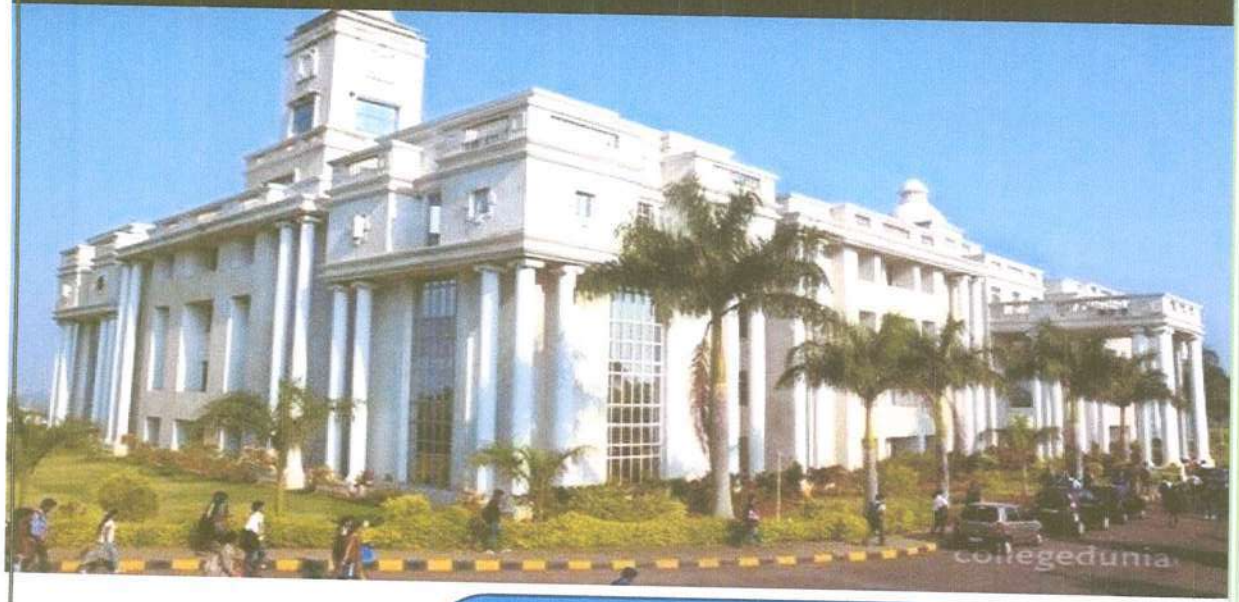
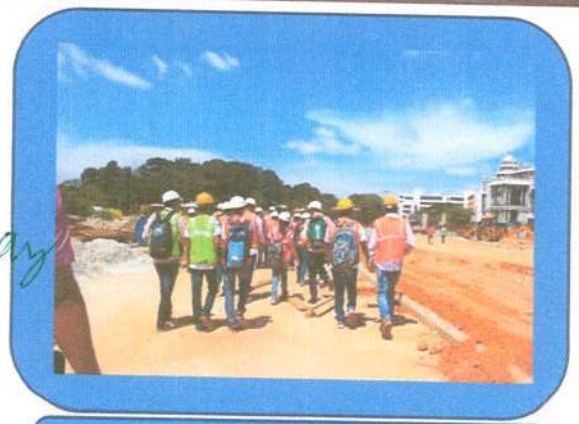
SCHEME AND SYLLABUS





Department of Civil Engineering

Dean Academic
Global Academy of Technology,
Rajarajeshwarinagar, Bengaluru-98

I-IV Semester Scheme (2023-24)

M.Tech in Structural Engineering

GLOBAL ACADEMY OF TECHNOLOGY

**(Autonomous institution affiliated to VTU, Belagavi.
Accredited by NAAC with 'A' grade,
NBA Accredited CIVIL, CS, E&C, E&E, MECH and IS branches)
Ideal Homes Township,
Raja Rajeshwari Nagar, Bengaluru-560098.**

Head of Department
Civil Engineering
Global Academy of Technology
Rajarajeshwarinagar Bangalore - 98

GLOBAL ACADEMY OF TECHNOLOGY

Autonomous Institution Affiliated to VTU, Belagavi.

DEPARTMENT OF CIVIL ENGINEERING

M-Tech Program in STRUCTURAL ENGINEERING

(Effective from the academic year 2023 – 24)

I SEMESTER M. Tech.

Sl. No	Course code	Course title	Teaching Hours /Week			Examination				Credits
			Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
			L	T	P					
1	23MST11	Special Concrete	3	-	-	3	50	50	100	3
2	23MST12	Structural Dynamics	3	-	2	3	50	50	100	4
3	23MST13	Computational Structural Mechanics.	3	2	-	3	50	50	100	4
4	23MST14	Advanced Design of Reinforced Concrete Structures	2	2	-	3	50	50	100	3
5	23MST15	Mechanics of Deformable Bodies	2	2	-	3	50	50	100	3
6	23RMI16	Research Methodology and IPR	3	-	-	3	50	50	100	3
7	23MSTL17	Structural Lab-1	1	-	2	3	50	50	100	2
8	23AUD18/ 23AEC18	BOS recommended ONLINE courses	Classes and evaluation procedures are as per the policy of the online course providers							PP
		TOTAL	**17**	**6**	**4**	**21**	**350**	**350**	**700**	**22**

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DEPARTMENT OF CIVIL ENGINEERING

M-Tech Program in STRUCTURAL ENGINEERING

(Effective from the academic year 2023 – 24)

II SEMESTER M. Tech.

Sl. No	Course Code	Course title	Teaching Hours /Week			Examination				Credits
			Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
			L	T	P					
1	23MST21	Advanced Design of Steel Structures	2	2	-	3	50	50	100	3
2	23MST22	Finite Element Analysis	3	-	2	3	50	50	100	4
3	23MST23X	Professional Elective 1	3	-	-	3	50	50	100	3
4	23MST24X	Professional Elective 2	3	-	-	3	50	50	100	3
6	23MSTMP	Mini Project with Seminar	-	-	4	--	100	-	100	3
7	23MSTL26	Structural Lab-2	-	-	2	3	50	50	100	2
8	23AUD27	Suggested ONLINE courses	Classes and evaluation procedures are as per the policy of the online course providers							PP
TOTAL			**11**	**2**	**8**	**15**	**350**	**250**	**600**	**18**

List of Elective Courses

Professional Elective 1

Sl. No.	Course Code	Course Title	Credits
1	23MST231	Structural Reliability	3
2	23MST232	Stability of Structures	3
3	23MST233	Design of High-Rise Structures	3
4	23MST234	Repair and Rehabilitation of structures	3

Professional Elective 2

Sl. No.	Course Code	Course Title	Credits
1	23MST241	Earthquake Resistant Design	3
2	23MST242	Advanced Materials	3
3	23MST243	Plate and Shells	3
4	23MST244	Structural Health Monitoring	3

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DEPARTMENT OF CIVIL ENGINEERING

M-Tech Program in STRUCTURAL ENGINEERING

(Effective from the academic year 2023 – 24)

III SEMESTER M. Tech.

Sl. No.	Course code	Course title	Teaching Hours /Week			Examination				Credits
			Theory Lecture	Tutorials	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
			L	T	P					
1	23MST31	Design of Bridges	3	2	-	3	50	50	100	4
2	23MST32X	Professional Elective 3	3	-	-	3	50	50	100	3
3	23MST33X	Professional Elective 4	3	-	-	3	50	50	100	3
4	23MST34	Project work Phase I	-	-	6	-	100	-	100	3
5	23MST35	Societal Project	-	-	6	-	100	-	100	3
6	23MST36	Internship	(06 weeks Internship Completed during the intervening vacation of II and III semesters.)			3	50	50	100	6
		TOTAL	**9**	**2**	**12**	**12**	**400**	**200**	**600**	**22**

List of Elective Courses

Professional Elective 3:

Sl. No.	Course Code	Course Title	Credits
1	23MST321	Design of Masonry Structures	3
2	23MST322	Design of Industrial Structures	3
3	23MST323	Design of Sub Structures	3
4	23MST324	Fracture Mechanics	3

Professional Elective 4:

Sl. No.	Course Code	Course Title	Credits
1	23MST331	Design of form work	3
2	23MST332	Optimization Techniques	3
3	23MST333	Advance Precast Concrete Structures	3
4	23MST334	Advanced Structural Analysis	3
5	23MST335	Advanced Prestressed Concrete	3

GLOBAL ACADEMY OF TECHNOLOGY

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DEPARTMENT OF CIVIL ENGINEERING

MTech Program in STRUCTURAL ENGINEERING

(Effective from the academic year 2023 – 24)

IV SEMESTER M. Tech.

Sl. No.	Course code	Course title	Teaching Hours /Week			Examination				Credits
			Theory Lectur	Tutorial	Practical	Duration in hours	CIE Marks	SEE Marks	Total Marks	
			L	T	P					
1	23MST41	Project work Phase 2	-	-	8	3	100	100	200	18
		TOTAL	-	-	**8**	**3**	**100**	**100**	**200**	**18**

SEMESTER – I

Course: Special Concrete

Course Code	**23MST11**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**03**	**Examination Hours**	**3**

Prerequisites: Concrete Technology

Course Objectives:

CLO1	To Identify the functional role of ingredients of concrete and apply to mix design philosophy
CLO2	To Understand fresh and hardened properties of special concrete
CLO3	To evaluate the effect of the environment on serviceability of structural concrete and measure the Non-Destructive Testing of Concrete Structure.
CLO4	To Understand the concepts, Mix proportioning and methods of special concreting operations.

Content	No. of Hours/ RBT levels
Module-1 Constituent materials: Role of constituents, Components of modern concrete, Rheology, Mineral and Chemical admixtures and their effect on properties of concrete Special cements: Need, Classifications, Blended cements, modified hydraulic cements, calcium aluminate cements, calcium sulphate based binders, calcium sulfo aluminate cements, shrinkage compensating (or) expansive cements, macro defect-free cements, phosphate cements, fast setting cements, their Performance and prescriptive specifications, Methods of mix proportioning: IS method, ACI method and BS method	**8 Hours L2**
Module 2 Light Weightconcrete: Introduction, classification, strength and elastic properties, durability, mix proportioning. High density concrete: Radiation shielding ability of concrete, materials for high density concrete, mix proportioning, properties in fresh and hardened state, placement methods. Self- compacting Concrete (SCC), General characteristics, Properties, microstructure. Robustness and methods of mix proportioning and applications	**8 Hours L2**
Module 3 Other concretes for special properties: High-volume fly ash concretes,	**8 Hours L2**

geo-polymer concrete, pervious concrete, aerated concrete, ultrahigh performance concretes, Reactive powder concrete, Bacterial concrete, Heat resistant and refractory concrete. Their significance, materials, general consideration strength and durability aspects. Mixture proportioning and parameters in the development of Special concreting operations: Guniting and shotcreting, pre- placed aggregate, anti-washout concretes, concrete pumping, tremie placement for underwater applications.	
Module 4 Fibre reinforced concrete: Fibre materials, mix proportioning, distribution and orientation, interfacial bond, properties in fresh state, Toughness and impact resistance, Elastic modulus, creep, and drying shrinkage, strength and behaviour in tension, compression and flexure, crack arrest and toughening mechanism, durability, applications. Ferro cement: Materials, mechanical properties, cracking of ferrocement, Types and methods of construction, strength and behaviour in tension, compression and flexure, Design of ferrocement in tension, durability, and applications.	**8 Hours** **L2**
Module 5 High strength concretes: Materials and mix proportion, Microstructure, stress-strain relation, fracture, drying shrinkage, and creep. Mass concrete and Roller compacted concrete: Constituents, mix proportioning, properties in fresh and hardened states, applications and limitations. Different NDT techniques for performance evaluation of structures: Rebound hammer, Ultrasonic pulse velocity meter, Profometer, Ground Penetrating Radar (GPR), Core test, Carbonation and Corrosion assessment	**8 Hours** **L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST11.1	Identify the functional role of ingredients of concrete and apply this knowledge to mix design philosophy
23MST11.2	Acquire and apply fundamental knowledge in the fresh and hardened properties of concrete for special properties.
23MST11.3	Evaluate the effect of the environment on service life performance, properties and failure of structural concrete and demonstrate techniques of measuring the Non-Destructive
23MST11.4	Understand the concepts, mix proportioning and methods of special concreting Operations

Text books:

1. Neville A.M, "Properties of Concrete" Pearson Education Asia,2000.
2. A.R.Santhakumar, (2007) "Concrete Technology"-Oxford University Press, New, Delhi, 2007.

Reference books:

1. Rudnai.G., "Light Weight concrete"-Akademiaikiado, Budapest 1963 9. http://qcin.org/CAS/RMCPC/.
2. Gambhir "Concrete Technology" TMH.

