Shri Rawatpura Sarkar University, Raipur

Examination Scheme & Syllabus

for

M.Tech.(Structural Engineering)

Semester-I

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the Session: 2022-23)

Shri Rawatpura Sarkar University, Raipur, Chhattisgarh

Faculty of Engineering

Two Years M.Tech. Programme

Scheme of Teaching and Examination

M.Tech. First Semester Structural Engineering

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the Academic Year 2022-2023)

S. No.	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			Sem End Exam Duration (Hrs)
			L	T	P		Continuous Evaluation	Sem End Exam	Total	
1	MENSE101T	Advanced Computational Methodology	3	1	-	4	30	70	100	3
2	MENSE102T	Advanced Concrete Technology and Admixtures	3	1	-	4	30	70	100	3
3	MENSE102P	Advanced Concrete Technology and Admixtures	-	-	2	1	15	35	50	
4	MENSE103T	Matrix Methods of Structural Analysis	3	1	-	4	30	70	100	3
5	MENSE103P	Matrix Methods of Structural Analysis	-	-	2	1	15	35	50	
6	MENSE104T	Instrumentation and Experimental Techniques	3	1	-	4	30	70	100	3
7	MENSE105T	Elective- I	3	1	-	4	30	70	100	3
	Total Contact Hr Per Week: 24		**Total Credit: 22**				**Grand Total Marks:**		**600**	

L: Lecture   T: Tutorial   P: Practical

Elective-I

S.NO.	Course Title
1	Limit State Design of Steel Structures
2	Advanced Design of Steel Structures
3	Theory of Elastic Stability

Course Title	Advanced Computational Methodology			
Course Code	**MENSE101T**			
Course Credits	**L**	**T**	**P**	**TC**
	3	**1**	**-**	**4**
Prerequisites	**Engineering Mathematics –I & II**			
Course Objectives	This course will enable students to: • Represent the problems mathematically. • Optimize the solutions.			
Course Contents	**UNIT – I** **Graph Theory And Its Application** Basic Terminology. Simple graph. Multi graph,. Types of graph .Path .Cycles Eulerian and Hamiltonian graph. Shortest path problem Representation of graph. Trees and their properties. Spanning Tree. Binary Tree. Tree traversal. **UNIT - II** **Fuzzy Set And Its Applications** Fuzzy sets-Basic definitions, α-level sets. Convex fuzzy sets. Basic operations on fuzzy sets. Types of fuzzy sets. Cartesian products, Algebraic products. Bounded sum and difference, t-norms and t-conorms. The Extension Principle- The Zadeh's extension principle. Image and inverse image of fuzzy sets. Fuzzy numbers. Elements of fuzzy arithmetic. **UNIT - III** **Cryptography And Its Application** Introduction to the Concepts of Security: The need for security, Security Approaches, Principles of Security, Types of Attacks. Cryptographic Techniques: Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key Range and Key Size, Possible Types of Attacks. DES, RSA, Digital Signature. **UNIT - IV** **Statistical Analysis** Expectation and variance of random variable. Sampling Distribution. Testing a Hypothesis. Level of significance. Confidence limits. Test of significance for large sample. Central limit theorem. Test of significance for means of two large samples. Sampling Variables-small samples. Student t-distribution, Chi-square test.			

