLEMENTATION - Computer implementation of FEM procedure - Preprocessing - meshing, P and H methods of mesh refinement - Discretization errors - Auto and adaptive mesh generation techniques - Error evaluation - Introduction to programming for simple problems. Introduction to plate bending problems, Dynamic Analysis	12
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive	

	learning and Collaborative learning. Software Analysis.
References/ Readings:	1. Bathe, K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall Inc., 2006. ISBN 0-13-301458-4 2. Chandrupatla. R. T and Belegundu. A.D., "Introduction to Finite Elements in Engineering", Prentice Hall of India, 2011. ISBN 978-0-13-216274-6 3. Hutton, David, "Fundamentals of Finite Element Analysis", Tata McGraw Hill Publishing Company Limited, New Delhi, 2005. ISBN-13: 978-0070601222 ISBN-10: 9780070601222 4. Krishnamoorthy, C.S., "Finite Element Analysis: Theory and Programming", Tata McGraw Hill, 2008. ISBN-13: 978-0074622100 ISBN-10: 9780074622100 5. Moaveni. S., "Finite Element Analysis Theory and Application with ANSYS", Prentice Hall Inc., 2003. Han, J., Principles and Practice of Ground Improvement, John Wiley & Sons. ISBN-13: 978-8131760642 ISBN-10: 8131760642
Course Outcomes:	After taking this course, student will be able to: CO 1. Formulate boundary value problems of finite element method. CO 2. Discretize the structure and determine interpolation functions using various elements. CO 3. Analyse structural problems using iso - parametric formulations. CO 4. Perform Finite Element Analysis by standard software.

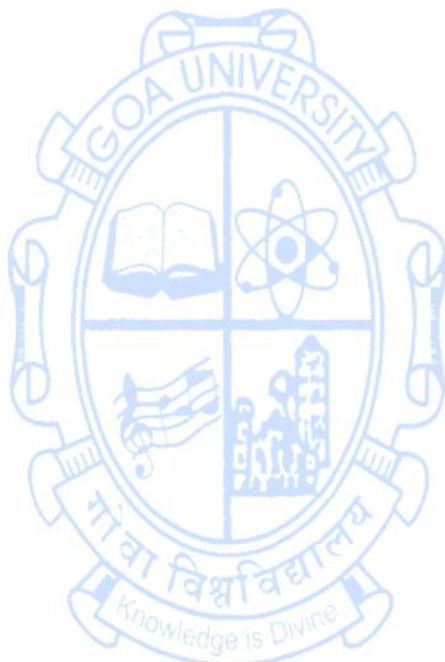
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Name of the Programme : Master of Engineering (Structural Engineering)
Course Code : STE-502
Title of the Course : Advanced Structural Analysis
Number of Credits : 04 (03L+01T)
Effective from AY : 2024-25

Pre-requisites for the Course:	Nil	
Course Objectives:	The course will enable the students to 1. Formulate mathematical model for structural analysis using matrix methods. 2. Analyse the components of civil engineering structures like trusses, beams, frames and grids under all probable loading conditions 3. Interpret the results of analysis for design purpose. 4. Use direct stiffness method in understanding its limitations	
Content:		No. of hours
Unit - 1	Review of basic concepts in structural analysis: structural elements, joints and supports, stability, rigidity and static indeterminacy, kinematic indeterminacy, levels of analysis; deriving stiffness and flexibility coefficients. Review of analysis of indeterminate structures: Force methods & Displacement Methods.	12
Unit - 2	Basic concepts of matrices, Local Coordinates and Global Coordinates. Stiffness Matrix Assembly of Structures: Stiffness Matrix in Global Coordinates, Boundary Conditions, Solution of Stiffness Matrix Equations, Calculation of Reactions and Member Forces.	14
Unit - 3	Applications to Simple Problems: Beams, Plane, Trusses, Plane Rigid Jointed Frames and Grids by Structure Approach and Member Approach.	17
Unit - 4	Flexibility matrix methods for beam, truss, frames Boundary Value Problems (BVP): Approximate Solution of Boundary Value Problems, Modified Galerkin Method for One-Dimensional BVP, Matrix Formulation of the Modified Galerkin Method	17
Pedagogy:	Constructive, Collaborative and Inquiry based learning.	
References/ Readings:	1. Jain, Ashok K.; "Advanced Structural Analysis"; Nem Chand and Bros, January 2015. ISBN: 978-939-487-2011 2. Pandit, G.S. and Gupta, S.P.; "Structural Analysis: A Matrix Approach"; Tata McGraw Hill, 2008. ISBN-13-978-007-066-7358 3. Weaver, William J. R., Gere, James M.; "Matrix Analysis of Frames Structures", CBS publications, 1990. ISBN: 978-041-207-8613 4. Wang, C.K.; "Indeterminate structural Analysis". McGraw-Hill Education, ISBN-13-978-0070702493	

Course Outcomes:	After taking this course, student will be able to: CO 1. Formulate mathematical model for structural analysis using matrix methods. CO 2. Analyse the components of civil engineering structures like trusses, beams, frames and grids under all probable loading conditions CO 3. Interpret the results of analysis for design purpose. CO 4. Use direct stiffness method in understanding its limitations
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Name of the Programme : Master of Engineering (Structural Engineering)
Course Code : STE-503
Title of the Course : Structural Engineering Lab - 1
Number of Credits : 01
Effective from AY : 2024-25

Pre-requisites for the Course:	Nil	
Course Objectives:	The course will enable the students to 1. Familiarize the students with numerical methods and techniques 2. Apply numerical techniques to structural engineering problems. 3. Perform regression analysis 4. Develop interpolation models	
Content:		No. of hours
	Students shall carry out at least 8 of the following: 1. Roots of an equation using Newton – Raphson method. 2. Experiments on Interpolation, Newton’s Interpolation - Forward, Backward, Hermite Interpolation, Spline Interpolation - Cubic, Inverse Interpolation, and Extrapolation. 3. Structural engineering application of Interpolation techniques: Stress contours, etc. 4. Experiments on numerical differentiation and integration. 5. Structural engineering application of numerical differentiation and integration, estimation of pile capacity, etc. 6. Experiments on curve fitting and errors. 7. Structural engineering applications of curve fitting and errors. 8. Solution of linear simultaneous equations using Gauss elimination. 9. Matrix inversion using GJ method. 10. Linear regression line of given points. 11. Curve fitting using Polynomial Regression. 12. Eigenvalue extraction power method.	30
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning.	
References/ Readings:	1. Chapra, S. C. and Canale, Raymond P. “Numerical methods for Engineers” McGraw Hill book Company, 4th edition, 2002, ISBN: 978-007-119-8522 2. Gerald, Curtis F. and Wheatley, Patrick O., “Applied numerical analysis”, Addison Wasley, 7th Edition: ISBN 978-032-113-3045 3. Jain, M.K. Iyengar, S.R.K., Jain, R.K. “Numerical methods for scientific and engineering computations”, Willey Eastern Limited, 1987, ISBN-978-812-240-0672	

	4. Sastry, S.S., Numerical methods, 5TH edition, Prentice-Hall of India, ISBN 978-812-034-5920 5. Shanta Kumar, M. "Computer based numerical analysis", Khanna Book publishers, New Delhi.
Course Outcomes:	After taking this course, student will be able to: CO 1. Familiarize the students with different laboratory test performed on the concrete samples and mix designs. CO 2. Apply numerical techniques to structural engineering problems. CO 3. Perform regression analysis CO 4. Develop interpolation models

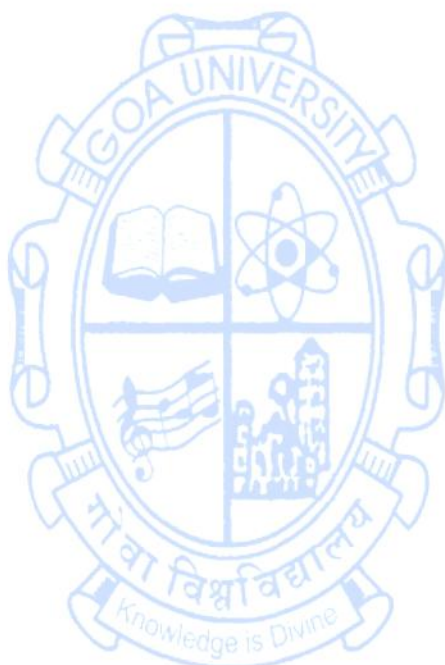
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Name of the Programme : Master of Engineering (Structural Engineering)
Course Code : STE-504
Title of the Course : Structural Engineering Lab - 2
Number of Credits : 01
Effective from AY : 2024-25

Pre-requisites for the Course:	Nil	
Course Objectives:	The course will enable the students to: 1. Understand the principles of modelling and analysing trusses, beams, and frames. 2. Apply programming techniques to create analysis tools for trusses, beams, and frames using the direct stiffness method. 3. Apply stress analysis techniques, including Mohr's circle, for evaluating 2-D stress states. 4. Analyze advanced structural behaviors, including moving loads, geometric nonlinearity, buckling, and eigenvalue problems, using industry-standard software	
Content:		No. of hours
	List of Experiments: (Any 8 Experiments should be performed) 1. Modelling and analysis of Truss. 2. Modelling and analysis of Beam. 3. Modelling and analysis of Frame. 4. Program Development for Analysis of truss, beams and frames by direct stiffness method. 5. Program development for 2-D stress analysis 6. Program development for 2-D stress analysis using Mohr's circle 7. Stress analysis of Slabs. 8. Moving load Analysis 9. Geometric Nonlinear analysis. 10. Buckling Analysis 11. Eigen value Analysis (Any Industry standard software can be used for analysis)	30
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning.	
References/ Readings:	1. Hibbeler R.C., "Structural Analysis", Pearson, 2017, ISBN-13: 978-0134610672 2. Kassimali A., "Matrix Analysis of Structures", Cengage Learning, 2011, ISBN-13: 978-1111426200. 3. Kim N, Sankar B.V., Kumar A.V. "Introduction to Finite Element Analysis and Design", Wiley, 2018, ISBN-13: 978-1119078722	
Course Outcomes:	After taking this course, student will be able to CO1. Understand the principles of modelling and analysing trusses, beams, and frames.	

	CO2. Apply programming techniques to create analysis tools for trusses, beams, and frames using the direct stiffness method. CO3. Apply stress analysis techniques, including Mohr's circle, for evaluating 2-D stress states. CO4. Analyze advanced structural behaviors, including moving loads, geometric nonlinearity, buckling, and eigenvalue problems, using industry-standard software.
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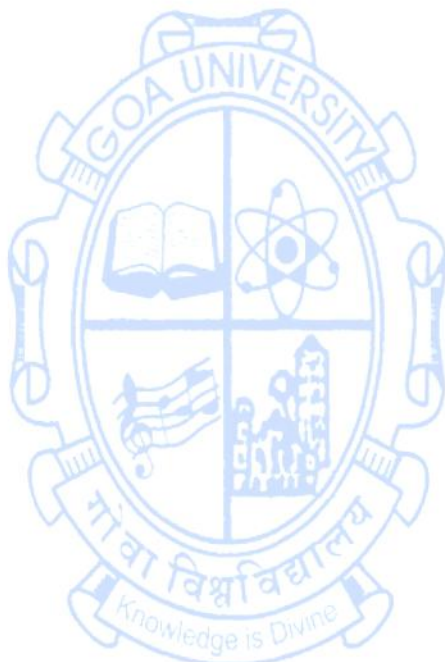


Programme Specific Elective (PSE) Courses**Name of the Programme : Master Of Engineering (Structural Engineering)****Course Code : STE-531****Title of the Course : Theory of Elasticity****Number of Credits : 04 (03L+01T)****Effective from AY : 2024-25**

Pre-requisites for the Course:	Nil	
Course Objectives:	The course will enable the students to 1. Understand the fundamentals of plastic behaviour. 2. Explain stress-strain resultants in both rectangular as well as polar coordinates. 3. Solve simple problems of elasticity and understand the basic concepts. 4. Apply the numerical techniques and tools for the complex problems in elasticity.	
Content:		No. of hours
Unit - 1	Introduction to Elasticity: Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity, Introduction to Thermo elasticity and non-linear elasticity.	12
Unit - 2	Strain and Stress Field: Elementary Concept of Strain, Strain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components. Equations of Elasticity: Equations of Equilibrium, Stress- Strain relations, Strain displacement and Compatibility Relations, Boundary Value Problems, Co-axiality of the Principal Directions.	16
Unit - 3	Two-Dimensional Problems of Elasticity: Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.	16
Unit - 4	Torsion of Prismatic Bars: Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes. Plastic Deformation: Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.	16
Pedagogy:	Constructive, Collaborative and Inquiry based learning.	
References/ Readings:	1. Singh, Sadhu, "Theory of Elasticity", Khanna Publishers. ISBN-13-978-817-409-0607 2. Srinath, L.S. "Advanced Mechanics of Solids", , Tata McGraw Hill, 2000. ISBN-13-978-007-013-9886	

	3. Theory of Elasticity, Prof. Amit Shaw, Prof. Biswanath Bannerjee, IIT Kharagpur, Swayam Nptel 4. Timoshenko, S. and Goodier, J. N., "Theory of Elasticity", McGraw Hill, 1961. ISBN-13-978-007-070-1229
Course Outcomes:	After taking this course, student will be able to: CO 1. Understand the fundamentals of plastic behaviour. CO 2. Explain stress-strain resultants in both rectangular as well as polar coordinates. CO 3. Solve simple problems of elasticity and understand the basic concepts. CO 4. Apply the numerical techniques and tools for the complex problems in elasticity.

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Name of the programme : Master Of Engineering (Structural Engineering)
 Course Code : STE-532
 Title of the Course : Repair and Rehabilitation of Structures
 Number of Credits : 04 (03L+01T)
 Effective from AY : 2024-25

Pre-requisites for the Course:	Nil	
Course Objectives:	The course aims to provide the student with: 1. Analyze the causes of distress and deterioration in concrete structures. 2. Diagnose the damage in concrete structures. 3. Design effective repair and protection strategies using advanced materials and techniques. 4. Formulate comprehensive repair, rehabilitation, and retrofitting solutions for addressing structural issues in concrete	
Content:		No. of hours
Unit - 1	INTRODUCTION: An overview of present repair practices, distress identification and repair management, Causes of distress in concrete structures deterioration of concrete, Permeability of concrete, aggressive chemical agents, durability aspects, Conditional Survey- Definition, objectives, different stages-Preliminary inspection, planning stage, visual inspection, field laboratory testing stage, consideration for repair strategy.	15
Unit - 2	NON-DESTRUCTIVE AND DESTRUCTIVE TESTING METHODS: Non-Destructive evaluation tests - Concrete strength assessment - Rebound hammer test - Ultrasonic pulse velocity tests, penetration resistance, pull out tests, core sampling and testing, Chemical tests - Carbonation tests and chloride content, Corrosion potential assessment, half cell potentiometer test, resistivity measurement, Identification and estimation of damage.	15
Unit - 3	TECHNIQUES FOR REPAIR AND PROTECTION METHODS Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Guniting and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and cathodic protection. Engineered demolition techniques for dilapidated structures – case studies	15
Unit - 4	REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES Repairs to overcome low member strength. Deflection, Cracking,	15

	Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure.	
Pedagogy:		
References/ Readings:	1. Gambhir.M.L., "Concrete Technology", McGraw Hill, 2013 ISBN: 9780074620626 2. Guha P.K., Maintenance and Repairs of Buildings, New Central Book Agency (P)Ltd, Kolkata. ISBN: 9788173818347 Year of Publication: 2012 3. Poonam Modi, Chirag Patel “ Repair and Rehabilitation of concrete Structures’ ISBN-13. 978-8120352148 4. Shetty M.S., "Concrete Technology - Theory and Practice", S.Chand and Company, 2008. ISBN: 9789352533800 5. Varghese P.C., “Maintenance, Repair & Rehabilitation And Minor Works of Buildings” 1st Edition, PHI Learning Private Ltd., New Delhi., 2014. ISBN: 9788120349841	
Course Outcomes:	After taking this course, student will be able to: CO 1. Analyze the causes of distress and deterioration in concrete structures CO 2. Diagnose the damage in concrete structures. CO 3. Design effective repair and protection strategies using advanced materials and techniques. CO 4. Formulate comprehensive repair, rehabilitation, and retrofitting solutions for addressing structural issues in concrete	

