Rashtreeya Sikshana Samithi Trust

R.V. College of Engineering

(Autonomous Institution Affiliated to VTU, Belagavi)

Department of Civil Engineering

Master of Technology (M. Tech.)

STRUCTURAL ENGINEERING

Scheme and Syllabus of
Autonomous System w.e.f 2016

R.V. College of Engineering, Bengaluru – 59

(Autonomous Institution Affiliated to VTU, Belagavi)

M. Tech. Structural Engineering

Department of Civil Engineering

Vision: Excel in Education, Research and Consultancy in Civil Engineering with emphasis on sustainable Development

Mission:

1. Disseminating and integrating the knowledge of structural, transportation, environmental and geotechnical engineering
2. Enhancing Industry – Institute interaction leading to Interdisciplinary research
3. Imbibing wide range of skills in cutting edge technology for sustainable development
4. Motivate entrepreneurship and professional ethics to serve the society

Program: STRUCTURAL ENGINERING

Program Educational Objectives (PEO)

After successful completion of structural engineering program, the post graduates will be able to

PEO1: Independently analyze and design various forms of structures with sustainable materials.

PEO2: Develop professionalism in academics, structural consultancy and entrepreneurship.

PEO3: Pursue advanced research, career and participate in professional societies.

PEO4: Address societal needs through interdisciplinary approach.

Program Outcomes (PO)

M. Tech. in Structural engineering graduates will be able to:

PO1: Scholarship of Knowledge – Acquire in depth knowledge of Structural Engineering, including wider and global perspective, with an ability to distinguish, evaluate, analyze and synthesize existing and new knowledge and integration of same for enhancement of knowledge.

PO 2: Critical Thinking – Analyze complex structural engineering problems critically, apply independent judgement for synthesizing information to make intellectual and creative advances for conducting research in the areas of wider theoretical, practical and policy context.

PO3: Problem Solving – Think laterally and originally, conceptualize and solve structural engineering problems, evaluate a wide range of potential solutions for those

problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of structural engineering.

PO4: Research Skill – Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually / in groups to the development of scientific / technological knowledge in domains of structural engineering such as alternate construction materials, techniques and structural masonry.

PO5: Usage of Modern tool – Create, select, learn and apply appropriate computational tools, techniques, resources, modern engineering and structural analysis and design software for prediction and modeling of complex engineering activities with an understanding of their limitations.

PO6: Collaborative and multidisciplinary research – Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative multi-disciplinary scientific research, demonstrate capacity for self-management and team work, decision making based on open mindedness, objectivity and rational analysis in order to achieve common goals and further learning of themselves as well as others.

PO7: Project management and Finance- Demonstrate knowledge and understanding of engineering and project management principles and apply the same to one's own work as a member and leader in team, manage projects efficiently in structural engineering and multi-disciplinary environments after consideration of economic and financial factors.

PO8: Communication – Communicate with the engineering community and with society at large, regarding complex structural engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate codal provisions, make effective presentations and give and receive clear instructions.

PO9: Life Long Learning – Recognize the need for, and have the preparation and ability to engage in lifelong learning independently, with high level of enthusiasm and commitment to improve knowledge and competence continuously.

PO10: Ethical Practices and Social responsibility – Acquire intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the society for sustainable development.

PO11 Independent and reflective thinking – Observe and examine critically, outcome of one's actions and make corrective measures subsequently and learn from mistakes without depending on external feedback.

Program Specific Criteria (PSC)

Lead Society: American Society of Civil Engineers

1. Curriculum

The program prepares students for professional, teaching and research careers. Emphasis is on the acquisition of knowledge concerning to analysis, design, construction, maintenance, management and performance of structural components and structures with due consideration to public governing policies and guidelines.

2. Faculty competency

Faculties are qualified with post graduate and doctoral degrees in the stream of structural engineering. The faculties are actively publishing research papers in peer reviewed national and international journals related to structural engineering and allied fields leading to sustainable development. The faculties are also actively involved in R&D activities, patenting and associated with professional bodies.

Program Specific Outcomes (PSO)

M. Tech. in Structural engineering graduates will be able to:

PSO 1. Apply knowledge of materials and analysis for design of RCC, steel and masonry structures.

PSO 2. Demonstrate the use of alternate engineering materials, technologies and management for sustainable environment.

R. V. College of Engineering, Bengaluru – 59.

(An Autonomous Institution affiliated to VTU, Belagavi)

Department of Civil Engineering

M. Tech. Structural Engineering

FIRST SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Experiential Learning S**	
1	16MEM11P	Project Management	IM	3	1	0	0	4
2	16MST12	Matrix Analysis of Structures	CV	4	0	1	0	5
3	16MST13	Advanced Design of RCC Structures	CV	4	0	0	1	5
4	16 MST 14	Mechanics of Deformable Bodies	CV	4	0	0	0	4
5	16 MST15X	Elective -1	CV	4	0	0	0	4
6	16HSS16	Professional Skill Development	HSS	0	0	2	0	2
		Total		**19**	**1**	**3**	**1**	**24**

Elective 1			
16MST151	Advanced Design of Steel Structures	16MST152	Structural Masonry

SECOND SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Experiential Learning S**	
1	16MEM21R	Research Methodology	IM	3	1	0	0	4
2	16 MST 22	Structural Dynamics	CV	4	0	1	0	5
3	16MST23X	Elective -2	CV	4	0	0	0	4
4	16 MST24X	Elective -3	CV	4	0	0	0	4
5	16 MST25X	Elective -4	CV	4	0	0	0	4
6	16MST26	Minor Project (in-house)	CV	0	0	5	0	5
		Total		**19**	**1**	**6**	**0**	**26**

Elective 2			
16MST231	Structural Reliability	16MST232	Repair and Rehabilitation of Structures
Elective 3			
16MST241	Advanced Pre-stressed Concrete	16MST242	Design of Substructures
Elective 4			
16MST251	Design of Plates and Shells	16MST252	Finite Element Method of Analysis

R. V. College of Engineering, Bengaluru – 59.

(An Autonomous Institution affiliated to VTU, Belagavi)

