OP Jindal University
Raigarh-Chhattisgarh

UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Scheme and Syllabus of
Masters in Technology
School of Engineering
Session- 2021-2023

Programme Outcomes for Engineering Post Graduate Programme

PO_1: Disciplinary knowledge: Accomplish vertical expertise in chosen discipline and enhance ability to function in multidisciplinary domains.

PO_2: Research aptitude: Ability and aptitude to exercise research intelligence in investigations/ innovations and to communicate the findings in a clear, concise manner.

PO_3: Project management: Develop and apply knowledge of engineering and management principles to manage a project in a multidisciplinary environment.

PO_4: Ethics: Gain knowledge of ethical principles and commit to professional ethics

PO_5: Self-directed lifelong learning: Ability to identify appropriate resources and learn independently for projects, research etc. using online resources.

Programme Specific Outcome (PSO) for Engineering Post Graduate Programme

PSO_1: Design and develop infrastructural facility using concepts of Mathematics, Civil Engineering and other related disciplines to meet end users' objectives.

PSO_2: Test and analyze the quality of various civil engineering materials and to integrate the same to assure quality in construction.

PSO_3: Ensure the holistic growth through the awareness of effective communication, ethical responsibilities and physical/mental fitness.

PSO_4: Build a solid foundation in the domain of Civil Engineering for developing analytical, technical, professional & management skills

SEMESTER I

Sl. No	Subject Code	Subject	Periods per Week			Scheme of Examination		Total Marks	Credit L+(T+P)/2
						Theory / Practical			
			L	T	P	PRE	ESE		
1.	SOE-M-SE101	Introduction to Earthquake Engineering	3	1	..	50	50	100	4
2.	SOE-M-SE102	Advanced Solid Mechanics	3	1	..	50	50	100	4
3.	SOE-M-SE103	Structural Dynamics	3	1	..	50	50	100	4
4.	SOE-M-SE104	Matrix Methods in Structural Analysis	3	1	..	50	50	100	4
5.	SOE-M-SE105 (1-3)	Program Elective (Annexure -I)	3	1	..	50	50	100	4
6.	SOE-M-SE106	Structural Dynamics Lab	..	..	4	50	50	100	2
7.	SOE-M-SE107	Matrix Method in Structural analysis Lab	..	..	4	50	50	100	2
8.	SOE-M-SE108	Research Seminar-I				25	25	50	2
Total			**15**	**5**	**8**	**375**	**375**	**750**	**26**

L: Lecture, T: Tutorial, P: Practical, ESE: End Semester Examination T.A: Teacher's Assessment.

Program Elective -I (CIE Annexure - I)

Sr. No.	Subject Code	Name of the Courses
1	SOE-M-SE105 (1)	Theory of Structural Stability
2	SOE-M-SE105 (2)	Structural Optimization
3	SOE-M-SE105 (3)	Structural Health Monitoring

SEMESTER II

Sl. No	Subject Code	Subject	Periods per Week			Scheme of Examination Theory / Practical		Total Marks	Credit L+(T+P)/2
			L	T	P	PRE	ESE		
1.	SOE-M-SE201	FEM in Structural Engineering	3	1	..	50	50	100	4
2.	SOE-M-SE202	Theory of Plates and Shells	3	1	..	50	50	100	4
3.	SOE-M-SE203	Advanced Steel Design	3	1	..	50	50	100	4
4.	SOE-M-SE204 (1-4)	Program Elective – II (PE Annexure – II)	3	1	..	50	50	100	4
5.	SOE-M-SE205	FEM Lab	..	..	4	50	50	100	2
6.	SOE-M-SE206	Numerical Analysis of Steel Structure Lab	..	..	4	50	50	100	2
7.	SOE-M-SE207	Research Seminar-II				25	25	50	2
Total			**12**	**4**	**8**	**325**	**325**	**650**	**22**

L: Lecture, T: Tutorial, P: Practical, ESE: End Semester Examination T.A: Teacher's assessment.

Program Elective II (PE Annexure – II)

Sr. No.	Subject Code	Name of the Courses
1	SOE-M-SE204 (1)	Advanced Design of Foundation
2	SOE-M-SE204 (2)	Advanced Design of RCC Structure
3	SOE-M-SE204 (3)	Soil Structure Interaction
4	SOE-M-SE204 (4)	Design of Industrial Structure

Programme:	**M.Tech.**	**Semester :**	**I**
Name of the Course:	**Introduction to Earthquake Engineering**	**Course Code:**	**SOE-M-SE101**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description:

The course on Introduction to Earthquake Engineering provides the fundamental concepts, principles and application of earthquake engineering in seismic analysis and design of structures.

The course begins with the Seismology explaining the causes of occurrence of earthquake and its characterization. The seismic analysis of the structures under earthquake excitation is developed. The structural system modeled as discrete and continuous system.

Course Outcomes:

Students will be able:

CO1	To understand the fundamentals of earthquake engineering and seismicity conditions of the country and world.
CO2	To perform site specific deterministic seismic hazard analysis.
CO3	To analyze earthquake characteristics and associated effects on structures, including linear responses.

Syllabus

UNIT- I

Introduction to earthquake phenomenon, Origin of earthquakes, Engineering geology, Seismicity of the world, Faults, Earth's Interior and Plate Tectonics, Causes of Earthquakes and Seismic Waves, Propagation of earthquake waves.