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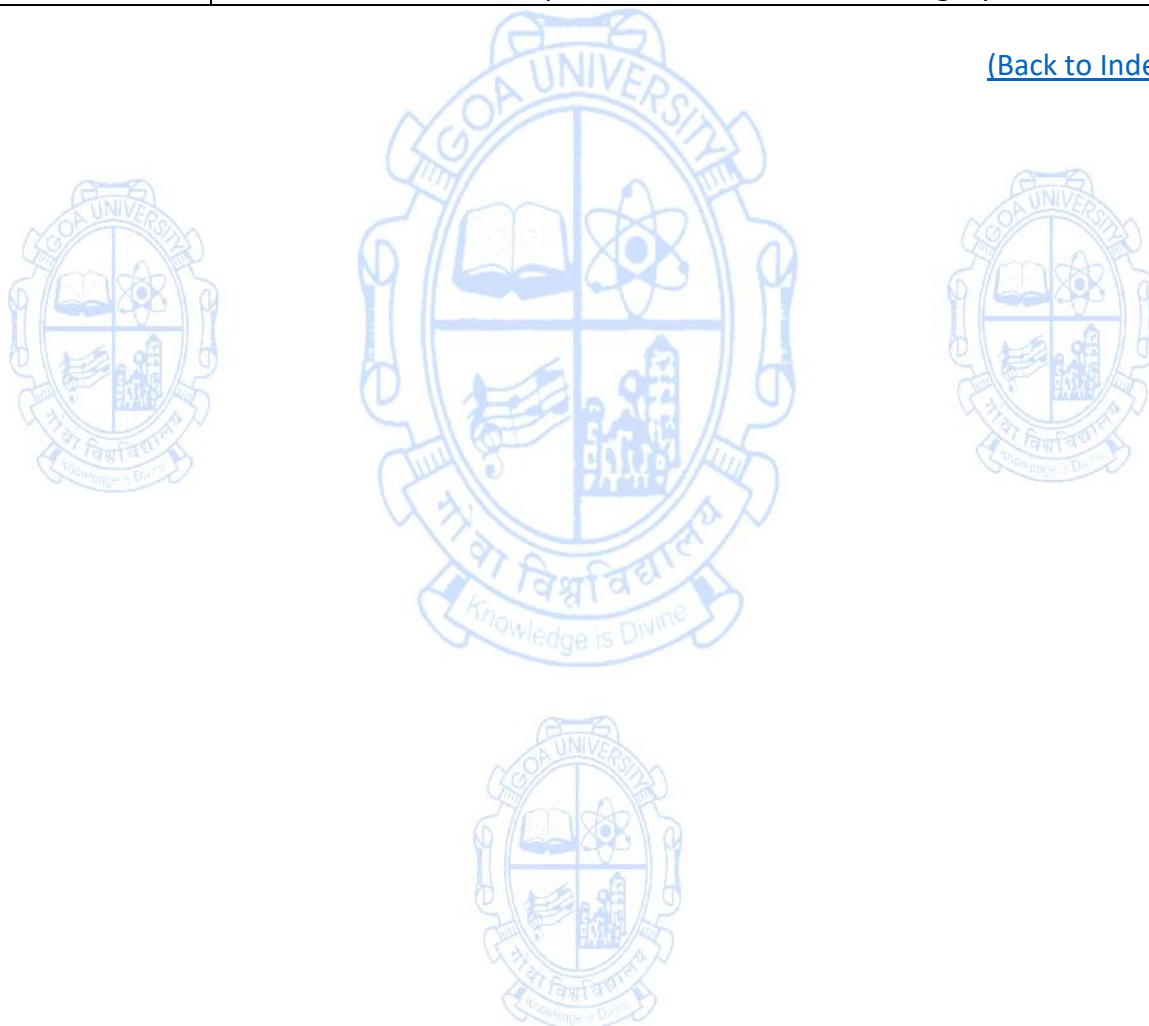
Research Specific Elective (RSE) Courses

Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : REC-561
Title of the Course : Engineering Research & Publication
Number of Credits : 4 (3L+1T)
Effective from AY : 2024-25

Pre-requisites for the Course:	Nil	
Course Objectives:	The course will enable the students to 1. Understand the importance of literature review, defining the research objectives. 2. Explain qualitative and quantitative methods of data analyses and its importance. 3. Classify research publications, select appropriate journals based on research areas. 4. Practice ethics in publication and academic integrity	
Content:		No of Hours
Unit -1	Overview of scientific research in engineering , foundational and fundamental concepts like types of research and considerations for research in specific domains, motivation to do research, critical thinking, assumptions and hypotheses, basic and applied research, importance of formulation of broad research objectives	11 + 4T
Unit -2	Purpose and Methodology of Literature Search and Review of the scientific and engineering publications. Sources such as scholarly databases, public domain, open access, current literature, review articles, critical review and gap analysis, defining research objectives	11 + 4T
Unit -3	Quantitative and qualitative Data – importance of data in research, types of data, data collection techniques, Quantitative methods for analysis of data – statistical tools, mathematical modeling, simulation, experimental data, optimization methods; Qualitative data collection, preparing questioners, rating scale, conducting survey, validation of models.	12 + 4T
Unit- 4	Preparation of Publications- Elements of research publications, types of publications, writing for journal publications, basic requirements for publication, selection of journals, journal quality indicators, peer review, reply to comments and responses, publication ethics, references, citations, authorship, plagiarism, academic integrity	11+ 3T
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	1. Herman Tang, 'Engineering Research-Design, Methods and Publications', John Wiley and Sons, 2021, ISBN:9781119624486.	

	2. Meikang Qiu, Han Qiu, Yi Zeng, 'Research & Technical Writing for Science and Engineering', Taylor & Francis Publications, 2022, ISBN:9781003139058 3. Michael Jay Katz, 'From Research to Manuscript', Springer Publication, 2009, ISBN:9781402094668. 4. Rob Dekkers, Lindsey Casey, Peter Langhorne, 'Making Literature Review Work', Springer Publications, 2022, ISBN:9783030900243
Course Outcomes:	After taking this course, student will be able to: CO 1. Understand the importance of literature review, defining the research objectives. CO 2. Explain qualitative and quantitative methods of data analyses and its importance. CO 3. Classify research publications, select appropriate journals based on research areas. CO 4. Practice ethics in publication and academic integrity

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Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : REC-562
Title of the Course : Literature Review & Technical Writing
Number of Credits : 4 (3L+1T)
Effective from AY : 2024-25

Pre-requisites for the Course:	Nil	
Course Objectives:	The course will enable the students to 1. Understand the importance of literature review and writing a review paper. 2. Explain the method to be followed to write a review paper. 3. Classify data for qualitative and quantitative analysis 4. Demonstrate technical writing for conference.	
Content:		No of Hours
Unit -1	Overview on Literature Review , difference between objectives of literature review and research objectives; types of literature review, qualitative and quantitative reviews, search strategies, primary and secondary sources, database search strategies, field search, root search, complimentary search, meta-analysis	12 + 4T
Unit -2	Database management of literature reviews , bibliometric analysis, importance of writing a review paper, reply to comments and responses, publication ethics, references, citations, authorship, plagiarism, academic integrity; public domain, open access, current literature.	11 + 4T
Unit -3	Technical writing on a specific research topic , structure of the paper, abstract, introduction, experimental, simulation, analysis, discussion, inferences, title, acknowledgment, referencing, presentation of tables, figures, graphs, equations; comparison between technical writing for conference papers and journal paper	11 + 4T
Unit- 4	Importance of data in research , types of data, data collection techniques, Quantitative methods for analysis of data – statistical tools, mathematical modeling, simulation, experimental data, optimization methods; Qualitative data collection, preparing questioners, rating scale, conducting survey, validation of models.	11 + 3T
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	1. Herman Tang, 'Engineering Research-Design, Methods and Publications', John Wiley and Sons, 2021, ISBN:9781119624486. 2. Meikang Qiu, Han Qiu, Yi Zeng, 'Research & Technical Writing for Science and Engineering', Taylor & Francis Publications, 2022, ISBN:9781003139058.	

	3. Michael Jay Katz, 'From Research to Manuscript', Springer Publication, 2009, ISBN:9781402094668 4. Rob Dekkers, Lindsey Casey, Peter Langhorne, 'Making Literature Review Work – Multidisciplinary Guide to Systematic Approaches', Springer Publications, 2022, ISBN:9783030900243.
Course Outcomes:	After taking this course, student will be able to: CO 1. Understand the importance of literature review and writing a review paper. CO 2. Explain the method to be followed to write a review paper. CO 3. Classify data for qualitative and quantitative analysis CO 4. Demonstrate technical writing for conference.

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Semester – II

Programme Specific Core (PSC) Courses

Name of the Programme : Master of Engineering (Structural Engineering)
Course Code : COS-505
Title of the Course : Advanced Design of Reinforced Concrete and Prestressed Structures
Number of Credits : 03 (3L)
Effective from AY : 2024-25

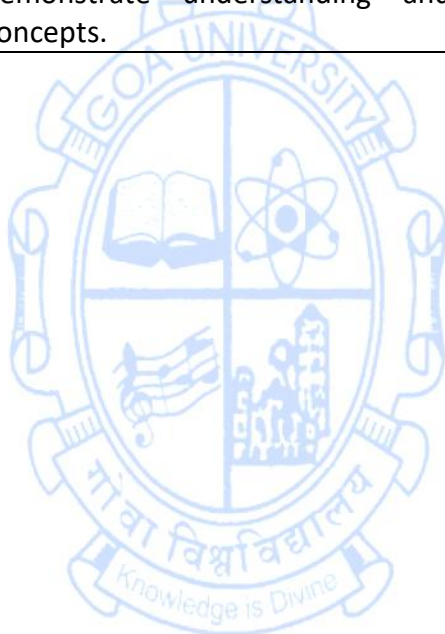
Pre-requisites for the course:	Structural Analysis, Design of Concrete Structures	
Course Objectives:	The course will enable the students to: 1. Understand the direct design method for flat slabs, including moment distribution and shear checks. 2. Apply the equivalent frame method and direct design method to analyze flat slabs, including reinforcement detailing. 3. Apply the limit state method to design prestressed concrete sections, including rectangular and flange sections, and calculate principal tension and shear strength. 4. Analyse the design of grid floors, storage structures, and chimneys, considering factors such as self-weight, wind, temperature, and stress combinations.	
Content:		No. of Hours
UNIT 1	Flat Slabs: Direct design method: Distribution of moments in column strips and middle strip-moment and shear transfer from slabs to columns. Shear in Flat Slabs-Check for one-way and two-way shears. Introduction to Equivalent frame method. Limitations of Direct design method, Distribution of moments in column strips and middle strip sketch showing reinforcement details.	12
UNIT 2	Grid Floor: Concept, Design and detailing of grid floors.	11
UNIT 3	Design of Prestressed Concrete Sections using Limit State Method: General philosophy of design, permissible stresses in concrete and steel, suitability of section, safe cable zone, design of rectangular and Flange sections using limit state method. Calculation of principal tension under working load, permissible principal tension, shear strength calculation under limit state of collapse for both sections cracked and uncracked in flexure. Design of end block. Post tensioned slabs	12
UNIT 4	Storage Structures: Design of Bunkers and Silos. Chimneys: Introduction, Design factors, Stresses due to self-weight, wind and temperature, Combinations of stresses.	10
Pedagogy:	Constructive, Collaborative and inquiry based learning, Field Visits	

References/ Readings:	1. Punmia, B. C., Jain, Ashok Kumar, & Jain, Arun Kumar, R.C.C. Structures, Laxmi Publications, New Delhi, 2015, ISBN-13: 978-8131809426 2. Raju, Krishna, Advanced Reinforced Cement Concrete Design, CBS Publishers & Distributors, New Delhi, 2016, ISBN-13: 978-8123929606 3. Raju, Krishnam, Structural Design and Drawing (RCC and Steel), University Press, New Delhi, 2005, ISBN-13: 978-8173714894 4. Raju, N. Krishna, Prestressed Concrete, McGraw-Hill Education Pvt. Ltd., 2012, ISBN-13: 978-1259050817 5. Varghese, P., Advanced Reinforced Cement Concrete Design, PHI Learning Pvt. Ltd., New Delhi, 2010, ISBN-13: 978-8120327870
Course Outcomes	After taking this course, students will be able to - CO 1. Understand the direct design method for flat slabs, including moment distribution and shear checks. - CO 2. Apply the equivalent frame method and direct design method to analyze flat slabs, including reinforcement detailing. - CO 3. Apply the limit state method to design prestressed concrete sections, including rectangular and flange sections, and calculate principal tension and shear strength. - CO 4. Analyze the design of grid floors, storage structures, and chimneys, considering factors such as self-weight, wind, temperature, and stress combinations.

Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : STE-506
Title of the Course : Structural Engineering Lab - 3
Number of Credits : 01 (1P)
Effective from AY : 2024-25

Pre-requisites for the course:	Structural Analysis, Finite Element Analysis and Basic Programming	
Course Objectives:	The course will enable the students to: 1. Understand and apply IS/ACI codes for high-grade and self-compacting concrete mix designs and study its flow characteristics. 2. Analyse and design flat slabs, grid floors, prestressed concrete members using software, spreadsheets. 3. Encourage practical learning through case studies and field observation 4. Compile findings, analysis, and insights from design, case studies, and field visits into comprehensive reports that demonstrate understanding and application of learned concepts.	
Content:		No. of Hours
	List of Experiments: 1. Design mix for high grade concrete based on IS code or ACI code. 2. Design mix for self-compacting concrete based on IS code or ACI code. 3. Flow Characteristics of Self Compacting concrete. 4. Analysis of flat slab systems using industry standard software and designing using spread sheets. 5. Analysis of grid floors systems using industry standard software and designing using spread sheets. 6. Analysis of prestressed slab using industry standard software and designing using spread sheets. 7. Detailed Case study report (unique) on design and execution of ongoing RCC structure projects. 8. Field visit on RCC construction site and Report submission (Any Industry standard software can be used for analysis)	30
Pedagogy:	Inquiry based learning, constructive planning of experiments, collaborative approach in performing experiments and field visits.	
References/ Readings:	1. Guidelines for Concrete Mix Design Proportioning [CED 2: Cement and Concrete], IS 10262 (2009). 2. Punmia, B. C., Jain, Ashok Kumar, & Jain, Arun Kumar, R.C.C. Structures, Laxmi Publications, New Delhi, 2015, ISBN-13: 978-8131809426. 3. Raju, Krishna, Advanced Reinforced Cement Concrete Design, CBS Publishers & Distributors, New Delhi, 2016, ISBN-13: 978-8123929606.	

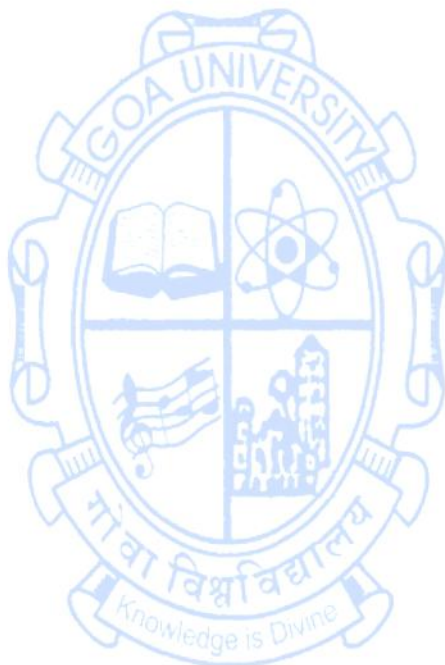
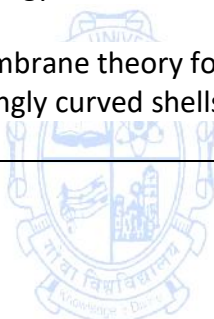
	4. Raju, Krishna, Structural Design and Drawing (RCC and Steel), University Press, New Delhi, 2005, ISBN-13: 978-8173714894. 5. Raju, N. Krishna, Prestressed Concrete, McGraw-Hill Education Pvt. Ltd., 2012, ISBN-13: 978-1259050817. 6. Varghese, P., Advanced Reinforced Cement Concrete Design, PHI Learning Pvt. Ltd., New Delhi, 2010, ISBN-13: 978-8120327870.
Course Outcomes	After taking this course, student will be able to CO 1. Apply IS/ACI codes for high-grade and self-compacting concrete mix designs and study its flow characteristics. CO 2. Analyse and design flat slabs, grid floors, prestressed concrete members using software, spreadsheets. CO 3. Apply practical learning through case studies and field observation CO 4. Analyse and compile findings, insights from design, case studies, and field visits into comprehensive reports that demonstrate understanding and application of learned concepts.



