BabuBanarasi Das University, Lucknow

Department of Civil Engineering

School of Engineering

Master of Technology (Structural Engineering) - Regular

Evaluation Scheme

SEMESTER I									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MAS006	Applied Mathematics	4	0	0	40	60	**100**	**4**
C	MCE2101	Advance Structure Analysis	4	0	0	40	60	**100**	**4**
C	MCE2102	Advance Concrete Structure Design	4	0	0	40	60	**100**	**4**
C	MCE2103	Theory of Elasticity and Plasticity	4	0	0	40	60	**100**	**4**
C	MCE2011/ MCE2014	Generic Elective I	4	0	0	40	60	**100**	**4**
C	MCE2151	Concrete Structures Lab	0	0	2	100	0	**100**	**1**
C	MCE2152	Seminar	0	0	2	100	0	**100**	**1**
C	MCE2153	Technical Paper Writing	0	0	2	100	0	**100**	**1**
Total			**20**	**0**	**6**	**500**	**300**	**800**	**23**

Legends:

L Number of Lecture Hours per week
T Number of Tutorial Hours per week
P Number of Practical Hours per week
CIA Continuous Internal Assessment
ESE End Semester Examination

Category of Courses:

C Core Course
GE Generic Elective

BabuBanarasi Das University, Lucknow

Department of Civil Engineering

School of Engineering

Master of Technology (Structural Engineering) - Regular

Evaluation Scheme

SEMESTER II									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	MCE2201	Advance Steel Structure Design	4	0	0	40	60	**100**	**4**
C	MCE2202	Non Linear Analysis of Structures	4	0	0	40	60	**100**	**4**
C	MCE2203	Finite Element Analysis	4	0	0	40	60	**100**	**4**
C	MCE2204	Structural Dynamics	4	0	0	40	60	**100**	**4**
C	MCE2021/ MCE2024	Generic Elective II	4	0	0	40	60	**100**	**4**
C	MCE2251	CADD Lab	0	0	2	100	0	**100**	**1**
C	MCE2252	Seminar	0	0	2	100	0	**100**	**1**
C	MCE2253	Technical Paper Presentation	0	0	2	100	0	**100**	**1**
Total			**20**	**0**	**6**	**500**	**300**	**800**	**23**

Legends:

L Number of Lecture Hours per week
T Number of Tutorial Hours per week
P Number of Practical Hours per week
CIA Continuous Internal Assessment
ESE End Semester Examination

Category of Courses:

C Core Course
GE Generic Elective

BabuBanarasi Das University, Lucknow

Department of Civil Engineering

School of Engineering

Master of Technology (Structural Engineering) - Regular

Evaluation Scheme

SEMESTER III									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MCE2351	State of the art Seminar#	-	-	-	200	0	**200**	**4**
C	MCE2352	Thesis - I*	-	-	-	400	0	**400**	**16**
Total			**-**	**-**	**-**	**600**	**0**	**600**	**20**

\# Student need to perform a literature survey and will give a state of the art presentation and will submit a synopsis clearly mentioning the problem statement. The presentation and synopsis will be evaluated internally within two months of the start of the semester and the result will be intimated to the students so as to proceed for thesis.

* Student will develop the workable model for the problem they have supposed in synopsis.

SEMESTER IV									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MCE2451	Thesis - II**	-	-	-	200	800	**1000**	**28**
Total			**-**	**-**	**-**	**200**	**800**	**1000**	**28**

** (a) This is in continuation with Thesis - I.
(b) The required experimental / mathematical verification of the proposed model will be done in this semester.

Legends:

L Number of Lecture Hours per week
T Number of Tutorial Hours per week
P Number of Practical Hours per week
CIA Continuous Internal Assessment
ESE End Semester Examination

Category of Courses:

C Core Course
GE Generic Elective

BabuBanarasi Das University, Lucknow

Department of Civil Engineering

School of Engineering

Master of Technology (Structural Engineering) - Regular

Evaluation Scheme

Course Code	GenericElective-I
MCE2011	CAD of Structures
MCE2012	Theory of plates and shells
MCE2013	Concrete Technology
MCE2014	Bridge Engineering

Course Code	GenericElective-II
MCE2021	Tall Buildings
MCE2022	Advance Retrofitting Methods
MCE2023	Prestressed Concrete Structures
MCE2024	Earthquake resistant design of Structures

BabuBanarasi Das University, Lucknow

Department of Civil Engineering

School of Engineering

Master of Technology (Structural Engineering) - Regular

Evaluation Scheme

Credit Summary Chart						
Course Category	**Semester**				**Total Credits**	**%age**
	I	**II**	**III**	**IV**		
C	19	19	20	28	86	91.48
GE	4	4			8	8.52
Total	**23**	**23**	**20**	**28**	**94**	**100**

Discipline wise Credit Summary Chart						
Course Category	**Semester**				**Total Credits**	**%age**
	I	**II**	**III**	**IV**		
Engg. Sciences	4				**4**	4.26
Professional Subject Core	13	17			**30**	31.92
Professional Subject - General Elective	4	4			**8**	8.52
Thesis, Seminar	2	2	20	28	**52**	55.32
Total	**23**	**23**	**20**	**28**	**94**	**100**

Legends:

L Number of Lecture Hours per week
T Number of Tutorial Hours per week
P Number of Practical Hours per week
CIA Continuous Internal Assessment
ESE End Semester Examination

Category of Courses:

C Core Course
GE Generic Elective

BabuBanarasi Das University, Lucknow

Department of Civil Engineering

School of Engineering

Master of Technology (Structural Engineering) –Part Time

Evaluation Scheme

SEMESTER I										
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MAS006	Applied Mathematics	4	0	0	40	60	**100**	**4**
C	MCE2101	Advance Structure Analysis	4	0	0	40	60	**100**	**4**
C	MCE2102	Advance Concrete Structure Design	4	0	0	40	60	**100**	**4**
Total			**12**	**0**	**0**	**120**	**180**	**300**	**12**

Legends:

L Number of Lecture Hours per week
T Number of Tutorial Hours per week
P Number of Practical Hours per week
CIA Continuous Internal Assessment
ESE End Semester Examination

Category of Courses:

C Core Course
GE Generic Elective

BabuBanarasi Das University, Lucknow

Department of Civil Engineering

School of Engineering

Master of Technology (Structural Engineering) –Part Time

Evaluation Scheme

SEMESTER II									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	MCE2201	Advance Steel Structure Design	4	0	0	40	60	**100**	**4**
C	MCE2202	Non Linear Analysis of Structures	4	0	0	40	60	**100**	**4**
C	MCE2203	Finite Element Analysis	4	0	0	40	60	**100**	**4**
Total			**12**	**0**	**0**	**120**	**180**	**300**	**12**

Legends:

L Number of Lecture Hours per week
T Number of Tutorial Hours per week
P Number of Practical Hours per week
CIA Continuous Internal Assessment
ESE End Semester Examination

Category of Courses:

C Core Course
GE Generic Elective

BabuBanarasi Das University, Lucknow

Department of Civil Engineering

School of Engineering

Master of Technology (Structural Engineering) –Part Time

Evaluation Scheme

SEMESTER III									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	MCE2103	Theory of Elasticity and Plasticity	4	0	0	40	60	**100**	**4**
C	MCE2011/ MCE2014	Generic Elective I	4	0	0	40	60	**100**	**4**
C	MCE2151	Concrete Structures Lab	0	0	2	100	0	**100**	**1**
C	MCE2152	Seminar	0	0	2	100	0	**100**	**1**
C	MCE2153	Technical Paper Writing	0	0	2	100	0	**100**	**1**
Total			**8**	**0**	**6**	**380**	**120**	**500**	**11**

Legends:

L Number of Lecture Hours per week
T Number of Tutorial Hours per week
P Number of Practical Hours per week
CIA Continuous Internal Assessment
ESE End Semester Examination

Category of Courses:

C Core Course
GE Generic Elective

BabuBanarasi Das University, Lucknow

Department of Civil Engineering

School of Engineering

Master of Technology (Structural Engineering) –Part Time

Evaluation Scheme

SEMESTER IV									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	MCE2204	Structural Dynamics	4	0	0	40	60	**100**	**4**
C	MCE2021/ MCE2024	Generic Elective II	4	0	0	40	60	**100**	**4**
C	MCE2251	CADD Lab	0	0	2	100	0	**100**	**1**
C	MCE2252	Seminar	0	0	2	100	0	**100**	**1**
C	MCE2253	Technical Paper Presentation	0	0	2	100	0	**100**	**1**
Total			**8**	**0**	**6**	**380**	**120**	**500**	**11**

Legends:

L Number of Lecture Hours per week
T Number of Tutorial Hours per week
P Number of Practical Hours per week
CIA Continuous Internal Assessment
ESE End Semester Examination

Category of Courses:

C Core Course
GE Generic Elective

BabuBanarasi Das University, Lucknow

Department of Civil Engineering

School of Engineering

Master of Technology (Structural Engineering) –Part Time

Evaluation Scheme

SEMESTER V									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	MCE2351	State of the Art Seminar#	-	-	-	200	-	**200**	**4**
C	MCE2352	Thesis – I*	-	-	-	400	-	**400**	**16**
Total			**-**	**-**	**-**	**600**	**-**	**600**	**20**

Student need to perform a literature survey and will give a state of the art presentation and will submit a synopsis clearly mentioning the problem statement. The presentation and synopsis will be evaluated internally within two months of the start of the semester and the result will be intimated to the students so as to proceed for thesis.

* Student will develop the workable model for the problem they have supposed in synopsis.

SEMESTER VI									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	MCE2451	Thesis – II**	-	-	-	200	800	**1000**	**28**
Total			**-**	**-**	**-**	**200**	**800**	**1000**	**28**

** (a) This is in continuation with Thesis - I.
(b) The required experimental / mathematical verification of the proposed model will be done in this semester.

Legends:

L Number of Lecture Hours per week
T Number of Tutorial Hours per week
P Number of Practical Hours per week
CIA Continuous Internal Assessment
ESE End Semester Examination

Category of Courses:

C Core Course
GE Generic Elective

BabuBanarasi Das University, Lucknow

Department of Civil Engineering

School of Engineering

Master of Technology (Structural Engineering) –Part Time

Evaluation Scheme

Course Code	GenericElective-I
MCE2011	CAD of Structures
MCE2012	Theory of plates and shells
MCE2013	Concrete Technology
MCE2014	Bridge Engineering

Course Code	GenericElective-II
MCE2021	Tall Buildings
MCE2022	Advance Retrofitting Methods
MCE2023	Prestressed Concrete Structures
MCE2024	Earthquake resistant design of Structures

BabuBanarasi Das University, Lucknow

Department of Civil Engineering

School of Engineering

Master of Technology (Structural Engineering) –Part Time

Evaluation Scheme

Credit Summary Chart

Course Category	Semester						Total Credits	%age
	I	II	III	IV	V	VI		
F								
C	12	12	7	7	20	28	86	93.62
GE			4	4			8	6.38
OE								
GP								
Total	**12**	**12**	**11**	**11**	**20**	**28**	**94**	**100**