Web Reference:

https://onlinecourses.nptel.ac.in/noc22_ce09/preview

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO-PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST11.1	2		2		1		2	1	
23MST11.2	2		2		1		2	2	
23MST11.3	3		3		1		2	3	
23MST11.4	3		3		1		2	3	
Average	2.5		2.5		1		2	2.25	

normal modes, Example of a 3-storeyed frame subjected to ground motion.	**10 Hours L2, L3**
Module 5 **Continuous systems**, Flexural vibration of beams, simply supported and cantilever beams, Longitudinal vibrations of bars, Longitudinal waves in bars, Waves, and vibration response of simply supported beams under uniformly distributed triangular pulse loading, Matrix formulation of beams with lumped masses.	**10 Hours L2, L3**

Lab Experiments	
1	Determine natural frequencies and mode shapes for multi-storied building without infill walls using shake table
2	Determine natural frequencies and mode shapes for multi-storied building with infill walls using shake table
3	Solve free vibration problems using python
4	Solve forced vibration problems using python

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST12.1	**Classify** the simple structures as discrete and continuous vibratory system
23MST12.2	**Compute** the response of single degree of freedom systems for various types of excitations.
23MST12.3	**Determine** natural frequencies and mode shapes of multi degree of freedom systems
23MST12.4	**Calculate** natural frequencies and mode shapes of a 3-storeyed shear building frame subjected to ground motion
23MST12.5	**Explain** the flexural vibration of beams with various boundary conditions and longitudinal vibration of bars

Textbooks:

1. Structural Dynamics: Vibrations and Systems, Madhujit Mukophadhyay, Publisher: ANE Books
2. Earthquake-Resistant Design of Building Structures by Dr. Vinod Hosur, wiley publications.
3. Basics of Structural Dynamics and A Seismic Design by Damodarasamy S.R and S. Kavitha, Prentice Hall India Learning Private Limited
4. Dynamics of Structures by Anil K Chopra, Pearson Education India

SEMESTER – I

Course: Structural Dynamics

Course Code	**23MST12**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**3**

Prerequisites: Matrix Methods of Structural Analysis

Course Objectives:

CLO1	Concepts of dynamic equilibrium and free vibrations in structural systems
CLO2	Modeling and analysis of single degree freedom systems subjected to dynamic forces
CLO3	Modeling and analysis of multi-degree freedom systems subjected to both free and forced vibrations
CLO4	Concepts of flexural, longitudinal vibrations of bars and beams with various end conditions

Content	**No. of Hours/ RBT levels**
Module-1 **Introduction**: Introduction to dynamic problems of Civil Engineering, Concept of degrees of freedom, D'Alembert's principle, Principle of virtual displacement and energy, Single degree of freedom systems, Examples of Single degree of freedom systems in Engineering, Free vibration of damped and undamped systems.	**10 Hours L2, L3**
Module 2 **Single degree of freedom systems:** subjected to sinusoidal loading, Resonance and its resonance diagram – support motion, Vibration isolation, transmissibility, Methods of damping measurements, Response of Single degree of freedom systems to arbitrary excitation, Duhamel integral solution, Response to suddenly applied load and triangular pulse loading, Principles of vibration measuring instruments.	**10 Hours L2, L3**
Module 3 **Dynamics of multi-Degree of freedom system**: Natural Frequency and normal modes, Orthogonality of modal vectors, Shear building model without damping and with proportional damping, Approximate methods of frequency analysis, Rayleigh's method, and matrix iteration methods.	**10 Hours L2, L3,**
Module 4 **Response of shear building** with proportion damping, Superposition of	

Reference books:

1. Structural Dynamics: Theory and Computation, 2nd Edition, Mario Paz, CBS Publisher.
2. Dynamics of Structures, Ray. W. Clough and J. Penzien, McGraw– Hill Education.
3. Theory of vibration with applications, William Thomson; 4th edition, 1996, CRC Press.

Web Reference:

1) https://archive.nptel.ac.in/courses/101/105/101105081/
2) https://archive.nptel.ac.in/courses/105/106/105106151/
3) https://archive.nptel.ac.in/courses/105/101/105101006/
4) https://sd-iiith.vlabs.ac.in/

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.
Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST12.1	2		2						
23MST12.2	3		3					2	
23MST12.3	3		3				3	2	
23MST12.4	3		3				3	2	
23MST12.5	3		2				3	2	
Average	**3**		**2.6**				**3**	**2**	

SEMESTER – I

Course: Computational Structural Mechanics

Course Code	**23MST13**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:2:0**	**SEE Marks**	**50**
No. of Credits	**04**	**Examination Hours**	**3**

Prerequisites: Design of RCC Structural elements

Course Objectives: Students will be able to

CLO1	Understand the concepts of matrix methods to develop co-ordinate system by force and displacement approach
CLO2	Understand local and global coordinate system to develop displacement transformation matrices.
CLO3	Understand Analyzing of structures using matrix methods for different degrees of freedom
CLO4	Understand the structures by direct stiffness method

Content	No.of Hours/ RBT levels
Module-1 Basic concepts of structural analysis and methods of solving simultaneous equations: Introduction, Types of framed structures, Static and Kinematic Indeterminacy, Equilibrium equations, Compatibility conditions, Principle of superposition, Energy principles, Equivalent joint loads, Methods of solving linear simultaneous equations- Gauss elimination method, Cholesky method and Gauss-Siedal method.	**10 Hours L2,L3**
Module 2 Fundamentals of Flexibility and Stiffness Methods: Concepts of stiffness and flexibility, Local and Global coordinates, Development of element flexibility and element stiffness matrices for truss, beam and grid elements, Force-transformation matrix, Development of global flexibility matrix for continuous beams,plane trusses and rigid plane frames, Displacement-transformation matrix, Development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames.	**10 Hours L3**
Module 3 Analysis using Flexibility Method (including secondary effects): Continuous beams, plane trusses and rigid plane frames	**10 Hours L3**

Module 4 Analysis using Stiffness Method (including secondary effects): Continuous beams, plane trusses and rigid plane frames	**10 Hours** **L3**
Module 5 Direct Stiffness Method: Stiffness matrix for truss element in local and global coordinates, Analysis of plane trusses, Stiffness matrix for beam element, Analysis of continuous beams and orthogonal frames.	**10 Hours** **L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST13.1	Demonstrate the concepts of matrix methods to develop co-ordinate system for trusses, beams, and frames by force and displacement approach.
23MST13.2	Apply knowledge of local and global coordinate system to develop displacement transformation matrices.
23MST13.3	Analyze structures using matrix methods by analytical methods for different degrees of freedom
23MST13.4	Analyze the structures by direct stiffness method

Textbooks:

1. Computational Structural Mechanics, S.Rajasekaran, G. Sankarasubramanian, 7th Edition, 2015, Prentice-Hall of India Pvt Ltd, NewDelhi-110092.ISBN-13:978-8120317345, ISBN- 10:8120317343
2. Computer Analysis of Framed Structures, DamodarMaity,2007, I K International Publishing House Pvt. Ltd., ISBN-13: 978-8189866198.

Reference books:

1. Martin, H, C., Introduction to Matrix Methods of Structural Analysis, McGraw-Hill, New York, 1966.
2. Rubinstein, M.F., Matrix Computer Analysis of Structures, Prentice- Hall, Englewood Cliffs, New Jersey, 1966.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST13.1	3		3				2		
23MST13.2	3		3				2	2	
23MST13.3	3		3				3	3	
23MST13.4	3		3				3	3	
Average	3		3				2.5	2.67	

SEMESTER – I

Course: Advanced Design of Reinforced Concrete Structures

Course Code	**23MST14**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**03**	**Examination Hours**	**3**

Prerequisites: Design of RCC Structural elements

Course Objectives: Students will be able to

CLO1	Design curved and deep beams for strength and serviceability requirements.
CLO2	Design rectangular slabs, Circular slabs and triangular slabs with various edge conditions – yield line patterns.
CLO3	Design Grid slab and Flat Slab using different methods of analysis.
CLO4	Design Water tanks for Strength and serviceability requirements.
CLO5	Design Chimneys, silos and bunkers for Strength and serviceability requirements.

Content	**No.of Hours/ RBT levels**
Module-1 **Curved and Deep Beams:** Analysis of Flexural and Torsional moments in circular Girders, Semicircular beams Supported on Three columns. Behaviour and Parameters influencing design of deep beams (Flexural and shear stresses in deep beams).	**10 Hours L2,L3**
Module 2 **Slabs:** Yield line theory for analysis of slabs: Equilibrium and virtual work methods of analysis, rectangular slabs and triangular slabs with various edge conditions – yield line patterns, Circular slabs.	**10 Hours L3**
Module 3 **Grid floors and Flat slabs**: General features, Rigorous and approximate methods of analysis, Design and detailing of grid floors. Design and detailing of flat slabs including unbalanced column moments.	**10 Hours L3**
Module 4 **Water retaining structures:** Design and detailing of rectangular and circular underground sump tanks with fixed, flexible base and Elevated water tanks.	**10 Hours L3**
Module 5 **Chimneys**: Analysis, Design check for stresses and detailing of base of chimney **Silos (circular), bunkers and Chimneys**: Analysis, design and detailing of side walls, hopper bottoms. Analysis, Design check for stresses	**10 Hours L3**

and detailing of base of chimney	

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST14.1	Compute reinforcement in curved and deep beams for strength and serviceability requirements.
23MST14.2	Calculate the reinforcement details for rectangular slabs, triangular slabs and Circular slabs with various moments and edge conditions.
23MST14.3	Design grid floors and flat slabs subjected to various load combinations.
23MST14.4	Design water tanks for critical bending stresses, shear forces and torsion
23MST14.5	Evaluate Chimneys, Silos and bunker for Strength and serviceability requirements.

Textbooks:

1) Krishna Raju. N., "Advanced Reinforced Concrete Design", CBS Publishers & Distributors
2) Unnikrishnan and Menon D., "Reinforced Concrete Design", Tata McGraw-Hill, 3rd Ed, 1999.
3) Shah.H.J, "Reinforced Concrete", Vol-1 and Vol-2, Charotar, 8th Edition – 2009 and 6th Edition – 2012 respectively.
4) Gambhir.M.L, "Design of Reinforced Concrete Structures", PHI Pvt. Ltd, New Delhi, 2008
5) Varghese. P. C., "Advanced Reinforced Concrete Design", Prentice-Hall of India, New Delhi, 2000
6) Relevant IS Code Books IS:456 2000, SP:16, SP:34

Reference books:

1) Hsu T. T. C. and Mo Y. L., "Unified Theory of Concrete Structures", John Wiley & Sons, 2010
2) Krishnamurthy, K.T., Gharpure S.C. and A.B. Kulkarni – "Limit design of reinforced concrete structures", Khanna Publishers, 1985
3) Lin T Y and Burns N H., "Reinforced Concrete Design". Wiley, 2004
4) Park & Paunlay.,"Reinforced Concrete Structures". Wiley, 2004
5) Punmia B.C, Ashok Kumar Jain and Arun Kumar Jain, "Comprehensive RCC Design", Laxmi Publications, New Delhi
6) Purushothaman. P., "Reinforced Concrete Structural Elements : Behaviour Analysis and Design", TataMc Graw Hill, 1986
7) Sinha. N.C. and Roy S.K., "Fundamentals of Reinforced Concrete", S. Chand and Company Limited, New Delhi, 2003

Web Reference:

NPTEL Course: https://onlinecourses.nptel.ac.in/noc18_ce24/preview

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
	Grand Total		**100**

CO/PO Mapping									
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
23MST14.1	3		2				3	3	
23MST14.2	3		3				3	3	
23MST14.3	3		3				3	3	
23MST14.4	3		3				3	3	
Average	3		2.75				3	3	

SEMESTER – I

Course: Mechanics of Deformable Bodies

Course Code	**23MST15**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks**	**50**
No. of Credits	**03**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	To make students to learn principles of Analysis of Stress and Strain.
CLO2	To predict the stress- strain behaviour of continuum.
CLO3	To evaluate the stress and strain parameters and their interrelations of the continuum.
CLO4	TO analyze two - Dimensional Problems in Cartesian and Polar Coordinates

Content	No. of Hours/ RBT levels
Module-1 **Analysis of stress:** Introduction, stress, components of stress at a point in Cartesian coordinates (2D & 3D), plane stress problems, equilibrium equations, stresses on inclined plane, stress transformation, principal stresses, maximum shear stress, stress invariants hydrostatic and deviatoric stresses, octahedral stresses, boundary conditions. Stress components (2D & 3D) in polar coordinates, equilibrium equations.	**10 Hours L2, L3**
Module 2 **Analysis of strain:** Strain, components of strain at a point in Cartesian coordinate's, plane strain problems, strain transformation, principal and octahedral strain. Strain Components in Polar Coordinate System.	**10 Hours L2, L3**
Module 3 **Stress strain relations and compatibility equations:** Generalized Hooke's law, constitutive equations, lame's constants, compliance matrix, Saint vaint's principle of superposition, compatibility equations for 3 dimensional elements in Cartesian coordinates, compatibility equations for plane stress and plane strain problems in terms of stress components, Naviers equations, boundary value problem, stress compatibility equations in polar coordinate system. Constitutive Relations in Polar Coordinate System.	**10 Hours L2, L3**
Module 4 **Two - Dimensional Problems in Cartesian and Polar Coordinates:**	**10 Hours**

Biharmonic equation in Cartesian coordinates, Airy's stress functions, polynomials, as stress functions. Stress functions for plane stress and plane strain, bending of cantilever and simply supported beams. Biharmonic equations in polar coordinates. Axisymmetric problems, thick walled cylinder subjected to internal and external pressures, Effect of circular hole on stress distribution.	**L2, L3**
Module 5 **Torsion of Prismatic Bars**: Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes. **Introduction to Plasticity:** Strain Hardening, Idealized Stress- Strain curve, Failure theories, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations.	**10 Hours** **L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST15.1	Explain the basic principles of Elasticity and plasticity
23MST15.2	Analyse the behavior of objects under two- and three-dimensional state of stress
23MST15.3	Evaluate the stress and strain in two- and three-dimensional problems.
23MST15.4	Formulate equations governing the behavior of two- and three-dimensional solids.

Text books:

1. Theory of Elasticity, Timoshenko &Goodier,3rd edition, Tata McGraw-Hill Publishing Company, ISBN-10: 0070702608, ISBN-13: 978-0070070268.
2. Elasticity for Engineers T G Sitaram & L Govindaraju, I K International Pvt Ltd, ISBN – 978-93- 85909-34-4

Reference books:

1. Advanced Mechanics of Solids, SrinathL.S,3rdedition,2010, Tata Mc Graw Hill Publishing company ISBN-10: 0070858055 ISBN-13: 978-0070858053
2. Theory of Plasticity, Chakrabarthy.T,3rd Edition, Tata Mc. Graw Hill Book Co, ISBN-10:9380931719 ISBN-13: 9789380931715.

Web Reference:

https://onlinecourses.nptel.ac.in/noc20_ce50/preview

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
23MST15.1	2		2					2	
23MST15.2	3		3				3	2	
23MST15.3	3		3				3	2	
23MST15.4	3		3				2	2	
Average	3		2.75				2.67	2	

SEMESTER – I

Course: Research Methodology and IPR

Course Code	23RMI16	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	3

Prerequisites: None

Course Objectives: The students will be taught:

CLO1	To access and use information ethically and legally
CLO2	To identify, evaluate, and select the most appropriate methods for finding information
CLO3	To understand the concept of IPR and filing procedure
CLO4	To understand the concepts of copyright in research.