Name of the Programme : Master of Engineering (Structural Engineering)
Course Code : COS-507
Title of the Course : Theory of Thin Plates & Shells
Number of Credits : 03 (3L)
Effective from AY : 2024-25

Pre-requisites for the course:	Engineering Mathematics, Strength of materials, Theory of Deformable bodies	
Course Objectives:	The course will enable the students to: 1. Understand plate theory, including small deflection theory for rectangular plates and solutions for various boundary conditions. 2. Apply energy methods to analyze rectangular and circular plates with clamped edges under symmetric loadings. 3. Apply curved surface theories to analyze different shell types, including spherical, cylindrical, and hyperbolic paraboloids. 4. Analyze axially symmetrical bending and finite element formulations for plates and shells.	
Content:		No. of Hours
UNIT 1	Introduction to plate theory: Introduction to plate theory, small deflection of laterally loaded thin rectangular plates for pure bending, Navier's and Levy's solution for various lateral loading and boundary conditions, Numerical examples.	12
UNIT 2	Energy methods for plates: Energy methods for rectangular and circular plates with clamped edges subjected to symmetric loadings.	11
UNIT 3	Introduction to curved surfaces: Introduction to curved surfaces and classification of shells, membrane theory of spherical shells, cylindrical shells, hyperbolic paraboloids, elliptic paraboloid and conoids.	12
UNIT 4	Axially symmetrical bending: Axially symmetrical bending of shells revolution, closed cylindrical shells, water tanks, spherical shells and Geckeler's approximation, bending theory of doubly curved shallow shells Finite Element Approach: Finite element formulation for Plates and shells.	10
Pedagogy:	Constructive, Collaborative and inquiry based learning	
References/ Readings:	1. Chatterjee, B. K., Theory and Design of Concrete Shell Roofs, Chapman and Hall, 1978, ISBN-13: 978-0412316609. 2. Reddy, J. N., Mechanics of Laminated Composite Plates and Shells: Theory and Analysis, CRC Press, 2003, ISBN-13: 9780203502808. 3. Szilard, R., Theory and Analysis of Plates: Classical and Numerical Methods, Prentice Hall, 1974, ISBN-13: 978-0139134265. 4. Timoshenko, S. and Woinowsky-Kreiger, Theory of Plates and Shells, McGraw-Hill Book Company, New York, 1959, ISBN-13: 9780070647794.	

	5. Ugural, A. C., Stresses in Plates and Shells, McGraw-Hill Book Company, 1999, ISBN-13: 9780070657694.
Course Outcomes	After taking this course, student will be able to CO 1. Analyse plates using the concept of Navier's and Levy's solution for various boundary conditions CO 2. Apply energy methods for plates with various boundary conditions CO 3. Apply membrane theory for shells of different shapes CO 4. Analyse singly curved shells, doubly curved shells and cylindrical shells



Name of the Programme : Master Of Engineering (Structural Engineering)
 Course Code : COS-508
 Title of the Course : Computational Structural Dynamics
 Number of Credits : 03 (3L)
 Effective from AY : 2024-25

Pre-requisites for the course:	Mathematics, Numerical Techniques, Engineering Mechanics, Structural	
Course Objectives:	The course will enable the students to: 1. Understand the fundamentals of single degree of freedom systems, including free and damped vibrations, and the associated equations of motion. 2. Apply methods to analyse the response of single degree of freedom systems to harmonic and general dynamic loading, including evaluation of damping and numerical methods. 3. Apply concepts to multiple degrees of freedom systems, including free vibration analysis, natural frequencies, and mode shapes. 4. Analyse dynamic behaviour in continuous systems and beams, including the formulation of stiffness and mass matrices and the application of computer programs for dynamic response analysis	
Content:		No. of Hours
UNIT 1	Single Degree of Freedom System subjected to free vibration: Degrees of freedom, undamped system, springs in parallel, in series. Newton's laws of motion, free body diagrams. D'Alembert's principle, solution of the differential equation of motion, frequency and period, amplitude of motion. Damped Single degree of freedom system – viscous damping, equation of motion, critically damped system, over damped system, under damped system, and logarithmic decrement.	12
UNIT 2	Response of single degree of freedom system to harmonic loading: Undamped harmonic excitation, damped harmonic excitation, evaluation of damping at resonance, bandwidth method (Half power) to evaluate damping, response to support motion, force transmitted to the foundation, seismic instruments. Response to General Dynamic Loading: Impulsive loading and Duhamel's integral, numerical evaluation of Duhamel's integral, un-damped system, numerical evaluation of Duhamel's integral, damped system. Numerical Evaluation of dynamic response using Newmark's methods.	11
UNIT 3	Multiple degrees of Freedom system: Dynamics of Multi-degree freedom systems: Mathematical models of multi-degree-of-freedom systems, Shear building concept, free and forced vibration of undamped and damped multi-degree-of- freedom systems – Natural frequencies and mode shapes – Orthogonality	10

	of modes. Dynamics of continuous systems: Dynamics of Continuous systems: Flexural vibration of beams with different end conditions Basics of Vibration Control: Base Isolation, Tuned Mass Damper	
UNIT 4	Dynamic Analysis of Beams: Stiffness matrix, mass matrix (lumped and consistent); equations of motion for the discretized beam in matrix form and its solutions. Computer Applications: Flowchart, Algorithms Computer logic for development of computer Programs for solution of Single and multiple degree of freedom system subjected to forced and free vibration.	10
Pedagogy:	Constructive, Collaborative and inquiry based learning	
References/ Readings:	1. Chopra, A. K., Dynamics of Structures – Theory and Applications, Pearson Education, 2017, ISBN-13: 9788131713297. 2. Clough, R. W. and Penzien, J., Dynamics of Structures, McGraw-Hill, New York, 1975, ISBN-13: 9780070113923. 3. Craig, R. R. and Kurdila, A. J., Fundamentals of Structural Dynamics, John Wiley & Sons, 2011, ISBN-13: 9781118174449. 4. Mukhopadhyay, M., Vibration, Dynamics, and Structural Problems, Oxford & IBH Publishing Co., 2008, ISBN-13: 9788180520907. 5. Paz, Mario, Structural Dynamics: Theory and Computations, 2nd Edition, CBS Publishers and Distributors, New Delhi, 2012, ISBN-13: 9781461504818	
Course Outcomes	After taking this course, student will be able to CO1 Understand the fundamentals of single degree of freedom systems including free and damped vibrations, and the associated equations of motion. CO2 Apply methods to analyze the response of single degree of freedom systems to harmonic and general dynamic loading, including evaluation of damping and numerical methods. CO3 Apply concepts to multiple degrees of freedom systems, including free vibration analysis, natural frequencies, and mode shapes CO4 Analyze dynamic behavior in continuous systems and beams including the formulation of stiffness and mass matrices and the application of computer programs for dynamic response analysis	

Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : STE-509
Title of the Course : Structural Engineering Lab - 4
Number of Credits : 02 (2P)
Effective from AY : 2024-25

Pre-requisites for the course:	Theory of Plates and shells, Computational Structural Dynamics, Finite Element Analysis	
Course Objectives:	The course will enable the students to: 1. Understand the principles and methodologies for analyzing thin plates and shells, including the differences between thin shells, thick shells, and membranes. 2. Apply program development techniques to perform free and forced vibration analysis of single degree of freedom systems. 3. Apply dynamic modeling and analysis methods to two-dimensional frame structures and develop Excel sheets for numerical evaluation of SDOF systems. 4. Analyze the dynamic behavior of three-dimensional building structures using industry-standard methods, including modal analysis, the equivalent static method, and the response spectrum method.	
Contents:		No. of Hours
	List of Experiments: 1. Analysis of Thin Plates 2. Analysis of Spherical Shells 3. Comparative analysis of thin shells, thick shells and membrane for Slab 4. Analysis of Cylindrical Shells 5. Analysis of axially symmetric bending of shells of revolution. 6. Analysis of axially symmetric bending of Closed Cylindrical shells. 7. Design of simple Shells- Spherical dome and Water tanks 8. Program Development for Free vibration Analysis of Single Degree of Freedom systems 9. Program Development for Forced vibration Analysis of Single Degree of Freedom systems 10. Dynamic modelling and analysis of a two-dimensional Frame structure. 11. Development of excel sheets for Numerical evaluation of SDOF systems. 12. Modal analysis of Three- dimensional building structure. 13. Dynamic Analysis of Three- dimensional building structure using Equivalent Static method 14. Dynamic Analysis of Three- dimensional building structure using Response Spectrum method (Any Industry standard software can be used for analysis)	60

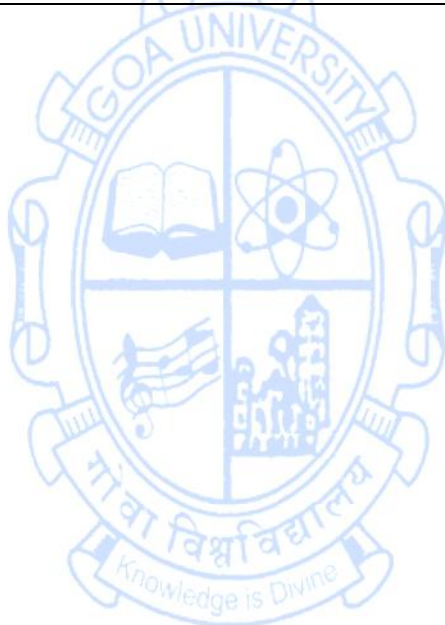
Pedagogy:	Inquiry based learning, constructive planning of experiments, collaborative approach in performing experiments and field visits.
References/ Readings:	1. Chatterjee, B. K., Theory and Design of Concrete Shell Roofs, Chapman and Hall, 1978, ISBN-13: 978-0412316609. 2. Chopra, A. K., Dynamics of Structures – Theory and Applications, Pearson Education, 2017, ISBN-13: 9788131713297. 3. Clough, R. W. and Penzien, J., Dynamics of Structures, McGraw-Hill, New York, 1975, ISBN-13: 9780070113923. 4. Craig, R. R. and Kurdila, A. J., Fundamentals of Structural Dynamics, John Wiley & Sons, 2011, ISBN-13: 9781118174449. 5. Mukhopadhyay, M., Vibration, Dynamics, and Structural Problems, Oxford & IBH Publishing Co., 2008, ISBN-13: 9788180520907. 6. Paz, Mario, Structural Dynamics: Theory and Computations, 2nd Edition, CBS Publishers and Distributors, New Delhi, 2012, ISBN-13: 9781461504818. 7. Reddy, J. N., Mechanics of Laminated Composite Plates and Shells: Theory and Analysis, CRC Press, 2003, ISBN-13: 9780203502808. 8. Szilard, R., Theory and Analysis of Plates: Classical and Numerical Methods, Prentice Hall, 1974, ISBN-13: 978-0139134265. 9. Timoshenko, S. and Woinowsky-Kreiger, W., Theory of Plates and Shells, McGraw-Hill Book Company, New York, 1959, ISBN-13: 9780070647794. 10. Ugural, A. C., Stresses in Plates and Shells, McGraw-Hill Book Company, 1999, ISBN-13: 9780070657694.
Course Outcomes	After taking this course, student will be able to - CO 1. Understand the principles and methodologies for analyzing thin plates and shells, including the differences between thin shells, thick shells, and membranes. - CO 2. Apply program development techniques to perform free and forced vibration analysis of single degree of freedom systems. - CO 3. Apply dynamic modeling and analysis methods to two-dimensional frame structures and develop Excel sheets for numerical evaluation of SDOF systems. - CO 4. Analyze the dynamic behavior of three-dimensional building structures using industry-standard methods, including modal analysis, the equivalent static method, and the response spectrum method.

Programme Specific Elective (PSE) Courses

Name of the Programme : Master of Engineering (Structural Engineering)
Course Code : COS-533
Title of the Course : Structural Health Monitoring
Number of Credits : 03 (3L)
Effective from AY : 2024-25

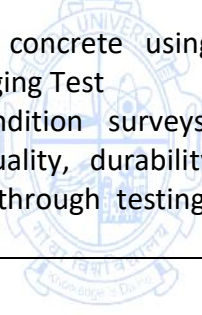
Pre-requisites for the course:	Material Science, Nondestructive testing methods	
Course Objectives:	The course will enable the students to: 1. Understand the principles of structural health monitoring (SHM), including definitions, motivations, and non-destructive testing (NDT) methods. 2. Apply static field-testing techniques and response measurement tools to evaluate real-world scenarios 3. Apply dynamic field-testing methods, such as vibration and impact tests, to evaluate structural performance. 4. Analyse and evaluate data acquisition systems and remote monitoring methods, including communication technologies and data compression techniques.	
Content:		No. of Hours
UNIT 1	Introduction - Definition of SHM - Motivation for structural health monitoring - Assessment by NDT equipment's. Static Testing - Static field testing- types of static tests- loading methods - Behavioural / Diagnostic tests - Proof tests - Static response measurement – strain gauges, LVDTs, dial gauges - case study.	12
UNIT 2	Dynamic field testing - Types of dynamic tests - Stress history data Dynamic load allowance tests - Ambient vibration tests - Forced Vibration Method - Dynamic response methods - Impact hammer testing - Shaker testing - Periodic and continuous monitoring.	11
UNIT 3	Data Acquisition - Static data acquisition systems - Dynamic data acquisition systems - Components of Data acquisition system - Hardware for Remote data acquisition systems.	12
UNIT 4	Remote Structural health monitoring - Remote Structural Health Monitoring - Importance and Advantages – Methodology - RF/PSTN/GSM/Satellite Communications - Networking of sensor - Data compression technique - Case Studies	11
Pedagogy:	Constructive, Collaborative and inquiry-based learning, Field Visits	
References/ Readings:	1. Adams, D. E., Health Monitoring of Structural Materials and Components: Methods with Applications, John Wiley and Sons, 2010, ISBN-13: 9780470511572. 2. Daniel, B., Claus-Peter, F., & Güemes, A., Structural Health Monitoring, John Wiley and Sons, 2010, ISBN-13: 9780470394403. 3. Giurgiutiu, V., Structural Health Monitoring with Wafer Active	

	Sensors, Academic Press Inc., 2014, ISBN-13: 9780124201026. 4. Huston, D., Structural Sensing, Health Monitoring, and Performance Evaluation, 2010, ISBN-13: 9781420012354. 5. Ou, J. P., Li, H., & Duan, Z. D., Structural Health Monitoring and Intelligent Infrastructure Vol-1, Taylor and Francis Group, London, U.K., 2005, ISBN-13: 978-0415396523.
Course Outcomes	After taking this course, student will be able to CO 1. Diagnose the distress in the structure CO 2. Apply knowledge of static and dynamic field-testing techniques to assess structural performance and health. CO 3. Effectively use static and dynamic data acquisition systems and understand their components for remote monitoring applications. CO 4. Implement remote structural health monitoring solutions, utilizing communication technologies, sensor networks, and data compression techniques.



Name of the Programme: Master of Engineering (Structural Engineering)
Course Code: COS-534
Title of the Course: Structural Health Monitoring Lab
Number of Credits: 01
Effective from AY: 2024-25

Pre-requisites for the course:	Concepts of Concrete Technology and Design of Concrete Structures.	
Course Objectives:	The course will enable the students to: 1. Evaluate the strength, integrity and homogeneity of concrete using non-destructive testing methods. 2. Evaluate durability by measuring different parameters like creep and shrinkage to assess its impact on the performance of concrete. 3. Assess the condition and performance of concrete using electrical resistance strain gauges Thermal Imaging Test 4. Document findings from condition surveys, including reinforcement details, concrete quality, durability factors, and any structural issues identified through testing, following CPWD guidelines.	
Contents:		No. of Hours
	List of Experiments (Minimum 8): 1. Conduct Condition Survey of a building and prepare detailed Visual Inspection Report as per CPWD guidelines. 2. To detect reinforcement details in concrete elements using Profometer. 3. Assess the quality of concrete with Rebound Hammer equipment. 4. Assess the quality of concrete with Ultrasonic Pulse Velocity equipment. 5. Carbonation Test on Concrete. 6. Rapid Chloride Permeability Test on Concrete. 7. Rapid Chloride Migration Test on Concrete. 8. Strain measurement – electrical resistance, strain gauges. 9. Short- and long-term durability tests and analysis using software 10. Shrinkage and Creep of concrete 11. Thermal imaging test.	30
Pedagogy:	Inquiry based learning, constructive planning of experiments, collaborative approach in performing experiments and field visits.	
References/ Readings:	1. Adams, D. E., Health Monitoring of Structural Materials and Components: Methods with Applications, John Wiley and Sons, 2010, ISBN-13: 9780470511572. 2. Daniel, B., Claus-Peter, F., & Güemes, A., Structural Health Monitoring, John Wiley and Sons, 2010, ISBN-13: 9780470394403. 3. General Standard for Qualification and Certification of Non-Destructive Testing Personnel [MTD 21: Non-Destructive Testing], IS	

	13805 (2004). 4. Giurgiutiu, V., Structural Health Monitoring with Wafer Active Sensors, Academic Press Inc., 2014, ISBN-13: 9780124201026. 5. Handbook on Repair and Rehabilitation of RCC Buildings, CPWD (Central Public Works Department), 2002. 6. Huston, D., Structural Sensing, Health Monitoring, and Performance Evaluation, 2010, ISBN-13: 9781420012354. 7. Method of Non-Destructive Testing of Concrete, Part 1: Ultrasonic Pulse Velocity [CED 2: Cement and Concrete], IS 13311-1 (1992). 8. Method of Tests for Strength of Concrete, BIS, New Delhi, India, IS 516:2006. 9. Ou, J. P., Li, H., & Duan, Z. D., Structural Health Monitoring and Intelligent Infrastructure Vol-1, Taylor and Francis Group, London, U.K., 2005, ISBN-13: 978-0415396523.
Course Outcomes 	After taking this course, student will be able to - CO 1. Evaluate the strength, integrity and homogeneity of concrete using non-destructive testing methods. - CO 2. Evaluate durability by measuring different parameters like creep, shrinkage to access its impact on the performance of concrete. - CO 3. Access the condition and performance of concrete using electrical resistance strain gauges Thermal Imaging Test - CO 4. Compile and document findings from condition surveys, including reinforcement details, concrete quality, durability factors, and any structural issues identified through testing, following CPWD guidelines. 

