ATMANIRBHAR BHARAT
SWAYAMPURNA GOA

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(Accredited by NAAC)

GU/Acad –PG/BoS -NEP Engg. /2024-25/789 Date: 28.01.2025

CIRCULAR

Ref. No.: GU/Acad –PG/BoS -NEP Engg. /2024/644 dated 11.11.2024

In supersession to the above referred Circular, the Syllabus of Semester II of the **Master of Engineering (Computer Aided Structural Engineering)** Programme approved by the Academic Council in its meeting held on 06th December 2024 is attached herewith. The syllabus of Semester I approved earlier 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 (Computer Aided 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 VYAS LAWANDE
Digitally signed by ASHWIN VYAS LAWANDE
Date: 2025.01.28 16:39:37 +05'30'

(Ashwin V. Lawande)
Deputy Registrar – Academic

To,

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

Copy to,

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 (COMPUTER AIDED 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	COS-500	Computational Structural Mechanics	3	0	0	3
2	COS-501	Theory of Deformable Bodies	3	0	0	3
3	COS-502	Python Programming	4	0	0	4
4	COS-503	Computer Aided Structural Engineering Lab-1	0	0	1	1
5	COS-504	Computer Aided Structural Engineering Lab-2	0	0	1	1
Programme Specific Elective (PSE) Courses						
6	COS-531	Numerical Techniques in Structural Engineering	3	1	0	4
OR						
7	COS-532	Structural Optimization	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	**16**	**2**	**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	COS-506	Computer Aided 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	COS-509	Computer Aided 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	COS-535	Stability of Structures	3	0	0	3
9	COS-536	Stability of 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**

Issued on: 28/01/2025

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	**COS-661**	Probabilistic Methods in Structural Engineering	2	0	0	2
10	**COS-662**	Probabilistic 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
General Elective (GE) Courses						
13	**GEC-681**	Sustainability Principles & Practices	3	0	0	3
14	**GEC-682**	Sustainability Principals 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**
General Elective (GE) Courses						
1	**GEC-685**	Financial Management	4	0	0	4
OR						
2	**GEC-686**	Entrepreneurship	4	0	0	4
Program Specific Dissertation/Internship						
3	**COS-698**	Dissertation	0	0	0	**16**
OR						
4	**COS-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	**COS-500**	Computational Structural Mechanics	3	0	0	3
2	**COS-503**	Computer Aided Structural Engineering Lab-1	0	0	1	1
Programme Specific Elective (PSE) Courses						
3	**COS-531**	Numerical Techniques in Structural Engineering	3	1	0	4
OR						
4	**COS-532**	Structural Optimization	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**

Issued on: 28/01/2025

Semester – I
Programme Specific Core (PSC) Courses
Name of the Programme : Master of Engineering (Computer Aided Structural Engineering)
Course Code : COS-500
Title of the Course : Computational Structural Mechanics
Number of Credits : 03 (3L)
Effective from AY : 2024-25

Pre-requisites for the course:	Engineering Mathematics, Engineering Mechanics, Strength of Materials, Structural Analysis	
Course Objectives:	The course will enable the students to: 1. Understand the concept of Matrix methods and FEM 2. Apply stiffness matrix method and analyze 2-D structures 3. Analyze structural elements using FEM. 4. Design and analyze flowcharts, algorithms, and computer programs for the structural analysis of trusses, beams, grids, and frames, enhancing the capability to solve practical engineering problems using computational methods	
Contents:		**No. of Hours**
UNIT 1	**Introduction to Matrix methods of structural Analysis**: Degrees of Static and Kinematic indeterminacies, Concepts of Stiffness and Flexibility, Local and Global Coordinate System, Force Transformation matrix, Displacement transformation matrix	**10**
UNIT 2	**Matrix Analysis of indeterminate Trusses**: Analysis of trusses with and without initial strains using Matrix Stiffness method. **FE Analysis of Bars and trusses:** Shape Functions for linear and higher order elements, FE formulation for bars and trusses. **Computer Applications:** Flowchart, Algorithm, Computer logic and concept of development of programs to analyze trusses.	**10**
UNIT 3	**Matrix Analysis of Beams**: Continuous beam analysis using Matrix Stiffness method. **FE Analysis of Beams:** Derivation of Shape Function for two nodded beam element, Hermitian Interpolation, Element Stiffness matrix, Consistent Nodal loads. Analysis of 2D beams using FEM. **Computer Applications:** Flowchart, Algorithm, Computer logic and concept of development of programs to analyze Continuous beams.	**10**
UNIT 4	**Matrix Analysis of Grids:** Torsional stiffness of grid element and advantage of torsion release; Analysis of Grids by Matrix Stiffness method **FE Analysis of Grids:** Grid analysis using FEM **Matrix Analysis of Frames**: Frame analysis using Matrix Stiffness method. **FE Analysis of Frames:** Analysis of 2D Frames using FEM.	**15**

	Computer Applications: Flowchart, Algorithm, Computer logic and concept of development of programs to analyze Frames.	
Pedagogy:	Constructive, Collaborative and inquiry based learning	
References/ Readings:	1. Chandrupatla, T. R. and Belegundu, A. D., Introduction to Finite Elements, Pearson, 2002. ISBN-13: 978-8120321069 2. Cook, R. D., Malkus, D. S. and Plesha, M. E., Concepts and Applications of Finite Element Analysis, John Wiley and Sons, 2007. ISBN-13: 978-8126513369 3. Rajasekaran, S. and Shankarsubramanian, G., Computational Structural Mechanics, PHI Learning, 2004. ISBN-13: 978-8120317345 4. Reddy, C. S., Basic Structural Analysis, Tata McGraw-Hill, 2010. ISBN-13: 978-0070702769 5. Weaver, W. and Gere, J. M., Matrix Analysis of Framed Structures, CBS Publishers and Distributors Pvt. Ltd, 2004. ISBN-13: 978-8123911519	
Course Outcomes:	After taking this course, student will be able: CO1. Understand the concept of Matrix methods and FEM CO2. Apply stiffness matrix method and analyze 2-D structures CO3. Analyse structural elements using FEM. CO4. Design and analyze flowcharts, algorithms, and computer programs for the structural analysis of trusses, beams, grids, and frames, enhancing the capability to solve practical engineering problems using computational methods.	