	UNIT - V **Optimization Techniques** Dynamic Programming-Deterministic and Probabilistic Dynamic programming. Inventory- Basic characteristics of an inventory system. The Economic order quantity. Deterministic models. Network analysis (PERT/ CPM).
Course Outcomes	**After the completion of course:** • This is the foundation of research and development in the computational domain of engineering and technology. • Analyze the result numerically and linguistically by fuzzy theory. • Emphasize the meaning and purpose of these techniques and their use in solving Engineering Problems. • As the prerequisite, this will be traced the thought and ideas to design the behavioral tools over the engineering range. • This is a transformation from theory to application through measuring theory of natural problems and its applications.
Text Books	1. Calculus of Variations with Applications, Gupta, A.S.-Prentice Hall of India(P) Ltd., New Delhi, 6th print,2006 2. Introduction to Partial Differential Equations, Sankar Rao, .K.- Prentice Hall of India(P) Ltd., New Delhi, 5th print,2004 3. Advanced Engineering Mathematics, Jain R. K Iyengar S.R.K.-Narosa publications 2nd Edition,2006 4. Numerical Methods in Science and Engineering, Grewal, B.S-Kanna Publications, New Delhi. 5. Numerical Methods, S Chandand Co. Ltd, Kandasamy. P, Thilagavathy. Kand Gunavathy, K- New Delhi, 5th Edition,2007 6. Theory and problems of Complex Variables with an Introduction to Conformal Mapping and Its applications, Schaum's outline series, Spiegel, M.R-McGraw Hill BookCo.,1987.
Reference Books	1. Multi - Objective Optimization Using Evolutionary Algorithms, K. Deb (2003) John Wiley 2. Applied Statistics & Probability for Engineers: Montgomery, Douglas C. & Runger, George C. (2007), 3/e, Wiley India. 3. Parallel distributed processing Vol.1 (1986) Rumelhart, D.E and McClelland, J.L., M I T Press, 1986. 4. Fuzzy logic implementation and applications (1996), Patyra, M.J. and Mlynek Wiley

Course Title	**Advanced Concrete Technology and Admixtures**
Course Code	**MENSE102T**

Course Credits	**L**	**T**	**P**	**TC**	
	3	**1**	**-**	**4**	

Prerequisites	**Concrete Technology**

Course Objectives	**This course will enable students to:-** • Define and understand concepts related concrete technology which involves types and property of concrete and different adhesive materials and its vital use for safe, economic development for the buildings. • Present the foundations of many basic engineering tools and concepts related to concrete technology and civil engineering. • Give an experience in the implementation of engineering concepts which are applied in field of civil engineering?
Course Contents	**UNIT I** **Materials And Properties-**IS specifications for materials and testing of concrete making materials, Properties, Grading, Methods of combining aggregates, Properties of fresh and hardened concrete, Variability of concrete strength, Elasticity, creep and shrinkage of concrete, Durability and factors affecting durability, behavior of concrete under aggressive environmental conditions including temperature. **UNIT II** **Admixtures -** Different types of admixtures for improving properties of concrete such as strength, workability, durability etc Suitability in different conditions. **UNIT III** **Concrete Mix Proportioning-**Principles of concrete mix proportioning, Methods of concrete mix proportioning (with and without admixtures), Trial mixes, testing of concrete mixes. **UNIT IV** **Special Concrete -**Light weight concrete, Fly ash concrete, Fiber reinforced concrete, Polymer Concrete, High performance concrete, Self compacting concrete, Concrete containing Silica Fumes, Concrete containing GGBS, No fines concrete. **UNIT V** **Concreting Methods -**Process of manufacturing of concrete, Methods of transportation, placing and curing - Extreme weather concreting, special concreting methods, Vacuum dewatering - underwater concrete, special from work.

Course Outcomes	**After the completion of course:-** • Engineering concepts which are applied in field Construction Fields. • Discuss the concrete ingredients and its influence at gaining strength. • Design of concrete mix and grade as per IS codes. • Summarise the concepts of conventional concrete and its differences with other concretes like no fines, light weight etc. • Describe the application and use of fiber reinforced concrete. • Design and develop the self compacting and high performance concrete.
Text Books	1. Properties of Concrete, Neville A.M., Pearson Education. 2. Concrete Technology, Shetty M.S., S.Chand and Company Ltd., Delhi
Reference Books	1. Concrete Admixtures Handbook, Ramachandran V.S., Standard Publishers Distributors, Delhi. 2. Proceedings of recent seminars / workshops / conferences and Papers from relevant National and International Journals.