Name of the Programme : Master of Engineering (Structural Engineering)
Course Code : STE-533
Title of the Course : Design of Industrial Structures
Number of Credits : 03 (3L)
Effective from AY : 2024-25

Pre-requisites for the course:	Structural Analysis, Design of Concrete Structures, Design of Concrete Structures	
Course Objectives:	The course will enable the students to: 1. Understand the direct design method for industrial structures, including moment distribution and shear checks. 2. Apply the appropriate method for analysis and design of industrial structures including reinforcement detailing. 3. Apply the limit state method to design RCC concrete structures concrete sections, including rectangular and flange sections, and calculate principal tension and shear strength. 4. Analyse the design of steel structures, storage structures, and chimneys, considering factors such as self-weight, wind, temperature, and stress combinations.	
Content:		No. of Hours
UNIT 1	Fundamentals of Industrial Structures: Overview of Industrial Structures, Types of industrial buildings (warehouses, factories, workshops, etc.). Functional requirements: space, ventilation, lighting, and safety considerations. Introduction to relevant design codes and standards (e.g., IS 800, IS 875, Eurocodes). Loads and Load Combinations, Dead, live, wind, seismic, and crane loads. Load combinations as per standards. Structural Systems for Industrial Buildings, Rigid frames, trusses, portals, and prefabricated systems.	13
UNIT 2	Steel Structures for Industrial Applications: Design of Roof Trusses, Selection of roof sheeting, purlins, and bracing systems. Analysis and design of steel roof trusses with different spans and slopes. Design of Gantry Girders, Design for crane loads and moving loads. Stresses due to impact and lateral thrust. Design of Steel Columns, Axially loaded and biaxially bent columns. Design of column splices and base plates.	10
UNIT 3	Reinforced Concrete (RC) Industrial Structures: Design considerations of Foundations for heavy industrial loads. Design considerations for machine foundations (vibration isolation). Design of Silos and Bunkers, Chimneys and Cooling Towers: wind and temperature effects. load considerations and design principles.	12

UNIT 4	Special Topics and Case Studies Pre-Engineered Buildings (PEBs) - Concept, analysis, and design, Comparison of PEBs and conventional steel structures. Seismic Design of Industrial Structures - Seismic load evaluation, Design and detailing for ductility. Case Studies and Applications - Design and analysis of real-world industrial structures. Challenges in retrofitting and rehabilitation of industrial buildings	10
Pedagogy:	Constructive, Collaborative and inquiry based learning, Field Visits	
References/ Readings:	1. Gambhir M. L., Fundamentals of Structural Steel Design, McGraw Hill Education, 2017, ISBN-13 : 978-1259006760 2. INSDAG., Guidebook for Steel-Concrete Composite Construction- Design Procedures of Structural Elements, Institute of Steel development and growth, 2000. 3. Raju, Krishna, Advanced Reinforced Cement Concrete Design, CBS Publishers & Distributors, New Delhi, 2016, ISBN-13: 978-8123929606 4. Subramanian N., Design of Steel Structures, Oxford University Press, 2017, ISBN-13: 978-0199460915. 5. Varghese, P., Advanced Reinforced Cement Concrete Design, PHI Learning Pvt. Ltd., New Delhi, 2010, ISBN-13: 978-8120327870. All relevant IS codes	
Course Outcomes	After taking this course, students will be able to CO 1. Understand the design method industrial structures CO 2. Apply the appropriate design method to analyze industrial structures CO 3. Apply the limit state method to design concrete sections, including rectangular and flange sections, and calculate principal tension and shear strength. CO 4. Analyze and design of steel structures, storage structures, and chimneys, considering factors such as self-weight, wind, temperature, and stress combinations.	



Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : STE-534
Title of the Course : Design Of Industrial Structures Lab
Number of Credits : 01
Effective from AY : 2024-25

Pre-requisites for the course:	Structural Analysis, Finite Element Analysis and Basic Programming	
Course Objectives:	The course will enable the students to: 1. Understand and apply IS/ACI codes for analysis and design of industrial structures. 2. Analyse and design special industrial structures like silos, chimneys, cooling towers 3. Encourage practical learning through case studies and field observation 4. Compile findings, analysis, and insights from design, case studies, and field visits into comprehensive reports that demonstrate understanding and application of learned concepts.	
Content:		No. of Hours
	List of Experiments: 1. Analysis and Design of a Roof Truss - Experiment: Analyze a steel roof truss for a given span and loading using software (e.g., STAAD.Pro or ETABS). - Deliverable: Calculation of member forces and detailing of connections. 2. Design of Gantry Girder - Experiment: Analyze and design a gantry girder subjected to crane loads. - Deliverable: Stress analysis, design of the cross-section, and connection detailing. 3. Design of a Steel Portal Frame - Experiment: Analyze and design a steel portal frame for industrial use. - Deliverable: Moment, shear, and axial force diagrams, and member designs. 4. Design of a Pre-Engineered Building (PEB) - Experiment: Analyze a PEB for an industrial shed using software tools. - Deliverable: Structural layout, load analysis, and design of key components. 5. Analysis of Wind Loads on Chimneys - Experiment: Evaluate wind pressure and forces on an RC or steel chimney. - Deliverable: Calculation of bending moments, deflections, and stresses.	30

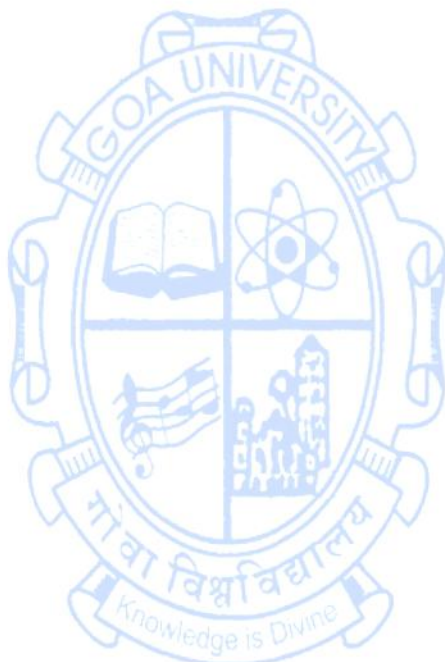
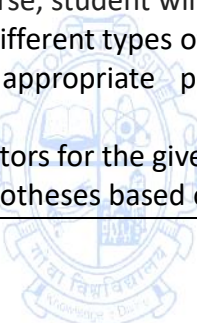
	6. Dynamic Analysis of Machine Foundation - Experiment: Perform vibration analysis for a machine foundation. - Deliverable: Design the foundation to mitigate vibrations. 7. Seismic Analysis of an Industrial Frame Structure - Experiment: Perform seismic load analysis for a steel or RC industrial frame. - Deliverable: Response spectrum analysis and detailing for ductility. 8. Design of a Bunker or Silo - Experiment: Design a storage bunker or silo for granular material. - Deliverable: Analysis of pressure distribution and reinforcement details. 9. Analysis of Cooling Tower Structure - Experiment: Model and analyze a cooling tower under wind and dead loads. - Deliverable: Structural analysis results and member design. 10. Study of Base Isolation in Industrial Structures - Experiment: Compare the performance of a base-isolated structure versus a fixed-base structure. - Deliverable: Results from simulation and recommendations for isolation systems	
Pedagogy:	Inquiry based learning, constructive planning of experiments, collaborative approach in performing experiments and field visits.	
References/ Readings:	- Gambhir M. L., Fundamentals of Structural Steel Design, McGraw Hill Education, 2017, ISBN-13 : 978-1259006760 - INSDAG., Guidebook for Steel-Concrete Composite Construction- Design Procedures of Structural Elements, Institute of Steel development and growth, 2000. - Raju, Krishna, Advanced Reinforced Cement Concrete Design, CBS Publishers & Distributors, New Delhi, 2016, ISBN-13: 978-8123929606 - Subramanian N., Design of Steel Structures, Oxford University Press, 2017, ISBN-13: 978-0199460915. - Varghese, P., Advanced Reinforced Cement Concrete Design, PHI Learning Pvt. Ltd., New Delhi, 2010, ISBN-13: 978-8120327870. All relevant IS codes	
Course Outcomes	After taking this course, student will be able to CO 1. Understand the design method industrial structures CO 2. Apply the appropriate design method to analyze industrial structures CO 3. Apply the limit state method to design concrete sections, including rectangular and flange sections, and calculate principal tension and shear strength. CO 4. Analyze and design of steel structures, storage structures, and chimneys, considering factors such as self-weight, wind, temperature, and stress combinations.	

Research Specific Elective (RSE) Courses

Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : REC-563
Title of the Course : Statistics and Data Analysis for Engineering Research
Number of Credits : 2
Effective from AY : 2024-25

Pre-requisites for the Course:	Basic Knowledge of Statistics	
Course Objectives:	The course will enable the students to 1. Explain the different types of data and parameter estimations 2. Explain standard probability distributions 3. Select the appropriate parameter estimation & distribution method 4. Co-relate different Hypotheses	
Content:		No of Hours
Unit -1	Data Analysis: Types of data, data collection techniques, Quantitative methods for analysis of data – statistical tools, experimental data, Qualitative data collection, questioners, rating scale, conducting survey. Statistical Modeling and Graphical Diagnostics - Scatter Plot, Stem-and-Leaf Plot, Histogram, Box Plot Correlation and Regression Modeling: Basic concept and numericals.	9
Unit -2	Probability distributions and Sampling distributions: Basic introduction to Bernoulli, Binomial and Normal distribution. Basic introduction to Sampling distributions- Normal, t-distribution, Chi-square and F- distributions.	7
Unit -3	Parameter estimation: Point Estimation – Concept, unbiased estimator, method of maximum likelihood. Parameter estimation of standard distributions- Binomial and Normal. Confidence Interval Estimation - Concept, Confidence interval on mean of single normal population with variance known, Confidence interval on the ratio of variances of two normal distributions	7
Unit- 4	Tests of Hypotheses: Introduction, Type I and type II errors, significance level and power of the test, Test of hypotheses - on mean of single normal population with variance known, on variance of single normal population.	7
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	1. D. V Thiel, 'Research Methods for Engineers', Cambridge Press, 2014, ISBN:978-110-70-3-488 2. T. Mustafy, T. U Rahman, 'Statistics & Data Analysis for Engineers and Scientists', Springer, 2024, ISBN:9789819946600. 3. D. C. Montgomery, C. G. Runger, 'Applied Statistics and Probability for Engineers', 6 th Edition, Wiley India, 2016, ISBN 0-471-20454-4	

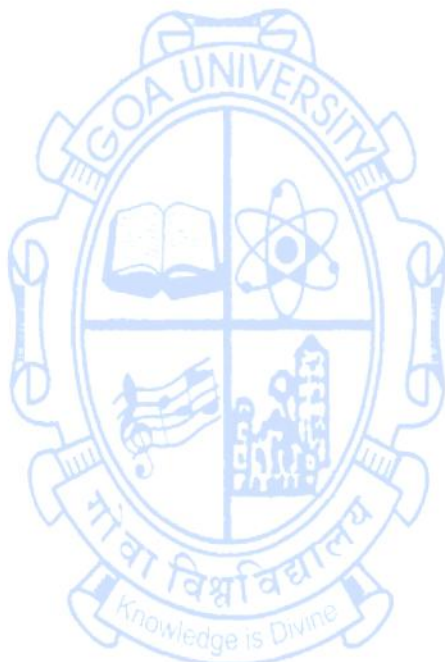
	4. R. E. Walpole, R. H. Myers, S. L. Myers, K. E. Ye; Probability and Statistics for Engineers and Scientists ,9th Edition, Pearson Education India, 2013, ISBN 978-0-321-62911-1 5. J. Schmuller, Statistical Analysis with Excel for Dummies, 5th Edition, John Wiley & Sons, 2022.
Course Outcomes:	After taking this course, student will be able to: CO 1. Explain the different types of data and probability distributions. CO 2. Select the appropriate parameter estimation & distribution method CO 3. Apply estimators for the given situations. CO 4. Evaluate Hypotheses based on the statistical considerations.



Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : REC-564
Title of the Course : Statistics and Data Analysis Lab
Number of Credits : 2
Effective from AY : 2024-25

Pre-requisites for the Course:	Basic Knowledge of Statistics	
Course Objectives:	The course will enable the students to 1. Apply the different types of data and parameter estimations 2. Analyze standard probability distributions 3. Demonstrate parameter estimation & distribution methods 4. Co-relate different Hypotheses	
Content:		No of Hours
	Using open-source software like libreoffice or any proprietary software perform following experiments: 1. Obtain measures of central tendency and dispersion. 2. Obtain Quartiles, Percentiles and prepare Box-and-Whisker Diagram 3. Develop Pie chart, Bar Chart, Histogram and Stem-and-Leaf Plot, 4. Develop correlation using Pearson's Correlation Coefficient and showing Scatter Diagrams and Trendlines 5. Develop Linear and Nonlinear Regression Models 6. Obtain probability values involving probability distributions – Binomial and Normal 7. Obtain values of Normal, t-distribution, Chi-square and F-statistic. 8. Develop confidence interval for single population and two populations with variance known. 9. Develop confidence interval on the ratio of variances of two normal distributions. 10. Perform test of hypotheses on mean/variance of single/ two population(s).	60
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	1. D. V Thiel, 'Research Methods for Engineers', Cambridge Press, 2014, ISBN:978-110-70-3-488 2. T. Mustafy, T. U Rahman, 'Statistics & Data Analysis for Engineers and Scientists', Springer, 2024, ISBN:9789819946600. 3. D. C. Montgomery, C. G. Runger, 'Applied Statistics and Probability for Engineers', 6 th Edition, Wiley India, 2016, ISBN 0-471-20454-4 4. R. E. Walpole, R. H. Myers, S. L. Myers, K. E. Ye; Probability and Statistics for Engineers and Scientists ,9 th Edition, Pearson Education India, 2013, ISBN 978-0-321-62911-1 5. J. Schmuller, Statistical Analysis with Excel for Dummies, 5 th Edition,	

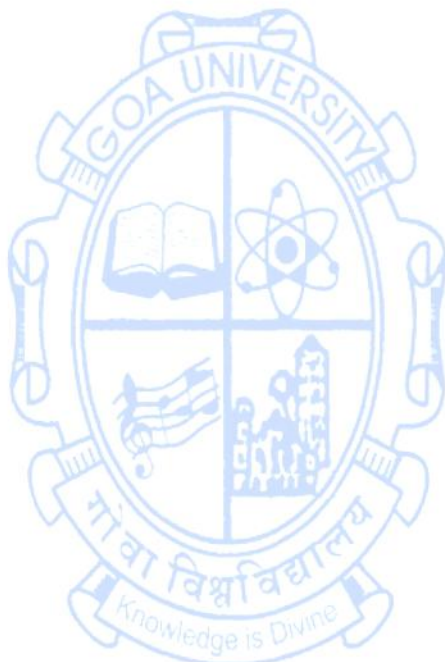
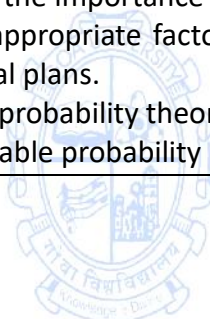
	John Wiley & Sons, 2022.
Course Outcomes:	After taking this course, student will be able to: CO 1. Apply the different types of data and parameter estimations CO 2. Analyze standard probability distributions CO 3. Demonstrate parameter estimation & distribution methods CO 4. Co-relate different Hypotheses



Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : REC-565
Title of the Course : Statistical Techniques for Engineering Research
Number of Credits : 2
Effective from AY : 2024-25

Pre-requisites for the Course:	Basic knowledge of Statistics and Probability	
Course Objectives:	The course will enable the students to 1. Understand the importance of statistical methods for research 2. Select the appropriate factorial design method for a given set of experimental plan. 3. Apply basic probability theorems and draw relevant inferences. 4. Analyze suitable probability model for given set of data	
Content:		No of Hours
Unit-1	Overview on Statistical methods , collection of data, one dimensional and two-dimensional statistical analysis, computation of central tendency and dispersion for grouped and ungrouped data, correlation preliminary, understanding variability in data.	6
Unit-2	Design of Experiments , Preparation of experimental plan, full factorial design, fractional factorial design, identification of parameters and levels, randomization, replication, blocking, interaction; numerical; Optimization methods for two parameters.	9
Unit-3	Probability Preliminary : Introduction to Probability, definition, Sample Space, Events, Conditional Probability, Theorem on total probability, Bayes' theorem. Random Variable: Introduction, Discrete and Continuous distribution, Characteristics- Mean, Variance and distribution function.	8
Unit-4	Probability and Sampling Distribution : Bernoulli, Binomial, Exponential, Normal, distribution. Mean, variance and distribution function, important properties, approximations and applications. Statistic and Sampling Distribution: Population and Sample. Statistic, Sampling distributions- Normal, t-distribution, Chi-square and F- distributions.	7
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	1. Tahvir Mustafy, Tauhid U Rahman, 'Statistics & Data Analysis for Engineers and Scientists', Springer, 2024, ISBN:9789819946600. 2. Jiju Antony, 'Design of Experiments for Engineers & Scientists', Elsevier, 2023, ISBN 978-044-315-1736 3. Douglas Montgomery, 'Design and Analysis of Experiments', Wiley India, Eighth Edition, 2013, 9788126540501 4. J. Ravichandran, Probability and Statistics for Engineers, Wiley India, 2010, ISBN: 9788126523504	