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Name of the Programme : **Master of Engineering (Computer Aided Structural Engineering)**
Course Code : **COS-501**
Title of the Course : **Theory of Deformable Bodies**
Number of Credits : **03 (3L)**
Effective from AY : **2024-25**

Pre-requisites for the course:	Engineering Mathematics, Engineering Mechanics, Strength of Materials	
Course Objectives:	The course will enable the students to: 1. Understand stress and strain concepts in 2-D and 3-D cases. 2. Apply stress transformation principles to determine principal stresses and strains. 3. Apply methods like Airy's stress function and finite difference equations to elasticity problems. 4. Analyze torsion effects on bars using Prandtl's analogy and energy methods.	
Content:		**No. of Hours**
UNIT 1	**Introduction:** Definition of stress and strain at a point, components of stress and strain at a point of Cartesian and polar co-ordinates, Constitutive relations, equilibrium equations, compatibility equations and boundary conditions in 2-D and 3-D cases.	**10**
UNIT 2	**Transformation of stress and strain at a point:** Principal stresses and principal strains, invariants of stress and strain, hydrostatic and deviatory stress, spherical and deviatory strains, maximum shear strain	**10**
UNIT 3	**Plane stress and plane strain:** Airy's stress function approach to 2 dimensional problems of elasticity, simple problems of bending beams. Solution of axi-symmetric problems, stress concentration due to presence of circular hole in plates.	**10**
UNIT 4	**Elementary problems on elasticity in 3 dimensions:** Stretching of a prismatical bar by its own weight, twist of circular shafts, torsion of non-circular sections, membrane analogy, propagation of waves in solid media, application of finite difference equations in elasticity. **Torsion of various shaped bars:** Prandtl's membrane analogy-energy method- Torsion of rolled Profiles- Stress concentration at re-entrant corners.	**15**
Pedagogy:	Constructive, Collaborative and inquiry-based learning	
References/ Readings:	1. Lu, Xi, Theory of Elasticity, John Wiley & Sons, 2000. ISBN-13: 978-9056992422 2. Sadhu Singh, Theory of Elasticity, Khanna Publishers, 1978. ISBN-13: 978-8174090607 3. Sadhu Singh, Applied Stress Analysis, Khanna Publishers, 1979. ISBN-13: 978-8174090768	

	4. Timoshenko, S. and Goodier, J. N., Theory of Elasticity, McGraw-Hill, 2010. ISBN-13: 978-0070701229 5. Verma, P. D. S., Theory of Elasticity, Vikas Publishing Pvt. Ltd., 1997. ISBN-13: 978-8125903697
Course Outcomes	After taking this course, student will be able to CO1. Apply elastic analysis to study mechanics of deformable bodies CO2. Demonstrate the application of plane stress and plane strain in a given situation CO3. Formulate and solve planar problems using Airy stress function for two dimensional problems. CO4. Solve specific three-dimensional problems like torsion, bending of non-circular prismatic bar, membrane analogy and simple plate bending

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Name of the Programme : **Master of Engineering (Computer Aided Structural Engineering)**
Course Code : **COS-502**
Title of the Course : **Python Programming**
Number of Credits : **04 (4L)**
Effective from AY : **2024-25**

Pre-requisites for the course:	Basic Computer Programming	
Course Objectives:	The course will enable the students to: 1. Demonstrate the concepts of control structures in Python. 2. Implement Python programs using functions and strings. 3. Implement methods to create and manipulate lists, tuples and dictionaries. 4. Apply the concepts of file handling and using packages.	
Content:		**No. of Hours**
UNIT 1	**Introduction to Python**: Python variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using Numeric data types: int, float etc. **Python Program Flow Control Conditional blocks**: if, else and else if, Simple for loops in python, For loop using ranges, string, list and dictionaries. Use of while loops in python, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks.	**15**
UNIT 2	**Python Complex data types**: Using string data type and string operations, Defining list and list slicing, Use of Tuple data type. String, List and Dictionary, Manipulations Building blocks of python programs, string manipulation methods, List manipulation. Dictionary manipulation, Programming using string, list and dictionary in-built functions. Python Functions, Organizing python codes using functions.	**15**
UNIT 3	**Python File Operations**: Reading files, Writing files in python, Understanding read functions, read(), readline(), readlines(). Understanding write functions, write() and writelines() Manipulating file pointer using seek Programming, using file operations. Database Programming: Connecting to a database, Creating Tables, INSERT, UPDATE, DELETE and READ operations, Transaction Control, Disconnecting from a database, Exception Handling in Databases.	**15**
UNIT 4	**Python packages**: Simple programs using the built-in functions of packages matplotlib, numpy, pandas etc. GUI Programming: Tkinter introduction, Tkinter and Python Programming, Tk Widgets, Tkinter examples. Python programming with IDE.	**15**
Pedagogy:	Constructive, Collaborative and inquiry based learning	
References/ Readings:	1. Chun, W. J., Core Python Applications Programming, Pearson Education. ISBN-13: 978-0134288768	

	2. Dierbach, Charles, Introduction to Computer Science Using Python, Wiley. ISBN-13: 978-1119456325 3. Downey, A. et al., How to Think Like a Computer Scientist: Learning with Python, John Wiley. ISBN-13: 978-1118290279 4. Jeeva Jose & Sojan Lal, P., Introduction to Computing and Problem Solving with Python, Khanna Publishers, New Delhi. ISBN-13: 978-8174093175 5. Lutz, Mark, Learning Python, O'Reilly Media. ISBN-13: 978-1492050628
Course Outcomes	After taking this course, student will be able to CO1. Demonstrate the concepts of control structures in Python. CO2. Implement Python programs using functions and strings. CO3. Implement methods to create and manipulate lists, tuples and dictionaries. CO4. Apply the concepts of file handling and using packages.