Department of Civil Engineering

M. Tech. Structural Engineering

THIRD SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Experiential Learning S**	
1	16 MST 31	Special Concretes	CV	4	0	1	0	5
2	16 MST 32X	Elective -5	CV	4	0	0	0	4
3	16 MST 33X	Elective -6	CV	4	0	0	0	4
4	16 MST 34X/16MHT34X	Elective -7	CV	4	0	0	0	4
5	16MST35	Internship/ Industrial Training	CV	0	0	3	0	3
6	16MST36	Technical Seminar	CV	0	0	2	0	2
		Total		**16**	**0**	**6**	**0**	**22**

Elective 5			
16MST321	Earthquake Resistant Structures	16MST322	Pre cast structures
Elective 6			
16MST331	Stability of structures	16MST332	Advanced Structural Analysis
Elective 7			
16MHT341/ 16MST341	Design of Bridges, flyovers and grade separators	16MHT342/ 16MST342	Earth Retaining structures

R. V. College of Engineering, Bengaluru – 59.

(An Autonomous Institution affiliated to VTU, Belagavi)

Department of Civil Engineering

M. Tech. Structural Engineering

FOURTH SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Experiential Learning S**	
1	16 MST 41	Major Project	CV	0	0	26	0	26
2	16 MST 42	Seminar	CV	0	0	2	0	2
		Total		**0**	**0**	**28**	**0**	**28**

FIRST SEMESTER

PROJECT MANAGEMENT						
Course Code	**:**	**16MEM11P**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L: T: P: S**	**3:2:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**4**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives:

Students are able to

1. Understand the principles and components of project management.
2. Appreciate the integrated approach to managing projects.
3. Elaborate the processes of managing project cost and project procurements.
4. Apply the project management tools and techniques.

Unit – I	**7 Hours**

Introduction: Project, Project management, relationships among portfolio management, program management, project management, and organizational project management, relationship between project management, operations management and organizational strategy, business value, role of the project manager, project management body of knowledge.

Unit – II	**8 Hours**

Generation and Screening of Project Ideas: Generation of ideas, monitoring the environment, corporate appraisal, scouting for project ideas, preliminary screening, project rating index, sources of positive net present value. Project costing,

Project Scope Management: Project scope management, collect requirements define scope, create WBS, validate scope, control scope.

Organizational influences & Project life cycle: Organizational influences on project management, project state holders & governance, project team, project life cycle.

Unit – III	**7 Hours**

Project Integration Management: Develop project charter, develop project management plan, direct & manage project work, monitor & control project work, perform integrated change control, close project or phase.

Project Quality management: Plan quality management, perform quality assurance, control quality.

Unit – IV	**7 Hours**

Project Risk Management: Plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk resources, control risk.

Project Cost Management: Plan cost management, estimate cost, determine budget, cost control

Unit-V	**7 Hours**

Network Techniques for Project Management: Development of project network, time estimation, determination of the critical path, PERT Model, CPM model, numerical problems. Scheduling when resources are limited.

Syllabus includes tutorials for two hour per week:

- Case discussions on project management
- Numerical problems on PERT & CPM
- Computerized project management exercises using M S Project Software

Course Outcomes:

After going through this course the student will be able to

CO1: Explain the process of project management and its application in delivering successful projects.

CO2: Illustrate project management process groups for various project / functional applications.

CO3: Appraise various knowledge areas in the project management framework.

CO4: Develop project plans and apply techniques to monitor, review and evaluate progress for different types of projects.

Reference Books:

1. Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", 5th Edition, 2013, ISBN: 978-1-935589-67-9
2. Harold Kerzner, "Project Management A System approach to Planning Scheduling & Controlling", John Wiley & Sons Inc., 11th Edition, 2013, ISBN 978-1-118-02227-6.
3. Prasanna Chandra, "Project Planning Analysis Selection Financing Implementation & Review", Tata McGraw Hill Publication, 7th Edition, 2010, ISBN 0-07-007793-2.
4. Rory Burke, "Project Management – Planning and Controlling Techniques", John Wiley & Sons, 4th Edition, 2004, ISBN: 9812-53-121-1

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	----	M	H	H	H	----	H	----
CO2	----	M	----	-----	M	H	H	H	L	H	----
CO3	---	M	H	---	M	H	H	H	H	H	M
CO4	M	H	M	L	H	H	H	H	----	H	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	-	M
CO2	-	M
CO3	-	L
CO4	-	H

MATRIX ANALYSIS OF STRUCTURES (Theory & Practice)						
Course Code	**:**	**16MST12**		**CIE Marks**	**:**	**100+50**
Hrs/Week	**:**	**L: T: P: S**	**4:0:2:0**	**SEE Marks**	**:**	**100+50**
Credits	**:**	**05**		**SEE Duration**	**:**	**3Hrs+3Hrs**

Course Learning Objectives (CLO):

Student will be able to

1. Apply the knowledge of different types of structures, to assess their degrees of freedom and indeterminacy.
2. Utilize concepts of matrix methods to model structural component.
3. Analyze the behavior of different types of structures.
4. Evaluate and compare beams, frames and trusses with different degrees of freedom.

Unit – I	**09Hrs**

Introduction to matrix, Types of matrices, Solution techniques including numerical problems for simultaneous equation, Gauss elimination and Cholesky method, Band width consideration.

Unit – II	**10Hrs**

Static and Kinematic indeterminacy of rigid jointed frames, trusses and grids. Concepts of stiffness and flexibility, development of structure stiffness matrices for two dimensional rigid jointed structures using basic fundamental approach, development of flexibility matrix for two dimensional determinate rigid jointed structures.

Unit – III	**10Hrs**

Displacement-transformation matrix using Stiffness Method, Development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames (having not more than six degrees of freedom – 6x6 stiffness matrix) ,Analysis of continuous beams, plane trusses and rigid plane frames by stiffness method (having not more than 3 degrees of freedom – 3x3 stiffness matrix).Analysis considering effect of sinking of supports, temperature, linear and rotational springs.

Unit – IV	**9Hrs**

Development of element stiffness matrix, global stiffness matrix by direct stiffness method for two dimensional beams, frames and trusses (having not more than six degrees of freedom – 6x6 stiffness matrix), Analysis of continuous beams, plane trusses and rigid plane frames by direct stiffness method (having not more than 3 degrees of freedom – 3x3 stiffness matrix).

Unit – V	**10Hrs**

Principles of analysis of three dimensional space truss, grid structures using direct stiffness method- development of structure stiffness matrix. Numerical problems restricted to three degrees of freedom.