Discipline wise Credit Summary Chart

Course Category	Semester						Total Credits	%age
	I	II	III	IV	V	VI		
Engg. Sciences	4						**4**	4.26
Professional Subject Core	8	12	5	5			**30**	31.91
Professional Subject - Generic Elective			4	4			**8**	8.51
Thesis, Seminar			2	2	20	28	**52**	55.32
Total	**12**	**12**	**11**	**11**	**20**	**28**	**94**	**100**

Legends:

L Number of Lecture Hours per week
T Number of Tutorial Hours per week
P Number of Practical Hours per week
CIA Continuous Internal Assessment
ESE End Semester Examination

Category of Courses:

C Core Course
GE Generic Elective

MCE2101 Advance Structure Analysis

Course Objective:

1. The main objective is to enable the student to have a good grasp of all the fundamental issues in these advanced topics in structural analysis, besides enjoying the learning process, and developing analytical and intuitive skills.
2. This course is also expected to enable a good understanding of how standard software packages (routinely used for frame analysis in design offices) operate.

Learning Outcome:

1. After competition of course the student would be able to analyze the real world structures in a more rational way.
2. This course lays impetus of the methods of analyzing that is being used in modern computer program.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Matrix Analysis of Structures: Introduction, Coordinate systems, Displacement and force transformation matrices, Element and structure stiffness matrices, Element and structure flexibility matrices, Equivalent joint loads, Stiffness and flexibility approaches.	30 Hours	1
II	Matrix Analysis Of Structures With Axial Elements**:**Axial stiffness and flexibility, Stiffness matrices for an axial element (two dof), plane truss element (four dof), space truss element (six dof),Analysis by stiffness method (two/one dof per element), Analysis by flexibility method. Plane Trusses: Analysis by stiffness and flexibility methods. Space Trusses: Analysis by stiffness method.	30 Hours	1
III	Matrix Analysis of Beams: Beam element stiffness (four dof): Generation of stiffness matrix for continuous beam, Dealing with internal hinges, hinged and guided-fixed end supports. Beam element stiffness (two dof): Dealing with moment releases, hinged and guided-fixed end supports. Flexibility Method for Fixed and Continuous Beams: Force transformation matrix, Element flexibility matrix, Solution procedure (including support movements).	30 Hours	1
IV	Matrix Analysis of Plane, Stiffness Method for Plane Frames: -Element stiffness (six dof), Generation of	30 Hours	1

	structure stiffness matrix and solution procedure,Dealing with internal hinges and various end conditions. Flexibility Method for Plane Frames: Force transformation matrix, Element flexibility matrix, Solution procedure (including support movements); Ignoring axial deformations.		

References:-

1. DevdasMenon, "Advanced Structural Analysis", Narosa Publishing House, 2009.
2. AsslamKassimali, "Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.
3. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.
4. DevdasMenon, "Structural Analysis", Narosa Publishing House, 2008.
5. William Weaver, JR. & James M. Gere, “Matrix Analysis of Framed Structures”, CBS Publisher.

MCE2102 Advance Concrete Structure Design

Course Objective:

1. The main objective is to provide students with a rational basis of the design of reinforced concrete members and structures through advanced understanding of material and structural behavior.

Learning Outcome:

1. The general mechanical behavior of reinforced concrete.
2. To analyze and design reinforced concrete flexural members.
3. Analyze and design reinforced concrete compression members.
4. Analyze and design for vertical and horizontal shear in reinforced concrete.
5. Understanding the criteria for deflection and crack control of reinforced concrete members.

Course Contents:

Module	**Course Topics**	**Total Hours**	**Credits**
I	Yield line theory for slabs: Nodal Forces and Two-way Slabs, Two-way Rectangular, Square, Triangular andCircular Slabs	30 Hours	1
II	Shells and Folded Plate Roofs:Introduction,type of shell roofs, advantages and disadvantages of shell roofs, folded plate roofs, behavior of folded plate roofs,behavior of shells,Lundgreen's Beam Theory for long shells,Design criteria for cylindrical shell roofs	30 Hours	1
III	Redistribution of moments in continuous span beams, plastic hinge concept, and rotation capacity of sections and detailing for ductility, Beam column joints	30 Hours	1
IV	Bunker and Silos: Introduction, Design of rectangular and circular bunkers, Design of silos.	30 Hours	1

References :

1. Raju N. Krishna , "Pre-Stressed concrete", Tata McGraw Hill Education (India) Private.
2. Verghese, P.C, "Advance Reinforced concrete design",PHI Learning Private Limited.
3. RamamruthamS.,"Design of Reinforced Concrete Structures", DhanpatRai, New Delhi India.
4. Ashok K. Jain,"Reinforced Concrete: Limit State Design",Nem Chand & Brothers.
5. PillaiS.And DevdasMenon, "Reinforced Concrete Design", Tata Mcgraw Hill Education Private Limited

MCE2103 Theory of Elasticity and Plasticity

Course Objective:

A course in Theory of Elasticity is a necessity for the as well for practicing engineers to understand the behaviour of elastic solids under given applied loads and also the limitations of the results given by the Elementary Mechanics of Materials.