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Name of the Programme : **Master of Engineering (Computer Aided Structural Engineering)**
Course Code : **COS-503**
Title of the Course : **Computer Aided Structural Engineering Lab - I**
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 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, constructive planning of experiments, collaborative approach in performing experiments and field visits.	
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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Name of the Programme : **Master of Engineering (Computer Aided Structural Engineering)**
Course Code : **COS-504**
Title of the Course : **Computer Aided Structural Engineering Lab - 2**
Number of Credits : **01**
Effective from AY : **2024-25**

Pre-requisites for the course:	Basic Computer Programming, Fundamentals of Python Programming	
Course Objectives:	The course will enable the students to: 1. Write algorithms and programs to solve Engineering problems. 2. Implement a variety of list operations, demonstrating the ability to manipulate and manage data using Python's list data structure effectively. 3. Implement a recursive approach to calculate the factorial of a number, showcasing an understanding of recursion and its practical applications. 4. Implement built-in functions from the matplotlib package for data visualization, demonstrating the ability to create and interpret graphical representations of data.	
Content:		**No. of Hours**
UNIT 1	**Part A (Any three experiments):** 1. Implementation of factorial of a given number 2. Implementation of basic calculator as a menu driven program 3. Implementation of list and various operations on it 4. Program to implement string manipulation functions. 5. Program to find Factorial of a Number Using Recursion.	**10**
UNIT 2	**Part B (Any three experiments):** 1. Implementation of dictionary and basic operations in Python 2. Implementation of functions in Python 3. Implementation of file I/O in Python 4. Implementation of basic database operations 5. Exception handling in database.	**10**
UNIT 3	**Part C (Any one experiments):** 1. Implementation of built- in functions from matplotlib package. 2. Implementation of arrays using numpy package	**5**
UNIT 4	**Part D (Any two experiments):** 1. Structural engineering application of Interpolation techniques 2. Structural engineering application of numerical integration 3. Structural engineering applications of curve fitting and errors	**5**
Pedagogy:	Inquiry based learning, constructive planning of experiments, collaborative approach in performing experiments.	
References/ Readings:	1. Kiusalaas J., “Numerical Methods in Engineering with Python 3”,Cambridge University Press,2013, ISBN-13: 978-1107033856	

	2. Kong Q, Siauw T., Bayen A., "Python Programming and Numerical Methods: A Guide for Engineers and Scientists, Academic Press, 2020, ISBN-13: 978-0128195499 3. Lora V. and Spanou K. "Python for Civil and Structural Engineers", Independent publisher, 2019, ISBN-13: 978-1077250939
Course Outcomes	After taking this course, student will be able to CO1 Write algorithms and programs to solve Engineering problems. CO2 Implement a variety of list operations, demonstrating the ability to manipulate and manage data using Python's list data structure effectively. CO3 Implement a recursive approach to calculate the factorial of a number, showcasing an understanding of recursion and its practical applications. CO4 Implement built-in functions from the matplotlib package for data visualization, demonstrating the ability to create and interpret graphical representations of data.

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Programme Specific Elective (PSE) Courses
Name of the Programme : Master Of Engineering (Computer Aided Structural Engineering)
Course Code : COS-531
Title of the Course : Numerical Techniques in Structural Engineering
Number of Credits : 04 (3L + 1T)
Effective from AY : 2024-25

Pre-requisites for the course:	Engineering Mathematics	
Course Objectives:	The course will enable the students to: 1. Solve first order initial value problems of Ordinary Differential Equations using appropriate Numerical methods. 2. Understand the implementation of numerical techniques for polynomial interpolation and numerical integration. 3. Apply numerical techniques to Solve an algebraic and transcendental equation and system of equations to the desired accuracy. 4. Apply numerical techniques to solve real life structural engineering problems.	
Content:		**No. of Hours**
UNIT 1	**Solution of linear system of equations:** Gaussian Elimination Method, Cholesky's factorisation, Crout's Reduction, Matrix inversion method, solution of Eigen value Problems, Gauss Jacobi Iteration, Gauss Seidel **Solution of Nonlinear Equations**: Newton Raphson's Method, Regula-Falsi Method.	**15**
UNIT 2	**Solution of ordinary Differential equations:** Euler 's Method, Modified Euler's Method, Fourth order Runge – Kutta method, Taylor series Method. **Numerical Integration:** Trapezoidal and Simpson's Rule, Weddle's Rule, Gauss Quadrature technique	**15**
UNIT 3	**Finite Difference Method:** Expression of derivatives by finite differences, Finite Difference Method, Boundary value problems of exact differential equations limited to second order only, PDE's-Parabolic-explicit. Hyperbolic equations, Elliptic equations. statically determinate and Indeterminate Problems, Buckling of Columns, Vibration of beams, bending of laterally loaded thin plates.	**15**
UNIT 4	**Interpolation and Extrapolation:** Newton's Interpolation-forward and backward, Lagrange's Interpolation, Hermite Interpolation, Spline Interpolation- Cubic, Inverse Interpolation, Extrapolation, Interpolation functions for axially loaded bar elements. **Curve Fitting and Errors:** Curve fitting (Interpolation, function that fits given values - approximate and exact, find function where reaches min/max or a specific value, linear regression, higher order polynomial, Gaussian, quantifying errors in curve	**15**