Content	No. of Hours/ RBT levels
Module-1 **Introduction** – Overview of research, Definitions and characteristics of engineering research; Types of engineering research; Main components of any research work. **Topic Selection:** Problem identification; Analysis and Statement of the problem: Learning Objectives; Analyzing the problem; Formulating the problem statement. Keywords. Concept of research cycle. **Ethics in Research** – Research fraud, competing for interest, authorship, slicing research, FFP, COPE guidelines. Plagiarism – Methods of avoiding plagiarism, Software pertaining to plagiarism.	8 Hours L2
Module 2 **Literature survey** - Use of literature review; Source of information (popular and scholarly, primary and secondary sources); Organization of information. **Research methodologies**: Plan for data collection; Methods of data collection; Plan for data processing and analysis. **Research writing and publication** - Introduction; Basic rules of academic writing, Precautions in academic writing, Research proposal writing; Abstract/ Conference Paper. Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations,	8 Hours L2

Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions.	
Module 3 **Patenting and IPR** – Building Intellectual Property Rights, Law of Patents, Fundamentals of Patent Law - Evolution of the patent system, Patentability Requirements; Patentable Subject Matter; Industrial Applicability/Utility; Novelty; Anticipation by publication; Anticipation by public knowledge and public use; Anticipation by public display; Anticipation by sale; Inventive Step/Non-Obviousness; Novelty Assessment; Inventive Step Assessment; Specification, Drafting of A Patent Specification - Introduction Patent Specification; Provisional Specification Complete Specification, Parts of the complete specification.	**8 Hours L2**
Module 4 **Patent Procedure in India** - Patenting Procedure; Patent Infringement andits types. Defences - Experiment - Research or Education - Bolar Exemption- Government use- Patent Exhaustion- Patent Misuse- Inequitable Conduct - Remedies- Injunction- Account of profits- Costs; International **Patent Regimes** - International Instruments; Paris Convention; TRIPS AGREEMENT; PCT; BUDAPEST TREATY, Patentable Subject Matter- USA- Europe- India; Patentability of Software Inventions - in the USA, Europe and India.	**8 Hours L2**
Module 5 **Module 5** **Interpretation and report writing** – Meaning of interpretation, Technique of interpretation, Precautions in interpretation, Significance of report writing, Different steps in report writing, Layout of research report, Types of reports, Oral presentation, Mechanics of writing research report, Precautions for writing research reports.	**08 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23RMI16.1	Identify and analyze the chosen problem and its relevance in research.
23RMI16.2	Organize and evaluate the information gathered through various modes of literature sources.
23RMI16.3	Understand the fundamentals of patent laws and drafting procedures.
23RMI16.4	Understand the copyright laws and subject matters of copyrights and designs.
23RMI16.5	Understand the data interpretation and report writing

Textbooks:

1. Dipankar Deb • Rajeeb Dey, Valentina E. Balas "Engineering Research Methodology", ISSN 1868- 4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13- 2946-3 ISBN 978-981-13-2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0
2. Kumar, R (2011). Research methodology - a step by step guide for beginners. SAGE publications, 3rd edition.
3. Property Rights, Law and Practice, The institute of company secretaries of India, Statuatory Body under an Act of Parliament, September 2013.

Reference books:

1. Pecorari D, (2018). Academic writing and Plagiarism: A linguistic analysis. Bloomsbury Academic India. ISBN-10: 9388038232, 214pp.
2. Fink A (2009). Conducting research literature reviews: From the Internet to Paper, SAGE publications.
3. Pandey N and Dharni K (2014). Intellectual property rights. 1st edition, Kindle edition., PHI learning.

Web Reference:

- https://archive.nptel.ac.in/courses/121/106/121106007/
- https://www.youtube.com/watch?v=cdhoJPlJNSg&list=PLLy_2iUCG87AuIWZ3qnjA1GriD-IGF3Za&index=10&t=5s
- https://onlinecourses.nptel.ac.in/noc22_ge23/preview

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
23RMI16.1	3	3	2					2	
23RMI16.2	3	3	2					2	
23RMI16.3	3	3	3					2	
23RMI16.4	3	3	3					2	
23RMI16.5	3	3	3					2	
Average	3	3	2.6					2	

SEMESTER – I

Course: Structural Engineering Lab-1

Course Code	**23MSTL17**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**1:0:2**	**SEE Marks**	**50**
No. of Credits	**2**	**Examination Hours**	**3**

Prerequisites: Concrete Technology

Course Objectives:

CLO1	Mix proportions for conventional, self-compacted concrete and find out its behavior in fresh and hardened state
CLO2	Flexural strength of RCC and FRC concrete beams
CLO3	Natural frequencies and mode shapes vibration of multi storey frames
CLO4	Application of Non-Destructive Testing (NDT) Equipments

Content	No. of Hours/ RBT levels
Module-1 Mix design of Conventional and Self-Compacted Concrete	**12 Hours L3, L4**
Module 2 Evaluation of fresh and hardened properties of Conventional and Self-Compacted Concrete	**12 Hours L3, L4**
Module 3 Loading Frame: Evaluation of flexural strength of RCC and FRC concrete beams	**12 Hours L3, L4**
Module 4 Shake Table Experiments: • Experiments on vibration of multi storey frame models for natural frequency and modes • Earthquake induced waves in rectangular water tanks • Seismic wave amplification, liquefaction and soil-structure interactions	**12 Hours L3, L4**
Module 5 Use of Non-Destructive Testing (NDT) Equipments: • Rebound hammer • Ultra sonic pulse velocity meter • Profometer	**12 Hours L3, L4**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MSTL17.1	**Estimate** the mix proportions for Conventional and Self-Compacted Concrete as per the codal provisions
23MSTL17.2	**Evaluate** the fresh and hardened properties of Conventional and Self-Compacted Concrete
23MSTL17.3	**Evaluate** the natural frequencies and mode shapes of water tanks, multi storey frames
23MSTL17.4	**Estimate** strength, dynamic modulus, bar diameter, spacing of bars, cover using rebound hammer, upv and profometer

Textbooks:

1) Neville A.M, "Properties of Concrete" Pearson Education Asia, 2000.
2) Concrete Technology by M. S. Shetty, S. Chand & Co
3) Earthquake-Resistant design of building structures by Dr. Vinod Hosur, Wiley India Pvt Ltd

Reference books:

1) Concrete: Micro Structure by P.K.Mehta, ICI, Chennai
2) Structural Dynamics: Theory and Computation, 2nd Edition, Mario Paz, CBS Publisher

Web Reference:

https://sd-iiith.vlabs.ac.in/

Scheme of Examination:

Semester End Examination (SEE):

SEE EVALUATION OF LAB COURSES

PARTICULARS	MARKS
Write up of the experience/ Program	20
Experimentation/Program	40
Results, Graphs, Discussions	20
Viva Voce	20
TOTAL	100

CO/PO Mapping									
CO/PO	PO1	.PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
23MSTL17.1	2	2	2	1	2	2	3	3	2
23MSTL17.2	1	1	3	1	-	2	3	2	-
23MSTL17.3	3	1	3	1	-	2	3	2	3
23MSTL17.4	2	2	3	2	-	2	3	2	3
Average	**2**	**1.5**	**2.75**	**1.25**	**2**	**2**	**3.00**	**2.25**	**2.67**

SEMESTER – II

Course: Advanced Design of Steel Structures

Course Code	**23MST21**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**4:0:0**	**SEE Marks**	**50**
No. of Credits	**04**	**Examination Hours**	**3**

Prerequisites: Design of Steel Structures

Course Objectives: Students will be able to

CLO1	Analyze unstrained beams and beam column behavior in frames
CLO2	Design steel beams with web openings and Vierendeel girders.
CLO3	Evaluate the behavior of Light gauge steel members.
CLO4	Design steel structures subjected to fire resistance.

Content	No.of Hours/ RBT levels
Module-1 **Laterally Unrestrained Beams:** Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of Cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, Mono-symmetric and non- uniform beams – Design Examples. Concepts of-Shear Center, Warping, Uniform and Non-Uniform torsion.	**10 Hours L3**
Module 2 **Beam- Columns in Frames:** Behaviour of Short and Long Beam - Columns, Effects of Slenderness Ratio and Axial Force on Modes of Failure, Biaxial bending, Strength of Beam Columns, Sway and Non-Sway Frames, Strength and Stability of rigid jointed frames, Effective Length of Columns-, Methods in IS 800	**10 Hours L3**
Module 3 **Steel Beams with Web Openings:** Shape of the web openings, practical guidelines, and Force distribution and failure patterns. Analysis of beams with perforated thin and thick webs, Design of laterally restrained castellated beams for given sectional properties. Vierendeel girders (design for given analysis results)	**10 Hours L3**
Module 4 **Cold formed steel sections:** Technique sand properties, Advantages, Typical profiles, Stiffened and unstiffened elements, Local buckling effects, effective	**10 Hours L3**

section properties, IS801&811code provisions-numerical examples, beam design, column design.	
Module 5 **Fire resistance:** Fire resistance level, Period of Structural Adequacy, Properties of steel with temperature, Limiting Steel temperature, Protected and unprotected members, Methods of fire protection, Fire resistance Ratings. Numerical Examples.	**10 Hours L3**

COURSE OUTCOMES:
Upon completion of this course, student will be able to:

23MST21.1	**Analyze** unrestrained beams and beam column behavior in frames as per IS:800 codal provisions
23MST21.2	**Design** steel beams with web openings and Vierendeel girders.
23MST21.3	**Evaluate** the behavior of Light gauge steel members.
23MST21.4	**Design** steel structures subjected to fire resistance.

Textbooks:

1. N. Subramanian, "Design of Steel Structures", Oxford, IBH
2. K S Duggal, "Design of Steel Structures", Tata McGraw Hill, New Delhi
3. IS 800: 2007, IS 801-2010, IS 811-1987, BS5950-Part 8

Web Reference:

INSDAG Teaching Resource Chapter 11 to 20:www.steel-insdag.org

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. Two questions shall be asked from each module. There can be maximum of three subdivisions in each question, if necessary. • One full question should be answered from each module. • Each question carries 50 marks.

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST21.1	2		2				2	2	
23MST21.2	3		3		1		3	2	
23MST21.3	3		3				3	3	
23MST21.4	2		2		1		3	3	
Average	**2.5**		**2.5**		**1**		**2.75**	**2.5**	

SEMESTER – II

Course: Finite Element Analysis

Course Code	**23MST22**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:2**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: The students will be taught:

CLO1	To analyze the structure using FE based Software To learn principles of design
CLO2	To investigate the performance of structural elements.
CLO3	To understand nodal variables for beams, bars and trusses using shape functions
CLO4	To design the structural components using FEA software

Content	**No. of Hours/ RBT levels**
Module 1 Basic concepts of elasticity – kinematics and static variables for various types of structural problems – approximate method of structural analysis – Rayleigh-Ritz method –principles of finite element method – advantages & disadvantages – finite element procedure – finite elements used for one-, two- and three-dimensional problems. Difference between Finite Difference Method and Finite Element Method – variational method and minimization of energy approach for element formulation Discretization: types of elements 1D, 2D and 3D elements, simplex, complex and multiplex elements, size of the elements, location of nodes, node numbering scheme, half bandwidth, properties of stiffness matrix, preprocessing, post processing. Types of local coordinate system– generalized and natural coordinates Interpolation models: **(Nodal displacement parameters)** Selection of the order of the interpolation polynomial, convergence requirements, 2d Pascal triangle, nodal displacement parameters, convergence criterion, compatibility requirements, geometric invariance.	**10 Hours L2, L3**
Module 2 **One dimensional bar element and FEM computational procedure:** Shape function: nodded using Lagrangian shape function Polynomial form of interpolation functions- linear, quadratic and cubic, linear interpolation polynomials in terms of global coordinates of bar. Formulation of one-	**10 Hours L2, L3**

dimensional bar element, two- and three- Derivation of element stiffness matrices and load vectors for concentrated and distributed loads for beam element.– numerical analysis of compound bars and plane trusses	
Module 3 Hermite shape function for beam formulation – Application of FEM to analysis of continuous beams and frames:stiffness of beam members, grid members, and space frame.	**10 Hours** **L2, L3**
Module 4 **Basic 2-D-Simplex element formulation and applications:** Plane -stress and plane-strain problems Shape functions of Triangular elements Formulation of two-dimensional three-nodded triangular (CST) – strain displacement matrix – stiffness matrix – consistent load vector Shape functions of Rectangular elements Formulation of rectangular elements basic strain-displacement matrix – stiffness matrix – consistent load vector. Higher order 2-D (Complex) elements: Formulation of higher order triangular and rectangular elements	**10 Hours** **L2, L3**
Module 5 **Isoparametric formulation:** Theory of isoparametric elements: Isoparametric, sub-parametric and super- parametric elements, characteristics of isoparametric elements, validity of isoparametric elements, numerical integration, Jacobian transformation matrix-Gauss quadrature for numerical integration Formulation of four-nodded quadrilateral element, and its application to plane stress, plane strain and axis- symmetric problems Numerical problems on: Computation of Jacobian matrix, consistent load vector, stresses and strains for 2D elements. Need for mesh quality checks and their effect on analysis, computer algorithms, flow charts, simple computer program for the analysis of 2D structures. **3-D element formulation and applications:** Finite element formulation, hexahedral elements and higher order elements, element stiffness, force terms, stress calculations, problems on modeling. Element aspect ratio – mesh refinement vs. higher order elements – numbering – static condensation technique – introduction to non-linear analysis – geometric and material non-linearity with examples.	**10 Hours** **L2, L3**

Lab Experiments:	
1	Model a two and three dimensional truss and analyze to obtain forces in members by programming in a language, and compare results by using a suitable FEA software
2	Model a two and three dimensional frames and analyze to obtain forces in members by programming in a language, and compare results by using a suitable software
3	Model and Analyze grid roof by using a suitable FEA software and compare results with a minimum of two design office methods.
4	Model and analyze a water tank/silo/bunker

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST22.1	**Explain** the basic concepts of elasticity and finite element method
23MST22.2	**Compute** shape functions for one, two and three dimensional first and higher order finite elements
23MST22.3	**Calculate** nodal variables for beams, bars and trusses using shape functions
23MST22.4	**Determine** strain-displacement matrix, stiffness matrix, consistent load vector for one and two dimensional basic finite elements

Textbooks:

1. Finite Element Analysis – Theory and Programming, C.S Krishnamoorthy, 1994, Tata McGraw-Hill, ISBN 0-07-462210-2
2. Concepts and applications of finite element analysis, RD Cook, DS Malkus, ME Plesha and RJ Witt, 2002, Wiley

Reference books:

1. The Finite Element Method: Its Basis and Fundamental, O.C Zienkiewicz and R.L Taylor, 2005 Butterwoth.
2. Finite Element Procedures KJ Bathe, 2002, Prentice Hall, ISBN 978-546-439-982
3. Fundamentals of Finite Element Analysis, DV Hutton, (2004), Tata McGraw Hill
4. A First course in the Finite Element Analysis, Deryl L Logan, Global engineering, ISBN:13.878-0- 495-66825-1
5. Finite Element Analysis, Rajashekharan,S Chand &Co Ltd,ISBN:9788121923149.