Course Title	Advanced Concrete Technology and Admixtures			
Course Code	**MENSE102P**			
Course Credits	**L**	**T**	**P**	**TC**
	-	**-**	**2**	**1**
Prerequisites	Concrete Technology			
Course Objectives	**This course will enable students to:-** • Understanding on cement chemistry, hydration reaction of Portland cement, influence of other cemenetitious materials to the progress of hydration reaction and the ultimate concrete properties, chemical and physical interaction of aggregates and admixtures with the hydrated cement paste and their effects on the performance of fresh and hardened concrete. • Concrete durability problems mechanisms, expected physical and chemical changes occurring on the concrete microstructure during the progress of durability problems and precautions' to be taken. Manufacture of special concretes and their properties			
Course Contents	**List of Experiments** 1. Tests for properties of Cement. 2. Tests for properties of Fine Aggregates. 3. Tests for properties of Coarse Aggregates. 4. Tests for properties of Admixtures. 5. Tests for strength of Concrete. 6. Tests for Flexural Strength of Concrete 7. Tests for Modulus of Elasticity of Concrete. 8. Concrete mix design (without Admixtures) and Trial Mixes. 9. Concrete mix design (with Admixtures) and Trial Mixes. 10. Non-destructive testing methods. 11. Behavior of Concrete under different curing conditions. 12. Behavior of Concrete under different exposure conditions. 13. Behavior of Concrete under different placing conditions. 14. Residual Strength of existing concrete structures. 15. Comparison of properties of concrete prepared with materials from different locations.			
Course Outcomes	**After the completion of course:-** • Describe microstructure of hydrated cement			

	• Explain the relationship between hydration products and resulting properties of concrete
	• Explain mechanisms behind functioning of chemical admixtures and supplementary cementing materials
	• Evaluate fresh and hardened properties of cement-based composites
	• Design an emerging material or specialized concrete mix
	• Evaluate properties of designed mix using traditional and non-destructive evaluation techniques
Text Books	1. Properties of Concrete, Neville A.M., Pearson Education 2. Handbook on Concrete Mixes, SP23 Bureau of Indian Standards, New Delhi.
Reference Books	1. Concrete Admixtures Handbook, Ramachandran V.S., Standard Publishers Distributors, Delhi. 2. Proceedings of recent seminars / workshops / conferences and Papers from relevant National and International Journals

Course Title	Matrix Methods of Structural Analysis			
Course Code	**MENSE103T**			
Course Credits	**L**	**T**	**P**	**TC**
	3	**1**	**-**	**4**
Prerequisites	**Structure Analysis-III**			
Course Objectives	**This course will enable students to:-** • Introduce to the students, matrix-based approach for linear elastic analysis of skeletal structure.			
Course Contents	**UNIT I** **Introduction-**Review of force and displacement methods of structural analysis, Degree of Static Indeterminacy, Degree of Kinematic Indeterminacy, Basic Concepts of Matrix methods in structural analysis, Determinants and Matrices. **UNIT II** **Flexibility Method For Beams-**Flexibility coefficients, development of flexibility matrix, Analysis of continuous beams by flexibility method. **UNIT III** **Flexibility Method For Frames -**Analysis of rigid jointed plane frame and pin jointed plane frame by flexibility method. **UNIT IV** **Stiffness Method For Beams-**Stiffness coefficient, development of stiffness matrix, relationship between flexibility matrix and stiffness matrix, Analysis of continuous beams by stiffness method. **UNIT V** **Stiffness Method For Frames-**Analysis of rigid jointed plane frame and pin jointed plane frame by stiffness method.			
Course Outcomes	**After the completion of course:-** • Knowledge of development of stiffness matrix for prismatic members, • Derivation of flexibility matrices for bars, trusses, beams and frame structures. • Derivation of stiffness matrices for bars, trusses, beams and frame structures. • Analysis of determinate and indeterminate structures using flexibility and stiffness matrix methods. • Analysis of determinate and indeterminate structures using direct stiffness method.			
Text Books	1. Structural Analysis – A Matrix Approach, Pandit G.S. and Gupta S.P., Tata			

	McGraw- Hill Publishing Company Limited, New Delhi
	2. Matrix Analysis of Framed Structures, Weaver W. and Gere J. M., CBS Publishers and Distributors, Delhi
Reference Books	1. Finite Element Analysis Theory and Programming, Krishanmurthy C.S., Tata McGraw- Hill Publishing Company Limited, New Delhi
	2. Proceedings of recent seminars / workshops / conferences and Papers from relevant National and International Journals.