Unit – VI (Lab Component)

Analysis using MATLAB Software

1) Analysis of plane trusses by displacement transformation stiffness method.
2) Analysis of rigid plane frames by displacement transformation stiffness method
3) Analysis of plane trusses by direct stiffness method
4) Analysis rigid plane frames by direct stiffness method

Analysis using Staad Pro Software

7) Analysis of two dimensional structures, plane trusses and rigid plane frames
8) Analysis of space structures, trusses, grids

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1. Apply the concepts of matrix methods to model trusses, beams, and frames.
CO2. Analyze structures using matrix methods by analytical methods and software tools with different degrees of freedom
CO3. Evaluate and compare behaviour of structural elements under different boundary conditions.
CO4. Estimate stress resultants using displacement approach

Reference Books:

1.	S.Rajasekaran, G. Sankarasubramanian "Computational Structural Mechanics", Prentice-Hall of India Pvt Ltd, 7th Edition, 2015, NewDelhi-110092.ISBN-13: 978-8120317345,ISBN-10:8120317343.
2.	Damodar Maity, "Computer Analysis of Framed Structures" I K International Publishing House Pvt. Ltd.,2007, ISBN-13: 978-8189866198.
3.	Rudra Pratap, "Getting started with MatLab" Oxford University Press,2010 ISBN: -13:978-0-19-806919-5
4.	Amos Gilat,'Matlab An introduction with applications', Wiley Publications, 4th edition 2012, ISBN-13: 978-8126537204.

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Continuous Internal Evaluation (CIE) for Practical

CIE for the practical courses will be based on the performance of the student in the laboratory, every week. The laboratory records will be evaluated for 40 marks. One test will be conducted for 10 marks. The total marks for CIE (Practical) will be for 50 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Practical

SEE for the practical courses will be based on conducting the experiments and proper results for 40 marks and 10 marks for viva-voce. The total marks for SEE (Practical) will be 50 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L	M	L	H	-	-	-	L	-	-
CO2	H	H	M	L	H	-	-	-	L	-	-
CO3	H	H	H	M	H	-	-	-	-	L	-
CO4	H	L	L	L	H	-	-	-	-	-	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	M	-
CO2	H	-
CO3	H	-
CO4	H	-

ADVANCED DESIGN OF RCC STRUCTURES						
Course Code	**:**	**16MST13**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:1**	**SEE Marks**	**:**	**100**
Credits	**:**	**5**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives (CLO):

Student will be able to

1. Understand the design concepts of RCC elements.
2. Apply the principles of RCC design.
3. Analyze the forces and stresses in RCC structures.
4. Design RCC structural elements.

Unit – I	**09 Hrs**
Advanced design of 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.	
Unit – II	**10 Hrs**
Grid or coffered floors: General features, Rigorous and approximate methods of analysis, Design and detailing of grid floors. Design and detailing of flat slabs including unbalanced column moments.	
Unit – III	**10 Hrs**
Water retaining structures: Design and detailing of rectangular and circular, ground level and underground sump tanks with fixed and flexible base.	
Unit – IV	**09 Hrs**
Silos (circular) and bunkers; analysis, design and detailing of side walls, hopper bottoms.	
Unit – V	**10 Hrs**
Concept of Earthquake resistant design of RCC structures, Ductile detailing of RCC elements, Expansion and contraction joints.	

Course Outcomes:

After successful completion of this course the student will be able to:

CO1: Apply principles of RCC to design slabs and walls.

CO2: Analyze the loads to assess critical bending moments, shear forces and torsion.

CO3: Design RCC walls, slabs and formwork under different loading conditions.

CO4: Develop detailing of reinforcement for RCC walls and slabs.

Reference Books:

1.	R Park and T Paulay, "Reinforced Concrete Structures", John Wiley & Sons, USA, 2nd Edition, 2013. ISBN: 9780471659174.
2.	S. Ramamrutham, "Design of Reinforced concrete Structures", Dhanpat Rai Publishing Co Pvt Ltd, 2nd Edition, 2015. ISBN 978-9384559984.
3.	P. C. Varghese, "Advanced Reinforced Concrete Design", PHI Learning Pvt. Ltd., 2nd Edition, 2009. ISBN: 812032787X, 9788120327870.

4.	Pankaj Agarwal and Manish Shrikhande, "Earthquake resistant design of structures", PHI learning Private Ltd, 3rd Edition, 2013. ISBN 9788120328921.

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L	M	-	-	-	-	-	-	-	-
CO2	H	L	M	-	-	-	-	-	L	-	-
CO3	H	L	M	-	-	-	-	-	-	M	-
CO4	H	L	M	-	-	-	-	-	L	M	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	H	-
CO3	H	-
CO4	L	-

MECHANICS OF DEFORMABLE BODIES						
Course Code	**:**	**16MST14**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3Hrs**

Course Learning Objectives (CLO):

Student will be able to

1. Understand the theoretical concepts of material behavior with particular emphasis on their elastic and plastic properties.
2. Explain the behaviour of bodies subjected to tensile and torsional loading.
3. Analyze the behavior of elastic solids under different loading conditions.
4. Develop mathematical model to assess the behavior of two dimensional elastic solids.

Unit – I	**10Hrs**

Stress and Strain in Cartesian Coordinates

Introduction: Definition of stress and strain and strain at a point, components of stress and strain at a point of Cartesian coordinates. Equilibrium equations, compatibility equations and boundary conditions. Stress transformation, Strain transformation, Principal stresses and principal strains, invariants of stress and strain, hydrostatic and deviatric stress, spherical and deviatoric strains, Strain Rossette.

Unit – II	**9Hrs**

Two dimensional problems in Cartesian coordinate system

Plane stress and plane strain problems, Constitutive relations, Compatability equations in terms of stress for plane stress and plane strain. Airy's stress function, Polynomials, Airy's stress function approach to 2-D problems of elasticity, simple problems of bending of beams.

Unit – III	**10Hrs**

Two Dimensional Problems in Polar Coordinates

Equations of Equilibrium in polar coordinates, Strain components in polar coordinates, Biharmonic equation in polar coordinates**,** Solution of axi-symmetric problems, Effect of circular hole on stress distribution, Concentrated force at a point of a straight boundary**.**

Unit – IV	**9Hrs**

Torsion of Prismatic Bars

General solution of the problem by displacement (St.Venant's warping function) and force (Prandtl's stress function) approaches, Membrane analogy, Torsion of shafts of circular and noncircular (Elliptic, triangular and rectangular) cross sectional shapes , Torsion of thin rectangular section and hollow thin walled single and multicelled sections.