Web Reference:

https://archive.nptel.ac.in/courses/105/105/105105041/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST22.1	2		2	2			2	2	
23MST22.2	2		1	2			2	2	
23MST22.3	3		3	3			3	3	
23MST22.4	3		3	3			3	3	
Average	2.5		2.25	2.5			2.5	2.5	

SEMESTER – II

Course: Structural Reliability

Course Code	23MST231	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	3

Prerequisites:

Course Objectives: The students will be taught:

CLO1	The concepts of Probability functions and distributions
CLO2	The concept of System reliability.
CLO3	The principles of reliability.
CLO4	Design and development of analytical skills

Content	No. of Hours/ RBT levels
Module-1 Probability mass function, probability density function, mathematical expectation, Chebyshev's theorem. Probability distributions: discrete distributions- binomial and poison distributions, continuous distributions-normal, lognormal distributions	8 Hours L2, L3
Module 2 Measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability analysis-first order second moment method (FOSM), point estimate method (PEM)	8 Hours L2, L3
Module 3 Advanced first order second moment method (Hasofer-Lind's method). Simulation Techniques: Monte Carlo simulation- statistical experiments, confidence limits, sample size and accuracy, generation of random numbers-random numbers with standard uniform distribution, continuous random variables, discrete random variables.	8 Hours L2, L3
Module 4 System Reliability of series, parallel and combined systems, evaluation of probability of survival for determinate and redundant structural system.	8 Hours L2, L3
Module 5 Reliability based design- Steel and RCC beams by FOSM and advanced FOSM, evaluation of geometrical dimension for given level of safety index	8 Hours L2, L3

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST231.1	Apply the theoretical principles of randomness of variables in structural engineering through density functions and probability distribution.
23MST231.2	Analyse components of structure to assess safety using concepts related to structural reliability by various methods.
23MST231.3	Evaluate the safety reliability index at system level.
23MST231.4	Design beam element for given safety index.

Textbooks:

1. Ranganathan, R. (1999). "Structural Reliability Analysis and design"- Jaico publishing house, Mumbai, India.
2. Ang, A. H. S., and Tang, W. H. (1984). "Probability concepts in engineering planning and design"- Volume –I, John Wiley and sons, Inc, New York.
3. Ang, A. H. S., and Tang, W. H. (1984). "Probability concepts in engineering planning and design"-Volume –II, John Wiley and sons, Inc, New York.
4. Milton, E. Harr (1987). "Reliability based design in civil engineering"- Mc Graw Hill book Co.

Reference books:

1. Nathabdndu, T., Kottegoda, and Renzo Rosso (1998). Statistics, "Probability and reliability for Civil and Environmental Engineers"- Mc Graw Hill international edition, Singapore.
2. Achintya Haldar and Sankaran Mahadevan (2000). "Probability, Reliability and Statistical methods in Engineering design"- John Wiley and Sons. Inc.
3. Thoft-christensen, P., and Baker, M., J., (1982), "Structural reliability theory and its applications"- Springer-Verlag, Berlin, NewYork.

Web Reference:

https://nptel.ac.in/courses/105103140

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST231.1	2		2	2			2	2	
23MST231.2	2		1	2			2	2	
23MST231.3	3		3	3			3	3	
23MST231.4	3		3	3			3	3	
Average	2.5		2.25	2.5			2.5	2.5	

SEMESTER – II

Course: Stability of Structures

Course Code	**23MST232**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**03**	**Examination Hours**	**3**

Prerequisites: Engineering Mechanics, Strength of Materials, Structural Analysis and Theory of Elasticity

Course Objectives: Students will be able to

CLO1	Understand concept behind Stability of columns and beams
CLO2	Understand the behavior of Inelastic buckling Behavior of columns.
CLO3	Understand the behavior of buckling of Eccentrically loaded columns.
CLO4	Understand Lateral Buckling of Beams and Thin plates.

Content	**No.of Hours/ RBT levels**
Module-1 **Buckling of columns**: Euler's equation for buckling of elastic column, Buckling of columns with various boundary conditions, Deflection shapes of buckled columns. Energy method, Concepts of Stable and unstable equilibrium of systems. Simple column model with a lateral spring, Approximate calculation of critical loads by energy method.	**10 Hours L3**
Module 2 **Inelastic Buckling:** Effect of shear force on the critical load of column. Application to buckling of Built up columns, Inelastic buckling. Limitations of Euler's theory, Reduced modulus theory and Shenley's tangent modulus theory, comparison with experimental results.	**10 Hours L3**
Module 3 **Buckling of Eccentrically loaded columns**: Effect of initial imperfections, Perry Robertson approach to column failure. Influence of eccentricity and secant formula. Multiple column formulas. Multiple Column curves of IS code for various imperfection factors. Selection of sections for compression members.	**10 Hours L3**
Module 4 **Lateral buckling of beams**: Lateral buckling of beams in pure bending,	**10 Hours**

Lateral buckling of cantilever beam and narrow rectangular beams. Simply supported beam of I section subjected to central concentrated load. Pure Torsion of thin – walled bars of open cross section. Non – uniform Torsion of thin – walled bars of open cross section	**L3**
Module 5 **Buckling of thin Plates:** Simply supported rectangular plate with uniform compression in one direction. Buckling of rectangular plates under the action of shearing stresses. Practical implication in the design of compression members and beams	**10 Hours** **L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST232.1	**Explain** the principles of strength, stability and phenomenon of buckling.
23MST232.2	**Apply** the principles of stability to calculate buckling load.
23MST232.3	**Calculate** the buckling load on column, beam – column, frames and plates using classical and approximate methods.
23MST232.4	**Illustrate** buckling of rectangular plates under the action of shearing stresses.

Textbooks:

1. Stephen P. Timoshenko, James M Gere, "Theory of Elastic Stability"-2nd Edition, Tata McGraw Hill, New Delhi,2010, ISBN-10 0-07-070241-1 ISBN-13 978-0-07-070241-7
2. Gambhir, "Stability Analysis and Design of Structures", springer, New York, 2004.
3. Advanced Mechanics of solids and structures, N. Krishna Raju, and D.R. Guru raja, 1997, Narosa Publishing House, New Delhi.

Reference Books:

1. Blunch- —Stability of Metallic Structure, Mc Graw Hill
2. Chem. &Atsute —Theory of Beam Columns, Vol I Mc Graw Hill.
3. Simitser.G.J and Hodges D.H,"Fundamentals of Structural Stability", Elsevier Ltd., 2006.
4. Brush and Almorth, —Buckling of Bars, Plates and Shells, Mc Graw Hill book company.
5. Chajes,A., — Principles of Structural Stability Theory, Prentice Hall.
6. Ashwini Kumar, — Stability theory of Structures, Tata Mc Graw Hill Publishing company Ltd, New Delhi.
7. Bleaigh— Elastic Stability, Tata Mc Graw Hill Publishing Company Ltd, New Delhi.
8. Advanced Mechanics of Materials, Boresi A.P., and Sidebottom O.M., 1985, John Wiley and Sons in N.Y.

Web Reference: https://onlinecourses.nptel.ac.in/noc22_ce91/preview

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. Two questions shall be asked from each module. There can be maximum of three subdivisions in each question, if necessary. • One full question should be answered from each module. • Each question carries 50 marks.

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST232.1	3		2				3	3	
23MST232.2	3		2				3	3	
23MST232.3	3		2				3	3	
23MST232.4	3		2				3	3	
Average	**3**		**2**				**3**	**3**	

SEMESTER – II

Course: Design of High-rise structures

Course Code	**23MST233**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: The students will be taught:

CLO1	Design philosophies and load reduction procedure
CLO2	Suitable design approach for high rise structures
CLO3	To Compute the responses of the structure using different techniques
CLO4	concepts of stability of tall structures

Content	**No. of Hours/ RBT levels**
Module-1 Design Criteria: Design philosophy, loading, sequential loading, and materials – high performance concrete, fiber reinforced concrete, lightweight concrete, design mixes. Loading and Movement: Gravity loading: Dead and live load, methods of live load reduction, Impact, Gravity loading, Construction loads	**8 Hours L2, L3**
Module 2 Wind loading: static and dynamic approach, Analytical and wind tunnel experimentation method. Earthquake loading: Equivalent lateral force, modal analysis, combinations of loading, working stress design, Limit state design, Plastic design.	**8 Hours L2, L3**
Module 3 Behavior of Various Structural Systems: Factors affecting growth, Height, and structural form; High rise behavior, Rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, Outrigger – braced and hybrid mega system.	**8 Hours L2, L3**
Module 4 Analysis and Design: Modeling for approximate analysis, accurate analysis and reduction techniques, analysis of building as total structural system considering overall integrity and major subsystem interaction, analysis for member forces; drift and twist, computerized general three-dimensional analyses.	**8 Hours L2, L3**

Module 5 Stability of Tall Buildings: Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first order and P-Delta analysis, Transnational, Torsional instability, out of plum effects, stiffness of member in stability, effect of foundation rotation. Structural elements: sectional shapes, properties and resisting capacities, design, deflection, cracking, pre-stressing, shear flow. Design for differential movement, creep and shrinkage effects, temperature effects and fire	**8 Hours** **L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST233.1	Understand design philosophy and load reduction procedure
23MST233.2	Identify the suitable design approach for high rise structures
23MST233.3	Summarize the behavior of various structural systems.
23MST233.4	Compute the responses of the structure using different techniques
23MST233.5	Understand the concepts of stability of tall structures

Textbooks:

1. Taranath B.S, "Structural Analysis and Design of Tall Buildings"- McGraw Hill.
2. Lynn S. Beedle, "Advances in Tall Buildings"- CBS Publishers and Distributors.Structural Design of Steel Work to EN1993&EN1994, Lawrence Martin & John Purkiss, Taylor & Francis 2008.

Reference books:

1. Bryan Stafford Smith &Alexcoull, "Tall building structures Analysis and Design"- John Wiley
2. T.Y Lin &D.Stotes Burry, "Structural concepts and system for Architects and Engineers"- John Wiley.

Web Reference:

https://nptel.ac.in/courses/105105162

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST233.1	3		2	1	-		2		
23MST233.2	3		3	3	3		3	3	
23MST233.3	3		3	3	2		3	3	
23MST233.4	3		3	3	2		3	3	
23MST233.5	3		2	2	-		2		
Average	**3**		**2.6**	**2.4**	**2.3**		**2.60**	**3.00**	

SEMESTER – II

Course: Repair and Rehabilitation of Structures

Course Code	**23MST234**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**03**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: Students will be taught:

CLO1	To analyze the causes of failure in concrete structures
CLO2	To understand the effects and protection of serviceability of concrete structures
CLO3	To Understand the techniques used in repair of concrete structures
CLO4	To develop simple and comprehensive solutions to rehabilitate deteriorated structures

Content	**No. of Hours/ RBT levels**
Module-1 Deterioration: Introduction, Cause of Deterioration of Concrete Structures, Diagnostic Methods and Analysis, Preliminary Investigation, Experimental Investigations Using NDT, Load Testing, Corrosion Mapping, Core Drilling, Other Instrumental Methods.	**8 Hours L1, L2**
Module 2 Influence on serviceability and durability: Effects Due to Climate, Temperature, Chemicals, Werand Erosion, Design and Construction Errors, Corrosion Mechanism, Effects of Cover, Thickness and Cracking, Methods of Corrosion Protection, Corrosion Inhibitors, Corrosion Resistant Steels, Coatings, Cathodic Protection	**8 Hours L2**
Module 3 Maintenance and repair strategies: Definitions, Maintenance, Repair and Rehabilitation, Facets of maintenance, Importance of Maintenance, Preventive Measures on Various Aspects, Inspection, Assessment Procedure for Evaluating a Damaged Structures, Causes of Deterioration, Testing Techniques.	**8 Hours L2**
Module 4 Techniques of Repair: Rust Eliminators, Polymers Coating for Rebar during Repair, Foamed Concrete, Mortar and Dry Pack, Gunite and Shotcrete, Epoxy	**8 Hours L2**

Injection Mortar, Repair for Cracks, Shoring and Underpinning.	
Module 5 Repair to Structures: Repairs to Overcome Low Member Strength Deflection, Cracking Chemical Disruption, Weathering, Wear Fire, Leakage, Marine Exposure, Engineered Demolition Techniques for Dilapidated Structure, Case Studies.	**8 Hours** **L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST234.1	Identify the causes of failure in concrete structures
23MST234.2	Analyze failures in concrete structures
23MST234.3	Evaluate causes for failures in deteriorated concrete structures
23MST234.4	Develop simple and comprehensive solutions to rehabilitate deteriorated structures

Text books:

1. Repair of concrete structures, RT Allen, and SC Edwards, Blakie and Sons ISBN 1352, 2009
2. Learning for failure from deficiencies in design construction and service, Raikar R. N,2008, R & D Center (SDCPL), ISBN:12657-764-853-2318

Reference books:

1. Rehabilitation of Concrete Structures, B Vedivelli, ,2013, Standard publishers and distributors, ISBN: 978-8180141102
2. Distress and Repair of Concrete Structures, Norb Dellate Failure, Nov9,2009, Ist Edition, Wood head Publishing Series in Civil and Structural Engineering, Woodhead Publishing.