UNIT- II

Quantification of earthquake (magnitude, energy, intensity of earthquake), Measurements of earthquake (accelerograph, accelogram recording), case study: Seismic Hazard Analysis of latest earthquake world over.

UNIT- III

Determination of magnitude, Epicental distance, focal depth, etc. Ground motion and their characteristics, Factors affecting ground motions, case study: Seismic Parameters Analysis of latest earthquake world over.

UNIT- IV

Concept of Response Spectrums of Earthquake, generation of site-specific spectrum, Time History Records and Frequency Contents of Ground Motion, Estimation of Peak Ground Acceleration, Earthquake design spectrum and inelastic spectra.

UNIT- V

Concept of earthquake Resistant design, design philosophy, four virtues of Earthquake Resistant Design (EQRD): Stiffness, Strength, ductility and Configurations, Introduction toCapacity design concepts, Introduction to IS:1893, Codal Coefficient and Response Spectrum Method.

Text Books:

1. Earthquake Resistance Design for Engineers and Architects, Dowrick, D. L. John Willey & Sons, 2 nd Edition, 1987.
2. Earthquake Design Criteria, Housner, G. W. &Jenning, P.C. Earthquake Engineering Research Institute, Oakland, California, USA, 1982.
3. Earthquake Spectra & Design, Earthquake Design Criteria, Newmark, N. M. & Hall, W.J. 1982.
4. Geotechnical Earthquake Engineering, Kramer, S. L. Prentice Hall, New Jersey, 1996.
5. Seismic analysis of structures by T. K. Dutta

Reference Books:

1. Design of Earthquake Resistance Buildings, Wakabayashi, M., McGraw Hill Books Company, 1986.
2. Introduction to Earthquake Engineering, Okamoto, S. University of Tokyo press, 2nd Edition, 1984.

Assessment:

Assessment includes attendance, class work, tutorials, assignments, quizzes, exams.

CO-PO&PSO Correlation

Course Name: Introduction to Earthquake Engineering									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3	3			2				3
CO2:	3	2				3			3
CO3:	3	2			2	3			3

Note:1: Low 2.: Moderate 3: High

Programme:	**M.Tech.**	**Semester :**	**I**
Name of the Course:	**Advanced Solid Mechanics**	**Course Code:**	**SOE-M-SE102**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description:

In this course 'Advanced Solid Mechanics' a general theory available to study the response of solids to applied forces will be developed and will be used to study simple boundary value problems. The aim of the course would be to inculcate in the reader some of the available tools to analyze a structure and to elucidate the simplifying assumptions made to make the structure analyzable.

Course Objectives:

Students will be able:

CO1	Solve the advanced practical problems related to the theory of elasticity, concepts of stress and strain, strain energy, and failure criteria.
CO2	Propose materials and structural elements to the analysis of complex structures.

Syllabus

UNIT- I

Theory of 3D Stresses: Introduction to stress tensor components,Analysis of stress and strain, stress components on an arbitrary plane, Equilibrium equations, Stress transformation, Principal stresses, invariants, stress Boundary conditions. Mohr's circle for the three dimensional state of stress.

UNIT- II

Theory of 3D Strains: Introduction to strain tensor components, Strain transformation. Principal Strains, Compatibility. Stress-strain relationship, Generalized Hooke's law, Strain-energy,Illustrative problems.

UNIT- III

Elastic Constants (Relation b/w E, K and U), Uniaxial Tension Test Conditions affecting mechanical properties, Members subjected to Uniaxial stress, Thermal Stress, Illustrative problems.

UNIT- IV

St. Venant's principle, Plane stress and plane strain problems in Cartesian and polar coordinates, Stress functions, axisymmetric problems.

UNIT- V

Stress concentration, Unsymmetrical bending and Torsion. Theory of Failure. Significance of the theories of failure, mohr's theory of failure Introduction to plasticity for metals. Ideally plastic solids.

Text Books:

1. Advanced Mechanics of Solid, L.S. Srinath, 3rd ed., McGraw-Hill Education, 2009.
2. Theory of Elasticity, S.P. Timoshenko and J. N. Goodier, 3rd ed., McGraw-Hill Education, 2010.

Reference Books:

1. Theory of Elasticity, M. Filonenko-Borodich, University Press of the Pacific, 2003.
2. Advance Mechanics of Solid by R.C. Hibbeler Beer & Johnson Boresi, A.P., and Sidebottom 1947.

Assessment:

Assessment includes attendance, class work, tutorials, assignments, quizzes, exams.

CO-PO&PSO Correlation

Course Name: Advanced Solid Mechanics									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3				3	2	2		3
CO2:	2	2			3	2	3		2

Note:1: Low 2.: Moderate 3: High

Programme:	**M.Tech.**	**Semester :**	**I**
Name of the Course:	**Structural Dynamics**	**Course Code:**	**SOE-M-SE103**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description:

Structural dynamics is a basic core course at the Master's level in Structural Engineering and an advanced elective course at the undergraduate level in Civil Engineering programme at many universities in India. The present Structural Dynamics course introduces the basic concepts of dynamic loading and the response of structures to such loads, and then uses these concepts to illustrate applications in practical structures.