Course Title	Matrix Methods of Structural Analysis
Course Code	MENSE103P

Course Credits	L	T	P	TC	
	-	-	2	1	

Prerequisites	Designing & Structure-I & II

Course Objectives	**This course will enable students to:-** • Impart the principles of elastic structural analysis and behavior of indeterminate structures. • Impart knowledge about various methods involved in the analysis of indeterminate structures. • Apply these methods for analyzing the indeterminate structures to evaluate the response of structures • Enable the student get a feeling of how real-life structures behave • Make the student familiar with latest computational techniques and software used for structural analysis.
Course Contents	**List of Experiments** 1. Introduction to Software for Structural Analysis, such as SAP2000 2. Analysis of Continuous Beams on SAP2000 (Support Conditions and Loading type I) 3. Analysis of Continuous Beams on SAP2000 (Support Conditions and Loading type II) 4. Analysis of Continuous Beams on SAP2000 (Support Conditions and Loading type III) 5. Analysis of Plane Frames (Rigid Jointed) on SAP2000 (Support Conditions and Loading type I) 6. Analysis of Plane Frames (Rigid Jointed) on SAP2000 (Support Conditions and Loading type II) 7. Analysis of Plane Frames (Rigid Jointed) on SAP2000 (Support Conditions and Loading type III) 8. Analysis of Plane Frames (Pin Jointed) on SAP2000 (Support Conditions and Loading type I) 9. Analysis of Plane Frames (Pin Jointed) on SAP2000 (Support Conditions and Loading type II) 10. Analysis of Plane Frames (Pin Jointed) on SAP2000 (Support Conditions and Loading type III).

12	11. Behaviour of Frames under Dead and Live Loads. 12. Behaviour of Frames under Wind Loads. 13. Behaviour of Frames under Earthquake Loads. 14. Behaviour of Frames under combinations of Dead Load, Live Load and Wind Load. 15. Behaviour of Frames under combinations of Dead Load, Live Load and Earthquake Load.
Course Outcomes	**After the completion of course:-** • Understand analysis of indeterminate structures and adopt an appropriate structural analysis technique • Determine response of structures by classical, iterative and matrix methods
Text Books	1. Users Manual for SAP2000 Software Package, Computers and Structures Inc., Berkley. 2. Verification Manual for SAP2000 Software Package, Computers and Structures Inc., Berkley
Reference Books	1. Finite Element Analysis Theory and Programming, Krishanmurthy C.S., Tata McGraw- Hill Publishing Company Limited, New Delhi 2. Proceedings of recent seminars / workshops / conferences and Papers from relevant National and International Journals.

M.Tech.(Structural Engineering)
Semester-I
2022-23

Course Title	Instrumentation And Experimental Techniques			
Course Code	MENSE104T			
Course Credits	L	T	P	TC
	3	1	-	4
Prerequisites	Engineering Physics, Basic Electrical & Electronics			
Course Objectives	**This course will enable students to:-** • Provide the knowledge of Pressure, Sound, Flow, Temperature, Level, Humidity, Torque, Viscosity and Vibration measurements			
Course Contents	**UNIT I** **Measurement-**Basic Concept in Measurements, Measurement of displacement, strain pressure, force, torque etc, Types of strain gauges (Mechanical, Electrical resistance, Acoustical etc.) **UNIT II** **Strain Gauges-**Strain gauge circuits, The potentiometer and Wheatstone bridge, use of lead wires switches etc. Use of strain gauges in structural applications. **UNIT III** **Data Processing-** Indicating and recording devices, Static and dynamic data recording, Data (Digital and Analogue) acquisition and processing systems. Strain analysis methods, Rosette analysis. Static and dynamic testing techniques. Equipment for loading-Moire's techniques. **UNIT IV** **Non Destructive Techniques-** Non destructive testing techniques. Photo elasticity, optics of photo elasticity, Polariscope, Isoclinics and Isochromatics, methods of stress separation. **UNIT V** **Model Analysis-**Laws of similitude, model materials, model testing, testing large scale structures, holographic techniques			
Course Outcomes	**After the completion of course:-** • Illustrate the different methods for the measurement of length and angle • Elucidate the construction and working of various industrial devices used to measure pressure, sound and flow • Explicate the construction and working of various industrial devices used. • Measure temperature, level, vibration, viscosity and humidity • Ability to analyze, formulate and select suitable sensor for the given industrial			

	applications.
Text Books	1. Experimental stress Analysis, Dally J W and Riley W.F, McGraw-Hill Inc. New York, 1991.
	2. Experimental Stress Analysis, Srinath L S et al, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 1984
Reference Books	1. Instrumentation – Devices and Systems, Rangan C S et al., Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 1983.
	2. Experimental Stress Analysis, Sadhu Singh, Khanna Publishers, New Delhi, 1996.