Web Reference:

https://archive.nptel.ac.in/courses/105/106/105106202/

https://archive.nptel.ac.in/courses/105/105/105105213/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three

sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST234.1	3		2	1	-		2		
23MST234.2	3		3	3	3		3	3	
23MST234.3	3		3	3	2		3	3	
23MST234.4	3		3	3	2		3	3	
Average	3		2	2	-		2		

SEMESTER – II

Course: Earthquake Resistant Design

Course Code	**23MST241**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Structural Dynamics

Course Objectives:

CLO1	The concepts of seismic waves, magnitude, intensity, risk and mitigation
CLO2	Methods of analysis such as equivalent lateral force and dynamic analysis procedures
CLO3	Concepts of structural configuration and behavior of masonry buildings
CLO4	To design columns, beams and shear walls for ductile detailing provisions

Content	No. of Hours/ RBT levels
Module-1 **Introduction to engineering seismology**: Geological and tectonic features of India, Origin and propagation of seismic waves, characteristics of earthquake and its quantification – Magnitude and Intensity scales, seismic instruments. Earthquake Hazards in India, Earthquake Risk Evaluation and Mitigation. Structural behavior under gravity and seismic loads, Lateral load resisting structural systems, Requirements of efficient earthquake resistant structural system, damping devises, base isolation systems	**10 Hours L2, L3**
Module 2 The Response history and strong motion characteristics. Response Spectrum – elastic and inelastic response spectra, tripartite (D-V-A) response spectrum, use of response spectrum in earthquake resistant design. Computation of seismic forces in multistoried buildings – using procedures (Equivalent lateral force and dynamic analysis) as per IS-1893	**10 Hours L2, L3**
Module 3 Structural Configuration for earthquake resistant design, Concept of plan irregularities and vertical irregularities, Soft storey, Torsion in buildings. Design provisions for these in IS-1893. Effect of infill masonry walls on frames, modeling concepts of infill masonry walls. Behavior of masonry buildings during earthquakes, failure patterns, strength of masonry in shear	**10 Hours L2, L3**

and flexure, concepts for earthquake resistant masonry buildings – Codal provisions	
Module 4 Design of Reinforced concrete buildings for earthquake resistance-load combinations, Ductility and energy absorption in buildings. Confinement of concrete for ductility, design of columns and beams for ductility, ductile detailing provisions as per IS-1893, IS-13920, IS-456, SP-16. Structural behavior, design and ductile detailing of shear walls.	**10 Hours** **L2, L3**
Module 5 Seismic response control concepts – Seismic demand, seismic capacity, Overview of linear and nonlinear procedures of seismic analysis. Performance Based Seismic Engineering methodology, Seismic evaluation and retrofitting of structures	**8 Hours** **L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST241.1	**Describe** the concepts of engineering seismology, magnitude, intensity, and load resisting structural systems
23MST241.2	**Determine** base shear of multi-storied buildings by equivalent lateral force method and dynamic analysis procedure
23MST241.3	**Explain** the structural configuration for earthquake resistant framed and masonry buildings.
23MST241.4	**Design** and ductile detailing of columns, beams and shear walls as per IS codal provisions.
23MST241.5	**Explain** the concepts of seismic response control such as seismic demand and capacity

Textbooks:

1) Dynamics of Structures–Theory and Application to Earthquake Engineering-2nd ed.–Anil K Chopra, Pearson Education.
2) Earthquake Resistant Design of Building Structures, Vinod Hosur, Wiley (India) 2013.
3) Earthquake Resistant Design of Structures – Pankaj Agarwal, Manish Shrikande - PHI India

Reference books:

1) Structural Masonry, Hendry A.W, 2nd edition, Palgrave Macmillan, Macmillan Education Ltd.
2) Seismic Design of Reinforced Concrete and Masonry Buildings, T Paulay and M J N Priestley John Wiley and Sons
3) Earthquake Resistant Design of Structures by S.K. Duggal, Oxford University Press
4) Some Concepts in Earthquake Behaviour of Buildings by C. V. R. Murty, Rupen Goswami, A. R. Vijayanarayanan & Vipul V. Mehta Published by Gujarat State Disaster Management Authority, Government of Gujarat.

Reference codes:

1) IS-13920 – 2016, Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces, BIS, New Delhi.
2) IS-1893 – 2016, Indian Standard Criteria for Earthquake Resistant Design of Structures, Part-1, BIS, New Delhi.
3) IS- 4326 – 2013, Earthquake Resistant Design and Construction of Buildings, BIS, New Delhi.
4) IS-13828 – 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings, BIS, New Delhi.
5) IS-3935 – 1993, Repair and Seismic Strengthening of Buildings-Guidelines, BIS, New Delhi.
6) IS-456 and SP-16

Web Reference:

1) https://eerc.iiit.ac.in/
2) https://nptel.ac.in/courses/105101004
3) https://www.nicee.org/index.php

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO-PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST241.1	2		2	2			2	2	
23MST241.2	2		1	2			2	2	
23MST241.3	3		3	3			3	3	
23MST241.4	3		3	3			3	3	
23MST241.5	3		3	3			3	3	
Average	2.6		2.4	2.6			**2.6**	**2.6**	

SEMESTER – II

Course: Advanced Materials

Course Code	**23MST242**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**03**	**Examination Hours**	**3**

Prerequisites: Concrete technology

Course Objectives: Students will be able to

CLO1	**Understand** composite materials in the context of structural engineering application
CLO2	**Analyzing** macro and micro mechanical behaviour of composites.
CLO3	**Understand** manufacturing of composites and its failure theories.

Content	No.of Hours/ RBT levels
Module-1 **Introduction:** Introduction to Composite materials, classifications (thermoset and thermoplastic) and civil/structural engineering applications. Constituent materials of composites – Reinforcements and matrix. Rule of mixture. Selection of materials. Manufacturing techniques – Hand layup method and compression moulding method. Basics of fiber reinforced composite (Synthetic and natural FR Polymer composites). Advantages and Limitations of composites.	**08 Hours L3**
Module 2 **Macro-mechanical Behaviour of a Lamina**: Introduction, Stress-Strain Relations For Anisotropic Materials. Stiffness's, compliances, and engineering constants for orthotropic materials. Restrictions on engineering constants. Numerical problems.	**08 Hours L3**
Module 3 **Macro-mechanical Behaviour of a Lamina contd...** Stress-strain relations for plane stress in an orthotropic material. Stress-strain relations for a lamina of arbitrary orientation. Invariant properties of an orthotropic lamina. Strengths of an orthotropic lamina, thermal and mechanical stress analysis. Numerical problems	**08 Hours L3**
Module 4 **Micro-mechanical behaviour of a lamina:** introduction, mechanics of materials approach to stiffness. Determination of E1. Determination of E2.	**08Hours L3**

Determination of v12. Determination of G12. Numerical problems.	
Module 5 **Classical composite lamination theory**, cross and angle – play laminates, symmetric, anti-symmetric and general symmetric laminates. Mechanical coupling. Analysis of simple laminated structural elements ply-stress and strain, lamina failure theories concepts. Maximum Stress Failure Criterion, Maximum Strain Failure Criterion and Tsai-Hill Failure Criterion. Numerical Problems.	**08 Hours** **L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST242.1	**Define** and classify the composite materials.	
23MST242.2	**Analyze** the macro-mechanical behaviour of composites.	
23MST242.3	**Derive** the engineering constants of composites	
23MST242.4	Select the appropriate constituent materials for composite manufacture	

Textbooks:

1. Mechanics of Composite Materials and Structures by M. Mukhopadhya-Universities Press 2009
2. Robart M.Jones, " **Mechanical of Composite Materials**"- McGraw Hill Publishing Co.

Reference Books:

1. Bhagwan D Agarvalm, and Lawrence J Brutman, " **Analysis and Performance of Fiber Composites**"- John Willy and Sons.
2. Autar K. Kaw, Mechanics of Composite Materias, Second edition., CRC Press,2006.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. Two questions shall be asked from each module. There can be maximum of three subdivisions in each question, if necessary. • One full question should be answered from each module. • Each question carries 50 marks.

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/

partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST242.1	3	3	2		2			3	
23MST242.2	3	3	2		2			3	
23MST242.3	3	3	2		2			3	
23MST242.4	3	3	2		2			3	
Average	**3**	**3**	**2**		**2**			**3**	

SEMESTER – II

Course: Plates and Shells

Course Code	**23MST243**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**03**	**Examination Hours**	**3**

Prerequisites: Strength of Materials

Course Objectives: Students will be taught

CLO1	Different methods of analysis and design of plates and shells
CLO2	To critically detail the plates, folded plates and shells
CLO3	The concept and classification of shells and paraboloid.
CLO4	To evaluate the performance of spatial structures.

Content	No.of Hours/ RBT levels
Module-1 Introduction to plate theory, Small deflection of laterally loaded thin rectangular plates of pure bending. Navier's solution for various lateral loading (No derivations), Numerical examples.	**08 Hours L3**
Module 2 Levy's solution for various lateral loading and boundary conditions (No derivations), Numerical examples. Energy methods for rectangular plates with clamped edges.	**08 Hours L3**
Module 3 Bending of circular plates with various edge conditions for both solid and annular plates.	**08 Hours L3**
Module 4 Introduction to curved surfaces and classification of shells, membrane theory of spherical shells, Cylindrical shell, Hyperbolic paraboloid, Elliptic paraboloid.	**08Hours L3**
Module 5 Design and detailing of cylindrical shells. Introduction to folded plates, analysis of folded plates by Whitney's and Simpson's method. FEM for plates and shells: Finite element analysis of thin plate, thick plate and skew plate using triangular CST elements, rectangular elements and finite element analysis of shell.	**08 Hours L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST243.1	**Explain** the basic concepts of plate theory.
23MST243.2	**Compute** rectangular plates, circular and annular plates for various lateral loading and boundary conditions.
23MST243.3	**Illustrate** the concept and classification of shells and paraboloid.
23MST243.4	**Design** of shells and folded plates by Whitney's and Simpson's method.

Textbooks:

1. Theory of Plates and Shells, Timoshenko, S. and Woinowsky-Krieger, W,2nd Edition,1959, McGraw-Hill Co., New York, ISBN-10: 0070647798; ISBN-13: 978-0070647794
2. Linear Elastic theory of thin shells. Volume I, J.E.Gibson B.G Neal, Elsevier, ISBN: 978-0-08- 010944-2

Reference Books:

1. Stresses in Plates and Shells, Ugural.A.C,2nd edition,1999, McGraw-Hill ISBN 10: 0070657300 ISBN 13:9780070657304
2. Theory and analysis of plates - classical and numerical methods, R. Szilard, 1994, Prentice Hall, ISBN-13: 9780139134265 ISBN: 0139134263

Web Reference:

NPTEL Course: https://onlinecourses.nptel.ac.in/noc21_ce59/preview

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. Two questions shall be asked from each module. There can be maximum of three subdivisions in each question, if necessary. • One full question should be answered from each module. • Each question carries 50 marks.

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST243.1	2		2	2			2	2	
23MST243.2	2		1	2			2	2	
23MST243.3	3		3	3			3	3	
23MST243.4	3		3	3			3	3	
Average	**2.5**		**2.25**	**2.5**			**2.5**	**2.5**	

SEMESTER – II

Course: Structural Health Monitoring

Course Code	**23MST244**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**03**	**Examination Hours**	**3**

Prerequisites: Precast concrete structures, Design of steel structures, Concrete Technology

Course Objectives: Students will be taught:

CLO1	Understand the factors causing distress in a building.
CLO2	Access structural health of the building

Content	**No. of Hours/ RBT levels**
Module-1 **Structural Health**: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance. **Structural Health Monitoring**: Concepts, Various Measures, Structural Safety in Alteration.	**8 Hours L2**
Module 2 **Materials:** Piezo–electric materials and other smart materials, electro–mechanical impedance (EMI)technique, adaptations of EMI technique. **Structural Audit**: Assessment of Health of Structure, Collapse and Investigation, InvestigationManagement, SHM Procedures.	**8 Hours L2**
Module 3 **Static Field Testing:** Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.	**8 Hours L2**
Module 4 **Dynamic Field Testing**: Types of Dynamic Field Test, Stress History Data, Dynamic ResponseMethods	**8 Hours L2, L3**
Module 5 **Remote Structural Health Monitoring**: Introduction, Hardware for Remote Data Acquisition Systems, Advantages, Case studies on conventional and Remote structural health monitoring	**8 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST244.1	Demonstrate the precast concrete concepts, types of precast construction and its advantages
23MST244.2	Identify precast plant set up for production and storage systems, plan logistics of precast elements
23MST244.3	Examine different types of pre-cast elements.
23MST244.4	Design of precast elements, manufacturing methods.

Reference books:

1. Precast Concrete Structures, Kim.S. Elliott,2002, Butterworth-Heinemann, An imprint of Elsevier Science.
2. Precast concrete structures, Hubert Bachmann and Alfred Steinle' First edition,2011, Ernst &Sohn, GmbH &Co., ISBN978-3-433-60096-2.

Reference books:

1. Multi –Storey Precast Concrete Framed Structures, Kim.S.Elliot and Colin K Jolly,2nd Edition, November 2013, Wiley-Blackwell, ISBN: 978-1-4051-0614-6.
2. PCI Journal– Proposed Design Requirements for Precast Concrete, Prestressed Concrete Institute, PCI Committee on Building Code and PCI Technical Activities Committee.

Web Reference: https://nptel.ac.in/courses/105106117

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO-PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST244.1	2		2	2			2	2	
23MST244.2	2		1	2			2	2	
23MST244.3	3		3	3			3	3	
23MST244.4	3		3	3			3	3	
Average	**2.5**		**2.25**	**2.5**			**2.5**	**2.5**	

SEMESTER –II

Course: Mini Project with Seminar

Course Code	**23MST25**	**CIE Marks**	**100**
Hours/Week (L: T: P)	**1:0:4**	**SEE Marks**	**-**
No. of Credits	**03**	**Examination Hours**	**-**

Mini Project with Seminar: This may be hands-on practice, survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analysing and authenticating, case studies, etc. The CIE marks shall be awarded by a committee comprising of HOD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project. Participation in the seminar by all postgraduate students of the program shall be mandatory. The CIE marks awarded for Mini-Project work and Seminar shall be based on the evaluation of Mini Project work and 6 Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. There is no SEE for this course.