Course Outcomes:

Students will be able to:

CO1	Convert structure into various SDOF systems and find response of free and force vibration (harmonic, periodic and transient).
CO2	Find natural frequency and mode shapes of MDOF system and carry out modal analysis.

Syllabus

UNIT- I

Sources of vibration, types of excitations, Principle and working of piezoelectric transducers, Spring action and damping; Degrees of freedom; Application of Newton's laws, D'Alembert's principle, Single degree of freedom systems; Mathematical model of physical systems; Free vibrations of un-damped and viscously damped systems; Coulomb damping, viscous damping.

UNIT- II

Response of viscously damped SDOF systems to harmonic excitation; Vibration Isolation, Force transmissibility and base motion; Principle of vibration measuring instruments; Equivalent viscous damping; structural damping, Response of an un-damped SDOF to short duration impulse; unit impulse response.

UNIT- III

Response of un-damped system of rectangular, triangular and ramp loading; response to general dynamic excitation; Duhamel integral method. Generation and use of response spectra, Numerical evolution of dynamic response of linear systems,

UNIT- IV

Multiple degree of Freedom system: Vibration of MDOF systems; Response of MDOF to harmonic excitation, mode superposition, vibration absorber, Fourier transformation, Lagrange equation and their application to lumped parameter models of MDOF.

UNIT- V

Methods of solving Eigen value problems; Dynamic response of MDOF systems-response spectrum and modal superposition method. Response of continuous systems to dynamic loads. Energy Principle, Rayleigh-Ritz method.

Text Books:

1. Dynamics of Structures, Chopra, A. K. (1995). (Vol. 3). New Jersey: Prentice Hall.
2. Dynamics of Structures, Clough, R. W., &Penzien, J. (1993). vol. 2.
3. Dynamics of Structures, Humar, J. L. Prentice-Hall, Englewood Cliffs, NJ, 1990.
4. Structural Dynamics: theory and computation, Paz, M. Springer India pvt.Ltd(2012).
5. Advanced Dynamics. Timoshenko, S. P., & Young, D. H. McGraw Hill, (1948).

Reference Books:

1. Elements of Vibration Analysis, Meirovitch, L. McGraw-Hill, (1975).
2. Introduction to Structural Dynamics, J. M., & Testa, B. (1964).
3. Fundamentals of Structural Dynamics, Craig, R. R., &Kurdila, A. J. John Wiley & Sons. (2006).
4.Elements of Earthquake Engineering and Structural Dynamics, Filiatrault, A.(2013).
5. Structural Dynamics for Engineers, Buchholdt, H. A. (1997), Thomas Telford.
6. Dynamics of Structures, Paultre, P. (2013), John Wiley & Sons.

Assessment:

Assessment includes attendance, class work, tutorials, assignments, quizzes, exams.

CO-PO&PSO Correlation

Course Name: Structural Dynamics									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3	2			2	2			3
CO2:	3	2			2	2	1		2

Note:1: Low 2.: Moderate 3: High

Programme:	**M.Tech.**	**Semester :**	**I**
Name of the Course:	**Matrix Methods in Structural Analysis**	**Course Code:**	**SOE-M-SE104**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description:

This course at PG level generally provides the fundamental concepts of stiffness and flexibility approach which is essential to understand the structural behaviour.

Course Outcomes:

The students shall acquire;

CO1	Knowledge of development of stiffness matrix for prismatic members.
CO2	Knowledge of matrix computations.
CO3	Ability to analyze determinate and indeterminate plane and space truss / frame system.

Syllabus

UNIT- I

Introduction to stiffness and flexibility approach, Cholesky Decomposition method , Gauss elimination method Formulation of algorithm for Gauss elimination method , static condensation, substructure technique. Stiffness matrix for spring, Bar, torsion, Assembly of structure stiffness matrix with structural load vector.

UNIT- II

Analysis of beam (2D), Introduction to local and global coordinate systems, transformation matrix, plane truss and plane frame subjected to joint loads.

UNIT- III

Analysis of structure under temperature loading, lack of fit and inclined support conditions. Problems on beam on elastic foundation.

UNIT- IV

Formulation of algorithm for stiffness approach and solutions in C++ /MATLAB for spring element, bar problem. Formulation of algorithm for Problems on beam on elastic foundation in C++ /MATLAB.

UNIT- V

Solutions in C++ /MATLAB for plane truss and plane frame subjected to joint and member loads.

Text Books:

1) Matrix Methods of Structural Analysis – Godbole and Sonparate
2) Structural analysis – A matrix approach by G.S.Pandit and Gupta
3) Matrix Analysis of Frame Structure-Wever/Gere
4) Advanced Structural analysis by Devdas Menon

Reference Books:

1) Numerical Methods for Engineering by Steven C. Chapra, Raymond P. Canale
2) Matrix Methods of Structural Analysis, Kanchi, M. B. (1993), New Age International.
3) Matrix Analysis of Structures SI Version, Kassimali, A. (2011), Cengage Learning.
4) Concepts and applications of finite element analysis, Cook, R.D.(2007),John Wiley & Sons.
5) Matrix Methods of Structural Analysis, Wang, C.K.,International Textbook Compant 1970.

Assessment:

Assessment includes attendance, class work, tutorials, assignments, quizzes, exams.