Learning Outcome:

1. To develop systematic - knowledge of stress strain concept
2. To develop systematic - knowledge of strain concept
3. To familiarize with the fundamentals of two dimensional problems
4. Introduction to the problems in plasticity

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Analysis of Stress:Stress Tensor, Equilibrium equations in Cartesian and Polar Co-ordinate, Normal and Shearing Stresses, Transformation equations for stresses, Principal Stresses and Principal Planes, Stress Invariants, octahedral stresses, deviator and hydrostatic stress tensor.	30 Hours	1
II	Analysis of Strain:Types of strain, strain tensors, strain transformation. Principal strains, strain invariants, octahedral strains. Mohr's Circle for Strain, equations of Compatibility for Strain.	30 Hours	1
III	Two dimensional problems:Airy's stress function - polynomials - biharmonic equations - general solution of problems by displacement (warping function) force (Prandtl's stress function) Two dimensional problems in carterian co-ordinates •Bending of Cantilever loaded at end •Bending of beam by uniform load	30 Hours	1
IV	Plasticity: Introduction to problems in plasticity-Physical assumption - Criterian of yielding - Rankines theory - St. Venant's theory - Flow rule (Plastic stress-strain relationship - Elastic Plastic problems of beams in bending.	30 Hours	1

References:

1. Dr. Sadhu Singh, “Applied Stress Analysis”, Khanna Publishers.
2. ChenW.F. and Han.D.J., “Plasticity for structural Engineers”, Springer-Verlag., NY.
3. Chakrabarty, “Theory of Plasticity “,Tata McGraw Hill Book Co., New Delhi, Third Edition, 2006
4. Mendelson. A., “Plasticity - Theory and Applications”, Krieger Pub Co., Florida, U.S.A,Second edition,1983.

MCE2151Concrete Structures Lab

Objectives:

This lab enables students to carry various experiments regarding Workability Test, Design Mix, Compressive Strength and Tensile Strength of Concrete, Nondestructive Testing.

Course Contents:

1. To determine the Workability of concrete by various methods.
2. Design the concrete mix of different grades, as per IS: 10262.
3. To determine the compressive strength of a nominal or design mix concrete of any grade.
4. To determine the split tensile strength of concrete.
5. Nondestructive Testing - Rebound Hammer test, Ultrasonic Pulse Velocity test.

MCE2201 Advanced Steel Structure Design

Course Objective:

The objectives are to provide students with advanced knowledge of steel structural design.

Learning Outcome:

1. It will provide the knowledge of plastic design.
2. It will give the exposure on types of bridges and compatibility of the bridges over its functioning.
3. It provides the basic knowledge of towers and chimneys.
4. It illustrates the concept of analysis and design of tanks and tubular section.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Plastic Design:Introduction, Shape Factor, Plastic hinge concept -Mechanism method Application to continuous beams and portal frames.	30 Hours	1
II	Bridges:Introduction**,** Design of steel bridges, plate Girder Bridge and truss girder bridge.	30 Hours	1
III	Towers:Basic structural configurations -free standing and guyed towers, wind loads, foundation design, design criteria for different configurations and transmission line towers. Chimneys:Analysis and design of steel chimneys	30 Hours	1
IV	Tank: Analysis and design of steel rectangular and circular water tank. Tubular Section: Introduction, Advantages and Disadvantages, Design of circular tubular sections.	30 Hours	1

References:

1. Duggal S. K**,** “Design of Steel Structures”,T. M.H. Publication
2. Arya and Ajmani, “Design of steel structures”, NBC Roorkee India.
3. Ramamrutham S., “Design of steel structures”, Dhanpatrai New Delhi India

MCE2202Non Linear Analysis of Structures

Course Objective:

1. To present systematic procedures for geometric and material nonlinear structural analysis.
2. To introduce and encourage the use of advanced nonlinear software .
3. To explore the significance of common nonlinear phenomena, particularly in relation to the structural response under extreme events.

Learning Outcome:

1. Distinguish between linear and nonlinear structural analysis and the types of problem for which nonlinear structural analysis is necessary
2. Use equilibrium paths to characterize the nonlinear structural response.
3. Understand basic incremental iterative solution procedures for tracing equilibrium paths.
4. Appreciate the fundamentals of nonlinear finite element discretization, including geometric and material nonlinearity

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction to nonlinear mechanics; statically determinate and indeterminate flexible bars of uniform and variable thickness Inelastic analysis of uniform and variable thickness members subjected to small deformations; inelastic analysis of flexible bars of uniform and variable stiffness members with and without axial restraints	30 Hours	1
II	Vibration theory and analysis of flexible members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading	30 Hours	1
III	Elastic and inelastic analysis of uniform and variable thickness plates	30 Hours	1
IV	Nonlinear vibration and Instabilities of elastically supported beams	30 Hours	1

References:

1. Delmetor E. Firtis, “Non Linear Mechanics” (CRC, Press)
2. Stein Krak, “Non Linear Modelling& Analysis of Solids & Structures”, (CRC Press)
3. McGuire, W., Gallagher, R., Zieman, R., “Matrix Structural Analysis”, 2nd Edition.
4. Bathe, K. J., “Finite Element Procedures”, Prentice-Hall, Englewood Cliffs, New Jersey.
5. Crisfield, M.A., “Non-linear Finite Element Analysis of Solids and Structures”, John Wiley & Sons, Chichester, England.
6. Yang, Y. B., and Kuo, S. R., “Theory and Analysis of Nonlinear Framed Structures”, Prentice Hall, Englewood Cliffs, New Jersey.

MCE2203Finite Element Analysis

Course Objective:

1. The objective of the course is to apprise the students about the basics of the Finite Element Technique, a numerical tool for the solution of different classes of problems in solid mechanics.

2. Different application areas will be dealt with after introducing the basic aspects of the method. However, major emphasis will be on the solution of problems related to Civil Engineering.