	fitting). Structural Engineering Applications.	
Pedagogy:	Constructive, Collaborative and inquiry based learning	
References/ Readings:	1. Chapra, S. C., & Canale, R. P., Numerical Methods for Engineers, McGraw-Hill. ISBN-13: 978-1260464381 2. Jain, K. K., Iyengar, S. R. K., & Jain, R. K., Numerical Methods: Problems and Solutions, Wiley India Pvt. Ltd. ISBN-13: 978-8126531270 3. Hamming, R. W., Numerical Methods for Scientists and Engineers, McGraw-Hill. 2012, ISBN-13: 978- 0486134826 4. Mathews, J. H., & Fink, K. D., Numerical Methods Using MATLAB, Pearson Education. ISBN-13: 978-0134694703 5. Scarborough, J. B., Numerical Mathematical Analysis, Oxford & IBH Publishing Co. Pvt. Ltd. ISBN-13: 978-0195684356	
Course Outcomes	After taking this course, student will be able to CO 1. Solve first order initial value problems of Ordinary Differential Equations using appropriate Numerical methods. CO 2. Understand the implementation of numerical techniques for polynomial interpolation and numerical integration. CO 3. Apply numerical techniques to Solve an algebraic and transcendental equation and system of equations to the desired accuracy. CO 4. Apply numerical techniques to solve real life structural engineering problems.	

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Name of the Programme : Master of Engineering (Computer Aided Structural Engineering)
Course Code : COS-532
Title of the Course : Structural Optimization
Number of Credits : 04 (3L +1T)
Effective from AY : 2024-25

Pre-requisites for the course:	Engineering Mathematics, Engineering Mechanics, Structural Analysis, Design of concrete structures	
Course Objectives:	The course will enable the students to: 1. Understand the fundamentals of optimization, including the formulation of structural optimization problems and their applications in engineering. 2. Apply classical optimization techniques, including single and multivariable optimization, to solve unconstrained and constrained engineering problems using various algorithms and methods. 3. Apply linear programming methods, such as the simplex algorithm and duality concepts, to optimize linear systems in structural engineering. 4. Analyze non-linear and constrained optimization techniques, including direct search methods, penalty function techniques, and the cutting plane method, for solving complex structural optimization problems	
Content:		**No. of Hours**
UNIT 1	**Introduction:** Introduction to optimization, engineering applications of optimization, formulation of structural optimization problems as programming problems. **Optimization techniques:** Classical optimization techniques, single variable optimization, multivariable optimization with no constraints, unconstrained minimization techniques and algorithms constrained optimized solutions by penalty function techniques, Lagrange multipliers techniques and feasibility techniques.	**15**
UNIT 2	**Linear programming:** Linear programming, standard form of linear programming, geometry of linear programming problems, solution of system of linear simultaneous equations, pivotal production of general systems of equations, simplex algorithms, revised simplex methods, duality in linear programming.	**15**
UNIT 3	**Non- linear programming:** Non- linear programming, one dimensional minimization methods, elimination methods, Fibonacci method, golden section method, interpolation methods, quadratic and cubic methods, unconstrained optimization methods, direct search methods, descent methods	**15**
UNIT 4	**Constrained optimization techniques:** Direct and complex methods, cutting plane method, exterior penalty function methods for structural engineering problems, formulation and solution of structural optimization problems by different techniques.	**15**

Pedagogy:	Constructive, Collaborative and inquiry based learning
References/ Readings:	1. Bhavikatti, S. S., Structural Optimization Using Sequential Linear Programming, Vikas Publishing House, 2003. ISBN-13: 978-8125911814 2. Bronson, R., Operations Research, Schaum's Outline Series, 1997. ISBN-13: 978-0070080201 3. Krisch, Uri, Optimum Structural Design, McGraw-Hill, 2012. ISBN-13: 978-3642848452 4. Rao, S. S., Optimization: Theory and Practice, Wiley Eastern Ltd., 2000. ISBN-13: 978-8122411492 5. Spunt, Optimum Structural Design, Prentice Hall, 2007. ISBN-13: 978-0136382706
Course Outcomes	After taking this course, student will be able to CO 1. Understand the fundamentals of optimization, including the formulation of structural optimization problems and their applications in engineering. CO 2. Apply classical optimization techniques, including single and multivariable optimization, to solve unconstrained and constrained engineering problems using various algorithms and methods. CO 3. Apply linear programming methods, such as the simplex algorithm and duality concepts, to optimize linear systems in structural engineering. CO 4. Analyze non-linear and constrained optimization techniques, including direct search methods, penalty function techniques, and the cutting plane method, for solving complex structural optimization problems.

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Research Specific Elective (RSE) Courses

Name of the Programme : Master of Engineering (Artificial Intelligence and Data Science)
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:	Knowledge of research requirements in real life	
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. Michael Jay Katz, 'From Research to Manuscript', Springer Publication,	

	2009, ISBN:9781402094668. 3. Rob Dekkers, Lindsey Casey, Peter Langhorne, 'Making Literature Review Work', Springer Publications, 2022, ISBN:9783030900243 4. Meikang Qiu, Han Qiu, Yi Zeng, 'Research & Technical Writing for Science and Engineering', Taylor & Francis Publications, 2022, ISBN:9781003139058.
Course Outcomes:	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 (Artificial Intelligence and Data Science)
Course code : REC-562
Title of the course : Literature Review & Technical Writing for Engineers
Number of credits : 4(3L + 1T)
Effective from AY : 2024-25

Pre-requisites for the Course:	Basics of Technical writing skills.	
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. Rob Dekkers, Lindsey Casey, Peter Langhorne, 'Making Literature Review Work – Multidisciplinary Guide to Systematic Approaches', Springer Publications, 2022, ISBN:9783030900243. 2. Michael Jay Katz, 'From Research to Manuscript', Springer Publication, 2009, ISBN:9781402094668. 3. Herman Tang, 'Engineering Research-Design, Methods and Publications', John Wiley and Sons, 2021, ISBN:9781119624486. 4. Meikang Qiu, Han Qiu, Yi Zeng, 'Research & Technical Writing for	

	Science and Engineering', Taylor & Francis Publications, 2022, ISBN:9781003139058.
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 (Computer Aided 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 and direct design methods 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 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.