SEMESTER –II

Course: Structural Engineering Lab-2

Course Code	23MSTL26	CIE Marks	50
Hours/Week (L: T: P)	0:0:2	SEE Marks	50
No. of Credits	2	Examination Hours	3

Prerequisites: Finite Element Analysis

Course Objectives:

CLO1	Concepts of static and dynamic behavior of multi-storied structures
CLO2	RCC and Steel structural elements design using FE packages
CLO3	Modelling and Analysis of folded plates and shell structures
CLO4	To develop computer program for continuous and portal frames

Content	No. of Hours/ RBT levels
Module-1 Static and Dynamic analysis of Multistory Building structures using any FE based software	**12 Hours L3, L4**
Module 2 Design of RCC and Steel Tall structures using any FE based software	**12 Hours L3, L4**
Module 3 Analysis of folded plates and shells using any FE software.	**12 Hours L3, L4**
Module 4 Develop MATLAB/-Python Program for continuous beams and portal frames.	**12 Hours L3, L4**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MSTL26.1	Determine static, dynamic properties of multistory building using FE based software
23MSTL26.2	Design the members of RCC, Steel Tall structures using FE based software
23MSTL26.3	Compute the response of folded plates, shells subjected to in-plane and out of plane loading using FE based software
23MSTL26.4	Construct MATLAB/Python Program for continuous beams, portal frames

Textbooks:

1) Duggal, S.K. Design of Steel Structures, Tata Mc Graw-Hill.
2) A First course in the Finite Element Analysis, Deryl L Logan, Global Engineering,
3) Earthquake Resistant Design of Building Structures, Vinod Hosur, Wiley (India) 2013
4) Python Programming by Reema Thareja, Oxford Higher Education.

Reference books:

1) Taranath B.S, "Structural Analysis and Design of Tall Buildings"- McGraw Hill
2) Dynamics of Structures–Theory and Application to Earthquake Engineering-2nd ed.–Anil K Chopra, Pearson Education.
3) Theory and Analysis of Plates - Classical and Numerical Methods, R. Szilard, 1994, Prentice Hall

Web Reference:

1) https://www.mathworks.com/
2) https://www.python.org/
3) https://www.bentley.com/en
4) https://www.csiamerica.com/

Scheme of Examination:
Semester End Examination (SEE):

PARTICULARS	MARKS
Write up of the experience/ Program	20
Experimentation/Program	40
Results, Graphs, Discussions	20
Viva Voce	20
TOTAL	100

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
23MSTL26.1	2	1	3	3	-	2	3	3	1
23MSTL26.2	2	2	3	3	1	2	3	3	2
23MSTL26.3	2	1	2	3	-	1	2	2	2
23MSTL26.4	2	2	3	3	1	2	3	2	2
Average	2	1.5	2.75	3	1	1.75	2.75	2.5	1.75

SEMESTER – III

Course: Design of Bridges

Course Code	**23MST31**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:2:0**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**3**

Prerequisites: Advanced Design of RCC Structures

Course Objectives: The students will be taught:

CLO1	Design of slab culvert as per IRC Specifications.
CLO2	Design of box culvert as per IRC Specifications.
CLO3	Design of T Beam and PSC Bridge as per IRC Specifications.
CLO4	Design of Balanced cantilever bridge as per IRC Specifications.

Content	No. of Hours/ RBT levels
Module-1 **Introduction & Design of Slab Culvert:** Bridge Engineering and its development in past, Ideal site selection for Bridges, Bridge classifications, Forces acting on Bridge. Analysis for maximum BM and SF at critical sections for Dead and Live load as per IRC class A, B, AA tracked and wheeled vehicles. Structural design of slab culvert using limit state method with reinforcement details	**10 Hours L2, L3**
Module 2 **Box Culvert:** Introduction to box culvert, advantage of structural continuity, Analysis for maximum BM and SF at critical sections using moment distribution method for various load combinations such as Dead, Surcharge, Soil, Water and Live load as per IRC class A, B, AA tracked and wheeled vehicles. Structural design of box culvert using limit state method with reinforcement details.	**10 Hours L2, L3**
Module 3 **T Beam Bridge Slab Design:** Proportioning of Components Analysis of interior Slab & Cantilever Slab Using IRC Class AA Tracked, Wheeled Class A Loading, Structural Design of Slab, with Reinforcement Detail. T Beam Bridge Cross Girder Design: Analysis of Cross Girder for Dead Load & Live Load Using IRC Class AA Tracked, Wheeled Class A Loading A Loads, Structural Design of beam with Reinforcement Detail using	**10 Hours L2, L3**

Courbon's Method.	
Module 4 **PSC Bridge:** Introduction to Pre & Post Tensioning, Proportioning of Components, Analysis & Structural Design of Slab, Analysis of Main Girder Using Courbon's Method for IRC Class AA, Tracked vehicle, Calculations of Prestressing Force, Calculations of Stresses, Cable profile, Design of End Block, Detailing of Main Girder.	**10 Hours L2, L3**
Module 5 **Balanced Cantilever Bridge**: Introduction & Proportioning of Components, Analysis of Main Girder Using Courbon's Method for IRC Class AA, Tracked vehicle Design of Simply Supported Portion, Cantilever Portion, Articulation, using limit state method with reinforcement details.	**10 Hours L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST31.1	Understand the concepts of bridges, IRC loadings and distribution theory as per IRC standards.
23MST31.2	Design slab culvert and box culvert subjected to various loading combinations and IRC standards.
23MST31.3	Analyse the maximum bending moment and shear force for T Beam bridge and PSC bridge as per COURBON'S method.
23MST31.4	Evaluate the maximum bending moment and shear force for Balanced Cantilever bridge as per IRC Codal provisions.

Textbooks:

1. N Krishna Raju, "Design of Bridges"- Oxford & IBH Publishing Co New Delhi-2013
2. Ponnuswamy. S, "Bridge Engineering"- Tata McGraw Hill 2000
3. Raina V.K., "Concrete Bridge Practice"- Tata McGraw Hill 2000
4. D Johnson Victor "Essentials of Bridge Engineering"-, Oxford & IBH Publishing Co New Delhi 1999
5. Relevant IS Code Books IS:456 2000, SP:16, IRC 6,18,21,

Reference books:

1. N. Rajagopalan, Bridge Superstructure, Narosa Publishing House, 2006.
2. W. F. Chen and L. Duan, Bridge Engineering Handbook, CRC press, 2003.
3. B. Bakht and L.G. Jaeger, Bridge Analysis Simplified, McGraw Hill, 1987.
4. E. J. O'Brien, and D. L. Keogh, Bridge Deck Analysis, Taylor and Francis, 1999.
5. H. Eggert and W. Kauschke, Structural Bearings, Ernst & Sohn, 2002.
6. T. Y. Lin and N. H. Burns, Design of Prestressed Concrete Structures, John Wiley and Sons, 1981.

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO-PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST31.1	2		2				2	2	
23MST31.2	3		3		1		3	2	
23MST31.3	3		3				3	3	
23MST31.4	3		3		1		3	3	
Average	2.75		2.75		1		2.75	2.5	

SEMESTER – III

Course: Design of Masonry Structures

Course Code	23MST321	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	3

Prerequisites:

Course Objectives: The students will be taught:

CLO1	the behavior of different masonry unit and its suitability in construction.
CLO2	Designing buildings using masonry for sustainable construction.

Content	No. of Hours/ RBT levels
Module-1 Introduction, Masonry units, materials, and types: History of masonry, historical buildings, Masonry arches, domes and vaults: Components, classification and construction procedure.	**8 Hours L2, L3**
Module 2 Characteristics of masonry constituents: Types of masonry units such as stone, bricks, concrete blocks, clay blocks and stabilized mud blocks. Properties of masonry units like strength, modulus of elasticity and water absorption. Masonry mortars – Classification and properties of mortars, selection of mortars.	**8 Hours L2, L3**
Module 3 Strength of Masonry in Compression: Behaviour of Masonry under compression, strength and elastic properties, factors influencing compressive strength of masonry, Effects of slenderness and eccentricity, water absorption, curing, ageing and workmanship on compressive strength. Prediction of strength of masonry in Indian context.	**8 Hours L2, L3**
Module 4 Shear and Flexure Behavior of Masonry: Bond between masonry unit and mortar, test methods for determining flexural and shear bond strengths, test procedures for evaluating flexural and shear strength, factors affecting bond strength, effect of bond strength on compressive strength, flexure and shear strength of masonry. Concept of Earthquake resistant masonry buildings.	**8 Hours L2, L3**
Module 5 Design of load bearing masonry buildings: concept of basic compressive	

stress, Permissible compressive stress, reduction factors. Increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses, Effective height of walls and columns, opening in walls,effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels; Wall carrying axial load, eccentric load with different eccentricity ratios, wall with openings, freestanding wall; Design of load bearing masonry for buildings up to 3 to 8 storey's using BIS codal provisions.	**8 Hours L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST321.1	Choose appropriate masonry unit and mortar mixes for masonry construction
23MST321.2	Distinguish wide range of materials for their suitability to arrive at feasible and optimal solutions for masonry constructions.
23MST321.3	Appraise knowledge of structural masonry for advanced research and construction procedures
23MST321.4	Design masonry buildings for sustainable development.

Textbooks:

1. Structural Masonry, Hendry A.W, 2nd edition, Palgrave Macmillan, Macmillan Education Ltd., ISBN 10: 0333733096 ISBN 13:9780333733097.
2. Masonry structures- Behavior and Design, Robert Ahmad A Hamid, 3rd edition ,2008 Boulder, CO: Masonry Society, ISBN 1929081332 9781929081332

Reference books:

1. Structural Masonry, Jagadish K S, 2015, I K International Publishing House Pvt Ltd, ISBN – 10: 9384588660, ISBN 13: 978-9384588663.
2. Structural Masonry, Sven Sahlin,1971, Prentice Hall Publisher: Prentice Hall, 1971, ISBN- 10: 0138539375, ISBN-13: 978-0138539375
3. **Codebooks:** IS 1905: 1987, Indian standard Specification for Code of Practice for Structural Useof Unreinforced.
4. Structural Masonry designers Manual,W G Curtin,G Shaw,JK Beck & Bray, Granada publishingLtd 1982 ISBN:10-0-632-05612-6,13:978-0-632-05612-5.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST321.1	2	-	1	1	2	-	1	2	1
23MST321.2	3	-	2	1	2	-	1	1	1
23MST321.3	2	-	2	1	2	-	1	1	-
23MST321.4	2	-	2	1	2	-	1	1	-
Average	**2**	-	**1.75**	**1**	**2**	-	**1**	**1**	-

SEMESTER – III

Course: Design of Industrial Structures

Course Code	**23MST322**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites:

Course Objectives: The students will be taught:

CLO1	Principles of Design of industrial building
CLO2	To design different components of industrial structures and to detail the structures.
CLO3	To evaluate the performance of the Pre engineered buildings
CLO4	Design and development of analytical skills

Content	No. of Hours/ RBT levels
Module 1 Analysis of industrial building for Gravity and Wind load. Analysis and design of framing components namely, girders, trusses, gable frames	**8 Hours L2, L3**
Module 2 Analysis and design of gantry column (stepped column / column with bracket), purlins, girts, bracings including all connections	**8 Hours L2, L3**
Module 3 Forms of light gauge sections, Effective width computation of unstiffened, stiffened, multiple stiffened compression elements of cold formed light gauge sections. Concept of local buckling of thin elements. Limiting width to thickness ratio. Post buckling strength.	**8 Hours L2, L3**
Module 4 Concept of Pre- engineered buildings, Design of compression and tension members of cold formed light gauge sections, Design of flexural members (Laterally restrained / laterally unrestrained).	**8 Hours L2, L3**
Module 5 Analysis of transmission line towers for wind load and design of towers including all connections.	**8 Hours L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST322.1	Achieve Knowledge of design and development of problem-solving skills.
23MST322.2	Understand the industrial building and the components
23MST322.3	Summarize the principles of Structural Design and detailing
23MST322.4	Understands the concept of pre-engineered buildings.

Textbooks:

1. N Subramanian- "Design of Steel Structure" oxford University Press.
2. B.C. Punmia, A.K. Jain "Design of Steel Structures", Laxmi Publications, New Delhi.

Reference books:

1. Duggal "Limit State Design of Steel Structures" TMH.
2. Bureau of Indian Standards, IS800-2007, IS875-1987, IS-801-1975. Steel Tables, SP 6(1) – 1984.

Web Reference:

https://onlinecourses.nptel.ac.in/noc22_oe02/preview

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST322.1	2		2	2			2	2	
23MST322.2	2		1	2			2	2	
23MST322.3	3		3	3			3	3	
23MST322.4	3		3	3			3	3	
Average	2.5		2.25	2.5			2.5	2.5	

SEMESTER – III

Course: Design of Substructures

Course Code	**23MST323**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Geotechnical Engineering, Foundation Engineering

Course Objectives: The students will be taught:

CLO1	Understanding geotechnical site investigation program for different civil engineering projects
CLO2	Ability to determine bearing capacity of soil by different methods
CLO3	Understanding of shallow and deep foundation analyses
CLO4	Understanding of choice of foundation design parameters

Content	No. of Hours/ RBT levels
Module 1 Introduction, Site investigation, In-situ testing of soils, Subsoil exploration, Classification of foundations systems. General requirement of foundations, Selection of foundations, Computations of Loads, Design concepts. Concept of soil shear strength parameters, Terzaghi's and IS: 6403 and 1981 method, Shallow foundations in clay, sand & C-Φ soils, Settlement analysis of footings, Design for Eccentric or Moment Loads, Footings on layered soils and sloping ground	**10 Hours L2, L3**
Module 2 **Shallow foundations** : Proportion of shallow foundation for equal settlement, Computation of design loads, design of combined footings (rectangular and trapezoidal), strap footings and strip footings, Types of rafts, bearing capacity and settlements of raft foundation, Design of raft foundation – Rigid methods, Flexible methods, coefficient of sub grade reaction.	**10 Hours L2, L3**
Module 3 **Deep Foundations**: Introduction Necessity of pile foundations, Classification, Load bearing capacity of single pile by Static formula, Dynamic formula, Pile load test and Penetration tests. Introduction, Pile groups, group action of piles in sand and clay, group efficiency of piles, settlement of piles, negative skin friction and under reamed piles. Proportioning and design of pile foundation	**10 Hours L2, L3**

Module 4 **Well Foundations:** Introduction, Different shapes and characteristics of wells. Components of well foundation. Forces acting on well foundation. Sinking of wells. Causes and remedies of tilts and shifts. **Foundations for tower structures**: Introduction, Forces on tower foundations, Selection of foundation type, Stability and design considerations.	**10 Hours L2, L3**
Module 5 **Foundations in Special Cases**: Foundation on expansive soils, under reamed pile foundation, Foundation for concrete Towers, chimneys, Machine foundations and basic principles of design of machine foundation	**10 Hours L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST323.1	Understand the principles of subsoil exploration and concepts of Settlement analysis
23MST323.2	Estimate the size of isolated and combined foundations to satisfy bearing capacity and settlement criteria
23MST323.3	Comprehend the classification of pile foundations and estimate load carrying capacity of single and pile group in cohesion and cohesion less soil.
23MST323.4	Analyze shallow foundation, deep foundations and special foundations depending on the type of soil.