Learning Outcome:

1. It is intended to cover the analysis methodologies for 1-D, 2-D and 3-D problems with the advantages and disadvantages clearly spelt out.
2. It gives the basic understanding of FEA, virtual work principle and isoparametric formulation.
3. It gives the exposure of stiffness of beams, truss and frames and also CST, LST and QST and axisymmetric element.
4. It explains the theories related to plates and shells.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction to Finite Element Analysis:Introduction, Basic Concepts of Finite Element Analysis, Introduction to Elasticity, Steps in Finite Element Analysis	30 Hours	1
II	Finite Element Formulation Techniques:Virtual Work and VariationalPrinciple,Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions. Element Properties:Natural Coordinates, Triangular Elements,RectangularElements,Lagrange and Serendipity Elements, Solid Elements,Isoparametric Formulation, Stiffness Matrix of Isoparametric Elements, Numerical Integration: One, Two and Three Dimensional.	30 Hours	1
III	Analysis of Frame Structures:Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and	30 Hours	1

	Space Frame FEM for Two and Three Dimensional Solids:ConstantStrain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Nonlinearity and Static Condensation, Axisymmetric Element, Finite Element Formulation of Axisymmetric Element, Finite Element Formulation for 3 Dimensional Elements		
IV	FEM for Plates and Shells:Introduction to Plate Bending Problems,Finite Element Analysis of Thin Plate, Finite Element Analysis of Thick Plate, Finite Element Analysis of Skew Plate, Introduction to Finite Strip Method Finite Element Analysis of Shell.	30 Hours	1

References:

1. KrishnamoortyC. S., "Finite Element Analysis", Tata McGraw-Hill
2. David V. Hutton, "Fundamentals of Finite Element Analysis", McGraw Hill
3. MaityD., "Computer Analysis of Framed Structures", I. K. International Pvt. Ltd. New Delhi
4. Erik G. Thompson, "Introduction to the Finite Element Method: Theory, Programming and Applications", John Wiley
5. MartinH. C. and CareyG. F., "Introduction to Finite Element Analysis - Theory and Application", NewYork, McGraw-Hill
6. Irving H. Shames, Clive L. Dym, "Energy and Finite Element Methods in Structural Mechanics", New Age International
7. BatheK. J., "Finite Element Procedures", Prentice-Hall of India, New Delhi, India
8. MukhopadhyayM., "Matrix, Finite Element, Computer and Structural Analysis", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India
9. ZienkiewiczO. C. and CheungY. K., "The Finite Element Method in Structural and Soild Mechanics", McGraw Hill, London.
10. CookR. D., "Concepts and Applications of Finite Element Analysis", Wiley.
11. RaoS. S., "Finite Element Analysis", Elsevier Butterworth-Heinemann.

MCE2204Structural Dynamics

Course Objective:

1. To introduce general theory of vibration and solve problems of single degree of freedom (SDOF) systems
2. To know the various mathematical modeling of various types loading conditions.
3. To introduce dynamic analysis of continuous systems
4. To solve dynamic problems in multi-degree of freedom (MDOF) systems

Learning Outcome:

1. An ability to apply knowledge of mathematics, science, and engineering by developing the equations of motion for vibratory systems and solving for the free and forced response.
2. Ability to identify, formulate and solve engineering problems. This will be accomplished by having students model, analyze and modify a vibratory structure order to achieve specified requirements.
3. Understanding professional and ethical responsibilities. This will be accomplished by emphasizing the importance of understanding how structural vibrations may affect safety and reliability of engineering systems.
4. Exposure on the free vibration response of MDOF and continuoussystems.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Undamped Single Degree-of-freedom System: Introduction, Degree of Freedom, mathematical modeling of an SDOF system, D'Alembert's Principle, Solution of the differential Equation of Motion, Frequency and period, amplitude of motion. Damped Single degree-of–freedom system: introduction, Equation of motion, critically damped system, underdamped system, overdamped system, logarithmic decrement.	30 Hours	1
II	Response of SDOF system to Harmonic Excitation: Introduction, Undamped Harmonic Excitation, Damped harmonic Excitation, vibration Isolation. Response of SDOF system to periodic loading:Introduction,Fourier series and Analysis,Response to the Fourier Series Loading	30 Hours	1

III	Response to general dynamic loading: Introduction, Duhamel's Integral, Numerical evaluation of Duhamel's Integral for damped and undamped system.	30 Hours	1
IV	Free Vibration Response of MDOF and ContinuousSystems**:**Undamped systems: natural modes and their properties; Numerical solution for the eigenvalue problem; Solution of free vibration response for undamped systems; Free and forced vibration of continuous system.	30 Hours	1

References:

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1. Mario Paz, "Structural Dynamics", (CBS Publishers)
2. DamodarasamyS.S.,KavithaS., "Basics of structural Dynamics and Aseismic design", (PHI).
3. PankajAgrawal, Manish Shrikhande, "Earthquake Resistant Design of Structures" (PHI).
4. John M. Biggs,"Introduction to Structural Dynamics", McGraw-Hill Companies
5. Anil K. Chopra,"Dynamics of Structure" ,Prentice Hall; 4 edition.

MCE2251 CADD Lab

Course Objective:

1. This subject is thought to impart knowledge of analysis and design of concrete and steel structures under various load and support conditions using STAAD Pro./ SAP/ ETAB package.