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Name of the Programme : **Master of Engineering (Computer Aided Structural Engineering)**
Course Code : **COS-506**
Title of the Course : **Computer Aided 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 their flow characteristics. 2. Analyse and design flat slabs, grid floors, and prestressed concrete members using software and 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 demonstrating understanding and applying learned concepts.	
Content:		**No. of Hours**
	List of Experiments (Minimum 8): 1. Design mix for high-grade concrete based on IS and ACI codes. 2. Design mix for self-compacting concrete based on IS and ACI codes. 3. Flow Characteristics of Self-Compacting Concrete. 4. Analysis of flat slab systems using industry-standard software and designing using spreadsheets. 5. Analysis of grid floor systems using industry-standard software and designing using spreadsheets. 6. Analysis of prestressed slab using industry-standard software and designing using spreadsheets. 7. Detailed Case study report (unique) on the 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 and 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.

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Name of the Programme : Master of Engineering (Computer Aided 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

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Name of the Programme : Master of Engineering (Computer Aided 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 and forced 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	**12**

	systems – Natural frequencies and mode shapes – Orthogonality 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 CO 1. Understand the fundamentals of single degree of freedom systems, including free and damped vibrations, and the associated equations of motion. CO 2. 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. CO 3. Apply concepts to multiple degrees of freedom systems, including free vibration analysis, natural frequencies, and mode shapes CO 4. 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	

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Name of the Programme : **Master of Engineering (Computer Aided Structural Engineering)**
Course Code : **COS-509**
Title of the Course : **Computer Aided Structural Engineering Lab 4**
Number of Credits : **2 P**
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 (Minimum 12): 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.

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Programme Specific Elective (PSE) Courses
Name of the Programme : Master Of Engineering (Computer Aided 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	**10**
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.

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Name of the Programme : **Master of Engineering (Computer Aided Structural Engineering)**
Course Code : **COS-534**
Title of the Course : **Structural Health Monitoring Lab**
Number of Credits : **1 P**
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.

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Name of the Programme : **Master of Engineering (Computer Aided Structural Engineering)**
Course Code : **COS-535**
Title of the Course : **Stability of Structures**
Number of Credits : **03 (3L)**
Effective from AY : **2024-25**

Pre-requisites for the course	Engineering Mathematics, Theory of deformable bodies, Theory of Plates and shells, Finite Element Analysis	
Course Objectives:	The course will enable the students to: 1. Understand the differential equations and formulations for beam-columns subjected to various lateral loads, including Euler's formulations for different column end conditions. 2. Apply methods to calculate critical loads and analyze buckling in frames and continuous beams, including the energy approach and effects of varying cross-sections. 3. Apply the finite element approach to stability analysis, including the calculation of critical loads for discretized columns and pin-jointed frames. 4. Analyse lateral buckling of beams and buckling of rectangular plates under various loading conditions, including uniaxial and biaxial loads.	
Content:		**No. of Hours**
UNIT 1	**Beam - Column:** Differential equation, beam column subjected to lateral concentrated load, several concentrated loads, continuous lateral load, application of trigonometric series, Euler's formulation using fourth order differential equation for pinned-pinned, fixed-fixed, fixed-free and fixed-pinned column.	**12**
UNIT 2	**Buckling of frames and continuous beams:** Elastic, energy method- approximate calculation of critical loads for cantilever, exact critical load for hinged-hinged column using energy approach, buckling of bar on elastic foundation, buckling of cantilever column under distributed loads, determination of critical loads by successive approximation, bars with varying cross section, effect of shear force on critical load.	**11**
UNIT 3	**Stability analysis by finite element approach:** Finite element formulation for buckling, Calculation of critical loads for a discretized (two elements) column (both ends built in), buckling of pin jointed frames (maximum of two active dof). **Lateral buckling of beams:** Differential equations, pure bending, cantilever beam with tip load, simply supported beam of I section subjected to central concentrated load.	**12**
UNIT 4	**Buckling of rectangular plates:** Buckling of simply supported rectangular plate- uniaxial load and biaxial load, buckling of uniformly compressed rectangular plate simply supported along two opposite sides perpendicular to the direction of compression and having edge condition along the other two sides.	**10**

Pedagogy:	Constructive, Collaborative and inquiry based learning
References/ Readings:	1. Cook, R. D., et al., Concepts and Applications of Finite Element Analysis, John Wiley and Sons, New York, 1981, ISBN-13: 9780471030508. 2. Jerath, S., Structural Stability Theory and Practice: Buckling of Columns, Beams, Plates, and Shells, John Wiley & Sons, 2020, ISBN-13: 9781119694526. 3. Simitse, G., et al., Fundamentals of Structural Stability, Hardcover, 2006, ISBN-13: 9780750678759. 4. Timoshenko, S. P., and Gere, J. M., Theory of Elastic Stability, McGraw-Hill, New Delhi, 2012, ISBN-13: 9780486134802. 5. Zeigler, H., Principles of Structural Stability, Blaisdell Publications, 1977, ISBN-13: 978376430886.
Course Outcomes	After taking this course, student will be able to CO 1. Understand the differential equations and formulations for beam-columns subjected to various lateral loads, including Euler's formulations for different column end conditions. CO 2. Apply methods to calculate critical loads and analyze buckling in frames and continuous beams, including the energy approach and effects of varying cross-sections. CO 3. Apply the finite element approach to stability analysis, including the calculation of critical loads for discretized columns and pin-jointed frames. CO 4. Analyze lateral buckling of beams and buckling of rectangular plates under various loading conditions, including uniaxial and biaxial loads.