Textbooks:

1. Analysis & Design of Substructures, SwamiSaran,2006, Oxford & IBHPub. Co.Pvt.Ltd. ISBN:434- 238-1343.
2. Foundation Analysis and Design,J.E.Bowles, Fifth Ed., 2008,McGraw-Hill Int. Editions, ISBN:745- 873-12854.
3. Braja, M. Das, "Principles of Geotechnical Engineering", Cengage Learning, India

Reference books:

1. Foundation Design, W.C. Teng, 2003, Prentice Hall of India Pvt. Ltd ISBN: 234-456-12343
2. Foundation Engineering,R.B. Peck, W.E. Hanson & T.H. Thornburn, Second Edition, 1984, Wiley Eastern Ltd., ISBN:2285-064-12328.
3. Bureau of Indian Standards: IS-1904, IS-6403, IS-8009, IS-2950, IS-2911 and all other relevant codes.

Web Reference:

https://nptel.ac.in/courses/105105207
https://nptel.ac.in/courses/105105185

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST323.1	2		2	2			2	2	
23MST323.2	2		1	2			2	2	
23MST323.3	3		3	3			3	3	
23MST323.4	3		3	3			3	3	
Average	2.5		2.25	2.5			2.5	2.5	

SEMESTER – III

Course: Fracture Mechanics

Course Code	**23MST324**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Mechanics of Deformable Bodies

Course Objectives:

CLO1	Theories of stress concentration in elastic materials
CLO2	Concepts of a modeling a crack by different techniques
CLO3	Definitions of fracture energy, quasi-brittle material and softening.
CLO4	Fracture mechanics applications in design of concrete structures.

Content	No. of Hours/ RBT levels
Module-1 **Stress concentration in elastic materials:** Theory of stress concentration in elastic materials, stress concentration factors around circular and elliptic holes. Influence of ratio of radii on stress concentration factor in elliptic hole.	**10 Hours L2, L3**
Module 2 **Linear Elastic Fracture mechanics:** Modeling a crack as a flat elliptic hole by Inglis and the limitations of the model, Griffith theory of brittle fracture, theories of linear elastic fracture mechanics, stress intensity factors, Irwin's definition. Fracture toughness KIc, KIIc, KIIIc & corresponding values of GC.	**10 Hours L2, L3**
Module 3 **Elasto-plastic fracture mechanics:** Crack-tip plasticity in metals. Irwin's modification for elasto-plastic material, J-integral, CMOD, CTOD. Mixed mode problems and evaluation of critical fracture parameters.	**10 Hours L2, L3**
Module 4 **Fracture of Concrete:** Limitations of theories of linear elastic fracture mechanics in concrete, Review of concrete behaviour in tension and compression, Kaplan's experiments, concept of fracture energy, definition of a quasi-brittle material, concept of softening.	**10 Hours L2, L3**
Module 5 **Advanced concepts in fracture behavior of concrete:** Definition of fracture energy by RILEM, Influence of size on fracture behavior, Bazant's size effect law, size dependent & independent fracture energies. Application of fracture mechanics in design of concrete structures.	**8 Hours L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST324.1	Describe the theory of stress concentration in elastic materials.
23MST324.2	Explain the concepts of crack modelling by various methods.
23MST324.3	Calculate the critical fracture mechanics parameters in metals.
23MST324.4	Explain the concept of fracture energy, quasi-brittle material and softening.
23MST324.5	Apply the advanced concepts of fracture mechanics in design of concrete structures.

Textbooks:

1. Srinath L.S., Advanced Mechanics of Solids, 10th print, Tata McGraw Hill Publishing company, New Delhi, 1994.
2. Timoshenko & Goodier, "Theory of Elasticity", McGraw Hill.
3. KRY Simha, Fracture Mechanics, University Press

Reference books:

1. Fracture Mechanics: Fundamentals and Applications, Anderson, T.L. 3rd Edition, CRC Press Taylor & Francis Gr.
2. Elementary Engineering Fracture Mechanics, Broek, D, 3rd Edition, Martinus Nijhoff Pub., 1984, ISBN: 90-247-2580-1
3. Practical Uses of Fracture Mechanics, Broek, D, 3rd Edition, Kluwer Academic Publishers.

Web Reference:

1) https://archive.nptel.ac.in/courses/112/106/112106065/
2) https://ocw.mit.edu/courses/3-35-fracture-and-fatigue-fall-2003/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/

partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO-PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST324.1	2		2	2			2	2	
23MST324.2	2		1	2			2	2	
23MST324.3	3		3	3			3	3	
23MST324.4	3		3	3			3	3	
23MST324.5	3		3	3			3	3	
Average	**2.6**		**2.4**	**2.6**			**2.6**	**2.6**	

SEMESTER – III

Course: Design of Formwork

Course Code	**23MST331**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**03**	**Examination Hours**	**3**

Prerequisites: Concrete Technology

Course Objectives:

CLO1	Choose proper Form work depending on the nature of job.
CLO2	Understand and design suitable form work

Content	No. of Hours/ RBT levels
Module-1 **Introduction**: Requirements and Selection of Formwork. **Formwork Materials**- Timber, Plywood, Steel, Aluminum, Plastic, and Accessories. Horizontal and Vertical Formwork Supports.	**8 Hours L1, L2**
Module 2 **Formwork Design**: Concepts, Formwork Systems and Design, for Tall Structures, Foundations, Walls, Columns, Slab and Beams.	**8 Hours L2**
Module 3 **Formwork Design for Special Structures**: Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.	**8 Hours L2**
Module 4 **Flying Formwork**: Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre- and Post-Award.	**8 Hours L2**
Module 5 **Formwork Failures**: Causes and Case studies in Formwork Failure, Formwork Issues in Multistorey Building Construction.	**8 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST331.1	Select proper formwork, accessories, and material.
23MST331.2	Design the form work for Beams, Slabs, columns, Walls, and Foundations.
23MST331.3	Design the form work for Special Structures.
23MST331.4	Understand the working of flying formwork and Judge the formwork failures through case studies

Text books:

1. Formwork for Concrete Structures, Peurify, 2015, McGraw Hill Education India, ISBN-13: 978- 9339221928.
2. Formwork for Concrete Structures, Kumar Neeraj Jha, 2012, Tata McGraw Hill Education, ISBN:9781259007330

Reference books:

1. Modern Practices in Formwork for Civil Engineering Construction Works Dr. Janardan Jhaand Prof. S K Sinha, Istedition, 2017, Laxmi Publications Pvt Ltd, ISBN-13: 978-9383828388.
2. Concrete Formwork Systems: 2 (Civil and Environmental Engineering Series), Hanna, First Edition, 1998, Vol. 2, CRC Press, ISBN-13: 978-0824700720.

Code Books:

1. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST331.1	2		2	2			2	2	
23MST331.2	2		1	2			2	2	
23MST331.3	3		3	3			3	3	
23MST331.4	3		3	3			3	3	
Average	2.5		2.25	2.5			2.5	2.5	

SEMESTER – III

Course: Optimization Techniques

Course Code	**23MST332**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Engineering Mathematics

Course Objectives:

CLO1	The objective of this course is to make students to learn principles of optimization, To implement the optimization Concepts for the structural engineering problems. To evaluate different methods of optimization

Content	No. of Hours/ RBT levels
Module 1 Introduction: Introduction to optimization, engineering applications of optimization, Formulation of structural optimization problems as programming problems. Optimization Techniques: Classical optimization techniques, single variable optimization, multivariable optimization with no constraints, unconstrained minimization techniques and algorithms constrained optimization 8 Hours L1, L2, L4 solutions by penalty function techniques, Lagrange multipliers techniques and feasibility techniques.	**08 Hours L2, L3**
Module 2 Linear Programming: Linear programming, standard form of linear programming, geometry of linear programming problems, solution of a system of linear simultaneous equations, pivotal production of general systems of equations, simplex algorithms, revised simpler methods, duality in linear programming.	**08 Hours L2, L3**
Module 3 Non-linear programming: Non-linear programming, one dimensional minimization methods, elimination methods, Fibonacci method, golden section method, interpolation methods, quadratic and cubic methods, Unconstrained optimization methods, direct search methods, random search methods, descent methods	**08 Hours L2, L3**
Module 4 Constrained optimization techniques such as direct methods, the complex methods, cutting plane method, exterior penalty function methods for structural engineering problems. Formulation and solution of structural optimization problems by different technique	**08 Hours L2, L3**

Module 5	
Geometric programming: Geometric programming, conversion of NLP as a sequence of LP/ geometric programming. Dynamic programming: Dynamic programming conversion of NLP as a sequence of LP/ Dynamic programming	**08 Hours L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST332.1	Achieve Knowledge of design and development of problem-solving skills.
23MST332.2	Understand the principles of optimization
23MST332.3	Design and develop analytical skills
23MST332.4	Summarize the Linear, Non-linear and Geometric Programming
23MST332.5	Understands the concept of Dynamic programming

Textbooks:

1. Spunt,"Optimum Structural Design"- Prentice Hall
2. S.S. Rao, "Optimization – Theory and Practice"- Wiley Eastern Ltd.

Reference books:

1. Uri Krisch, "Optimum Structural Design"- McGraw Hill
2. Richard Bronson, "Operation Research"- Schaum's Outline Series
3. Bhavikatti S.S.- "Structural optimization using sequential linear programming"- Vikas publishing house

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST332.1	2		2	2			2	2	
23MST332.2	2		1	2			2	2	
23MST332.3	3		3	3			3	3	
23MST332.4	3		3	3			3	3	
23MST332.5	3		3	3			3	3	
Average	**2.6**		**2.4**	**2.6**			**2.6**	**2.6**	

SEMESTER – III

Course: Advanced Precast Concrete Structures

Course Code	23MST333	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	03	Examination Hours	3

Prerequisites: Precast concrete structures, Design of steel structures, Concrete Technology

Course Objectives: Students will be taught:

CLO1	To understand the behaviour of pre-stressed elements.
CLO2	To understand the manufacturing methods, equipments for hoisting and erection Techniques for erection of different types of members
CLO3	To understand the types of pre-stress hollow core slabs
CLO4	Design and detailing of precast unit for factory structures and to understand modular construction process.

Content	No. of Hours/ RBT levels
Module-1 Concept of precast, precast products, standardization, precast accessories, types of precast constructions, methodologies, equipments and machineries, economy of prefabrication, Planning for Components of prefabricated structure, Disuniting of structures.	**10 Hours L2**
Module 2 Choice of production setup, Manufacturing methods, Stationary and mobile production, Planning of production setup, Storage of precast elements, Dimensional tolerances, Acceleration of concrete hardening. Equipments for hoisting and erection Techniques for erection of different types of members like Beams, Slabs, Wall panels and Columns – Vacuum lifting pads. Logistics and transportation	**10 Hours L2**
Module 3 Types of pre-stress hollow core slabs, manufacturing methodology, load chart and curves, preparation of layout cutting list, loading sequence, production loading transportation and erection, services and maintenance.	**10 Hours L2**
Module 4 Roof and floor panels, ribbed floor panels, wall panels, footings, Joints for different structural Connections, Effective sealing of joints for water proofing,	**10 Hours L2, L3**

Provisions for non-structural fastenings, Expansion joints in pre-cast construction. Designing and detailing of precast unit for factory structures, Purlins, Principal rafters, roof trusses, lattice girders, gable frames, Single span single storeyed frames, Single storeyed buildings, slabs, beams, and columns.	
Module 5 Modular construction, types of precast elements, typical layout, joint details, shop drawings, design of precast columns, beams, panel, stairs, and slab, mould fabrication, reinforcement details, casting, curing, stockyard and loading, transportation, site preparation and erection, finishing and handling over service and maintenance.	**10 Hours L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST333.1	Demonstrate the precast concrete concepts, types of precast construction and its advantages
23MST333.2	Identify precast plant set up for production and storage systems, plan logistics of precast elements
23MST333.3	Examine different types of pre-cast elements.
23MST333.4	Design of precast elements, manufacturing methods.

Reference books:

1. Precast Concrete Structures, Kim.S. Elliott,2002, Butterworth-Heinemann, An imprint of Elsevier Science.
2. Precast concrete structures, Hubert Bachmann and Alfred Steinle' First edition,2011, Ernst &Sohn, GmbH &Co., ISBN978-3-433-60096-2.

Reference books:

1. Multi –Storey Precast Concrete Framed Structures, Kim.S.Elliot and Colin K Jolly,2nd Edition, November 2013, Wiley-Blackwell, ISBN: 978-1-4051-0614-6.
2. PCI Journal– Proposed Design Requirements for Precast Concrete, Prestressed Concrete Institute, PCI Committee on Building Code and PCI Technical Activities Committee.