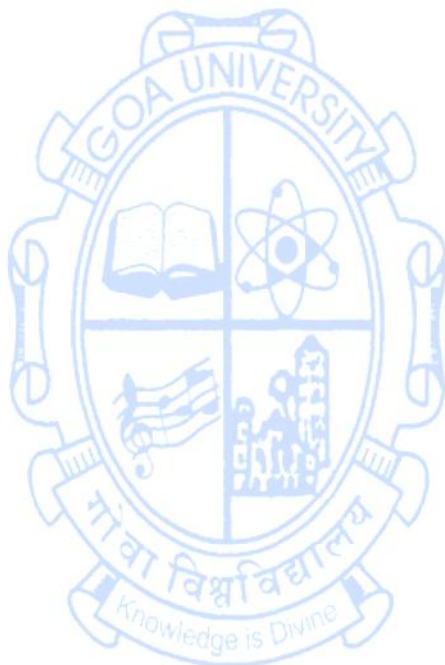
	5. R. Johnson, Probability and Statistics for engineers, Eighth Edition, Prentice Hall of India, New Delhi, 2015, ISBN 978-1-292-17601-7 6. J. Schmuller, Statistical Analysis with Excel for Dummies, 5th Edition, John Wiley & Sons, 2022.
Course Outcomes:	After taking this course, student will be able to: CO 1. Understand the importance of statistical methods for research CO 2. Select the appropriate factorial design method for a given set of experimental plans. CO 3. Apply basic probability theorems and draw relevant inferences. CO 4. Analyze suitable probability model for given set of data



Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : REC-566
Title of the Course : Statistical Techniques Lab
Number of Credits : 2
Effective from AY : 2024-25

Pre-requisites for the Course:	Basic knowledge of Statistics and Probability	
Course Objectives:	The course will enable the students to 1. Apply basic probability theorems and draw relevant inferences. 2. Analyze suitable probability model for given set of data 3. Demonstrate factorial design methods 4. Synthesize fractional and full factorial experimental design data	
Content:		No of Hours
	Using open-source software like libreoffice or any proprietary software perform following experiments: 1. Obtain probability values involving discrete probability distributions - Bernoulli, Binomial. 2. Obtain probability values involving continuous probability distributions - Exponential and Normal distributions. 3. Obtain values of Normal, t-distribution, Chi-square and F-statistic. 4. Obtain values of Mean, Variance and distribution function of Bernoulli and Binomial distribution. 5. Obtain values of Mean, Variance and distribution function of Exponential and Normal distributions. 6. Obtain values of central tendency of grouped and ungrouped data. 7. Obtain values of dispersion of grouped and ungrouped data. 8. Analyse experimental output using full factorial design. 9. Analyse experimental output using fractional factorial design. 10. Analyse a full case study in involving full factorial design or fractional factorial design.	60
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	1. Tahvir Mustafy, Tauhid U Rahman, 'Statistics & Data Analysis for Engineers and Scientists', Springer, 2024, ISBN:9789819946600. 2. Jiju Antony, 'Design of Experiments for Engineers & Scientists', Elsevier, 2023, ISBN 978-044-315-1736 3. Douglas Montgomery, 'Design and Analysis of Experiments', Wiley India, Eighth Edition, 2013, 9788126540501 4. J. Ravichandran, Probability and Statistics for Engineers, Wiley India, 2010, ISBN: 9788126523504 5. R. Johnson, Probability and Statistics for engineers, Eighth Edition, Prentice Hall of India, New Delhi, 2015, ISBN 978-1-292-17601-7 6. J. Schmuller, Statistical Analysis with Excel for Dummies, 5 th Edition,	

	John Wiley & Sons, 2022.
Course Outcomes:	After taking this course, student will be able to: CO 1. Apply basic probability theorems and draw relevant inferences. CO 2. Analyze suitable probability model for given set of data CO 3. Demonstrate factorial design methods CO 4. Synthesize fractional and full factorial experimental design data



Semester III

Programme Specific Core (PSC) Courses

Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : COS-600
Title of the Course : Advanced Design of Steel Structures
Number of Credits : 03
Effective from AY : 2024-25

Pre-requisites for the course:	Knowledge of Structural Analysis, Design of steel Structures	
Course Objectives:	The course will enable the students to: 1. Understand the fundamental properties of structural steel, types of connections, and relevant IS specifications for design and analysis. 2. Apply appropriate design principles and codal provisions to the structural design of industrial buildings, multi-storeyed buildings, tanks, and towers under various loading conditions including wind and seismic actions. 3. Analyze different structural systems and connection types to determine their behavior, stability, and efficiency. 4. Evaluate and Create optimal and economical structural steel solutions by integrating advanced analysis techniques, design philosophies and performance-based criteria for serviceability and safety.	
Content:		No. of Hours
UNIT 1	Introduction: Properties of Structural Steel, Corrosion, Fire Protection, Indian Standard Specifications and Sections, Design Requirements & Design Process, Analysis Procedures & Design Philosophy, Introduction to Limit State Design, Other Design Requirements. Design of flexible, semi-rigid and rigid beam connections: Framed connections, seated connections, small moment connections, large moment connections, End-plate Connections.	10
UNIT 2	Industrial Buildings: Structural Configurations, Functional and Serviceability Requirements, Industrial Floors, Roof Systems, Plastic Analysis and Design of Portal Frames, Crane Gantry Girders, Design for Wind Actions, Design for Earthquake Actions	10
UNIT 3	Multi-Storeyed Buildings: Structural Configurations, Steel-Concrete Composite Floor Systems, Loading, Analysis for Gravity Loads, Lateral Load Resisting Systems, Analysis for	12

	Lateral Loads, Dual Systems, Advanced Structural Forms.	
UNIT 4	Tanks: Introduction- Types of Tanks, Load and Load Combination, Design Aspects of cylindrical Tanks, Design Aspects of Rectangular Tanks Wind effects, Staging Design. Towers: Classification of Types of Towers, Loads and Load Combinations, Wind Effects on Towers, Methods of Analysis. Design Approaches. Economy and Optimisation.	13
Pedagogy:	Interactive learning, reflective thinking, critical analysis, and problem-solving	
References/ Readings:	<u>Text Books</u> 1. Gambhir, M. L., "Design of Steel Structures", Tata McGraw-Hill Education, New Delhi, 2013, ISBN: 9780070144520. 2. Subramanian, N., "Design of Steel Structures", Oxford University Press, New Delhi, 2008, ISBN: 9780195676815. <u>Reference Books</u> 3. Beedle, Lynn S., "Plastic Design of Steel Frames", John Wiley & Sons, New York, 1990, ISBN: 9780471509901. 4. Narayanan, R., et al., "Teaching Resource on Structural Steel Design", INSDAG, Ministry of Steel Publishing, Kolkata, 2000. 5. Yu, Wei-Wen, "Design of Cold-Formed Steel Structures", McGraw-Hill Book Company, New York, 1996, ISBN: 9780070711173.	
Course Outcomes	After going through this course, students will be able to - CO1. Understand the fundamental properties of structural steel, corrosion mechanisms, fire protection strategies, and relevant Indian Standard specifications - CO2. Design different types of steel connections and structural components as per codal provisions - CO3. Analyze and design industrial and multi-storeyed steel buildings under gravity, wind, and seismic loads using appropriate structural systems and design methodologies. - CO4. Evaluate and create optimized structural designs for tanks and towers, considering functional requirements, load combinations, and economic factors.	

Name of the Programme : Master of Engineering (Structural Engineering)
Course Code : COS-601
Title of the Course : Advanced Design of Steel Structures Lab
Number of Credits : 01
Effective from AY : 2024-25

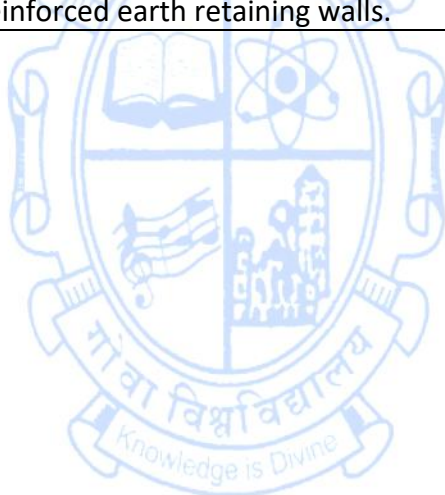
Pre-requisites for the course:	Knowledge of Structural Analysis, Finite Element Analysis and Basic Programming	
Course Objectives:	The course will enable the students to: 1. Provide hands-on experience in modeling and designing steel structures and connections using Indian Standards and modern engineering software 2. Analyze and design steel structures under various loading conditions including wind, gravity, and seismic actions. 3. Interpret connection behavior and stiffness characteristics from detailing exercises 4. Prepare professional quality design and detailing drawings for steel structures.	
Content:		No. of Hours
	List of Experiments 1. Modelling IS Steel Sections & Code-Based Design Checks 2. Modelling and Design of Angle Cleat & End Plate Connections 3. Plastic Analysis of Single-Span Portal Frame 4. Wind Load Analysis on Industrial Steel Structure 5. Modelling of Multi-storeyed Steel Structure with Gravity Loads 6. Composite Steel-Concrete Floor System Design 7. Lateral Load Analysis – Bracing vs. Shear Wall vs. Moment Frame 8. P-Delta and Stability Check for Tall Steel Structures 9. Load Application and Design of Cylindrical Steel Tank 10. Rectangular Tank with Wind Load and Staging Design 11. Analysis and Design of Transmission/Communication Tower (Any Industry standard software can be used for analysis)	30
Pedagogy:	Instructional learning, Inquiry based learning, Constructive learning, Collaborative learning and problem solving.	
References/ Readings:	Text Books 1. Gambhir, M. L., “Design of Steel Structures”, Tata McGraw-Hill	

	Education, New Delhi, 2013, ISBN: 9780070144520. 2. Subramanian, N., "Design of Steel Structures", Oxford University Press, New Delhi, 2008, ISBN: 9780195676815. <u>Reference Books</u> 3. Beedle, Lynn S., "Plastic Design of Steel Frames", John Wiley & Sons, New York, 1990, ISBN: 9780471509901. 4. Narayanan, R., et al., "Teaching Resource on Structural Steel Design", INS DAG, Ministry of Steel Publishing, Kolkata, 2000. 5. Yu, Wei-Wen, "Design of Cold-Formed Steel Structures", McGraw-Hill Book Company, New York, 1996, ISBN: 9780070711173.
Course Outcomes 	After going through this course, student will be able to CO1. Model and design standard IS steel sections and connections (angle cleats, end plates) using relevant design codes and software tools. CO2. Perform structural analysis of steel buildings (industrial and multi-storeyed) under gravity and lateral loads including wind and seismic effects. CO3. Evaluate and design complex systems such as composite floors, portal frames (plastic analysis), tanks (cylindrical and rectangular), and towers under real-world load conditions. CO4. Carry out advanced stability checks, including P-Delta analysis, and compare lateral load resisting systems like bracing, shear walls, and moment frames.

Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : COS-602
Title of the Course : Design Of Substructures
Number of Credits : 03
Effective from AY : 2024-25

Pre-requisites for the course:	Knowledge of Soil Mechanics and Structural Analysis and design	
Course Objectives:	The course will enable the students to: 1. Explain the fundamentals of soil investigation, bearing capacity, and the criteria for selecting appropriate shallow and deep foundations. 2. Analyse the load carrying capacity of each type of foundation. 3. Design various types of shallow foundations and deep foundations. 4. Handle special foundation cases such as expansive soils, under-reamed piles, and foundations for towers, chimneys, and reinforced earth walls.	
Content:		No. of Hours
UNIT 1	Shallow Foundations: Soil investigation – Basic requirements of foundation – Types and selection of foundations. Bearing capacity of soil - plate load test – Design of reinforced concrete isolated, strip, combined and strap footings – mat foundation.	10
UNIT 2	Pile Foundation: Introduction – Types of pile foundations – load carrying capacity - pile load test – structural design of straight piles – different shapes of piles cap – structural design of pile cap, Design of end bearing and frictional piles, Combined piled raft foundations	11
UNIT 3	Machine Foundation: Introduction – Types of machine foundation – Basic principles of design of machine foundation – Dynamic properties of soil – vibration analysis of machine foundation – Design of foundation for Reciprocating machines and Impact machines – Reinforcement and construction details – vibration isolation.	12
UNIT 4	Well Foundation: Types of well foundation – Grip length – load carrying capacity – construction of wells – Failures and Remedies – Design of well foundation – Lateral stability. Special Foundations: Foundation on expansive soils – choice of foundation – under-reamed pile foundation. Foundation for concrete Towers, chimneys – Design of anchors- Reinforced earth retaining walls.	12
Pedagogy:	Interactive learning, reflective thinking, critical analysis, and problem-solving	
References/ Readings:	<u>Text Books</u> 1. Saran Swami, Analysis and Design of Substructures: Limit State Design, Oxford & IBH Publishing Co. Pvt. Ltd., 2006, ISBN-13: 978-0415418447	

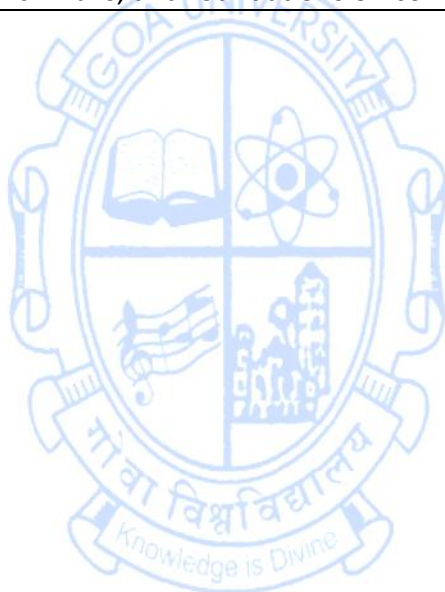
	2. Varghese, P. C., Design of Reinforced Concrete Foundations, PHI Learning Pvt. Ltd., New Delhi, 2009, ISBN-13: 978-8120336155. Reference Books 3. Bowles, Joseph E., Foundation Analysis and Design, McGraw-Hill, New York, 1995, ISBN-13: 978-0079122477 4. Tomlinson, M. J., Foundation Design and Construction, Pearson, 2001, ISBN-13: 978-0130311801
Course Outcomes	After going through this course, student will be able to CO1. Explain the process of soil investigation, interpret plate load test results, and determine bearing capacity for selecting suitable foundation types. CO2. Design shallow foundations such as isolated, strip, strap, combined footings, and mat foundations for different loading and soil conditions CO3. Analyze and design deep foundations including straight piles, pile caps, end-bearing and friction piles, as well as machine foundations subjected to dynamic loads. CO4. Evaluate and design foundations for special conditions such as expansive soils, under-reamed piles, well foundations, and reinforced earth retaining walls.



Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : COS-603
Title of the Course : Design Of Substructures Lab
Number of Credits :
Effective from AY : 2024-25

Pre-requisites for the course:	Knowledge of Soil Mechanics and Structural Analysis and design	
Course Objectives:	The course will enable the students to: 1. Understand soil behavior through laboratory tests like direct shear and triaxial tests, and relate the results to foundation design. 2. Estimate soil bearing capacity using IS code methods and use it for the design of shallow and deep foundations. 3. Design and detail various types of foundations (isolated, combined, pile, raft, well, machine) using spreadsheets and standard design software. 4. Model, analyze, and design special foundations including pile caps, reinforced earth walls, and foundations on complex soil conditions.	
Content:		No. of Hours
	List of Experiments 1. Determination of Cohesion and friction by Direct shear/ Triaxial test 2. Estimation of SBC by IS code method to design shallow foundation 3. Design and Detailing of Isolated footing by spread sheets/ industry standard software 4. Design and detailing of combined footing by spread sheets/ industry standard software 5. Design and detailing of Pile foundation using spread sheets/ industry standard software 6. Design and detailing of well foundation using spread sheets/ industry standard software 7. Design and Detailing of machine foundation using spread sheets/ industry standard software 8. Design and Detailing of any two Special foundation using spread sheets/ industry standard software 9. Modelling and Analysis of Raft Foundation 10. Structural Design of Pile Cap with Group Piles (Any Industry standard software can be used for analysis)	30
Pedagogy:	Instructional learning, Inquiry based learning, Constructive learning, Collaborative learning and problem solving.	
References/ Readings:	Text Books 1. Saran Swami, Analysis and Design of Substructures: Limit State Design, Oxford & IBH Publishing Co. Pvt. Ltd., 2006, ISBN-13: 978-0415418447	

	2. Varghese, P. C., Design of Reinforced Concrete Foundations, PHI Learning Pvt. Ltd., New Delhi, 2009, ISBN-13: 978-8120336155. Reference Books 3. Bowles, Joseph E., Foundation Analysis and Design, McGraw-Hill, New York, 1995, ISBN-13: 978-0079122477 4. Tomlinson, M. J., Foundation Design and Construction, Pearson, 2001, ISBN-13: 978-0130311801
Course Outcomes	After going through this course, student will be able to CO1. Understand practical soil behavior through laboratory tests like direct shear and triaxial tests, and relate the results to foundation design. CO2. Estimate soil bearing capacity using IS code methods and use it for the design of shallow and deep foundations CO3. Design and detail reinforced concrete shallow foundations, pile foundations, well foundations, and machine foundations CO4. Evaluate special foundations including pile caps, reinforced earth walls, and foundations on complex soil conditions.