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Name of the Programme : **Master of Engineering (Computer Aided Structural Engineering)**
Course Code : **COS-536**
Title of the Course : **Stability of Structures Lab**
Number of Credits : **01 P**
Effective from AY : **2024-25**

Pre-requisites for the course:	Engineering Mathematics, Theory of deformable bodies, Theory of Plates and shells, Finite Element Analysis, Basics of Programming	
Course Objectives:	The course will enable the students to: 1. Analyze the stability and buckling behavior of different structural elements under various loading conditions. 2. Develop and implement Python programs to perform buckling analysis for beam columns, continuous beams, frames, beams subjected to lateral instability, and rectangular plates. 3. Compare the results obtained from industry-standard software and Python-based buckling analysis to evaluate accuracy, efficiency, and applicability in real-world scenarios. 4. Apply learned techniques to solve real-world buckling problems, enabling students to interpret results and make informed decisions for structural design and safety.	
Contents:		**No. of Hours**
	List of Experiments (Minimum 8): 1. Buckling analysis of beam column using industry standard software 2. Buckling analysis of continuous beam using industry standard software 3. Buckling analysis of frames using industry standard software 4. Buckling analysis of beam subjected to lateral instability using industry standard software 5. Buckling analysis of rectangular plates using industry standard software 6. Developing a computer program to perform buckling analysis of beam column 7. Developing a computer program to perform buckling analysis of continuous beam 8. Developing a computer program to perform buckling analysis of frames 9. Developing a computer program to perform buckling analysis of beam subjected to lateral instability 10. Developing a computer program to perform buckling analysis of rectangular plates	**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. Analyze the stability and buckling behavior of different structural elements under various loading conditions. CO 2. Develop and implement Python programs to perform buckling analysis for beam columns, continuous beams, frames, beams subjected to lateral instability, and rectangular plates. CO 3. Compare the results obtained from industry-standard software and Python-based buckling analysis to evaluate accuracy, efficiency, and applicability in real-world scenarios. CO 4. Apply learned techniques to solve real-world buckling problems, enabling students to interpret results and make informed decisions for structural design and safety

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Research Specific Elective (RSE) Courses
Name of the Programme : Master of Engineering (Computer Aided 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', 6th Edition, Wiley India, 2016, ISBN 0-471-20454-4	

Issued on: 28/01/2025

	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.

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Name of the Programme : **Master of Engineering (Computer Aided 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', 6th 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. 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

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Name of the Programme : **Master of Engineering (Computer Aided 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

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Name of the Programme : Master of Engineering (Computer Aided 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, 5th 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

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GOA UNIVERSITY

Syllabus

of

MASTER OF ENGINEERING (COMPUTER AIDED STRUCTURAL ENGINEERING)

Detailed Syllabus of Sem III and Sem IV

RC 2024-25

April 2025

Semester III

Name of the Programme: **MASTER OF ENGINEERING (COMPUTER AIDED 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 Hrs**
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	**12**

	Loads, Lateral Load Resisting Systems, Analysis for 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:	**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. **Reference Books** 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 (COMPUTER AIDED 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 Hrs**
	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:	**<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. **Reference Books** 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, 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 (COMPUTER AIDED 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 Hrs**
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:	**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** 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 (COMPUTER AIDED STRUCTURAL ENGINEERING)**
Course Code: **COS-603**
Title of the Course: **DESIGN OF SUBSTRUCTURES LAB**
Number of Credits: **01**
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 Hrs**
	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 11. Analysis of Reinforced Earth Wall	**30**

	(Any Industry standard software can be used for analysis)	
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.	

Name of the Programme: **MASTER OF ENGINEERING (COMPUTER AIDED 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 1. 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 Hrs**
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,	**10**

	deflection, cracking, pre stressing, shear flow, creep, shrinkage, temperature effects and fire.	
Pedagogy:	interactive learning, reflective thinking, critical analysis, and problem-solving	
References/ Readings:	**Text Books** 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. **Reference Books** 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, 1988,	
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 (COMPUTER AIDED 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 Hrs**
	List of Experiments: 1. **Modeling and Analysis of a Multi-Storey Frame** o Gravity loading o Floor load distribution 2. **Wind Load Analysis on Tall Buildings** o Manual wind load calculation (as per IS 875 Part 3) o Application in software 3. **Seismic Analysis Using Response Spectrum Method** o As per IS 1893:2016 o Base shear, modal participation 4. **P-Delta Effect and Stability Check in Software** o Modeling for second-order effects 5. **Design of Core Wall and Shear Wall Systems** o Detailing and reinforcement layout 6. **Outrigger and Belt Truss System Modelling** o Effect on drift control **7. Behavior of rigid frames versus braced frames under various loading conditions** 8. **Foundation Modeling for High Rise Structures** o Raft / Pile foundation in SAFE or STAAD Foundation 9. **Comprehensive Project**	**30**

	• 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)	
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 (COMPUTER AIDED 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 Hrs**
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:**	**12**

	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 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 (COMPUTER AIDED 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 Hrs**
	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	**30**

	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 equivalent can be used to develop Worksheets)	
Pedagogy:	Instructional learning, Inquiry based learning, Constructive learning, Collaborative learning 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** 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.	