Web Reference: https://nptel.ac.in/courses/105106117

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	**50**
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
23MST333.1	2		2	2			2	2	
23MST333.2	2		1	2			2	2	
23MST333.3	3		3	3			3	3	
23MST333.4	3		3	3			3	3	
Average	2.5		2.25	2.5			2.5	2.5	

SEMESTER – III

Course: Advanced Structural Analysis

Course Code	**23MST334**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**3**	**Examination Hours**	**3**

Prerequisites: Strength of materials, Structural Analysis

Course Objectives:

CLO1	To develop differential equations for beams on elastic foundation
CLO2	Differential equations for beam-column for different loads with various end conditions
CLO3	The buckling load concepts for prismatic and non-prismatic columns
CLO4	Concepts of stresses, deflections and shear center in symmetric and unsymmetrical sections.
CLO4	Buckling load procedures on plates using energy and finite difference method

Content	**No. of Hours/ RBT levels**
Module-1 **Beams on elastic foundations:** Differential equations of elastic line interpretation of constants of integration, infinite beam with concentrated load, moment and UDL and problems related to infinite beams. Semi-infinite beams with concentrated load, moment and UDL, semi-infinite beam with fixed and hinged conditions, problems on semi-infinite beams.	**10 Hours L2, L3**
Module 2 **Beam-Column:** Governing differential equation for axial and lateral loads, analysis of beam columns subjected to axial and concentrated loads, axial and UDL, beam column with different end conditions.	**10 Hours L2, L3**
Module 3 **Buckling of Columns:** Assumptions, Euler's theory of buckling governing differential equation, prismatic columns with different end conditions, obtaining the characteristic equation for the critical load for non- prismatic columns, buckling of frames.	**10 Hours L2, L3**
Module 4 **Unsymmetrical bending of beams**: Introduction, stresses in beams, deflections of beams subjected to unsymmetrical bending, problems related to unsymmetrical bending.	**10 Hours L2, L3**

Shear Centre: Introduction, shear center for symmetrical and unsymmetrical sections, problems related to shear center.	
Module 5 **Plastic Analysis of Structures:** Introduction, plastic moment of resistance, plastic modulus, shape factors, moment–curvature relationship, plastic hinge and mechanism, analysis of indeterminate beams and frames, upper and lower bound theorem, ultimate strength of fixed and continuous beams, applications of static and kinematic theorem for plastic analysis of beams and frames.	**8 Hours** **L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST334.1	**Construct** differential equations for beams on elastic foundation
23MST334.2	**Construct** differential equations for beam-column for different loads with various end conditions
23MST334.3	**Calculate** the critical load for prismatic and non-prismatic columns
23MST334.4	**Compute** stresses, deflections and shear center in symmetric and unsymmetrical sections.
23MST334.5	**Determine** plastic moment capacity and collapse load for beams, frames by plastic analysis procedure

Textbooks:

1. Ashwini Kumar, "Stability Theory of Structures", Allied publishers Ltd., New Delhi, 2003.
2. Gambhir, "Stability Analysis and Design of Structures", springer, New York, 2004.
3. Advanced Mechanics of solids and structures, N. Krishna Raju, and D.R. Guru raja, 1997, Narosa Publishing House, New Delhi.

Reference books:

1. Advanced Mechanics of Materials, Boresi A.P., and Sidebottom O.M., 1985, John Wiley and Sons in N.Y.
2. Simitser.G.J and Hodges D.H, "Fundamentals of Structural Stability", Elsevier Ltd., 2006.
3. Timoshenko.S.P, and Gere.J.M, "Theory of Elastic Stability", McGraw Hill Book Company,1963
4. Chajes, A. "Principles of Structures Stability Theory", Prentice Hall, 1974.

Web Reference:

https://onlinecourses.nptel.ac.in/noc22_ce91/preview

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST334.1	2		2	2			2	2	
23MST334.2	2		1	2			2	2	
23MST334.3	3		3	3			3	3	
23MST334.4	3		3	3			3	3	
23MST334.5	3		3	3			3	3	
Average	**2.6**		**2.4**	**2.6**			**2.6**	**2.6**	

SEMESTER III

Course: Advanced Pre-stressed Concrete

Course Code	**23MST335**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:0:0**	**SEE Marks**	**50**
No. of Credits	**03**	**Examination Hours**	**3**

Prerequisites: Precast concrete structures, Design of steel structures, Concrete Technology

Course Objectives: Students will be taught:

CLO1	To identify various prestressed structural elements.
CLO2	To apply analytical skills to evaluate performance of prestressed structural elements
CLO3	To analyze prestressed structural elements with various considerations.
CLO4	To design and detail prestressed structural elements for various loading conditions.

Content	No. of Hours/ RBT levels
Module-1 Design of Section for Flexure: Allowable stresses - Elastic design of simple beams having rectangular and I-section for flexure - kern lines - cable profile and cable layout. Design of Sections for Shear: Shear and Principal stresses - Improving shear resistance by different prestressing Techniques - horizontal, sloping and vertical prestressing - Analysis of rectangular and I-beam - Design of shear reinforcement - Indian code provisions, Importance of modulus of elasticity of Prestressing tendons, failures of prestressed concrete	**10 Hours L3**
Module 2 Shear and Torsional resistance- ultimate shear resistance- Design of shear reinforcement in torsion	**10 Hours L3**
Module 3 Composite sections of prestressed concrete beam and cast in situ RC slab analysis of stresses differential shrinkage deflections Flexural and shear strength of composite sections Design of composite sections	**10 Hours L3**
Module 4 Transfer of Prestress in Pretensioned Members: Transmission of prestressing force by bond Transmission length, Flexural bond stresses - IS code provisions - Anchorage zone stresses in post tensioned members - stress distribution in End block - Analysis by approximate, Guyon and	**10 Hours L3**

Magnel methods -Anchorage zone reinforcement.	
Module 5 Statically indeterminate Structures: Advantages & disadvantages of continuous Prestressed beams - Primary and secondary moments - P and C lines - Linear transformation concordant and nonconcordant cable profiles -Analysis of continuous beams and simple portal frames (single bay and single story)	**10 Hours** **L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

23MST335.1	Identify various prestressed structural elements.
23MST335.2	Apply analytical skills to evaluate performance of prestressed structural elements
23MST335.3	Analyze prestressed structural elements with various considerations.
23MST335.4	Design and detail prestressed structural elements for various loading conditions.

Reference books:

1. Prestressed Concrete, N Krishnaraju, 2008, ISBN 0070634440, 9780070634442. Tata McGraw- Hill Education, Precast concrete structures, Hubert Bachmann and Alfred Steinle' First edition,2011, Ernst &Sohn, GmbH &Co., ISBN978-3-433-60096-2.
2. Prestressed Concrete structures, LinT.Y and H.Burns, 2009, WileyPublication, ISBN:978-0-471- 01898-8

Reference books:

1. Prestressed Concrete, N. Rajagopalan, 2nd Edition, 2005, Narosa Publishing House. ISBN2053 2005.
2. Design of Prestressed Concrete, A. Nilson, 2nd edition, John Willey & Sons., ISBN 1765 1997.

Web Reference:

https://nptel.ac.in/courses/105106117

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be

proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 40 marks each. Average of two test marks will be added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	40	50
	CIE Test-2	40	
	Average of CIE	**40**	
	Quiz 1/AAT	05	
	Quiz 2/AAT	05	
SEE	**Semester End Examination**	**50**	**50**
Grand Total			**100**

CO/PO Mapping									
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
23MST335.1	2		2				2	2	
23MST335.2	3		3		1		3	2	
23MST335.3	3		3				3	3	
23MST335.4	3		3		1		3	3	
Average	2.2		2.75		1		2.75	2.5	

SEMESTER – III

Course: Project work phase 1

Course Code	23MST34	CIE Marks	100
Hours/Week (L: T: P)	0:0:6	SEE Marks	
No. of Credits	03	Examination Hours	3 Hrs

GUIDELINES:

1. The Major Project work comprises of Phase-I and Phase-II. Phase-I is to be carried out in third semester and Phase-II in fourth semester.
2. The total duration of the Major project Phase-I shall be for 16 weeks.
3. Major project shall be carried out on individual student basis in his/her respective PG programme specialization. Interdisciplinary projects are also considered.
4. The allocation of the guides shall be preferably in accordance with the expertise ofthe faculty.
5. The project may be carried out on-campus/industry/organization with prior approval from Internal Guide and Head of the Department.
6. Students have to complete Major Project Phase-I before starting Major Project Phase-II.
7. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12.

Course Outcomes	
23MST34.1	Conceptualize, design and implement solutions for specific problems
23MST34.2	Communicate the solutions through presentations and technical reports.
23MST34.3	Apply project and resource managements skills, professional ethics, societal concerns
23MST34.4	Synthesize self-learning, sustainable solutions and demonstrate life-long learning

Scheme of Continuous Internal Examination (CIE)

The internal assessment marks shall be awarded by the project guide The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review	Selection of the topic, Literature Survey, Problem Formulation, and objectives	45%
	Methodology and Report writing	55%

Scheme for Semester End Evaluation (SEE):

Major Project Phase-I evaluation shall be done by respective guide and domain expert. The SEE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill and performance in Question-and-Answer session in the ratio 50:25:25.

SEMESTER – III

Course: Societal Project

Course Code	23MST35	CIE Marks	100
Hours/Week (L: T: P)	06	SEE Marks	-
No. of Credits	03	Examination Hours	-

Societal Project: Students in consultation with the internal guide as well as with external guide (much preferable) shall involve in applying technology to workout/proposing viable solutions for societal problems. CIE marks shall be awarded by a committee comprising of HOD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25. Those, who have not pursued /completed the Societal Project, shall be declared as fail in the course and have to complete the same during subsequent semester/s after satisfying the Societal Project requirements. There is no SEE (University examination) for this course.

SEMESTER – III

Course: Internship

Course Code	**23MST36**	**CIE Marks**	**50**
Hours/Week (L: T: P)		**SEE Marks**	**50**
No. of Credits	**6**	**Examination Hours**	**3 Hrs**

GUIDELINES

1) The duration of the internship shall be for a period of 8 weeks on full time basis after II semester final exams and before the commencement of III semester.
2) The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3) Internship must be related to the field of specialization of the respective PG programme in which the student has enrolled.
4) Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5) Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report. However, interim or periodic reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry/organizations.
6) The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Light Blue .
7) The broad format of the internship final report shall be as follows
    - Cover Page
    - Certificate from College
    - Certificate from Industry /Organization
    - Acknowledgement
    - Synopsis
    - Table of Contents
    - Chapter 1 - Profile of the Organization: Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices.
    - Chapter 2 - Activities of the Department
    - Chapter 3 - Tasks Performed: summaries the tasks performed during 8-week period
    - Chapter 4 – Reflections: Highlight specific technical and soft skills that you acquired during internship

- References & Annexure

Course Outcomes	
23MST36.1	Apply engineering and management principles
23MST36.2	Analyze real-time problems and suggest alternate solutions
23MST36.3	Communicate effectively and work in teams
23MST36.4	Imbibe the practice of professional ethics and need for lifelong learning.

A Semester end examination shall be conducted during III semester and the prescribed internship credit shall be counted for the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent examination after satisfying the internship requirements.

The CIE marks of Internship shall be awarded by a committee comprising of the guide, senior professor, and the supervisor from industry/organisation. The committee shall assess the presentation and the progress reports in two reviews.

The evaluation criteria shall be as per the rubrics given below:

Sl. No.	Activity	Weightage
Review-I	Explanation of the application of engineering knowledge in industries and Industrial Practices, ability to comprehend the functioning of the organization/ departments.	45%
Review-II	Importance of Project management, environment, and sustainability. Presentation skills and report writing.	55%

SEE marks shall be awarded by a committee comprising of Guide, and External Examiner (Domain Expert). The SEE marks awarded for internship shall be based on the evaluation of Internship Report, Presentation skill and performance in Question-and-Answer session in the ratio 50:25:25.

Evaluation shall be done in batches, not exceeding 6 students per batch.

SEMESTER – IV

Course: Project work phase 2

Course Code	**23MST41**	**CIE Marks**	**100**
Hours/Week (L: T: P)	**0:0:8**	**SEE Marks**	**100**
No. of Credits	**18**	**Examination Hours**	**3 Hrs**

GUIDELINES:

1. Major Project Phase-II is continuation of Phase-I.
2. The duration of the Phase-II shall be of 16 weeks.
3. The student needs to complete the project work in terms of methodology, algorithm development, experimentation, testing and analysis of results.
4. It is desirable that the student should present/publish the work in National/International conferences or Journals
5. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer Cover of the report (wrapper) has to be Light Blue .

Course Outcomes	
23MST41.1	Conceptualize, design and implement solutions for specific problems
23MST41.2	Communicate the solutions through presentations and technical reports.
23MST41.3	Apply project and resource managements skills, professional ethics, societal concerns
23MST41.4	Synthesize self-learning, sustainable solutions and demonstrate life-long learning

Scheme of Continuous Internal Examination (CIE)

The evaluation committee shall consist of Guide and a senior faculty. The evaluation criteria shall be as per the rubrics given below:

	Activity	Weightage
Review	Review and refinement of Objectives, Methodology and Implementation	20%
	Design, Implementation and Testing	40%
	Experimental Result & Analysis, Conclusions and Future Scope of Work, Report Writing and Paper Publication	40%

Scheme for Semester End Evaluation (SEE):

Major Project Phase-II SEE shall be conducted in two stages. This is initiated after fulfilment of submission of project report and CIE marks.

Stage-1 Report Evaluation

Evaluation of Project Report shall be done by guide and an external examiner.

Stage-2 Project Viva-voce

Major Project Viva-voce examination is conducted after receipt of evaluation reports from guide and external examiner.

Both Stage-1 and Stage-2 evaluations shall be completed as per the evaluation formats.

SEE procedure is as follows:

	Internal Guide	External Examiner	TOTAL	
SEE Report Evaluation	100 marks	100 marks	200 marks	
			(A)	(200/2) = 100 marks
Viva-Voce	Jointly evaluated by Internal Guide & External Evaluator		(B)	100 marks
Total Marks				**[(A)+(B)]/2 = 100**

SEE marks are proportionately reduced to 50 marks.

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