Unit – V	**10Hrs**

Introduction to Plasticity

Stress – strain diagram in simple tension, perfectly elastic, Rigid –Perfectly plastic, Linear work hardening, Elastic Perfectly plastic, Elastic Linear work hardening materials. Failure theories, criteria of yielding, Rankine's theory, St.Venant's theory, Tresca and Von-Mises criteria of yielding.

Expected Course Outcomes:

After successful completion of this course the student will be able to:
CO1: Apply the classical theory of Elasticity and plasticity in two and three dimensional state of stress
CO2: Analyse the behavior of solids under different loads
CO3: Evaluate the stress and strain in two and three dimensional problems.
CO4: Formulate equations governing the behavior of two dimensional solids.

Reference Books:

1.	Timoshenko & Goodier, "Theory of Elasticity", Tata McGraw-Hill Publishing Company; 3rd edition ISBN-10: 0070702608 ISBN-13: 978-0070070268
2.	Mohammed Ameen, "Computational Elasticity" Revised Edition 2011, Alpha Science International Limited, ISBN-10: 1842654497, ISBN – 13: 978-1842654491
3.	Srinath L.S., Advanced Mechanics of Solids, TataMcGraw Hill Publishing company, 3rd edition,2010, ISBN-10: 0070858055 ISBN-13: 978-0070858053
4.	Chakrabarthy.T "Theory of Plasticity", Tata Mc. Graw Hill Book Co, 3rd edition,ISBN-10:9380931719 ISBN-13: 9789380931715.

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Course outcomes	Programme outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	M	L	-	-	-	-	-	L	-	-
CO2	M	H	L	-	-	-	-	-	-	-	-
CO3	H	H	M	-	-	-	-	-	-	-	-
CO4	H	H	M	-	-	-	-	-	L	-	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	M	-
CO2	H	-
CO3	H	-
CO4	H	-

ADVANCED DESIGN OF STEEL STRUCTURES (ELECTIVE – 1)						
Course Code	**:**	**16MST151**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L: T: P: S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3Hrs**

Course Learning Objectives (CLO):

Student will be able to:

1. Develop a loading model on different types of steel structures.
2. Apply the principles of behavior of steel members to analyze steel components.
3. Design steel components in accordance with standards and guidelines.

Unit – I	**10Hrs**

Components of industrial structure, assessment of dead loads, live loads and wind loads on a mill bent frame. Analysis and design of knee brace, column and purlins.

Unit – II	**9Hrs**

Analysis and design of gantry girder subjected to single and two wheel loads, Splices for bending moment and shear force.

Unit – III	**9Hrs**

Components self supporting steel chimneys, assessment of wind loads, moments at base, assessment of seismic loads. Analysis and Design of self supporting circular steel chimneys.

Unit – IV	**10Hrs**

Forms of light guage sections, Effective width computation of unstiffened, stiffened, multiple stiffened compression elements of cold formed light guage sections. Concept of local buckling of thin elements. Limiting width to thickness ratio. Post buckling strength. Design of compression and tension members of cold formed light guage sections, Design of flexural members (Laterally restrained / laterally unrestrained).

Unit – V	**10Hrs**

Design of open web flexural structures (triangular and rectangular), Concept of Pre- engineered buildings.

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1: Apply the knowledge of various components of different types of steel structures to identify them.

CO2: Analyze the steel components for different loads acting on them.

CO3: Design various types of steel structural components using provisions of standards, codes of practice for ethical design of steel components and develop professional competencies.

CO4: Propose design solution of industrial steel structures at component and system level.

Reference Books:

1.	Bureau of Indian Standards, IS800-2007, IS875-1987, IS-801-1975. Steel Tables, SP 6 (1) – 1984, IS6533(Part 1 and 2),IS1893(part 4):2005.
2.	N Subramanian- "Design of Steel Structure" Oxford University Press, ISBN:0-19-567681-5.
3.	Ramchandra and Virendra Gehlot " Design of Steel Structures " Vol 1 and Vol.2, Scientific Publishers, Jodhpur, 2010
4.	Duggal S K "Limit State Design of Steel Structures" TMH publication,New Dehli, ISBN (13):978-0-07-070023-9. 2009

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

Course outcomes	Programme outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	L	L	L	-	-	-	-	L	-	-
CO2	H	H	H	M	-	-	-	-		L	M
CO3	H	H	H	M	-	-	-	-	H	H	H
CO4	H	H	H	M	-	-	-	-	H	H	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	-
CO2	H	-
CO3	H	-
CO4	H	-

STRUCTURAL MASONRY (ELECTIVE-1)						
Course Code	**:**	**16MST152**		**CIE Marks**	**:**	100
Hrs/Week	**:**	**L: T: P: S**	**4:0:0:0**	**SEE Marks**	**:**	100
Credits	**:**	**04**		**SEE Duration**	**:**	**3 hours**

Course Learning Objectives (CLO):

Student will be able to

1. Understand masonry materials and its mechanical properties.
2. Analyze the behavior of structural masonry
3. Demonstrate testing, analysis and design methodologies
4. Summarize construction practices, specifications and inspection of masonry buildings

Unit – I	**8 Hrs**

Introduction, Masonry units, materials and types: History of masonry, historical buildings, Masonry arches, domes and vaults: Components, classification and construction procedure.

Unit – II	**10 Hrs**

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.

Unit – III	**10 Hrs**

Strength of Masonry in Compression: Behaviour of Masonry under compression, strength and elastic properties, factors influencing of compressive strength masonry, Effects of slenderness and eccentricity, water absorption, curing, ageing and workmanship on compressive strength. Prediction of strength of masonry in Indian context.

Unit – IV	**10 Hrs**

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.

Unit – V	**10 Hrs**

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 storeys using BIS codal provisions.

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1: Select appropriate masonry unit and mortar mixes for masonry construction.

CO2: Distinguish from a wide range of materials for their suitability to arrive at feasible and optimal solutions for masonry constructions.

CO3: Apply knowledge of structural masonry for advanced research and construction procedures.

CO4: Justify the design of masonry buildings for sustainable development.