Name of the Programme: **MASTER OF ENGINEERING (COMPUTER AIDED STRUCTURAL ENGINEERING)**
Course Code: **COS-661**
Title of the Course: **PROBABILISTIC METHODS IN STRUCTURAL ENGINEERING**
Number of Credits: **02**
Effective from AY: **2024-25**

Pre-requisites for the Course:	Knowledge of Engineering Mathematics, Theory of deformable bodies, Design of Concrete Structures, Design of Steel Structures	
Course Objectives:	**The course will enable the students to:** 1. Understand the concepts of probability and statistical analysis methods 2. Identify and quantify the uncertainties in material properties 3. Analyze the stability of structures considering uncertainties in material properties. 4. Design structures, considering uncertainties in material properties and loads.	
Content:		**No. of hours**
Unit - 1	**Concept of variability:** Applications of Statistical principles to deal with randomness in basic variables, statistical parameters and their significance, Description of various probability distributions – Binomial, Poisson, Normal, Log-Normal, Beta, Gama, distributions. Testing of goodness– of – fit of distributions to the actual data using chi square method and K - S Method **Statistical regression and correlation:** Operation on one Random variable, expectation, multiple random variables, reliability distributions – basic formulation.	07
Unit - 2	**Statistical Quality control in Structural Engineering:** Characteristic strength and characteristic load, probability modelling of strength, geometrical dimensions, material properties and loading. Application problems on Mean value method and its applications in structural designs.	08
Unit - 3	**Safety assessment of structures:** Reliability analysis using mean value theorem –1st, 2nd and 3rd order Reliability formats.	07
Unit - 4	**Simulation Techniques and Reliability based design:** Monte Carlo method, Reliability index - reliability formulation in various limit states, application to design of RC, PSC and steel structural elements – LRFD Concept.	08
Pedagogy:	interactive learning, reflective thinking, critical analysis, and problem-solving.	
References/ Readings:	**Text Books** 1. Haldar, A., and Mahadevan, S., *Probability, Reliability and Statistical Methods in Engineering Design*, John Wiley and Sons, New York, 2000. ISBN-13: 978-0471331216	

	2. Ranganathan, R., *Reliability Analysis and Design of Structures*, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1999. ISBN-13: 978-0074600627. **Reference Books** 3. Ang, A. H. S., and Tang, W. H., *Probability Concepts in Engineering Planning and Design*, Vols. I & II, John Wiley and Sons, New York, 1984. ISBN-13: 978-0471036135. 4. Kennedy, John B., and Neville, Adam M., *Basic Statistical Methods for Engineers and Scientists*, Harper and Row Publishers, New York, 1976. ISBN-13: 978-0060436781. 5. Melchers, Robert E., *Structural Reliability Analysis and Prediction*, John Wiley and Sons, Chichester, 1999. ISBN-13: 978-0471982319.
Course Outcomes:	**After going through this course, student will be able to:** CO1 Apply statistical principles for analysing randomness in variables. CO2 Test goodness of fit of distribution in the data. CO3 Adopt different acceptance and rejection tests for strength and other parameters of measurement. CO4 Carry out reliability analysis and compute reliability index, for the given design details.

Name of the Programme: **MASTER OF ENGINEERING (COMPUTER AIDED STRUCTURAL ENGINEERING)**
Course Code: **COS-662**
Title of the Course: **PROBABILISTIC METHODS IN STRUCTURAL ENGINEERING LAB**
Number of Credits: **02**
Effective from AY: **2024-25**

Pre-requisites for the Course:	Knowledge of Engineering Mathematics, Theory of deformable bodies, Design of Concrete Structures, Design of Steel Structures	
Course Objectives:	**The course will enable the students to:** 1. Understand statistical tools and techniques for analysing variability in engineering materials and loading. 2. Apply probability distributions to model uncertainties in structural engineering problems. 3. Evaluate reliability indices using simulation and analytical techniques for various structural components. 4. Interpret results from simulation and reliability analysis to inform design decisions and ensure structural safety.	
Content:		**No. of hours**
	List of Experiments (Minimum 16): (Use software such as MSExcel, MATLAB, TK Solver or equivalent software wherever applicable) 1.Finding statistical parameters like Mean, median, mode, standard deviation, variance, coefficient of variation 2. Plotting and Interpreting Probability Distributions like Normal, Log-Normal, Binomial, Poisson, Beta and Gamma distributions. 3. Fitting a Probability Distribution to Experimental Data. 4. Calculation of Characteristic Strength of Materials. 5. Characteristic Load Calculations from Survey Data 6. Estimating probability density functions for RC/Steel members. 7. Reliability analysis for axial members. 8. Simulation of second-order effects in reliability. 9. Reliability Index Calculation for RC Beams. 10. Monte Carlo Simulation for Load and Resistance Model. 11. Reliability Index from Simulated Load Effects. 12. Reliability Based Design of a Steel Beam. 13. Reliability Based Design of a Retaining Wall. 14. Reliability Assessment of Pre-stressed Concrete Girders 15. Failure Surface Mapping for Steel Beam under Combined Bending and Shear. 16. Reliability Analysis using First Order Reliability Method (FORM) for a Simply Supported Beam. 17. Second Order Reliability Method (SORM) Application for RC Column. 18. Comparative Study of FORM and SORM for Structural Elements	60
Pedagogy:	Instructional learning, Inquiry based learning, Constructive learning,	