CO-PO&PSO Correlation

Course Name: Matrix methods in Structural Analysis									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3				1	2			3
CO2:	2				1	2		2	
CO3:	3	2			2	3		2	3

Note:1: Low 2.: Moderate 3: High

Programme:	**M.Tech.**	**Semester :**	**I**
Name of the Course:	**Theory of Structural Stability**	**Course Code:**	**SOE-M-SE104(1)**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description:

This course is meant primarily for senior undergraduate and post-graduate students in Civil, Aerospace and Mechanical Engineering.
Major topics covered are: stability of discrete systems; buckling of columns; buckling of beam-columns and frames; buckling of thin rectangular plates; torsional and lateral-torsional buckling.

Course Objectives:
Students will be able to:

CO1	The students are expected to be able to apply the theory of elastic stability, to study the buckling of beams, columns, frames and plates.

Syllabus

UNIT- I
Fundamental concepts: Concept of stability, instability and bifurcation, different forms of structural instability, analytical approaches of stability analysis.

UNIT- II
Columns: Governing differential equation, cases of standard boundary conditions, effective length concept, elastically restrained column, column with geometric imperfections, eccentrically loaded column, large deflection analysis. Inelastic Buckling.

UNIT- III
Beam-columns & frames: Standard cases of beam columns, continuous columns and beam columns, single-storey frames, frames with sway and no-sway, buckling analysis using stiffness method, Haarman's method

UNIT- IV
Elastic buckling of thin plates: Governing differential equation and boundary conditions, Equilibrium and energy approach, Post-buckling analysis.

UNIT- V
Lateral-torsional buckling: Torsional buckling, torsional-flexural buckling, lateral buckling of beams with symmetric I-section.

NOTE: Application of basic principles of theory of structural stability as described in above units using computer programme is envisaged.

Text Books:

1. Stability of Structures, Ashwini Kumar, Allied Publishers, New Delhi, 1998.
2. Principles of Structural Stability Theory, Alexander Chajes, Prentice-Hall, 1974.
3. Stability Analysis and Design of Structures, Gambhir, MurariK, Springer, New Delhi 2004.

Reference Books:

1) Elastic Stability of Structural Elements, N.G.R. Iyengar, Macmillan India, 2007.
2) Theory of Elastic Stability, S.P. Timoshenko and J.M. Gere, McGraw-Hill, 2nd edition, 1961.

Assessment:

Assessment includes attendance, class work, tutorials, assignments, quizzes, exams.

CO-PO&PSO Correlation

Course Name: Theory of Structural Stability									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3				1	3	2	2	3

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Tech.**	**Semester :**	**I**
Name of the Course:	**Structural Optimization**	**Course Code:**	**SOE-M-SE105 (2)**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description: Structural optimization is a discipline dealing with optimal design of load-carrying mechanical structures.

Course Outcomes:
Students will be able to:

CO1	Understand the concepts of Optimization problems in the Structural Engineering.
CO2	Know the different methods for the Optimization problems.
CO3	Understand the concepts of Linear and Non-Linear Programming techniques.
CO4	Understand the concepts of Stochastic Optimization Methods.
CO5	Understand the concepts of Genetic Algorithm based Optimization Methods.

Syllabus

UNIT- I
Optimal cross-section area profile for the stiffest bar under arbitrary loading. Including the governing equations in the weak form. Imposing upper and lower limits on the area of cross-section.

UNIT- II
Min-max type problems with stress constraints. Min-max type stress constraint. Deflection constraint at a point.

UNIT- III
Worst load determination, A case of a single scalar unknown along with an unknown function. Revisiting of the concepts with beam examples.

UNIT- IV
Design for deflection problem for a beam. Numerical implementation of structural optimization. Beam optimization problem using the optimality criteria method.

UNIT- V
Truss and frame optimization problem for the desired deflection and an inkling of topology optimization problem.

Text Books:

1. Calculus of Variations, M. Gelfand and S. V. Fomin Dover publications
2. Variational Methods in Optimization, Smith, D. R., Dover Publications, 1998.
3. Elements of Structural Optimization, Haftka, R. T. and Gurdal, Z., Kluwer Academic Publishers, 1992.

Reference Books:

1) Elements of Structural Optimization, Haftka, R. T. and Gurdal, Z., Kluwer Academic Publishers, 1992.

Assessment:

Assessment includes attendance, class work, tutorials, assignments, quizzes, exams.

CO-PO&PSO Correlation

Course Name: Structural Optimization									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	2	2			2	3	1	2	2
CO2:	2	2			2	3	1	2	2
CO3:	2				1	3	3		3
CO4:	2	2			1	2	0		2
CO5:	2	2			1	2	0		1

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Tech.**	**Semester :**	**I**
Name of the Course:	**Structural Health Monitoring**	**Course Code:**	**SOE-M-SE105(3)**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description: Structural health monitoring (SHM) refers to the process of implementing damage detection and characterization strategy for engineering structures Here damage is defined as changes to the material and/or geometric properties of a structural system, including changes to the boundary conditions and system connectivity, which adversely affect the system's performance.

Course Outcomes:
Students will be able to:

CO1	To understand the structural health issue and identify.
CO2	To suggest techniques for health monitoring.
CO3	To perform health procedure and draw appropriate conclusion
CO4	To suggest optimized solution.