Reference Books:

1.	Hendry A.W., "Structural masonry"- Palgrave Macmillan Macmillan Education Ltd., 2nd edition, ISBN 10: 0333733096 ISBN 13:9780333733097.
2.	Robert G Drysdale; Ahmad A Hamid, Masonry structures: Behavior and Design. Boulder, CO : Masonry Society, 2008. 3rd ed, ISBN 1929081332 9781929081332
3.	Jagadish K S, Structural Masonry, I K International Publishing House Pvt Ltd, 2015, ISBN – 10: 9384588660, ISBN 13: 978-9384588663.
4.	Sven Sahlin, "Structural Masonry"- Prentice Hall Publisher: Prentice Hall, 1971, ISBN-10: 0138539375, ISBN-13: 978-0138539375

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	M	H	-	-	-	-	-	L	-
CO2	H	-	M	H	-	-	-	L	-	L	L
CO3	M	M	-	M	-	-	-	L	-	-	-
CO4	M	-	M	L	-	-	-	-	-	L	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	L
CO2	M	-
CO3	H	-
CO4	M	H

PROFESSIONAL SKILL DEVELOPMENT						
Course Code	**:**	**16HSS16**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L:T:P:S**	**0:0:4:0**	**Credits**	**:**	**02**

Course Learning Objectives:

Students are able to

1. Understand the importance of verbal and written communication
2. Improve qualitative and quantitative problem solving skills
3. Apply critical and logical think process to specific problems
4. Manage stress by applying stress management skills

UNIT 1	5 Hours

Communication Skills: Basics of Communication, Personal Skills & Presentation Skills, Attitudinal Development, Self Confidence, SWOC analysis.

Resume Writing: Understanding the basic essentials for a resume, Resume writing tips Guidelines for better presentation of facts.

UNIT 2	6 Hours

Quantitative Aptitude and Data Analysis*:* Number Systems, Math Vocabulary, fraction decimals, digit places etc. Reasoning and Logical Aptitude, - Introduction to puzzle and games organizing information, parts of an argument, common flaws, arguments and assumptions. Verbal Analogies – introduction to different question types – analogies, sentence completions, sentence corrections, antonyms/synonyms, vocabulary building etc. Reading Comprehension, Problem Solving

UNIT 3	4 Hours

Interview Skills: Questions asked & how to handle them, Body language in interview, Etiquette, Dress code in interview, Behavioral and technical interviews, Mock interviews - Mock interviews with different Panels. Practice on Stress Interviews, Technical Interviews, General HR interviews

UNIT 4	5 Hours

Interpersonal and Managerial Skills: Optimal co-existence, cultural sensitivity, gender sensitivity; capability and maturity model, decision making ability and analysis for brain storming; Group discussion and presentation skills;

UNIT 5	4 Hours

Motivation and Stress Management: Self motivation, group motivation, leadership abilities Stress clauses and stress busters to handle stress and de-stress; professional ethics, values to be practiced, standards and codes to be adopted as professional engineers in the society for various projects**.**

Note: The respective departments should discuss case studies and standards pertaining to their domain

Course Outcome:

After going through this course the students will be able to

CO1: Develop professional skill to suit the industry requirement

CO2: Analyze problems using quantitative and reasoning skills

CO3: Develop leadership and interpersonal working skills

CO4: Demonstrate verbal communication skills with appropriate body language.

References

1. Stephen R Covey, "The 7 Habits of Highly Effective People", Free Press, 2004 Edition, ISBN: 0743272455
2. Dale Carnegie, "How to win friends and influence people", General Press, 1st Edition, 2016, ISBN: 9789380914787
3. Kerry Patterson, Joseph Grenny, Ron Mcmillan, "Crucial Conversation: Tools for Talking When Stakes are High", McGraw-Hill Publication, 2012 Edition, ISBN: 9780071772204
4. Ethnus, "Aptimithra: Best Aptitude Book", Tata McGraw Hill, 2014 Edition, ISBN: 9781259058738

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in TWO Phases

Phase	Activity	Weightage
I	After 7 weeks - Unit 1, 2 & Part of Unit 3	50%
II	After 12 weeks – Unit 3, 4, 5	50%

CIE Evaluation shall be done with weightage as follows:

Writing skills	10%
Logical Thinking	25%
Verbal Communication & Body Language	35%
Leadership and Interpersonal Skills	30%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	---	L	---	----	H	----	H	H	H	M
CO2	H	M	H	---	---	---	----	---	M	H	M
CO3	---	---	L	---	---	H	---	H	H	H	H
CO4	---	---	H	---	----	H	L	H	H	H	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	-	M
CO2	-	L
CO3	-	M
CO4	-	M

SEMESTER II

RESEARCH METHODOLOGY						
Course Code	**:**	**16MEM21R**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L: T: P: S**	**3:2:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives:

Students are able to

1. Understand of the underlying principles of quantitative and qualitative research
2. Perform the gap analysis and identify the overall process of designing a research study.
3. Choose the most appropriate research methodology to address a particular research problem
4. Explain a range of quantitative and qualitative approaches to analyze data and suggest possible solutions.

Unit – I	**7 Hours**

Overview of Research

Meaning of Research, Types of Research, Research and Scientific Method, Defining the Research Problem, Research Design, Different Research Designs.

Unit – II	**7 Hours**

Methods of Data Collection

Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.

Unit – III	**8 Hours**

Sampling Methods

Sampling process, Non-probability sampling, probability sampling: simple random sampling, stratified sampling, cluster sampling systematic random sampling, Determination of sample size, simple numerical problems.

Unit – IV	**7 Hours**

Processing and analysis of Data

Processing Operations, Types of Analysis, Statistics in Research, Measures of: Central Tendency, Dispersion, Asymmetry and Relationship, correlation and regression, Testing of Hypotheses for single sampling: Parametric (t, z and F) Chi Square, ANOVA, and non-parametric tests, numerical problems.

Unit-V	**7 Hours**

Essential of Report writing and Ethical issues:

Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Precautions for Writing Research Reports.

Syllabus includes 12 hours of tutorials in which:

- Faculty is expected to discuss research methodology for specializations under consideration.
- Numerical problems on statistical analysis as required for the domains in which students are studying must be discussed.
- Statistical analysis using MINITAB/ MatLab and such other softwares can be introduced.

Course Outcomes:

After going through this course the students will be able to

CO 1. Explain various principles and concepts of research methodology.

CO 2. Apply appropriate method of data collection and analyze using statistical methods.