	Collaborative learning and problem solving..
References/ Readings:	**<u>Text Books</u>** 6. Haldar, A., and Mahadevan, S., *Probability, Reliability and Statistical Methods in Engineering Design*, John Wiley and Sons, New York, 2000. ISBN-13: 978-0471331216 7. Ranganathan, R., *Reliability Analysis and Design of Structures*, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1999. ISBN-13: 978-0074600627. **<u>Reference Books</u>** 8. Ang, A. H. S., and Tang, W. H., *Probability Concepts in Engineering Planning and Design*, Vols. I & II, John Wiley and Sons, New York, 1984. ISBN-13: 978-0471036135. 9. Kennedy, John B., and Neville, Adam M., *Basic Statistical Methods for Engineers and Scientists*, Harper and Row Publishers, New York, 1976. ISBN-13: 978-0060436781. 1. Melchers, Robert E., *Structural Reliability Analysis and Prediction*, John Wiley and Sons, Chichester, 1999. ISBN-13: 978-0471982319.
Course Outcomes:	**After going through this course, student will be able to:** CO1 Apply statistical and probabilistic methods to assess randomness in material and loading parameters. CO2 Perform goodness-of-fit tests to determine the best-fit distribution for structural data. CO3 Develop and simulate models for structural variability and uncertainty using programming and software tools. CO4 Carry out reliability analysis using methods such as FORM, SORM, and Monte Carlo simulation.

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 Hrs**
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 Masonary 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, Masonary structures. Forensic analysis of Building Facades and Foundations.	**08**

	Forensic Analysis of Temporary structures.	
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** CO1 Explain the principles and professional role of forensic structural engineers in failure investigations CO2 Diagnose structural failures based on material behavior, loading conditions, and construction practices CO3 Conduct forensic investigations including evidence collection,	

	damage assessment, and documentation CO4 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 nondestructive 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 Hrs**
	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 of steel structures 7. Forensic analysis Case study of Masonary 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):	**60**

	Identification of moisture ingress and delamination.	
Pedagogy:	Instructional learning, Inquiry based learning, Constructive learning, Collaborative learning and problem solving.	
References/ Readings:	1. Ratay, R. T. (Ed.). *Forensic Structural Engineering Handbook*. McGraw-Hill Education, 2010, 2nd Edition. 2. Bungey, J. H., Millard, S. G., & Grantham, M. G. *Testing of Concrete in Structures*. CRC Press, 2006, 4th edition 3. Mindess, S., Young, J. F., & Darwin, D. *Concrete*. Prentice Hall, 2003, 3rd edition. 4. IS 13311 (Part 1 & 2) – Non-Destructive Testing of Concrete. 5. ASTM Standards relevant to field testing: (i) ASTM C805 – Rebound Hammer 1. ASTM C876 – Half-Cell Potential 2. ASTM C597 – UPV Testing	
Course Outcomes	**After going through this course, student will be able to** **CO1:** Identify signs of structural distress, damage, and material deterioration in existing structures. **CO2:** Demonstrate proficiency in using non-destructive testing (NDT) methods such as rebound hammer, UPV, and half-cell potential tests. **CO3:** Analyze test data and inspection findings to determine the probable cause(s) of structural damage or failure. **CO4:** Prepare professional forensic engineering reports and effectively communicate findings and recommendations.	

Name of the Programme: **MASTER OF ENGINEERING (COMPUTER AIDED 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:** **CO1.** Understand the importance of sustainability practices **CO2.** Assess, Plan and Suggest basic sustainability practices **CO3.** Explain the steps involved in implementing sustainable solutions **CO4.** Prepare a plan for sustainability practices to real life situations.	

Name of the Programme: **MASTER OF ENGINEERING (COMPUTER AIDED STRUCTURAL ENGINEERING)**

Course Code: **GEC-682**
Title of the Course: **SUSTAINABILITY - PRINCIPLES & PRACTICES 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 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:		**No. of Hours**
	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	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:** **CO1.** Understand the importance of sustainability Development Goals (SDGs) **CO2.** Assess, Plan and Suggest basic sustainability practices **CO3.** Explain the steps involved in order to achieve the SDG **CO4.** Prepare a plan for sustainability practices to real life situations.	

Name of the Programme: **MASTER OF ENGINEERING (COMPUTER AIDED 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, 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	10
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:** **CO1.** Explain the importance of Project Management **CO2.** Describe the various components of Project Management **CO3.** Analyze the importance of cost, human resource, procurement, quality, time and risk management **CO4.** Apply project management knowledge in their professional life.	

Name of the Programme: **MASTER OF ENGINEERING (COMPUTER AIDED 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	30

	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	
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:** **CO1:** Understanding of the various features of project management **CO2**: Explanation of the relevance of applying project management knowledge to any one domain **CO3**: Describes the advantages of applying project management tools & techniques to address specific problems **CO4:** Ability to prepare reports and presentation on specific areas by applying knowledge of Project Management	

Semester IV

Name of the Programme: **MASTER OF ENGINEERING (COMPUTER AIDED 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 hrs
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 hrs
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 hrs

Unit-4	**Working Capital Management** -Working Capital Policy, Cash and Liquidity Management, Credit Management, Inventory Management, Working Capital Financing; **Corporate Valuation:** Debt analysis and management, Leasing, Hire Purchase, Valuation, Mergers, acquisitions and Restructuring; **Long Term Financing:** Sources of Long Term Finance, Raising Long Term Finance.	14 hrs
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:** **CO1:** Understand the Financial Systems and Its Management **CO2**: Explain Financial Planning, Fund Flow and Cost Analysis **CO3**: Analyze Capital & Working Capital Management, Valuation, Long Term Financing **CO4:** Describe product cost analysis, break even analysis and investment management.	

Name of the Programme: **MASTER OF ENGINEERING (COMPUTER AIDED 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 Literary; 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 Praszkier, 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:** **CO1.** Understand entrepreneurial skill sets and different types of entrepreneurship **CO2.** Classify New Enterprise, Social Enterprise and Family Business **CO3.** Explain process of preparing business plan, operational plans to start an enterprise **CO4.** Apply the knowledge of market analysis, product planning, customer requirements, costing and finance.	