Syllabus

UNIT- I
Introduction: Definition, Principles, significance of SHM, potential applications in Civil, Naval, Aerospace & Manufacturing Engineering

UNIT - II
Operational Evaluation: Sensor technology, piezoelectric wafer active sensors, data acquisition and cleaning procedures, elastic waves in solid structures, guided waves

UNIT -III
Feature Extraction methods: Identifying damage sensitive properties, signal processing, Fourier and short term Fourier transform, wavelet analysis

UNIT- IV
Pattern Recognition: State-of-Art damage identification and pattern reorganization methods, neural networks, Feature extraction algorithms

UNIT -V
Case studies: SHM based flaw detection in mechanical structures- Integrity and damage recognition in plates and pipes, defect identification in weld joints, wear monitoring in cutting tools

Text Books:

1. Structural Health Monitoring, Claus-Peter Fritzen and Alfredo Guemes, Daniel Balageas, John Wiley & Sons, 2006.
2. Structural Health Monitoring with Piezoelectric wafer Active Sensors, Victor Giurgiutiu, Academic Press, 2008.

Reference Books:

1. Structural Health Monitoring: Current Status and Perspectives, Fu Ko Chang

Assessment:
Assessment includes attendance, class work, tutorials, assignments, quizzes, exams.

CO-PO&PSO Correlation

Course Name: Structural Health Monitoring									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3	2			2	3			2
CO2:	2					3			3
CO3:	1					3			3
CO4:	2	2				3			

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Tech.**	**Semester :**	**I**
Name of the Course:	**Structural Dynamics Lab**	**Course Code:**	**SOE-M-SE106**
Credits :	**2**	**No of Hours :**	**2 Hrs/Week**
Max Marks:	**50**		

Course Description: The Structural Analysis courses at PG level generally provide the fundamental concepts which are suitable for hand calculations.

Course Outcomes:

Students will be able to:

CO1	At the completion of this course, the student shall acquire knowledge and ability to perform experiments and computer simulation of vibrating system.

List of Experiments:

1. To find the time period of compound pendulum
2. To compare natural frequency of SDOF system using C++/MATLAB and Physical verification in Lab.
3. To compare natural frequency of two DOF system using C++/MATLAB and Physical verification in Lab.
4. To compare natural frequency of three DOF system using C++/MATLAB and Physical verification in Lab.
5. To observe liquefaction of soil
6. To observe phenomenon of vibration absorption
7. Frequency analysis of MDOF system using C++/MATLAB and Physical verification in Lab.
8. Generation of response spectrum.
9. Response of MDOF system using modal superposition using C++/MATLAB and Physical verification in Lab.
10. Response spectrum analysis of MDOF system using C++/MATLAB and Physical verification in Lab.

Recommended Books:

1) Numerical Methods for Engineers by Chopra
2) Matrix Analysis of Frame Structure-Wever/Gere
3) Numerical Methods for Engineers by Steven C. Chapra, Raymond P. Canale

CO-PO&PSO Correlation

Course Name: Structural Dynamics Lab									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3	2			1	2			1

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Tech.**	**Semester :**	**I**
Name of the Course:	**Matrix Method in Structural analysis Lab**	**Course Code:**	**SOE-M-SE107**
Credits :	**2**	**No of Hours :**	**2 Hrs/Week**
Max Marks:	**50**		

Course Description: The Matrix Method in Structural Analysis Lab courses at PG level generally provide the fundamental concepts which are suitable for coding of computer programme.

Course Outcomes:

Students will be able to:

CO1	to perform experiments and computer simulation of building system.

List of Experiments:

1. Analysis of various structural systems using STAAD Pro/SAP.
2. Modelling of two storey Framed structure in STAAD Pro/SAP.
3. Study of various mathematical models like Buildings with braces and shear walls
4. Design of multi-storey RCC Framed structure in STAAD Pro/SAP.

Recommended Books:

1) Numerical Methods for Engineers by Chopra

Assessment:

Assessment includes attendance, class work, assignments, quizzes, exams.

CO-PO&PSO Correlation

Course Name: Matrix Method in Structural Analysis Lab									
	Program Outcomes					**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**
CO1:	**3**	**1**			**1**	**3**			**2**

Note:1: Low 2.: Moderate 3: High

Programme:	**M.Tech.**	**Semester :**	**II**
Name of the Course:	**FEM in Structural Engineering**	**Course Code:**	**SOE-M-SE201**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description: This course is meant primarily for senior undergraduate and post-graduate students in Civil Engineering. Major topics covered are: CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations. Computer Implementation of FEM procedure, Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software.

Course Outcomes:

Students will be able to

CO1	At the completion of this course, the student shall acquire knowledge and ability to perform experiments and computer simulation of building system.

Syllabus

Unit I:

Introduction: History and Applications. Finite element formulation using Minimum Potential Energy Principle, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.

Unit II:

Method of Weighted Residuals: Galerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.

Unit III:

Plane Stress, CST Element, Plane Strain Rectangular Element, Three-Dimensional Elements, Numerical Integration, Gaussian Quadrature.

Unit IV:

Application to Solid Mechanics: Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations.

Unit V:

Computer Implementation of FEM procedure, Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software

Text Books:

1. Finite – Element Method - Zienkiewicz O.C. & Taylor R.L.Vol. I, II & III, Elsevier, 2000.
2. Finite Element Methods in Engineering- Belegundu A.D., Chandrupatla, T.R, Prentice Hall India, 1991.
3. Finite Element Analysis, Seshu P., Prentice-Hall of India,2005.