Course Contents:

1. Working on Structural Engineering software for Analysis and Design of Civil Structure using STAAD Pro./ SAP/ ETAB.

MCE2011 Computer Aided Design of Structures

Course Objective:

1. Basics of drafting are introduced
2. Use of software for design and detailing
3. Application of optimal design principles
4. To introduce fundamentals of AI and expert system

Learning Outcome:

1. Explain how computer technology is revolutionizing drafting, design and modification.
2. Describe the basic features and operation of a computer added program andthe various commands used.
3. Enlist different types of CAD software and their applications.
4. Explain expert system shells and exposure on principle of neural network.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction**:**Elements of Computer Aided Design and its advantages over conventional design.	30 Hours	1
II	Principals and Concepts: Principles of software design, concept of modular programming, debugging and testing.	30 Hours	
III	Application:Computer applications in analysis and design of Civil Engineering systems. Use ofsoftware packages in the area of Structural, Geotechnical, and Environmental fields.	30 Hours	1
IV	Artificial intelligence:Introduction, Heuristic search, knowledge based expert systems, Architecture and application of KBES, Expert system shells, Principles ofneural network.	30 Hours	1

References:-

1. Krishnamoorthy C.S and Rajeev S., "Computer Aided Design", NarosaPublishing House New Delhi , 1991
2. SrivastavaS. K.,“Computer Aided Design: A Basic and Mathematical Approach”, I.K. Internationlal Publishing House Pvt. Ltd.
3. Regalla, SrinivasaPrakash, “Computer Aided Analysis and Design” I.K. International Publishing House Pvt Ltd.

MCE2012Theory of Plates and Shells

Course Objective:

1. Understand different types of shells and folded plates.
2. Know different theories for the analysis and procedure to analyze the structures.
3. Differentiate between different theories of analysis. Achieve fundamental understanding of the classical theory of elastic plates.
4. Introduce analytical and numerical solution techniques in thin plate theory.
5. Apply theory of plates to the problems involving various geometrics and boundary conditions. Apply Navier, Levy's, and Rayleigh—Ritz solutions to plates with different end conditions. Provide enhanced knowledge in solid mechanics and advanced structural mechanics
6. Use appropriate theory to analyse the shell structures. Differentiate a shell structure based on its properties. Design shell structures ¬ Understand the structural importance of shell and folded plates

Learning Outcome:

1. Apply the theory of plates in engineering designs.
2. Discover and exploit various modeling avenues for structural engineering components and obtain the exact and/or approximate solutions.
3. Select an appropriate plate theory for different Engineering applications.
4. Gain a thorough understanding of Kirchhoff's, First order shear deformation theories.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Laterally loaded thin plates – Differential equation – Boundary conditions. Bending of plates – Simply supported rectangular plates – Navier's solution and Levy's method – Rectangular plates with various edge conditions.	30 Hours	1
II	Classification of shells, membrane theory for shells of revolution with axi-symmetric and non-symmetric loading, bending analysis of shells of revolution for axi-symmetric loadings	30 Hours	1
III	Membrane and bending theories of cylindrical shells, theory of edge beams, doubly curved shells, membrane theory and design of hyperbolic shells, buckling of shells, design applications	30 Hours	1
IV	Folded plate structures, Structural behaviour, Various types,Design of folded plates, Reinforced detailing.	30 Hours	1

References:-

1. Timoshenko S. P. and Woinowsky-krieger S., "Theory of plates and shells", Mcgraw- hill.
2. Marti Peter, "Theory of Structures: Fundamentals, Framed Structures, Plates and Shells", Blackwell Publishers.
3. Bhavikatti, S S., "Theory of Plates and Shells**",** New Age International.

MCE2013Concrete Technology

Course Objective:

1. The basic course on Civil Engineering Materials deals with some fundamentals related to concrete and concrete materials, besides dealing with masonry, steel etc.
2. The specific course on "Concrete Technology" focuses more on detailed understanding of concrete making materials including supplementary cementitious materials.
3. Concrete production process also forms a part of the discussion. Recent developments in concrete materials are also given adequate consideration.
4. Going through the course one would develop adequate understanding on concrete production process and properties and uses of concrete as a modern material of construction.

Learning Outcome:

1. The courses will enable one to make appropriate decision regarding ingredient selection and use of concrete.
2. Optimise the ingredients of the various concrete mixes.
3. Selection of various other materials in making of concrete mixes.
4. It gives the exposure of special concretes and mix design.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Cement:Production, composition, and properties; cement chemistry, Types of cements; special cements. Aggregates:Mineralogy, properties, tests and standards. **Chemical and Mineral Admixtures**:Water reducers, air entrainers, set controllers, specialty admixtures - structure properties, and effects on concrete properties, Introduction to supplementary cementing materials and pozzolans.Fly ash, blast furnace slag, silica fume, and metakaolin - their production, properties, and effects on concrete properties,Other mineral additives - reactive and inert.	30 Hours	1
II	**Concrete Production & Fresh Concrete**:Batching of ingredients; mixing, transport, and placement,Consolidation, finishing, and curing of concrete; initial and final set - significance and measurement,Workability of concrete and its measurement.	30 Hours	1
III	**Engineering Properties of Concrete**: Compressive strength and parameters affecting it, tensile strength - direct and indirect, modulus of elasticity and Poisson's	30 Hours	1

	ratio, Stress strain response of concrete. **Dimensional Stability and Durability**:Creep and relaxation - parameters affecting; Shrinkage of concrete - types and significance, parameters affecting shrinkage; measurement of creep and shrinkage**.**		
IV	**Special Concretes**:Properties and applications of: High strength - high performance concrete, reactive powder concrete,Lightweight, heavyweight, and mass concrete, fibre reinforced concrete, self-compacting concrete, shotcrete, Ready mix concrete. **Concrete Mix Design:**Basic principles; IS method, new approaches based on rheology and particle packing.	30 Hours	

References:-

1. Neville, A.M., "Properties o Concrete", Pitman.
2. Brandt, A.M., "Cement Based Composites: Materials, Mechanical Properties and Performance", E & FN Spon. 1995.
3. Newman, K., "Concrete Systems in Composite Materials",EDT BY L.Holliday. Elsevier Publishing Company. 1966.
4. Powers, T.C., "The Properties of Fresh Concrete", John Wiley & Sons, Inc.
5. Mehta, P.K., "Concrete Structure, Material and Properties", Prantice Hall Inc.
6. Shetty, M.S., “Concrete Technology Theory and Practice”, S.Chand and company, New Delhi.