Course Title	Limit State Design of Steel Structures				
Course Code	MENSE105T (Elective-I)				
Course Credits	**L**	**T**	**P**	**TC**	
	3	**1**	**-**	**4**	
Prerequisites	Steel Structure-I&II				
Course Objectives	**This course will enable students to:-** • Introduce steel structures and its basic components • Introduce structural steel fasteners like welding and bolting • Design tension members, compression members, beams and beam-columns • Design column splices and bases				
Course Contents	**UNIT I** **Materials And Methods Of Analysis-**Properties of Structural Steel, I. S. Specification for Rolled Sections, Elastic Analysis, Plastic Analysis for steel beams and frames - plastic hinges, Collapse mechanism, plastic modulus, shape factor. Introduction to working stress method and Limit state method of design of steel structures, Classification of rolled sections, types of loads and load combinations. **UNIT II** **Fasteners And Tension Members-**Riveted, Bolted and Welded Connections, Strength, Efficiency and Design of Joints, Advantages and Disadvantages of Welded Joints, Design of Fillet and Butt Welds, Design of Eccentric Connections, High strength friction grip bolts. Net Sectional Area of Tension Members, Design of Axially Loaded Tension Member, Steel Angles under tension **UNIT III** **Compression Members**-Modes of Failure of a Column, Buckling Failure: Euler's Theory, Effective Length, Slenderness Ratio, I.S. Code approach for design of Compression Members, Design of Built-Up Compression Members. **UNIT IV** **Beams-**Design Procedure, laterally supported and laterally unsupported beams, Web Crippling, Web Buckling, Design of Built-Up Beams, Curtailment of Flange Plates **UNIT V** **Beam Columns And Column Bases-**Design of Member Subjected to combined forces, Eccentricity of Load, Interaction Formulae. Slab and Gusseted Bases, Eccentrically Loaded Base Plates.				
Course	**After the completion of course:-**				

Outcomes	• Learn the basic elements of a steel structure • Learn the fundamentals of structural steel fasteners • Able to design basic elements of steel structure like tension members, compression members, beams and beam-columns • Able to design column splices and bases. • The students will learn to understand the theoretical and practical aspects of Design of Steel Structure along with the planning and design aspects.
Text Books	1. Teaching Resource for Structural Steel Design, Volumes I – III, Institute for Steel Development and Growth, Kolkata. 2. Various Indian Standard codes of practice on steel structures.
Reference Books	1. Design of steel structures by K.S.Sai Ram, Pearson Education, 2010 2. Limit state design of steel structures by M.R.Shiyekar , PHI Learning,2010.

Course Title	Advanced Design of Steel Structures			
Course Code	MENSE105T (Elective-I)			
Course Credits	L	T	P	TC
	3	1	-	4
Prerequisites	Steel Structure-I & II			
Course Objectives	**This course will enable students to:-** • Recommended for seniors in the civil engineering program who are interested in learning the design of steel structures. • Learn the behavior and design of structural steel components (members and connections in two - dimensional (2D) truss and frame structures) and to gain an educational and comprehensive experience in the design of simple steel structures.			
Course Contents	**UNIT I** **Plate And Gantry Girders-**Design of Plate Girders, Vertical and Horizontal Stiffeners for plate girders, Connections and Splices. Forces acting on gantry girders, Cross sections for Gantry Girders, Design Considerations. **UNIT II** **Industrial Buildings** -Single storey Industrial buildings and bents, Design of Trusses, Purlins, Louver rails, Gable column etc., Analysis of Gable Frames, check for deflection. **UNIT III** **High Rise Buildings-**Design of members subjected to lateral loads and axial loads Sway and non-sway frames, Permissible sway. **UNIT IV** **Connections-**Types of connections, Design of framed and seated beam connections, Unstiffened and Stiffened seat connections, Continuous beam-to-beam connections and continuous beam-to-column connection, moment resisting connections, welded and bolted connections. **UNIT V** **Light Gauge Steel Structures-**Types of cross sections, local bucking and lateral bucking, concepts of Effective width, Design of compression and tension members, Beams, Deflection of beams and design of beam webs. Combined stresses and connections.			
Course Outcomes	**After the completion of course:-** • Identify and compute the design loads on a typical steel building. • Identify the different failure modes of steel tension and compression members			