Reference Books:

1. Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995.
2. Fundamentals of Finite Element Analysis, Hutton David, McGraw Hill, 2004.
3. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995.

CO-PO&PSO Correlation

Course Name: FEM									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3	3			3	3	2		3
CO2:	2	3			3	3			3
CO3:	3	3			3	3			3

Note:1: Low 2.: Moderate 3: High

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UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme:	**M.Tech.**	**Semester :**	**II**
Name of the Course:	**Theory of Plates and Shells**	**Course Code:**	**SOE-M-SE202**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description:

This course is meant primarily for senior undergraduate and post-graduate students in Civil, Aerospace and Mechanical Engineering.

Major topics covered are: Bending of long thin rectangular plate to a cylindrical surface, Kirchhoff plate theory, Introduction to orthotropic plates, Circular plates with various boundary conditions and loadings, Numerical methods for solution of plates, Navier's, Levy's solutions.

Course Outcomes:

Students will be able to

CO1	Use analytical methods for the solution of thin plates and shells.
CO2	Use analytical methods for the solution of shells.
CO3	Apply the numerical techniques and tools for the complex problems in thin plates.
CO4	Apply the numerical techniques and tools for the complex problems in shells.

Syllabus

Unit II:

Governing differential equations of thin rectangular Plates with various boundary conditions and loadings.

Unit II:

Bending of long thin rectangular plate to a cylindrical surface, Kirchhoff plate theory, Introduction to orthotropic plates.

Unit III:

Circular plates with various boundary conditions and loadings.

Numerical methods for solution of plates, Navier's, Levy's solutions.

Unit IV:

General shell geometry, classifications, stress resultants, equilibrium equation, Membrane theory for family of Shells (Parabolic, Catenary, Cycloid, Circular, hyperbolic).

Unit V:

Classical bending theories of cylindrical shells with and without edge beams such as approximate analysis of cylindrical shells.

Text Books:

1. Theory of Elasticity- S P Timoshenko and J N Goodier, Tata McGraw Hill Publishing Company Limited, New Delhi.
2. Computational Elasticity- M Ameen, Narosa, Publishing House.

Reference Books:

1. Advanced Mechanics of Solids - L S Srinath Tata McGraw Hill Publishing Company Limited, New Delhi.
2. Theory of Plasticity - J Chakrabarty Elsevier Butterworth-Heinemann
3. Advanced Mechanics of Materials - A P Boresi and R J Schmidt John Wiley & Sons, Inc.

CO-PO&PSO Correlation

Course Name: Theory of Plates and Shells									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3	2			2	3		3	3
CO2:	3	1			1	3		3	3
CO3:	3	2			3	3		2	3
CO4:	2	2			3	3		2	3

Note:1: Low 2.: Moderate 3: High

Programme:	**M. Tech.**	**Semester :**	**II**
Name of the Course:	**Advanced Steel Design**	**Course Code:**	**SOE-M-SE203**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description:

This course is meant primarily for senior undergraduate and post-graduate students in Civil, Aerospace and Mechanical Engineering.
Major topics covered are: Plastic design, Load and Resistance Factor Design, Loadings as per IRC, IRS, IS (IS:800, IS:875 part 1-V, IS:1893) applicable to various steel structures.

Course Outcomes:

Students will be able to

CO1	Design steel structures/ components by different design processes.
CO2	Analyze and design beams and columns for stability and strength, and drift.
CO3	Design welded and bolted connections.

Syllabus

Unit I:

Introduction to Allowable Stress Design, Plastic design, Load and Resistance Factor Design
(LFRD).

Unit II:

Loadings as per IRC, IRS, IS (IS:800, IS:875 part 1-V, IS:1893) applicable to various steel
structures.

Unit III:

Design of Beams, Beam-column, Plate Girders, Open web structures and Space structures.

Unit IV:

Bridges, Industrial Buildings including crane girders.

Unit V:

Welded and riveted connections. Composite structures.

Text Books:

3. Design of Steel Structures , Arya A. S., Ajmani J. L., Nemchand and Bros Roorkee.
4. The Steel Skeleton- Baker J. F., Horne M. R., Heyman J,
5. Design of Steel Structures by N. Subramanian Oxford Higher Education
6. Steel Structures - Design Behaviour by Salmon Johnson
7. Steel Structures: Controlling Behavior Through Design by E. Englekirk

Reference Books:

1. Neal B. G., Chapman –Plastic Methods of Structural Analysis, Hall London.
2. IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.
3. SP – 6 - Handbook of Structural Steel Detailing, BIS,198

CO-PO&PSO Correlation

Course Name: Advanced Steel Design									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3				2	3		1	2
CO2:	2				2	3		1	3
CO3:	2				1	2		2	1

Note:1: Low 2.: Moderate 3: High

Programme:	**M.Tech.**	**Semester :**	**II**
Name of the Course:	**Advance Design of Foundation**	**Course Code:**	**SOE-M-SE204(1)**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description:

This course is meant primarily for senior undergraduate and post-graduate students in Civil, Aerospace and Mechanical Engineering.
Major topics covered are: Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings along with Various Penetration Tests, Shallow Foundations, Pile Foundations, Well Foundation, IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods, Tunnels.