CO 3. Analyze research outputs in a structured manner and prepare report as per the technical and ethical standards.

CO 4. Formulate research methodology for a given engineering and management problem situation.

Reference Books:

1. Kothari C.R., "Research Methodology Methods and techniques", New Age International, 2004, ISBN: 9788122415223
2. Krishnaswami, K.N., Sivakumar, A. I. and Mathirajan, M., "Management Research Methodology", Pearson Education India, 2009 Edition, ISBN:9788177585636
3. Levin, R.I. and Rubin, D.S., "Statistics for Management", 7th Edition, Pearson Education: New Delhi, ISBN-13: 978-8177585841

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	---	---	M	----	----	---	H	---	H	-----
CO2	---	L	H	H	M	M	L	L	----	M	L
CO3	L	M	M	M	H	M	L	M	---	---	M
CO4	H	H	H	H	----	L	L	M	H	---	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	-	L
CO2	-	M
CO3	-	L
CO4	-	M

STRUCTURAL DYNAMICS (Theory and Practice)						
Course Code	**:**	**16MST22**		**CIE Marks**	**:**	**100+50**
Hrs/Week	**:**	**L:T:P:S**	**4:0:1:0**	**SEE Marks**	**:**	**100+50**
Credits	**:**	**05**		**SEE Duration**	**:**	**3 Hrs+3Hrs**

Course Learning Objectives (CLO):

Student will be able to

1. Understand principles of structural dynamics.
2. Describe the dynamics of single, multi degree and responses of shear buildings.
3. Evaluate the responses of various systems using different approaches.
4. Develop mathematical models to predict the system responses.

Unit – I	**10 Hrs**

Introduction: Introduction to dynamic problems of Civil Engineering, Concept of degrees of freedom, D'Alemberts 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.

Unit – II	**10 Hrs**

Single degree of freedom systems subjected to sinusoidal loading, Resonance andits 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.

Unit – III	**09 Hrs**

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.

Unit – IV	**09 Hrs**

Response of shear building with proportion damping, Superposition of normal modes, Example of a 3-storeyed frame subjected to ground motion.

Unit – V	**10 Hrs**

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.

Unit – VI (Lab Component)	

1. Dynamic models of Single degree of freedom systems and multi-degree of freedom systems using poly carbonate bars.
2. Demonstration of Single degree of freedom systems with base excitation low frequency, Resonant and high frequency excitation.
3. Cantilever beam (Poly carbonate or Meter Scale), Vibration by hand tapping, Demonstration of

second mode with nodal point, Frequency measurement using Accelerometer.

4. 3-Storeyed frame with and without soft first story (Polycarbonate).
5. Vibration of multi-Storeyed modal (Aluminium) with sinusoidal base excitation, Frequency and mode shapes.

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1: Determine the response of single and multi degree freedom systems.

CO2: Apply appropriate techniques to analyze and interpret data for solving problems related to single and multi-degree freedom systems and shear buildings

CO3: Demonstrate the knowledge and understanding of principles of dynamics under varying loading conditions.

CO4: Develop mathematical solutions to predict system response subjected to dynamic loads.

Reference Books:

1.	Structural Dynamics : Vibrations and Systems, Madhujit Mukophadhyay, Publisher: ANE Books ISBN: 9788180520907, 8180520900 Edition: 01, 2008
2.	Structural Dynamics: Theory and Computation, 2nd Edition, Mario Paz, CBS Publisher ISBN: 9788123909783, 8123909780
3.	Dynamics of Structures, R,W.clough and J.Penzien, McGraw – Hill Education, 2nd revised Edition, 1993, ISBN -10: 0071132414, ISBN -13: 978-0071132411.
4.	Theory of vibration with applications, Willaim Thomson, CRC Press; 4th edition, 1996, ISBN -10: 0748743804, ISBN -13: 978-0748743803.

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Continuous Internal Evaluation (CIE) for Practical

CIE for the practical courses will be based on the performance of the student in the laboratory, every week. The laboratory records will be evaluated for 40 marks. One test will be conducted for 10 marks. The total marks for CIE (Practical) will be for 50 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Practical

SEE for the practical courses will be based on conducting the experiments and proper results for 40 marks and 10 marks for viva-voce. The total marks for SEE (Practical) will be 50 marks.

Mapping of COs with POs:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	-	-	-	-	-	-	L	-	-
CO2	L	M	-	-	-	-	-	-	-	-	-
CO3	-	-	H	-	-	-	-	L	-	-	-
CO4	-	-	H	-	-	-	-	L	L	-	-

	PSO1	PSO2
CO1	L	-
CO2	H	-
CO3	L	L
CO4	M	-

STRUCTURAL RELIABILITY (ELECTIVE - 2)						
Course code	**:**	**14MST231**		**CIE marks**	**:**	100
Hrs/week	**:**	**L: T: P: S**	4:0:0:0	**SEE marks**	**:**	100
Credits	**:**	4		**SEE duration**	**:**	3 Hrs

Course learning objectives (CLO):

Student will be able to

1. To understand the concept of structural reliability and its definitions in the context of structural engineering
2. To apply the concepts of structural reliability and statistics to understand the quantification of structural reliability due to structure uncertainties in assessment of structural behavior,
3. To be able to perform computations of structural reliability using alternative methods as a function of the nature of the mathematical model associated with the problem.
4. To apply safety assessment methodologies for different forms of structures

Unit – I	**8 Hrs**

Preliminary Data Analysis: Graphical representation- histogram, frequency polygon, measures of central tendency- grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve fitting and correlation: fitting a straight line, curve of the form $y = ab^{x}$, and parabola, coefficient of correlation.

Unit – II	**10 Hrs**

Probability Concepts: Random events-sample space and events, Venn diagram and event space, measures of probability interpretation, probability axioms, addition rule, multiplication rule, conditional probability, probability tree diagram, statistical independence, total probability theorem and Bayer's theorem.

Unit – III	**10 Hrs**

Random Variables: probability mass function, probability density function, mathematical expectation, Chebyshev's theorem. Probability distributions: discrete distributions- binomial and poison distributions, continuous distributions- normal, lognormal distributions.

Unit – IV	**10 Hrs**

Reliability Analysis: measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability methods-first order second moment method (FOSM), point estimate method (PEM), and advanced first order second moment method (Hasofer-Lind's method).