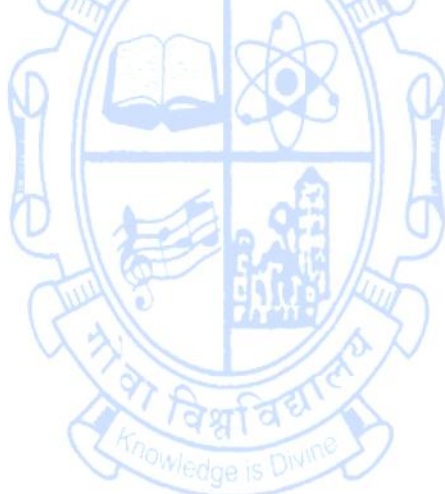


Programme Specific Elective (PSE) Courses

Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : COS-631
Title of the Course : Design of High-Rise Structures
Number of Credits : 03
Effective from AY : 2024-25

Pre-requisites for the course:	Knowledge of Structural Analysis, Structural design	
Course Objectives:	The course will enable the students to: 1. Understand design philosophy of tall structures. 2. Identify different systems and various loads in tall structures 3. Analyse the behaviour of various structural systems for high rise buildings. 4. Design the tall structures and understand the concept of stability for high rise buildings	
Content:		No. of Hours
UNIT 1	Design criteria: Design philosophy, loading, sequential loading and material, high performance concrete, fibre reinforced concrete, light weight concrete, design mixes, loading and movement- gravity loading- dead load & live load, methods of live load reduction, impact, gravity loading, construction loads. Behaviour of various structural systems: Factors affecting height and structural form, high rise behaviour, rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, outrigger- braced and hybrid mega system.	12
UNIT 2	Wind loading: Static and dynamic approach, analytical and wind tunnel experimentation method. Earthquake loading- Equivalent lateral force, modal analysis, combination of loading and design.	11
UNIT 3	Analysis and design: Modelling for approximate analysis, accurate analysis and reduction techniques, analysis of building as total structural system considering overall integrity and major subsystem interaction, analysis of member forces, drift and twist, computerized general three-dimensional analysis.	12
UNIT 4	Stability of tall buildings: Overall buckling analysis of frames, second order effects of gravity loading, P-Delta analysis, simultaneous first order and P-Delta analysis, translational, torsional instability, effect of foundation rotation, structural elements- sectional shapes, properties and resisting capacities, design, deflection, cracking, pre stressing, shear flow, creep, shrinkage, temperature effects and fire.	10
Pedagogy:	Interactive learning, reflective thinking, critical analysis, and problem-solving	

References/ Readings:	<u>Text Books</u> 1. Taranath, Bungale S., "Structural Analysis and Design of Tall Buildings", McGraw-Hill, New York, 1988, ISBN: 978-0070628786. 2. Schueller, Wolfgang, "High-Rise Building Structures", Wiley, New York, 1977, ISBN: 978-0471015307. 3. Smith, Bryan S. and Coull, Alex, "Tall Building Structures: Analysis and Design", Wiley, New York, 1991, ISBN: 978-0471512370. <u>Reference Books</u> 4. Beedle, Lynn S. (Ed.), "Advances in Tall Buildings", Van Nostrand Reinhold, New York, 1986, ISBN: 978-0442215996 / 978-1420012354. 5. Lin, T.Y. and Stotes, B.D., "Structural Concepts and Systems for Architects and Engineers", Wiley, New York, 1988p
Course Outcomes	After going through this course, student will be able to - CO1. Understand design philosophy of tall structures - CO2. Identify different systems and various loads in tall structures - CO3. Analyse the behaviour of various structural systems for high rise buildings - CO4. Design the tall structures and understand the concept of stability for high rise buildings



Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : COS-632
Title of the Course : Design of High-Rise Structures Lab
Number of Credits : 01
Effective from AY : 2024-25

Pre-requisites for the course:	Knowledge of Structural Analysis, Structural design	
Course Objectives:	The course will enable the students to: 1. Model high-rise structures with appropriate load combinations and structural systems using Industry standard software. 2. Simulate wind and earthquake loads as per relevant IS codes and interpret the building response. 3. Analyse the building for various loads and loads combinations 4. Evaluate the structural stability of tall buildings under combined loads, including second-order effects	
Contents:		No. of Hours
	List of Experiments: 1. Modeling and Analysis of a Multi-Storey Frame ○ Gravity loading ○ Floor load distribution 2. Wind Load Analysis on Tall Buildings ○ Manual wind load calculation (as per IS 875 Part 3) ○ Application in software 3. Seismic Analysis Using Response Spectrum Method ○ As per IS 1893:2016 ○ Base shear, modal participation 4. P-Delta Effect and Stability Check in Software ○ Modeling for second-order effects 5. Design of Core Wall and Shear Wall Systems ○ Detailing and reinforcement layout 6. Outrigger and Belt Truss System Modelling ○ Effect on drift control 7. Behavior of rigid frames versus braced frames under various loading conditions 8. Foundation Modeling for High Rise Structures ○ Raft / Pile foundation in SAFE or STAAD Foundation 9. Comprehensive Project • End-semester mini-project involving the modeling, analysis, and design of a G+10 or higher structure Report preparation and viva presentation (Any Industry standard software can be used)	30

Pedagogy:	Instructional learning, Inquiry based learning, Constructive learning, Collaborative learning and problem solving.
References/ Readings:	Reference Books 1. Taranath, Bungale S., "Structural Analysis and Design of Tall Buildings", McGraw-Hill, New York, 1988, ISBN: 978-0070628786. 2. Smith, Bryan S. and Coull, Alex, "Tall Building Structures: Analysis and Design", Wiley, New York, 1991, ISBN: 978-0471512370. 3. Beedle, Lynn S. (Ed.), "Advances in Tall Buildings", Van Nostrand Reinhold, New York, 1986, ISBN: 978-0442215996 / 978-1420012354. 4. Lin, T.Y. and Stotes, B.D., "Structural Concepts and Systems for Architects and Engineers", Wiley, New York, 1988, 5. Schueller, Wolfgang, "High-Rise Building Structures", Wiley, New York, 1977, ISBN: 978-0471015307.
Course Outcomes	After going through this course, student will be able to CO1. Model high-rise structures with appropriate load combinations and structural systems using Industry standard software. CO2. Simulate wind and earthquake loads as per relevant IS codes and interpret the building response. CO3. Analyse the building for various loads and loads combinations CO4. Evaluate the structural stability of tall buildings under combined loads, including second-order effects

Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : COS-633
Title of the Course : Design Of Earthquake Resistant Structures
Number of Credits : 03
Effective from AY : 2024-25

Pre-requisites for the course	Knowledge of Structural dynamics, Structural analysis and design	
Course Objectives:	The course will enable the students to: 1. Explain the causes & effects of earthquakes, architectural features on the seismic behaviour of structures. 2. Apply codal provisions in solving problems related to dynamic analysis of structure. 3. Perform dynamic analysis of structure subjected to earthquake load 4. Design earthquake resistant structures for controlling dynamic response.	
Content:		No. of Hours
UNIT 1	Introduction to Engineering seismology: Geological and tectonic features of India, Origin and propagation of seismic waves, characteristics of earthquake and its quantification – Magnitude and Intensity scales, seismic instruments. Earthquake Hazards in India, Earthquake Risk Evaluation and Mitigation. Structural behaviour under gravity and seismic loads, Lateral load resisting structural systems, Requirements of efficient earthquake resistant structural system. Ground motion parameters – Amplitude, frequency content and duration Review of Single Degree of Freedom (SDOF) Systems: Free (undamped and damped) vibration of SDOF systems, Natural frequency and period of vibration, Types of damping: viscous and Coulomb damping, Effects of damping on frequency and amplitude, Logarithmic decrement, Forced vibration and dynamic load factors	10
UNIT 2	Response history and strong motion characteristics: Response Spectrum – elastic and inelastic response spectra, tripartite (D-V-A) response spectrum, use of response spectrum in earthquake resistant design. Computation of seismic forces in multi-storied buildings – using procedures (Equivalent lateral force and dynamic analysis) as per IS- 1893	10
UNIT 3	Structural Configuration for earthquake resistant design: Concept of plan irregularities and vertical irregularities, soft storey, Torsion in buildings. Design provisions for these in IS-1893. Effect of infill masonry walls on frames, modelling concepts of infill masonry walls. Behaviour of masonry buildings during earthquakes, failure patterns, strength of masonry in shear and flexure, Slenderness concept of masonry walls, concepts for earthquake resistant	12

	masonry buildings – codal provisions.	
UNIT 4	Design of Reinforced concrete buildings for earthquake resistance: Load combinations, Ductility and energy absorption in buildings. Confinement of concrete for ductility, design of columns and beams for ductility, ductile detailing provisions as per IS1893. Structural behaviour, design and ductile detailing of shear walls. Performance Based Seismic Design: Introduction and methodology	13
Pedagogy:	Interactive learning, reflective thinking, critical analysis, and problem-solving	
References/ Readings:	Text Books 1. Agarwal, Pankaj, & Shrikande, Manish, Earthquake Resistant Design of Structures, PHI Learning Pvt. Ltd., New Delhi, 2006, ISBN-13: 978-8120328921. 2. Chopra, Anil K., Dynamics of Structures – Theory and Application to Earthquake Engineering, 2nd ed., Prentice Hall, New Jersey, 2000, ISBN-13: 978-0138552145. 3. Duggal, S. K., Earthquake Resistant Design of Structures, Oxford University Press, New Delhi, 2013, ISBN-13: 978-0198083528. Reference Books 4. Hosur, Vinod, Earthquake Resistant Design of Building Structures, Wiley India Pvt. Ltd., New Delhi, 2012, ISBN-13: 978-8126531905. 5. Paulay, T., & Priestley, M. J. N., Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons, New York, 1992, ISBN-13: 978-0471549154. 6. Wakabayashi, Minoru, Design of Earthquake Resistant Buildings, McGraw-Hill Book Company, Tokyo, 1986, ISBN-13: 978-0074517680. 7. Bureau of Indian Standards, IS 1893 (Part 1): 2016, IS 13920: 2016, IS 4326: 2013, IS 13828: 1993 – Indian Standard Codes for Earthquake Resistant Design, BIS, New Delhi	
Course Outcomes	After going through this course, student will be able to CO1. Explain the causes & effects of earthquakes, architectural features on the seismic behaviour of structures. CO2. Apply codal provisions in solving problems related to dynamic analysis of structure. CO3. Perform dynamic analysis of structure subjected to earthquake load CO4. Design earthquake resistant structures for controlling dynamic response.	

Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : COS-634
Title of the Course : Design Of Earthquake Resistant Structures Lab
Number of Credits : 01
Effective from AY : 2024-25

Pre-requisites for the course:	Knowledge of Structural dynamics, Structural analysis and design	
Course Objectives:	The course will enable the students to: 1. Model and analyse multi-storeyed buildings for seismic actions using Industry standard software as per IS 1893. 2. Apply equivalent static and dynamic analysis techniques including response spectrum and time history methods. 3. Assess and interpret the effects of structural irregularities, soft storey, and infill walls on seismic performance. 4. Design key structural elements for earthquake resistance and carry out ductile detailing in line with IS 13920.	
Contents:		No. of Hours
	List of Experiments 1. Determination of Lateral loads on a multi-storeyed building due to earthquake using Equivalent Static load method 2. Determination of Lateral loads on a multi storeyed building due to earthquake using Response Spectrum method 3. Time History Analysis Using Real Earthquake Ground Motion Data 4. Modal Analysis and Mode Shape Interpretation for a multi-Storeyed building 5. Modelling and Analysis of Braced Frame System for Seismic Resistance 6. Seismic Design and Ductile Detailing of Beams as per IS 13920 7. Seismic Design and Ductile Detailing of Columns as per IS 13920 8. Modelling and Design of RC Shear Wall System 9. Performance Based Analysis of Multi -Storeyed Building 10. Comparative analysis of seismic performance of Structure with and without Base Isolators. 11. Comparative analysis of seismic performance of Structure with and without dampers. 12. Comparative Analysis of structure with and without masonry infill. 13. Modelling and Analysis of Irregular Structure (Vertical and Plan Irregularities Combined) (Any Industry standard software can be used for analysis and design, Software such as MS Excel, MATLAB, TKSolver or	30

	equivalent can be used to develop Worksheets)	
Pedagogy:	Instructional learning, Inquiry based learning, Constructive learning, Collaborative learning and problem solving.	
References/ Readings:	<u>Text Books</u> 1. Agarwal, Pankaj, & Shrikande, Manish, Earthquake Resistant Design of Structures, PHI Learning Pvt. Ltd., New Delhi, 2006, ISBN-13: 978-8120328921. 2. Chopra, Anil K., Dynamics of Structures – Theory and Application to Earthquake Engineering, 2nd ed., Prentice Hall, New Jersey, 2000, ISBN-13: 978-0138552145. 3. Duggal, S. K., Earthquake Resistant Design of Structures, Oxford University Press, New Delhi, 2013, ISBN-13: 978-0198083528. <u>Reference Books</u> 4. Hosur, Vinod, Earthquake Resistant Design of Building Structures, Wiley India Pvt. Ltd., New Delhi, 2012, ISBN-13: 978-8126531905. 5. Paulay, T., & Priestley, M. J. N., Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons, New York, 1992, ISBN-13: 978-0471549154. 6. Wakabayashi, Minoru, Design of Earthquake Resistant Buildings, McGraw-Hill Book Company, Tokyo, 1986, ISBN-13: 978-0074517680. 7. Bureau of Indian Standards, IS 1893 (Part 1): 2016, IS 13920: 2016, IS 4326: 2013, IS 13828: 1993 – Indian Standard Codes for Earthquake Resistant Design, BIS, New Delhi	
Course Outcomes	After going through this course, student will be able to - CO1. Model and analyse multi-storeyed buildings for seismic actions using Industry standard software as per IS 1893. - CO2. Apply equivalent static and dynamic analysis techniques including response spectrum and time history methods. - CO3. Assess and interpret the effects of structural irregularities, soft storey, and infill walls on seismic performance. - CO4. Design key structural elements for earthquake resistance and carry out ductile detailing in line with IS 13920.	



Research Specific Elective (RSE) Courses

Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : STE-661
Title of the Course : Experimental Methods in Structural Engineering
Number of Credits : 02
Effective from AY : 2024-25

Pre-requisites for the Course:	Knowledge of Structural Analysis, Design of Concrete Structures, Design of Steel Structures	
Course Objectives:	The course will enable the students to: 5. Understand the role of experimental methods in the analysis and verification of structural behavior. 6. Familiarize students with modern tools and techniques used for measuring strain, stress, and displacements in structural elements. 7. Explore photoelasticity as a visual method for stress analysis and its application in structural components. 8. Introduce various non-destructive testing (NDT) methods for evaluating the condition and integrity of concrete structures..	
Content:		No. of hours
Unit - 1	Introduction to General Experimentation: Role and limitations of experiments in structural engineering, Properties of engineering materials and typical failure modes, Failure due to excessive stresses, buckling, fatigue, creep, and impact, Use of standard testing machines for various structural material tests.	07
Unit - 2	Force and Strain Measurement: Measurement of strain using different types of strain gauges, Electrical resistance strain gauges and cross-sensitivity factor, Use of gauge indicators and dynamic strain measurement techniques, Galvanometers and oscilloscopes, Basic model analysis concepts and model materials, Dimensional analysis and scaling laws, Application of forces and measurement of displacement, Calculation of displacements in prototypes.	08
Unit - 3	Photo Elasticity: Fundamentals of photoelasticity and stress-optic laws, Concepts of isoclinics and isochromatics, Determination of material fringe value, Application to stress analysis in beams, rings, and discs.	07
Unit - 4	Non-Destructive Methods of Testing of Concrete: Introduction to NDT techniques: Ultrasonic Testing, Schmidt Hammer, and Magnetometer, Evaluation of concrete strength and quality using NDT methods, Detection of corrosion and carbonation in reinforced concrete members, Concept of structural condition surveys, Load testing of structures and associated code provisions, Review of other advanced NDT methods for concrete assessment.	08
Pedagogy:	Interactive learning, reflective thinking, critical analysis, and problem-	

	solving
References/ Readings:	<u>Text Books</u> 1. Srinath, L. S., Raghavan, M., Ingaiah, K., Gargasha, G., Pant, B., & Ramachandra, "Experimental Stress Analysis", Tata McGraw-Hill Publishing Co., New Delhi, 1984. 2. Dally, J. W. & Riley, W. F., "Experimental Stress Analysis", McGraw-Hill Book Co., New York, 1977. ISBN-10: 0070152047, ISBN-13: 978-0070152045. <u>Reference Books</u> 3. Frocht, M. M., "Photoelasticity", John Wiley & Sons, New York, 1941. 4. Singh, Sadhu, "Experimental Stress Analysis", Khanna Publishers, New Delhi, 4th edition, 2014, ISBN-13: 9788174091826.
Course Outcomes:	After going through this course, student will be able to: CO1. Describe and explain the significance of experimental methods in structural analysis CO2. Apply strain measurement techniques using strain gauges and interpret results. CO3. Analyze stress distribution using the principles of photoelasticity CO4. Evaluate the strength and integrity of concrete structures using NDT techniques.

Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : STE-662
Title of the Course : Experimental Methods in Structural Engineering Lab
Number of Credits : 02
Effective from AY : 2024-25

Pre-requisites for the Course:	Knowledge of Physics and strength of materials	
Course Objectives:	The course will enable the students to: 1. Introduce students to experimental methods and instrumentation used in structural engineering. 2. Explain the behavior of structural materials under different loading and failure conditions. 3. Develop skills in measuring strain, stress, displacement, and evaluating results. 4. Enable students to assess structural conditions using non-destructive testing techniques.	
Content:		No. of hours
	List of Experiments (Use software such as MScExcel, MATLAB, TK Solver or equivalent software wherever applicable) 1. Tensile Test on Mild Steel Using UTM 2. Compression Test on Concrete Cube 3. Strain Measurement Using Electrical Resistance Strain Gauges 4. Deflection Measurement of a Simply Supported Beam 5. Model Analysis Using Scaling Laws 6. Ultrasonic Pulse Velocity Test on Concrete 7. Rebound Hammer Test (Schmidt Hammer) 8. Cover Meter Test and Detection of Corrosion in RC Members 9. Flexural Test on Concrete Beam 10. Measurement of Deflection in Simply Supported Beams Using LVDTs/Dial Gauges. 11. Measurement of Bending Stress in Beams 12. Thermal imaging of damaged concrete surface 13. Determination of natural frequency and damping by using accelerometer. 14. Torsion Test with Strain Measurement 15. System Identification of three-storeyed building by using vibration signatures. 16. System Identification of three-storeyed building by using vibration signatures. 17. Use photo-elastic materials to visualize stress patterns 18. Study stress using plane polariscope.	60
Pedagogy:	Instructional learning, Inquiry based learning, Constructive learning, Collaborative learning and problem solving.	

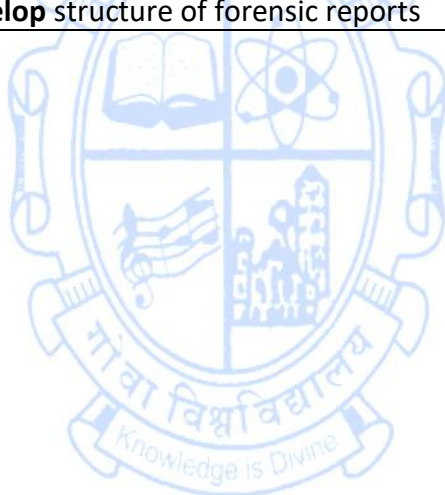
References/ Readings:	<u>Text Books</u> 1. Singh, Sadhu, "Experimental Stress Analysis", Khanna Publishers, New Delhi, 4th edition, 2014, ISBN-13: 9788174091826. 2. Dally, J.W. & Riley, W.F., "Experimental Stress Analysis", McGraw-Hill, New York, 1977, ISBN-10: 0070152047, ISBN-13: 978-0070152045. <u>Reference Books</u> 3. Ross, F.M., "Non-Destructive Testing of Materials", Pitman Publishing, London, 1989, ISBN-13: 978-0273018982. 4. Bureau of Indian Standards, "IS 13311 (Part 1): Non-Destructive Testing of Concrete – Ultrasonic Pulse Velocity", New Delhi, 1992. 5. Bureau of Indian Standards, "IS 13311 (Part 2): Non-Destructive Testing of Concrete – Rebound Hammer", New Delhi, 1992. 6. Bureau of Indian Standards, "IS 516 (Part 1): Methods of Tests for Strength of Concrete", New Delhi, 1959 (Reaffirmed 2018). 7. ASTM International, "ASTM C805/C805M-13a: Standard Test Method for Rebound Number of Hardened Concrete", West Conshohocken, PA, 2013. 8. Gambhir, M.L., "Concrete Technology: Theory and Practice", McGraw-Hill Education, New Delhi, 5th edition, 2017. ISBN-13: 9781259062551.
Course Outcomes:	After going through this course, student will be able to: - CO1. Identify appropriate experimental methods and instruments for structural testing. - CO2. Apply principles of strain and force measurement using standard sensors and techniques - CO3. Analyze experimental data to evaluate structural behavior and validate models. - CO4. Evaluate the condition of concrete structures using standard NDT methods

Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : COS-663
Title of the Course : Forensic Structural Engineering
Number of Credits : 02
Effective from AY : 2024-25

Pre-requisites for the course:	Knowledge of Structural Analysis, Design of Concrete Structures
Course Objectives:	The course will enable the students to: 1. Understand principles of failure analysis and damage evaluation in civil structures. 2. Analyse common causes and modes of failure in structural systems and materials. 3. Apply forensic techniques including NDT, structural modeling, and condition assessment. 4. Develop professional forensic reports and communicate findings effectively in legal or engineering contexts.

Content:		No. of Hours
UNIT 1	Introduction to Forensic Structural Engineering: Definition, scope, and importance, Role of the forensic engineer, Historical structural failures and lessons learned, Ethics and legal responsibilities Design and Construction practices: Review of Design-Construction process, Design Standards Engineering Response to failures and Investigation process: The first steps after failure, Safety, Preservation of perishable evidence, Reserving samples and Documentation of evidence.	08
UNIT 2	Causes of failures: Loads and Hazards with reference to gravity, wind, earthquake, Flood, blast, fire loads. Modes of failure of various types of structural elements and structures. Design errors, Construction defects in steel, Concrete and Masonry structures, Execution errors due to Project Miscommunication. Defects, deterioration and durability in Concrete steel and masonry structures.	07
UNIT 3	Forensic Analysis: Forensic Analysis of Concrete, steel, Masonry structures. Forensic analysis of Building Facades and Foundations. Forensic Analysis of Temporary structures.	08
UNIT 4	Professional Reporting and Legal Aspects: Writing a forensic report: format, photos, sketches, Expert witness testimony and dispute resolution, Role of structural engineer in litigation, Insurance, liability, and professional conduct Case Studies and Failure Documentation: Case-based learning: collapsed structures, cracked bridges, failed retaining walls, Field documentation methods: sketches, photos, logs, Root cause identification and discussion, Learning from historic and recent disasters	07
Pedagogy:	Interactive learning, reflective thinking, critical analysis, and problem-solving	
References/ Readings:	Reference Books 1. American Concrete Institute, "ACI PRC-364.4-21: Determining the Load Capacity of a Structure when Structural Drawings are Unavailable – TechNote", American Concrete Institute, Farmington Hills, MI, 2021. ISBN: 9781641951285. 2. Chakrabarti, A. et al., "Handbook on Seismic Retrofit of Buildings", Narosa Publishing House, New Delhi, 2008. ISBN: 9788173198616 3. Emmons, Peter H., "Concrete Repair and Maintenance Illustrated: Problem Analysis, Repair Strategy, Techniques", Galgotia Publications Pvt. Ltd., New Delhi, 2002. ISBN: 9780070191448. 4. Feld, Jacob and Carper, Kenneth L., "Construction Failures", 2nd ed., Wiley Europe, Chichester, 1997. ISBN: 9780471122134	

	5. Kaminetzky, Dov, "Design and Construction Failures: Lessons from Forensic Investigations", Galgotia Publications, New Delhi, 2001. ISBN: 9780070349290. 6. Kardon, Joshua B., "Guidelines for Forensic Engineering Practice", American Society of Civil Engineers (ASCE), Reston, VA, 2003. ISBN: 9780784407022. 7. Raikar, R. N., "Diagnosis and Treatment of Structures in Distress", R&D Centre of Structural Designers & Consultants Pvt. Ltd., Mumbai, 1994.. 8. Ratay, R. T. (Ed.), "Forensic Structural Engineering Handbook", 2nd ed., McGraw-Hill Education, New York, 2010. ISBN: 9780071633435. 9. Woodson, R. Dodge, "Concrete Structures: Protection, Repair and Rehabilitation", Elsevier, Burlington, MA, 2009. ISBN: 9781856175494.
Course Outcomes	After going through this course, students will be able to CO 1. Explain the principles and professional role of forensic structural engineers in failure investigations CO 2. Diagnose structural failures based on material behavior, loading conditions, and construction practices CO 3. Conduct forensic investigations including evidence collection, damage assessment, and documentation CO 4. Develop structure of forensic reports



Name of the Programme : Master Of Engineering (Structural Engineering)
Course Code : COS-664
Title of the Course : Forensic Structural Engineering Lab
Number of Credits : 02
Effective from AY : 2024-25

Pre-requisites for the course:	Knowledge of Structural Analysis, Design of Concrete Structures	
Course Objectives:	The course will enable the students to: 1. To familiarize students with forensic investigation techniques for assessing structural health and detecting damage. 2. To train students in the use of non-destructive testing (NDT) tools and visual inspection methods. 3. To develop analytical skills in interpreting field data and test results for diagnosis of structural failures. 4. To encourage critical thinking through the study of real-life case histories of structural failures.	
Content:		No. of Hours
	List of Experiments: 1. Visual Inspection Techniques: Preparation of inspection checklist, Mapping of cracks and structural distress 2. Perform Rebound Hammer Test, Ultrasonic Pulse Velocity (UPV) Test on an existing structure under distress and present a detailed report. 3. Detection of reinforcement corrosion using Half-cell potential meter or simulation software. 4. Mini-Project / Field Investigation: On-site or simulated forensic analysis of an existing structure, Report preparation and presentation. 5. Forensic analysis Case study of Concrete structures 6. Forensic analysis Case study of steel structures 7. Forensic analysis Case study of Masonry structures 8. Forensic analysis Case study of building Facades 9. Forensic analysis Case study of Foundations 10. Forensic analysis Case study of Temporary structures. 11. Forensic analysis Case study of Foundations 12. Forensic analysis Case study of Retaining walls 13. Modelling and simulation of structural failures due to design errors using Finite element software. 14. Analysis of steel joint failures (bolt/shear/weld failure) using software tools. 15. Infrared Thermography (Demonstration/ Simulation): Identification of moisture ingress and delamination.	60
Pedagogy:	Instructional learning, Inquiry based learning, Constructive learning, Collaborative learning and problem solving.	

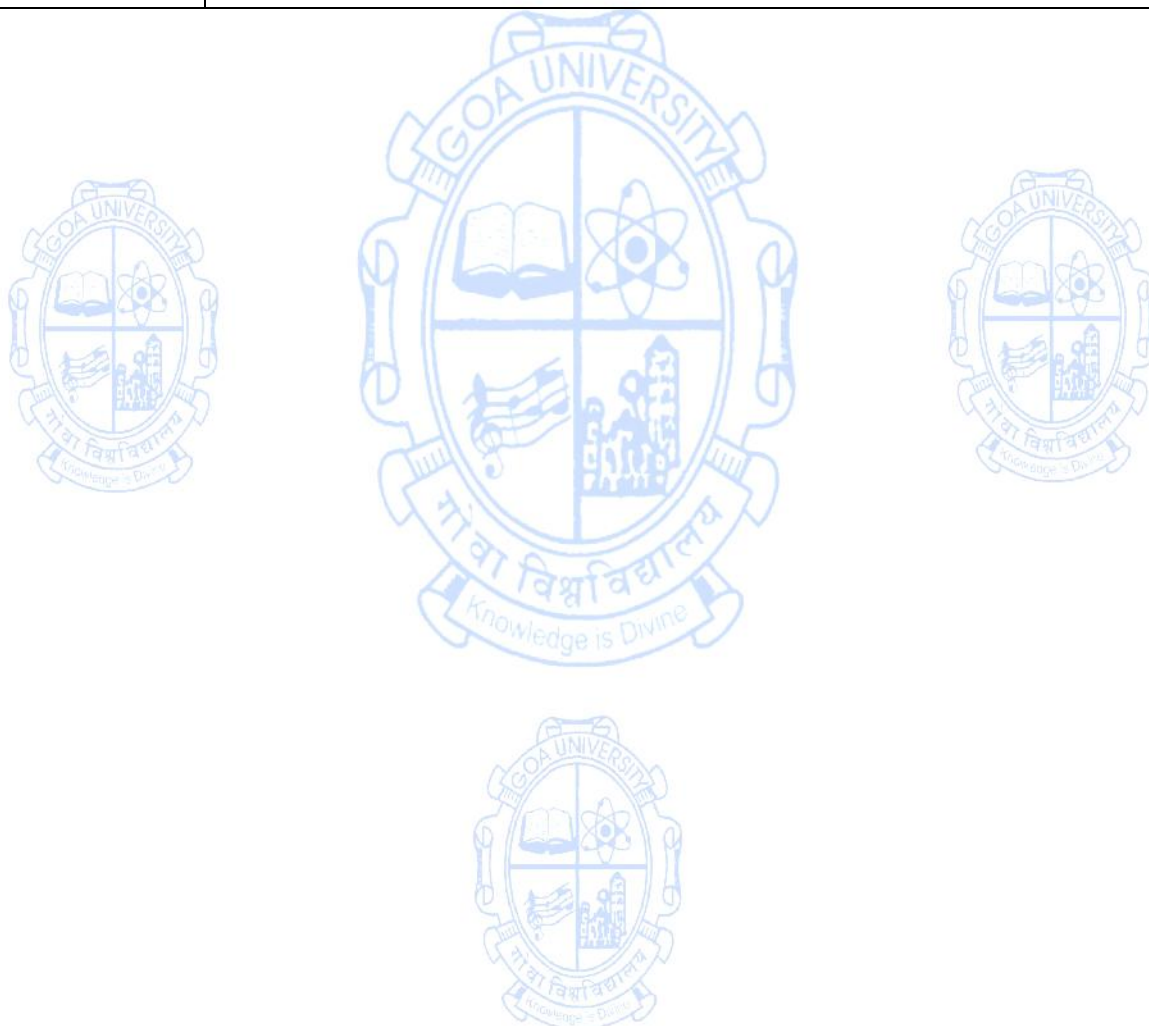
References/ Readings:	6. Ratay, R. T. (Ed.). <i>Forensic Structural Engineering Handbook</i> . McGraw-Hill Education, 2010, 2nd Edition. 7. Bungey, J. H., Millard, S. G., & Grantham, M. G. <i>Testing of Concrete in Structures</i> . CRC Press, 2006, 4 th edition 8. Mindess, S., Young, J. F., & Darwin, D. <i>Concrete</i> . Prentice Hall, 2003, 3 rd edition. 9. IS 13311 (Part 1 & 2) – Non-Destructive Testing of Concrete. 10. ASTM Standards relevant to field testing: (i) ASTM C805 – Rebound Hammer (ii) ASTM C876 – Half-Cell Potential (iii) ASTM C597 – UPV Testing
Course Outcomes	After going through this course, student will be able to CO 1. Identify signs of structural distress, damage, and material deterioration in existing structures. CO 2. Demonstrate proficiency in using non-destructive testing (NDT) methods such as rebound hammer, UPV, and half-cell potential tests. CO 3. Analyze test data and inspection findings to determine the probable cause(s) of structural damage or failure. CO 4. Prepare professional forensic engineering reports and effectively communicate findings and recommendations.