Course Outcomes:

Students will be able to

CO1	Decide the suitability of soil strata for different projects.
CO2	Design shallow foundations deciding the bearing capacity of soil.
CO3	Analyze and design the pile foundation.
CO4	Understand analysis methods for well foundation.

Syllabus

Unit I:

Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of
Borings along with Various Penetration Tests.

Unit II:

Shallow Foundations, Requirements for Satisfactory Performance of Foundations, Methods of
Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using
Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws.

Unit III:

Pile Foundations, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations,Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimationof Load- Settlement Behaviour of Piles, Proportioning of Pile Foundations, Lateral and UpliftCapacity of Piles.

Unit IV:

Well Foundation, IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods.

Tunnels and Arching in Soils, Pressure Computations around Tunnels.

Unit V:

Open Cuts, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.
Coffer Dams, Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structure interaction

Text Books:

1. Design of foundation system- N.P. Kurian, Narosa , Publishing House
2. Foundation Analysis and Design- J. E. Bowles , Tata McGraw Hill New York

Reference Books:

1. Analysis and Design of Substructures- SawmiSaran , Oxford and IBH Publishing Co. Pvt. Ltd, New,Delhi.

CO-PO&PSO Correlation

Course Name: Advance Design of Foundation									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3	2			2	1	1	2	2
CO2:	2				1	3	1	2	2
CO3:	3				2	3	1	2	3
CO4:	3				2	3	1	2	3

Note:1: Low 2.: Moderate 3: High

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Programme:	**M.Tech.**	**Semester :**	**II**
Name of the Course:	**Advance Design of RCC Structures**	**Course Code:**	**SOE-M-SE204(2)**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description:

This course is meant primarily for senior undergraduate and post-graduate students in Civil Engineering.
Major topics covered are: Limit State Design of RC members. Confinement of concrete, ductile detailing, beams, Preliminary sizing and modelling of RC structures. Design of Flat slab and grid slabs, Basics of Prestressed concrete Design, Material, Prestressing systems, Losses, Stress checks, Strength check, Deflection of prestressed concrete beams, Prestressed slabs and Beams, Behaviour of un bonded and bonded prestressed concrete beams.

Course Outcomes:

Students will be able to

CO1	Analyze the special structures by understanding their behavior.
CO2	Design and prepare detail structural drawings for execution citing relevant IS codes.

Syllabus

Unit I:

Review of Limit State Design of RC members. Confinement of concrete, ductile detailing.
Beams (Flexural, Shear and torsion)

Unit II:

Uni-axial and biaxial Beam-column (Axial, shear and moments)

Unit III:

Preliminary sizing and modelling of RC structures. Design of Flat slab and grid slabs.

Unit IV:

Basics of Prestressed concrete Design, Material, Prestressing systems, Losses, Stress checks, Strength check, Deflection of prestressed concrete beams, Prestressed slabs and Beams, Behaviour of un bonded and bonded prestressed concrete beams.

Unit V:

Shear and Torsional resistance of the prestressed concrete members, Analysis and design of End blocks.

Text Books:

3. Design of Reinforced Concrete Structures- P. Dayaratnam., P.Sarah, Oxfored and IBH Publishing House Co. Pvt. Ltd,4th Ed.
4. Advanced Reinforced Concrete Design- Varghese, P.C. , Prentice Hall of India.
5. Reinforced Concrete Design- Pillai S. U. and Menon D. , Tata McGraw-Hill, 3rd Ed, 1999.
6. Design of Prestressed Concrete Structures-T.Y.Lin., Ned H. Burns Wiley Publication, 3rd ed.

Reference Books:

4. Advanced Reinforced Concrete Design - Krishna Raju, N. CBS Publishers.
5. Reinforced Concrete Structure Structural Elements: Behaviour Analysis and Design-Purushothaman, P, Tata McGraw-Hill.
6. Design of Concrete Structures- Arthur H. Nilson, Tata McGraw-Hill.

CO-PO&PSO Correlation

Course Name: Advance Design of RCC Structures									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3	1			2	3	2	3	3
CO2:	3	1			3	3		3	3

Note:1: Low 2.: Moderate 3: High

Programme:	**M.Tech.**	**Semester :**	**II**
Name of the Course:	**Soil Structure Interaction**	**Course Code:**	**SOE-M-SE204(3)**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description:

This course is meant primarily for senior undergraduate and post-graduate students in Civil.

Major topics covered are: Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction. Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method. Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics.

Course Outcomes:

Students will be able to

CO1	Understand soil structure interaction concept and complexities involved.
CO2	Evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics.
CO3	Prepare comprehensive design oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.

Syllabus

Unit I:

Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil
Structure Interaction. Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method.

Unit II:

Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of
Structure under various Conditions of Loading and Subsoil Characteristics.

Unit III:

Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, RaftsEtc.

Unit IV:

Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits withLinear and Non-Linear Stress-Strain Characteristics.

Unit V:

Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles Considering Stress-Strain Characteristics of Real Soils, Anchor Piles and determination of Pull-out Resistance

Text Books:

1. Analytical and Computer Methods in Foundation- Bowels J.E., ,McGraw Hill Book Co., New York, 1974.
2. Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw Hill Book Co., New York.
3. Soil Structure Interaction - The real behavior of structures, Institution of Structural Engineers.
4. Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol-17, Elsevier Scientific Publishing Company.