Unit – V	**10 Hrs**

System Reliability: redundant and non-redundant systems-series, parallel and combined systems, 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.

Expected course outcomes:

After successful completion of this course the student will be able to:

CO1: Apply the concepts of statistics for probabilistic analysis and importance of uncertainty (randomness) in structural analysis and design .

CO2: Apply the theoretical principles through density functions.

CO3: Analyze components of structure using concepts related to structural reliability.

CO4: Evaluate the safety reliability index of component and system by various methods.

Reference books:

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 & II, John Wiley and Sons, Inc, New York.
3. Achintya Haldar, And Sankaran Mahadevan (2000). "Probability, Reliability and Statistical Methods in Engineering Design"- John Wiley and Sons. Inc.
4. Nathabdndu, T., Kottegoda, And Renzo Rosso (1998). Statistics, "Probability and Reliability for Civil and Environmental Engineers"- Mc Graw Hill International Edition, Singapore.

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	-	-	-	-	-	-	M	-	M
CO2	H	H	M	-	-	-	-	-	M	-	M
CO3	H	H	L	-	-	-	-	-	M	-	M
CO4	H	H	H	M	-	-	-	-	M	-	M

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	**PSO2**
CO1	L	-
CO2	M	-
CO3	M	-
CO4	H	-

REPAIR AND REHABILITATION OF STRUCTURES (ELECTIVE – 2)						
Course Code	**:**	**16MST232**		**CIE Marks**	**:**	100
Hrs/Week	**:**	**4:0:0:0**	**4**	**SEE Marks**	**:**	100
Credits	**:**	**04**	**4**	**SEE Duration**	**:**	**3 hours**

Course Learning Objectives:

Student will be able:

1. Describe Causes of deterioration of concrete structures
2. Analyze failures of concrete structures
3. Evaluate failures and deterioration in concrete structures
4. Develop repair techniques for deteriorated concrete structures

Unit – I	**9 Hrs**

Deterioration: Introduction cause of deterioration of concrete structures, diagnostic methods and analysis, preliminary investigation, experimental investigations using NDT, load testing, corrosion mapping, core drilling and other instrumental methods.

Unit – II	**10Hrs**

Influence on serviceability and durability: effects due to climate, temperature, chemicals, wear and 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.

Unit – III	**10Hrs**

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

Unit – IV	**09Hrs**

Techniques of repair: rust eliminators and polymers coating for rebar during repair foamed concrete, mortar and dry pack, vaccum concrete, gunite and shotcrete epoxy injection mortar repair for cracks shoring and underpinning.

Unit – V	**10Hrs**

Repair of to structures: repairs to overcome low member strength deflection, cracking chemical disruption, weathering wear fire, leakage, marine exposure, engineered demolition techniques for dilapidated structures .Case Studies

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1: Identify the causes of failures in concrete structures

CO 2: Analyze failures in concrete structures

CO 3: Evaluate causes for failures in deteriorated concrete structures

CO 4: Develop simple and comprehensive solutions to rehabilitate deteriorated structures

Reference Books:

1. RT Allen and SC Edwards, " Repair of concrete structures" Blakie and sons ISBN 1352, 2009

3.	Raiker R.N Learning for failure from deficiencies in design construction and service" R & D Center (SDCPL), 2008.ISBN:12657-764-853-2318
4.	B Vedivelli, "Rehabilitation of concrete structures", Standard publishers and distributors 2013, ISBN: 978-8180141102

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	-	M	M	M	-	-	-	-	M	M
CO2	-	-	M	M	M	-	-	-	-	-	-
CO3	L	-	L	L	-	-	-	-	-	-	-
CO4	L	L	-	-	-	-	-	-	-	L	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	-
CO2	H	-
CO3	L	-
CO4	H	L

ADVANCED PRE-STRESSED CONCRETE (ELECTIVE 3)

Course Code	**:**	**16MST241**		**CIE Marks**	**:**	100
Hrs/Week	**:**	**4:0:0:0**	**4**	**SEE Marks**	**:**	100
Credits	**:**	**04**	**4**	**SEE Duration**	**:**	**3 hours**

Course Learning Objectives (CLO):

Student will be able to:

1. Understand various types prestressed structural elements.
2. Analyze and determine loads and stresses in PSC Members
3. Apply knowledge of analytical solution in problem solving
4. Design and detailing of Prestressed structural elements.

Unit – I	**09 Hrs**

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 l-beam - Design of shear reinforcement - Indian code provisions, Importance of modulus of elasticity of Prestressing tendons, failures of prestressed concrete.

Unit – II	**10 Hrs**

Shear and Torsional resistance- ultimate shear resistance- Design of shear reinforcement in torsion.

Unit – III	**09 Hrs**

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.

Unit – IV	**10 Hrs**

Transfer of Prestress in Pretensioned Members : Transmission of prestressing force by bond Transmission length , Flexural bond stresses - lS code provisions - Anchorage zone stresses in post tensioned members - stress distribution in End block - Analysis by approximate, Guyon and Magnel methods -Anchorage zone reinforcement.

Unit – V	**10 Hrs**

Statically indeterminate Structures : Advantages & disadvantages of continuous Prestressed beams - Primary and secondary moments - P and C lines - Linear transformation concordant and non-concordant cable profiles -Analysis of continuous beams and simple portal frames (single bay and single story)

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1: Identify various prestressed structural elements.

CO2: Apply analytical skills to evaluate performance of prestressed structural elements

CO3: Analyze prestressed structural elements with various considerations.

CO4: Design and detail prestressed structural elements for various loading conditions.

Reference Books:	
1.	N Krishnaraju " Prestressed Concrete", Tata McGraw- Hill Education, 2008,ISBN0070634440,9780070634442
2.	Lin T. Y and H. Burns "Prestressed Concrete structures", Wiley Publication, 2009, ISBN: 978-0-471-01898-8
3.	N. Rajagopalan, "Prestressed Concrete", Narosa Publishing House.2nd edition,ISBN 2053 2005.
4.	A. Nilson, "Design of Prestressed Concrete", John Willey & Sons.2nd edition, ISBN 1765 1997.