MCE2014 Bridge Engineering

Course Objective:

1. Develop an understanding of and appreciation for basic concepts in proportioning and design of bridges in terms of aesthetics, geographical location and functionality.
2. Develop an intuitive feeling about the sizing of bridge elements. Develop a clear understanding of conceptual design.
3. Understand the load flow mechanism and identify loads on bridges.
4. Carry out the design of bridge starting from conceptual design, selecting suitable bridge, geometry to sizing of its elements

Learning Outcome:

1. Understanding of various types of bridges and its compatibility with IRC recommendations as well as design of slab culvert.
2. Various methods of designing the deck slab and girders.
3. State of art of design of various types of bridges e.gPrestressed and steel bridges.
4. Illustrates about the various substructure components of bridges like piers, pier cap, bearings etc.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Site selection, various types of bridges and their suitability, loads, forces and IRC bridge loading and permissible stresses, Design of RCslab culvert,	30Hours	1
II	Design of RCbridges under concentrated loads using effective width and Pigeauds Method.Courbon's method of load distribution, Design of T-beam bridge, Design of box culverts Prestressed Concrete Girder Bridges : Advantages of presstressed concrete slab and girder bridges – suitable spans, design of slab and beam cross sections for given bending moment, shear– finding prestresing force, eccentricity (analysis of bridges need not be repeated)	30 Hours	1
III	Steel Bridges: Design and detailing of plate girder, Design and detailing of box girder, Design and detailing of Truss bridges.	30 Hours	1
IV	Design of piers and pier caps, Design of Abutments and bearings.	30 Hours	1

References:-

1. Johnson Victor D.,"Essentials of Bridge Engineering", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.
2. Krishna Raju.N., "Design of Bridges", fourth edition Oxford & IBM Publishing Co, Bombay,2009.
3. Taylor F.W, Thomson S.E. and Smulski. E, “Reinforced Concrete Bridges", John Wiley & Sons, New York 1955.
4. IRC: 3-1983, “Dimensions and Weights of Road Design Vehicles”.
5. IRC:5-1998, “Standard Specifications and Code of Practice for Road Bridges, Section I – General Features of Design” (Seventh Revision).
6. IRC:6-2010, “Standard Specifications and Code of Practice for Road Bridges, Section II – Loads and Stresses” (Fifth Revision).

MCE 2021Tall Buildings

Course Objective:

This course is intended to teach the concept of tall structures.

1. Various methods to analyzeand design the tall structure with codal recommendations.
2. Design the shear wall system and in filled frame systems.

Learning Outcome:

1. Toknow the types of tall buildings according to NBC and different anticipated loads.
2. Exposure on wind effect aerodynamics and structural responses
3. Basic understanding of cause and effects of earthquake and its solution.
4. Versatile nature of shear walls and infill walls.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction - Classification of buildings according to NBC – Types of loads – wind load – Seismic load	30 Hours	1
II	Wind Effect: Bluff body aerodynamics; aero-elastic phenomena; wind directionality effects; structural response and design considerations; standard provisions for wind loading.	30 Hours	1
III	Earthquake Effect: Introduction to earthquake engineering and earthquake resistant design of buildings; earthquake motion and response; general principles and design criteria for buildings; codal provisions, seismic design of structures; dynamic analysis; effect of torsion; design of stack like structures; earthquake forces in tall buildings.	30 Hours	
IV	Shear Wall: Shear in buildings; need and location of shear walls in tall buildings; analysis and design of shear walls. In-filled Frame Systems: Importance – Methods of analysis – Equivalent truss and frame method – Force-displacement method – Effect of perforation in the in-filled frame.	30 Hours	1

References:-

1. Dr. BungaleTaranathS.,“Reinforced Concrete Design of Tall Buildings”, CRC Press, 2009
2. Bryan Stafford Smith, “Tall Building Structures: Analysis and Design”, Alex Coull,
3. Ramachandra, “Design of Steel Structures–Vol.II”, Standard Book House, 1750- a, NaiSarak, Delhi-6.
4. SarwarAlamRaz, “Analytical methods in Structural Engineering”, Wiley Eastern Private Limited, New Delhi.
5. Ghali.A., Neville.A.M and Brown.T.G, “Structural Analysis – A unified classical and Matrix Approach (Fifth Edition)”, Span press

MCE2022Advance Retrofitting Methods

Course Objective:

1. To get conversant with the latest techniques with seismic retrofit of the buildings.
2. Various methods for the inspection of structural components

Outcome:

1. It explains the evaluation and criteria of seismic hazards
2. It gives the exposure on repair Strengthening and Rehabilitations.
3. Illustrates about the repair and retrofitting of masonary structures.
4. It gives the knowledge of retrofitting of various RC buildings and bridges.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Seismic Hazard Evaluation, Methodologies for seismic evaluation, Components of seismic evaluation Methodology, seismic evaluation of RC Columns, Beams, Joints and Slabs, Non destructive evaluation techniques, Principles of Repair and Retrofitting.	30 Hours	1
II	Terminology in Repair, Restoration, Strengthening and Rehabilitations, Criteria for Repair.	30 Hours	1
III	Restoration and Retrofitting; Repair Materials; In-situ testing methods for RC and masonry structure; Techniques of repair and retrofitting of masonry buildings.	30 Hours	1
IV	Techniques of Repair and Retrofitting in RC buildings; Retrofitting of buildings by seismic base isolation and supplemental damping; Retrofitting of heritage structures; Retrofitting of bridges; Case studies in retrofitting.	30 Hours	1

References:

1. Xin Lin Lu, “Retrofitting Design for Building Structures”, (CRC Press)
2. AgrawalPankaj, ShikhandeMainsh, “Earthquake Resistant Design of Structures”, (PHI Pvt Ltd.)
3. Handbook on sesmic retrofit of building, Central public works department Government of India, New Delhi.
4. Handbook on repair and rehabilitation of RCC Buildings, Central public works department, Government of India, New Delhi.