Reference Books:

5. Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific
Publishing Company.
6. Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd.

CO-PO&PSO Correlation

Course Name: Soil Structure Interaction									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3	2			2	1	2	2	2
CO2:	2	0			2		2	2	2
CO3:	3	3			3	3		2	2

Note:1: Low 2.: Moderate 3: High

Programme:	**M.Tech.**	**Semester :**	**II**
Name of the Course:	**Design of Industrial Structure**	**Course Code:**	**SOE-M-SE204(4)**
Credits :	**4**	**No of Hours :**	**4 Hrs/Week**
Max Marks:	**100**		

Course Description:

This course is meant primarily for senior undergraduate and post-graduate students in Civil Engineering.
Major topics covered are: gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure, Design of square bunker – Jansen's and Airy's theories – IS Code provisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners, chimney, water tank.

Course Outcomes:
Students will be able to

CO1	Design Steel Gantry Girders.
CO2	Design Steel Portal, Gable Frames.
CO3	Design Steel Bunkers and Silos.
CO4	Design Chimneys and Water Tanks.

Syllabus

Unit I:

Steel Gantry Girders – Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure.

Unit II:

Portal Frames – Design of portal frame with hinge base, design of portal frame with fixed base -Gable Structures – Lightweight Structures.

Unit III:

Steel Bunkers and Silos – Design of square bunker – Jansen's andAiry's theories – IS Codeprovisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners.

Unit IV:

Chimneys – Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.

Unit V:

Design of pressed steel water tank – Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder – Design of staging and foundation.
Design of Steel Bridges (Railway Bridges).

Text Books:

1. Design of Steel Structure- Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers, 1998.
2. Design of Steel Structures- Ram Chandra , 12th Ed., Standard Publishers, 2009.
3. Design of Steel Structures- Subramaniyam, Tata McGraw-Hill.
4. Design of Prestressed Concrete Structures- T.Y.Lin., Ned H. Burns Wiley Publication, 3rd ed.

Reference Books:

1. Advanced Reinforced Concrete Design- Krishna Raju, N. , CBS Publishers and Distributers.
2. Reinforced Concrete Structure Structural Elements: Behaviour Analysis and Design- Purushothaman, P, Tata McGraw-Hill.
3. Design of Concrete Structures- Arthur H.Nilson, Tata McGraw-Hill.

CO-PO&PSO Correlation

Course Name: Design of Industrial Structures									
	Program Outcomes					PSOs			
Course Outcomes	1	2	3	4	5	1	2	3	4
CO1:	3	1			1	3		3	3
CO2:	3	1			1	3		3	3
CO3:	3	1			1	3		3	3
CO4:	3	1			1	3		3	3

Note:1: Low 2.: Moderate 3: High

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Programme:	**M.Tech.**	**Semester :**	**II**
Name of the Course:	**FEM Lab**	**Course Code:**	**SOE-M-SE205**
Credits :	**2**	**No of Hours :**	**2 Hrs/Week**
Max Marks:	**100**		

Course Description:
The Structural Analysis courses at PG level generally provide the fundamental concepts which are suitable for hand calculations.

Course Outcomes:
Students will be able to

CO1	At the completion of this course, the student shall acquire knowledge and ability to perform experiments and computer simulation of building system.

List of Experiments:

1. Analysis of various structural systems using ANSYS.
2. Modelling of two storey Framed structure in ANSYS.
3. Modelling of various mathematical models like Buildings with braces and shear walls in ANSYS
4. Design of multi-storey RCC Framed structure in ANSYS.

Recommended Books:
1) Numerical Methods for Engineers by Chopra

Assessment:
Assessment includes attendance, class work, assignments, quizzes, exams.

CO-PO&PSO Correlation

Course Name: FEM Lab									
	Program Outcomes					**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**
CO1:	**2**	**2**			**2**	**3**		**2**	**2**

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Tech.**	**Semester :**	**II**
Name of the Course:	**Numerical Analysis of Steel Structure Lab**	**Course Code:**	**SOE-M-SE206**
Credits :	**2**	**No of Hours :**	**2 Hrs/Week**
Max Marks:	**100**		

Course Description: The Structural Analysis courses at PG level generally provide the fundamental concepts which are suitable for hand calculations.

Course Outcomes:

Students will be able to

CO1	At the completion of this course, the student shall acquire knowledge and ability to perform experiments and computer simulation of steel structures.

List of Experiments:

1. Analysis and Design of Bridge structure
   OR
2. Analysis and Design of Industrial Buildings including gantry girders.

Recommended Books:

8. Design of Steel Structures - Ramchandra Vol. II, Standard Book House, Delhi.
9. Design of Steel Structures , Arya A. S., Ajmani J. L., Nemchand and Bros Roorkee.
10. Plastic Behaviour and Design- Baker J. F., Horne M. R., Heyman J,The Steel Skeleton- Vol. II.

Assessment:

Assessment includes attendance, class work, assignments, quizzes, exams.

CO-PO&PSO Correlation

Course Name: Numerical Analysis of Steel Structure Lab									
	Program Outcomes					**PSOs**			
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**
CO1:	**2**	**1**			**1**	**3**		**2**	**2**

Note: 1: Low 2.: Moderate 3: High