	and beams, and compute their design strengths
	• Identify the different failure modes of bolted and welded connections, and determine their design strengths.
	• Design bolted and welded connections for tension and comp. members and beams. to understand methods of structural steel design,
	• Design various types of steel structures
	• Understand techniques and method of communicating engineering design to industry
Text Books	1. Steel Designers' Manual, Davidson B. and Owens, G.W., Blackwell Publishing, UK 2. Steel Design, 4th Edition, W.T. Segui, Thomson Engr. Publishing Company, 2007. 3. Teaching Resource for Structural Steel Design, Volumes I – III, Institute for Steel Development and Growth, Kolkata. 4. Various Indian Standard codes of practice on steel structures.
Reference Books	1. Davidson B. and Owens, G.W., Steel Designers' Manual, Blackwell Publishing, UK 2. Proceedings of recent seminars / workshops / conferences and Papers from relevant National and International Journals.

M.Tech.(Structural Engineering)
Semester-I
2022-23

Course Title	Theory of Elastic Stability			
Course Code	MENSE105T (Elective-I)			
Course Credits	L	T	P	TC
	3	1	-	4
Prerequisites	RCC & Steel Structure			
Course Objectives	**This course will enable students to:-** • Learn about various theories of elasticity and apply them to solve 2D Cartesian and polar problems. • Demonstrate various theories of torsion and apply them to solve 2D torsional problems. • Provide knowledge of various theories of plastic behavior and apply them to solve 2D problems.			
Course Contents	**UNIT I** **Stability Of Columns-**Concepts of Elastic Structural stability, Analytical approaches to stability, characteristics of stability analysis, Elastic Buckling of columns, Equilibrium, Energy and Imperfection approaches, Non-prismatic columns, Built up columns, orthogonally of buckling modes, Effect of shear on buckling load, Large deflection theory. **UNIT II** **Methods Of Analysis-**approximate methods, Rayleigh and Galerkin methods, numerical methods, Finite difference and finite Element, analysis of columns, Experimental study of column behavior, South well plot, Column curves, Derivation of Column design formula, Effective length of Columns. **UNIT III** **Beam Columns And Frames-**Beam column behavior, standard cases, Continuous columns and beam columns, Column on elastic foundation, Buckling of frames, Single storey portal frames with and without side sway, Classical and stiffness methods, Approximate evaluation of critical loads in multistoried frames **UNIT IV** **Buckling of Beams-**Lateral buckling of beams, Energy method, Application to Symmetric and simply symmetric I beams, simply supported and Cantilever beams, Narrow rectangular cross sections, Numerical solutions, Tensional buckling, Uniform and non uniform Torsion on open cross section, Flexural tensional buckling, Equilibrium and energy approach. **UNIT V** **Buckling of Thin Plates-**Isotropic rectangular plates, Governing Differential equations, Simply Supported on all edges, Use of Energy methods, Plates with			

	stiffeners, Numerical Techniques.
Course Outcomes	**After the completion of course:-** • Analyze plastic stress-strain behavior to solve basic problems. • Analyze various criteria for material yielding and apply to various problems. • Analyze 2D problems for finding collapse loads • Define state of stress and strains, equilibrium and compatibility, • Derive the governing equations and their solutions for application to problems in plane • Stress state, plane strain state, torsion, bending.
Text Books	1. Stability of Structures, Ashwini kumar, Allied Publishers Ltd. 2. Theory of Elasticity, Sadhu Singh Khanna Publishers, 4th Edition, 2012 3. Theory of Elastic stability, Stephen P. Timoshenko and Gere McGraw-Hill Company.
References Books	1. Smitses, Elastic Stability of Structures, Prentice Hall. 2. NGR Iyengar, "Structural Stability of Columns and Plates" Affiliated East-West Press Pvt. Ltd