MCE 2023 Prestressed Concrete Structures

Course Objective:

1. To develop an understanding of the necessity of prestressed concrete structuresandvarious techniques of prestressing.
2. Various losses encountered in the pre-tensioning and post tensioning of concrete members.
3. To design of prestressed concrete members for ultimate limit state and limit state of serviceability.
4. To develop an understanding of the design offlangedbeams.

Learning Outcome:

1. The knowledge of evolution of various prestressing techniques.
2. Exposure of various losses in lieu of codal provisions.
3. Develop skills in analysis of prestressed concrete beams.
4. Develop skills to satisfy the serviceability and strength provisions of the Indian Standards (IS: 1343-1980).

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction:Prestressing Systems, Material Properties and: Losses in Prestress.Types of prestressing: pretensioning and post-tensioning, external and internal prestressing, full and partial prestressing, uniaxial and biaxial prestressing. Advantages and disadvantages of prestressing, advantages of precast members; Material properties:aggregates, cement, concrete, allowable stresses, creep, shrinkage, steel, allowable stresses, relaxation, fatigue.	30 Hours	1
II	Losses in Prestress:Immediate losses: elastic shortening, Friction and anchorage slip, Force flow diagram, Time dependent losses: creep, shrinkage, relaxation; IS Code provisions.	30 Hours	1
III	Analysis of Members: Analysis of members under axial load. Analysis of members under flexure at service loads: stress concept, force concept, load balancing concept. Cracking moment, kern point, pressure line, and concept of limiting zone. Analysis of rectangular sections under flexure at ultimate loads: equations of equilibrium and Compatibility and constitutive models, stress block for concrete, solution procedure, minimum and maximum amount of prestressed reinforcement. Analysis of flanged	30 Hours	1

	sections under flexure at ultimate loads. Analysis of partially prestressed sections under flexure at ultimate loads.		
IV	Design of Members for Flexure:Design based on service loads: preliminary design. Final design for Type I member (no tensile stress). Final design for Type II (limited tensile stress) and TYPE III (limited cracking) members. Choice of cross section: flexural efficiency; Determination of limiting zone; Post-tension in stress. Magnel's graphical method. Design based on ultimate loads. Detailing requirement.	30 Hours	1

References:

1. Raju. N. Krishna, "Pre stressed Concrete", Third Edition, Tata McGraw Hill Co.
2. Rajagopal. N, "Prestressed Concrete, Second Edition", Narosa Publishing House.
3. Dayarathnam P, "Prestressed Concrete Structures", S.Chand Publishers.
4. Sinha.N.C and Roy.S.K, "Fundamentals of Pre-stressed Concrete", S.Chand& Company limited.

MCE2024Earthquake Resistant Design of Structures

Course Objective:

1. Understand possible causes for the movements of the plates.
2. Describe elastic rebound theory as it is related to seismic activity.
3. Distinguish between earthquake magnitude and earthquake damage (intensity).
4. Understand soil structure interaction and base isolation techniques.

Learning Outcome:

1. Occurrence of earthquake and hazards associated with it.
2. Assess seismic performance of non-structural components and building contents and identify effective measures to mitigate potential damage.
3. Basic understanding of dynamic properties of soil.
4. Mitigating the earthquake with the help of base isolation techniques.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Seismology: Earth's Interior and Plate Tectonics; Causes of Earthquakes and Seismic Waves; Measurement of Earthquakes and Measurement parameters; Modification of Earthquake due to the Nature of Soil; Seismic Hazard Analysis I; Seismic Hazard Analysis II; Discussion on Tutorial Problems.	30 Hours	1
II	Earthquake Inputs: Time History Records and Frequency Contents of Ground Motion; Power Spectral Density Function of Ground Motion; Concept of Response Spectrums of Earthquake; Combined D-V-A Spectrum and Construction of Design Spectrum; Site Specific, Probabilistic and Uniform Hazard Spectrums; Predictive Relationships for earthquake parameters; Discussion on Tutorial Problems	30 Hours	1
III	Seismic Soil - Structure Interaction: Fundamentals of Seismic Soil-Structure Interaction; Direct Method of Analysis of Soil-Structure; Sub structuring Method of Analysis of Soil- Structure Interaction Problem	30 Hours	1
IV	Base isolation for earthquake resistant design of structures: Base isolation concept, isolation systems and their modeling; linear theory of base isolation; stability of elastomeric bearings; codal provisions for	30 Hours	1

	seismic isolation, practical applications.		

References:

1. Duggal S.K., "Earthquake-resistant Design of Structures", Oxford University Press
2. AgarwalPankaj **&**ShrikhandeManish,"Earthquake Resistant Design of Structures", PHI Publication
3. Damodarasamy S.S., KavithaS.,"Basics of structural Dynamics and Aseismic design", (PHI).