Generic Elective (GE) Courses

Name of the Programme : Master of Engineering (Structural Engineering)
Course Code : GEC-681
Title of the Course : Sustainability - Principles & Practices
Number of Credits : 03
Effective from AY : 2024-25

Pre-requisites for the Course:	Undergraduate level knowledge of any branch of engineering	
Course Objectives:	The course aims to provide the student with an: 1. Understanding of importance of Sustainability Practices 2. Explanation of Assessment, Planning and Implementation of Sustainability Principles 3. Description of the steps involved in implementing sustainable solutions 4. Apply the knowledge of sustainability practices to real life situations.	
Content:		No. of Hours
Unit-1	Overview on Global Sustainability Goals (SDGs): Industry-Innovation-Infrastructure, Health & Well Being, Clean Water & Sanitation, Education, Responsible Consumption and production, Climate Action, Quality Education, Economic growth, sustainable community living,	10
Unit-2	Sustainability: Requirements for Sustainability, Approaches towards Sustainable Engineering, Sustainability Challenges, Environmental Challenges; Reasons for Un-sustainability – Economics and Environment, Corporate View of Sustainability, Social Attitude, Approach, Cultural Narratives, Political Aspects, Ethics and Morals. Steps in life cycle impact assessment	13
Unit-3	Sustainability Assessment: Steps in assessing life cycle, data availability, process network analysis, Input-Output Analysis, Hybrid Models; Carbon footprint, Water footprint, Energy analysis of technologies, processes and its economics; Concept of Exergy and Emergy Analysis; Ecosystem Services in Sustainability Assessment; Case Studies	10
Unit-4	Solutions for Sustainability: Designing sustainable processes and products; Techno-Economic Analysis; Energy Ecosystem and its dynamic characteristics; Circular Economy; Nature based solutions, Green infrastructure, Techno-ecological synergy; Economic Policies, Societal Developments; Case Studies.	12
Pedagogy	Interactive learning, reflective thinking, critical analysis, and problem-	

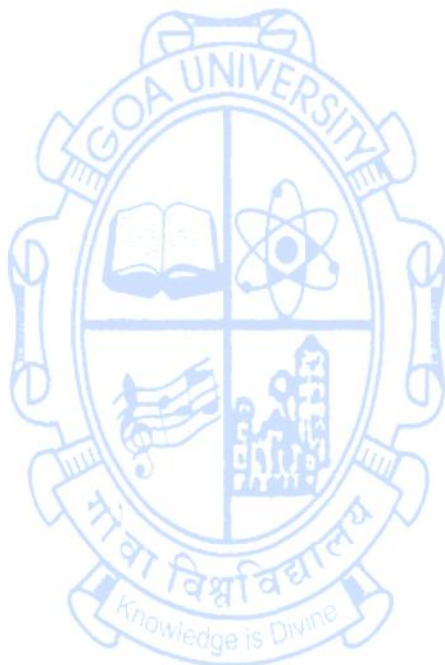
	solving.
References/ Readings:	1. Raj Gaurang Tiwari, 'Sustainability Principles and Applications in Engineering Practices', Nova Science Publishers, 2024, ISBN:9798891136403 2. Bhavik R Bakshi, 'Sustainable Engineering', Cambridge University Press, 2019, ISBN:9781108420457 3. Margaret Robertson, 'Sustainability – Principles & Practices', Routledge Publishers, 2017, ISBN: 97811138650244
Course Outcomes:	After going through this course, student will be able to: CO 1. Understand the importance of sustainability practices CO 2. Assess, Plan and Suggest basic sustainability practices CO 3. Explain the steps involved in implementing sustainable solutions CO 4. Prepare a plan for sustainability practices to real life situations.



Effective from AY : 2024-25

Pre-requisites for the Course:	Undergraduate level knowledge of any branch of engineering	
Course Objectives:	The course aims to provide the student with an: 1. Understanding of importance of Sustainability Development Goals (SDG) 2. Explanation on Assessment, Planning and Implementation of SDG 3. Description of the steps involved in order to achieve the SDG. 4. Apply the knowledge of sustainability practices to real life situations.	
Content:	The United Nations has promulgated Sustainable Development Goals (SDG)s. Every student has to prepare a detail report and presentation, based relevant literature, field visits and data collection, interaction with experts, on ANY TWO topics of SDG as applied to the local region or State of Goa. (1) No Poverty (2) Zero Hunger (3) Good Health & Well Being (4) Quality Education (5) Gender Equality (6) Clean Water & Sanitation (7) Affordable & Clean Energy (8) Decent Work and Economic Growth (9) Industry, Innovation and Infrastructure (10) Reduce Inequalities (11) Sustainable Cities & Communities (12) Responsible Consumption and Production (13) Climate Action (14) Life Below Water (15) Life on Land (16) Peace, Justice & Strong Institutions	No. of Hours 30
Pedagogy	Instructional learning, Inquiry based learning, Constructive learning, Collaborative learning and problem solving	
References/ Readings:	1. Raj Gaurang Tiwari, 'Sustainability Principles and Applications in Engineering Practices', Nova Science Publishers, 2024, ISBN:9798891136403 2. Bhavik R Bakshi, 'Sustainable Engineering', Cambridge University Press, 2019, ISBN:9781108420457	

	3. Margaret Robertson, 'Sustainability – Principles & Practices', Routledge Publishers, 2017, ISBN: 97811138650244
Course Outcomes:	After going through this course, student will be able to: CO 1. Understand the importance of sustainability Development Goals (SDGs) CO 2. Assess, Plan and Suggest basic sustainability practices CO 3. Explain the steps involved in order to achieve the SDG CO 4. Prepare a plan for sustainability practices to real life situations.



Name of the Programme : Master of Engineering (Structural Engineering)
Course Code : GEC-683
Title of the Course : Project Management
Number of Credits : 03
Effective from AY : 2024-25

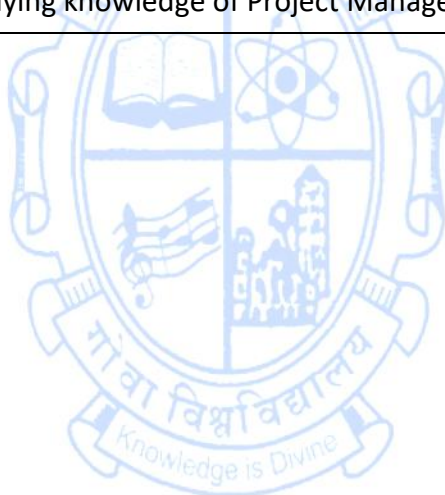
Pre-requisites for the Course:	Undergraduate level knowledge of any branch of engineering	
Course Objectives:	The course aims to provide the student with an: 1. Understanding of the various features of project management 2. Explanation of the relevance of human resource planning and management 3. Describes the importance of procurement planning, cost estimation, and quality management. 4. Detailed explanation on time and risk management.	
Content:		No. of Hours
Unit-1	Overview on Project Management: Need for Project Management, Project Life Cycle and its Phases, Scope of the project, requirements and scope, Organizational Influences, Project Management Plan, Integrated Change Control Plan, Agile Project Management and Lean Project Management, Project selection and portfolio management. Economics & Cost Management: Time Value of Money, Cost-Benefit Ratio, Cost estimation, methods of preparing estimates, budgeting, Cost monitoring and Control, cost on completion.	10
Unit-2	Human Resource Management, Planning Human Recourses, Acquiring human resources, developing and strategizing deployment of resources, leadership qualities, team management – motivation, monitoring and control, conflict management and interpersonal relationship management. Importance of Communication and communication management – tools and techniques; basic human fundamentals, ethics and professional conduct,	12
Unit-3	Procurement Management- Planning, Implementation – Monitoring and control of goods and services; Stakeholders Management, Contracts drafting, preparation, approval, implementation and closure. Quality Management: Introduction, quality planning tools and techniques, quality monitoring and control, tools and techniques,	13
Unit-4	Time Management: Purpose of Time Management, Time Planning, different methods of activity planning, milestones,	10

	resource assignment and time lines. Time monitoring and control - different types of charts; Path Planning – forward, backward, critical, lag and lead time lines. Risk Management – Risk Identification, Risk Qualitative Analysis, Risk Quantitative Analysis, Risk Response, Monitoring and Control	
Pedagogy	Interactive learning, reflective thinking, critical analysis, and problem-solving.	
References/ Readings:	1. J. Michael Bennet, Danny S.K. Ho, 'Project Management for Engineers', World Scientific Publishing, 2014, ISBN: 13-978-981444-7928. 2. J. M. Nicholas, Herman Steyn, 'Project Management for Engineering, Business and Technology, 6th Edn, Taylor & Francis Publications, 2021, ISBN: 978-0-367-277730-7 3. Neil G Siegel, Engineering Project Management, Wiley Publications, 2019, ISBN: 9781119525769. 4. Khanna.R.B., Project Management, PHI Publishing, 2011, ISBN: 978-81-203-4288.	
Course Outcomes:	After going through this course, student will be able to: CO 1. Explain the importance of Project Management CO 2. Describe the various components of Project Management CO 3. Analyze the importance of cost, human resource, procurement, quality, time and risk management CO 4. Apply project management knowledge in their professional life.	

Name of the Programme : Master of Engineering (Structural Engineering)
Course Code : GEC-684
Title of the Course : Project Management Lab
Number of Credits : 01
Effective from AY : 2024-25

Pre-requisites for the Course:	Undergraduate level knowledge of any branch of engineering	
Course Objectives:	The course aims to provide the student with an: 1. Understanding of the various features of project management 2. Explanation of the relevance of applying project management knowledge to any one domain 3. Describes the advantages of applying project management tools & techniques to address specific problems 4. Ability to prepare reports and presentation on specific areas by applying knowledge of Project Management	
Content:		No. of Hours
	Project Management is applicable to all types of Human Activities. Every Student has to choose ANY TWO topics, prepare a detail report and presentation, based relevant literature, field visits and data collection, interaction with experts in the local region or State of Goa. The student shall apply project management knowledge to any ONE topics given below, the list is only indicative, students can choose topics from related / allied areas: (1) Large construction site (on-going projects) – residential, commercial, highways, ports, airports (2) Large Manufacturing Industry in any of the Industrial Areas in Goa, scaling up production, sales / marketing. (3) Waste Management; Water Management; (4) Application of Project Management to Law Enforcement (5) Project Management in Education – infrastructure, skill training (6) Project Management as applied to consumer goods / supplies (7) Manpower Management in the context of AI in software industry (8) Project Management – Global markets for local products using Digital Marketing platforms (9) Project management for Logistics and Transportation (10) Project management for Hospital & Health Management	30
Pedagogy	Instructional learning, Inquiry based learning, Constructive learning,	

	Collaborative learning and problem solving
References/ Readings:	1. J. Michael Bennet, Danny S.K. Ho, 'Project Management for Engineers', World Scientific Publishing, 2014, ISBN: 13-978-981444-7928. 2. J. M. Nicholas, Herman Steyn, 'Project Management for Engineering, Business and Technology, 6th Edn, Taylor & Francis Publications, 2021, ISBN: 978-0-367-277730-7 3. Neil G Siegel, Engineering Project Management, Wiley Publications, 2019, ISBN: 9781119525769. 4. Khanna.R.B., Project Management, PHI Publishing, 2011, ISBN: 978-81-203-4288.
Course Outcomes:	After going through this course, student will be able to: CO 1. Understanding of the various features of project management CO 2. Explanation of the relevance of applying project management knowledge to any one domain CO 3. Describes the advantages of applying project management tools & techniques to address specific problems CO 4. Ability to prepare reports and presentation on specific areas by applying knowledge of Project Management



Semester IV

Generic Elective (GE) Courses

Name of the Programme : Master of Engineering (Structural Engineering)

Course Code : GEC-685

Title of the Course : Financial Management

Number of Credits : 04

Effective from AY : 2024-25

Pre-requisites for the Course:	Basic knowledge of Finance, Economics	
Course Objectives:	The course aims to provide the student with an: 1. Understanding of Financial Systems and Its Management 2. Explanation of Financial Planning, Fund Flow and Cost Analysis 3. Analysis of Capital & Working Capital Management, Valuation, Long Term Financing 4. Description of product cost analysis, break even analysis and investment management.	
Content:		No. of Hours
Unit-1	Financial Management: An Overview – Types of Business organizations, Fundamental principle of finance. The Financial System - Functions, Financial Assets and Markets, Financial Statements, Taxes, and Cash Flow - Balance Sheet, Profit and loss Account, Profits Vs Cash Flow, Taxes; Financial decision making.	15
Unit-2	Financial Statement Analysis - Financial Ratios- Liquidity Ratios, Leverage & Profitability Ratios; Fund Flow Analysis - Fund Flow Statement; Breakeven Analysis and Leverages - Cost Volume Profit Analysis; Financial Planning & Forecasting - Financial Planning, Sales Forecast; Cost Analysis - Determination of product cost, overhead cost, volume and profits, planning and control on costs and decision making using costs.	16
Unit-3	Fundamental Valuation Concepts -The Time Value of Money, Risk and Return. Capital Budgeting -Techniques of Capital Budgeting – Capital Budgeting Process, project classification; cash flows, risk analysis, cost of capital; Investment Criteria - Net Present value, Benefit Cost Ratio, Internal Rate of return, Payback Period, Accounting rate of Return.	15
Unit-4	Working Capital Management -Working Capital Policy, Cash and Liquidity Management, Credit Management, Inventory Management, Working Capital Financing; Corporate Valuation:	14

	Debt analysis and management, Leasing, Hire Purchase, Valuation, Mergers, acquisitions and Restructuring; Long Term Financing: Sources of Long Term Finance, Raising Long Term Finance.	
Pedagogy	Interactive learning, reflective thinking, critical analysis, and problem-solving.	
References/ Readings:	1. Prasanna Chandra "Financial Management: Theory and Practice" 11th Edition, McGraw Hill Education Publishers, 2023, ISBN: 978-9355-322-203 2. Pandey I.M., Finance- A Management Guide for Managing Company Funds and Profits, Prentice Hall India Publications, 1995, ISBN:978-8120-309-180 3. Van Horne, J.C, "Fundamentals of Financial Management", 13th Edition, Pearson Publications, 2015, ISBN:978-933-255-8670. 4. Khan, M.Y. and Jain, P.K., "Financial Management", 8th Edition, McGraw-Hill Education Publishers, 2018, ISBN:978-9353-1622-184	
Course Outcomes:	After going through this course, student will be able to: CO 1. Understand the Financial Systems and Its Management CO 2. Explain Financial Planning, Fund Flow and Cost Analysis CO 3. Analyze Capital & Working Capital Management, Valuation, Long Term Financing CO 4. Describe product cost analysis, break even analysis and investment management.	

Name of the Programme : Master of Engineering (Structural Engineering)
Course Code : GEC-686
Title of the Course : Entrepreneurship
Number of Credits : 04
Effective from AY : 2024-25

Pre-requisites for the Course:	Basic knowledge of Creative Thinking, Innovation, Finance, Economics	
Course Objectives:	The course aims to provide the student with an: 1. Understanding of entrepreneurial skill sets and different types of entrepreneurship. 2. Explanation of Differences between New Enterprise, Social Enterprise and Family Business 3. Describes the process of preparing business plan, operational plans to start an enterprise 4. Apply the knowledge of market analysis, product planning, customer requirements, costing and finance	
Content:		No. of Hours
Unit-1	Entrepreneurial Characteristics: Overview on Entrepreneurship, Broad classification of entrepreneurs; Leadership, Goal Setting, Time and resource Planning, Communication, Networking, Knowledge & Skill Upgradation; Awareness of Social and Industrial Eco-system; Awareness of Government Policies and Schemes; Digital marketing and business promotion; Local and global market; Basic understanding of Legal and regulatory system, Intellectual Property Rights; Financial Literacy; Decision making and risk taking abilities	18
Unit-2	Creation of New Enterprise: Creativity, Innovation, technology, wealth creation, social impact, Team building, Business Plan, project formulation and feasibility analysis; business simulation; designing and configuring business models and customers, Enterprise management tools and techniques; Launching and managing enterprises; Sales & Marketing Strategies; Human Resources; Incubation, Costing and Financial Plans, Case Studies	14
Unit-3	Social Entrepreneurship: Overview, project formulation and feasibility analysis; understanding customer needs, positioning the firm for social change and strategic advantage; social business model; participatory development; stakeholders; social impact assessment; networking; regional economic models; banking and loans; Women Entrepreneurship; Case Studies	14

Unit-4	Family Business Management : Small and Medium Business Enterprises; Growth plan formulation; Vision, Values and Strategies, Turn around strategies, cost management, finance and liquidity, family to corporate culture; Case Studies;	14
Pedagogy	Interactive learning, reflective thinking, critical analysis, and problem-solving.	
References/ Readings:	1. Nagasubba Rayudu, 'A Textbook on Entrepreneurship & Incubation', Mahi Publications, 2023, ISBN: 978811949282 2. Balasubramanya. M.H., 'Entrepreneurial Ecosystems for Tech Startup in India', Verlag Max Publications, 2021, 9783110679298. 3. Kenji Uchino, 'Entrepreneurship for Engineers', CRC Press, 2010, ISBN: 978143980063 4. Ryszard Praszkiar, Andrzej Nowak, 'Social Entrepreneurship', Theory and Practice, Cambridge University Press, 2011, ISBN 9781139504331 5. Peter Leach, Tatwamasi Dixit, 'Indian Family Business Mantras', Rupa Publications, 2016, ISBN: 9788129136945 6. Bill Bolton, John Thompson, 'Entrepreneurs – Talent, Temperament, Opportunity', Elsevier Publications, 2004, ISBN:0750661283 7. John Bessant, Joe Tidd, 'Entrepreneurship', John Wiley Publications, 2015, ISBN: 9781118993095	
Course Outcomes:	After going through this course, student will be able to: CO 1. Understand entrepreneurial skill sets and different types of entrepreneurship. CO 2. Classify New Enterprise, Social Enterprise and Family Business CO 3. Explain process of preparing business plan, operational plans to start an enterprise CO 4. Apply the knowledge of market analysis, product planning, customer requirements, costing and finance	