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	M	-	M	-	L	-	L	M
CO2	H	L	-	-	-	-	-	M	-	L	-
CO3	M	-	M	L	-	-	-	M	-	-	L
CO4	L	M	L	M	-	L	-	M	-	-	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	-
CO2	L	-
CO3	H	-
CO4	L	-

DESIGN OF SUBSTRUCTURES (ELECTIVE 3)						
Course Code	**:**	**16MST242**		**CIE Marks**	**:**	100
Hrs/Week	**:**	**L: T: P: S**	**4:0:0:0**	**SEE Marks**	**:**	100
Credits	**:**	**04**		**SEE Duration**	**:**	**3 hours**

Course Learning Objectives:

Student will be able to:

1. Understand principles of subsoil exploration,
2. Develop analytical skills in solving complex problem
3. Evaluate the soil shear strength parameters.
4. Design the sub structures.

Unit – I	**9 Hrs**

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.

Unit – II	**10Hrs**

Concept of soil shear strength parameters, Settlement analysis of footings, Shallow foundations in clay, Shallow foundation in sand & C-Φ soils, Footings on layered soils and sloping ground, Design for Eccentric or Moment Loads.

Unit – III	**10Hrs**

Types of rafts, bearing capacity & settlements of raft foundation, Rigid methods, Flexible methods, soil-structure interaction, different methods of modeling the soil. Combined footings (rectangular & trapezoidal), strap footings & wall footings, Raft – super structure interaction effects & general concepts of structural design, Basement slabs.

Unit – IV	**09Hrs**

Deep Foundations: Load Transfer in Deep Foundations, Types of Deep Foundations, Ultimate bearing capacity of different types of piles in different soil conditions, Laterally loaded piles, tension piles & batter piles, Pile groups: Bearing capacity, settlement, uplift capacity, load distribution between piles, Proportioning and design concepts of piles.

Unit – V	**10Hrs**

Types of caissons, Analysis of well foundations, Design principles, Well construction and sinking. Foundations for tower structures: Introduction, Forces on tower foundations, Selection of foundation type, Stability and design considerations, Ring foundations – general concepts.

IMPORTANT NOTE: Only design principles of all type footings as per relevant BIS codes are to be covered, design of RC elements need not be covered.

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1: Explain design parameters of substructure

CO 2: Evaluate soil shear strength parameters.

CO3: Assess settlement depending on ground condition.

CO4: Design of shallow and deep foundation.

Reference Books:

1.	Swami Saran – "Analysis & Design of Substructures"- Oxford & IBH Pub. Co. Pvt. Ltd., 1998. ISBN:434-238-1343.
2.	W.C. Teng – "Foundation Design"- Prentice Hall of India Pvt. Ltd., 2003. ISBN:234-456-12343.
3.	R.B. Peck, W.E. Hanson & T.H. Thornburn – "Foundation Engineering"- Wiley Eastern Ltd.,Second Edition, 1984. ISBN:2285-064-12328.
4.	J.E. Bowles – "Foundation Analysis and Design"- McGraw-Hill Int. Editions, Fifth Ed., 1996. ISBN:745-873-12854.

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	L	M	-	-	-	-	-	-	-
CO2	-	-	M	-	-	-	-	-	-	M	-
CO3	L	-	-	M	-	-	-	-	-	L	M
CO4	H	-	M	H	-	-	-	-	-	H	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	-
CO2	L	-
CO3	L	L
CO4	H	-

DESIGN OF PLATES AND SHELLS (ELECTIVE 4)						
Course Code	**:**	**16MST251**		**CIE Marks**	**:**	100
Hrs/Week	**:**	**L:P:T:S**	**4:0:0:0**	**SEE Marks**	**:**	100
Credits	**:**	**04**		**SEE Duration**	**:**	**3 hours**

Course Learning Objectives:

Student will be able:

1. Understand various types of Spatial structures.
2. Analyze spatial structures by various methods
3. Apply knowledge of analytical solution in problem solving
4. Design and detailing of spatial structures.

Unit – I	**9 Hrs**
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.	
Unit – II	**10Hrs**
Levy's solution for various lateral loading and boundary conditions (No derivations), Numerical examples. Energy methods for rectangular plates with clamped edges.	
Unit – III	**10Hrs**
Bending of circular plates with various edge conditions for both solid and annular plates.	
Unit – IV	**09Hrs**
Introduction to curved surfaces and classification of shells, membrane theory of spherical shells, Cylindrical shell, Hyperbolic paraboloid, Elliptic paraboloid.	
Unit – V	**10Hrs**
Design and detailing of cylindrical shells. Introduction to folded plates, analysis of folded plates by whitney's and simpson's method.	

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1: Explain principles of analysis for special structures.

CO2: Apply analytical skills to evaluate performance of spatial structures

CO3: Analyze spatial structures using various methods

CO4: Prepare Design and detailing for spatial structures

Reference Books:

1.	Timosheko, S. and Woinowsky-Krieger, W., "Theory of Plates and Shells" 2nd Edition, McGraw-Hill Co., New York,1959, ISBN-10: 0070647798; ISBN-13: 978-0070647794
2.	J E Gibson BG Neal, Linear Elastic theory of thin shells Volume I ,Elsevier, ISBN: 978-0-08-010944-2
3.	Ugural, A. C. "Stresses in Plates and Shells", 2nd edition, McGraw-Hill, 1999, ISBN 10: 0070657300 ISBN 13: 9780070657304
4.	R. Szilard, "Theory and analysis of plates - classical and numerical methods", Prentice Hall,1994, ISBN-13: 9780139134265 ISBN: 0139134263

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	L	-	-	-	-	-	-	-	-
CO2	L	M		-	-	-	-	-	-	-	-
CO3	-	M	M	-	-	-	-	-	-	-	-
CO4	L	-	H	-	-	-	-	-	L	-	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	M	-
CO2	H	-
CO3	M	-
CO4	M	L

FINITE ELEMENT METHOD OF ANALYSIS (ELECTIVE 4)						
Course Code	**:**	**16MST252**		**CIE Marks**	**:**	100
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	100
Credits	**:**	**4**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives (CLO):

Student will be able to

1. Understand numerical analysis techniques available in structural analysis.
2. Apply the concepts of shape function construction, and derivation of stiffness for different elements.
3. Analyse the complex structures using finite elements.
4. Explain the concept of condensation and minimization of matrix bandwidth that enables memory savings in computers.

Unit – I	**10 Hrs**

Basic concepts of elasticity – kinematics and static variables for various types of structural problems – approximate method of structural analysis – Rayleigh-Ritz method – Difference between Finite Difference Method and Finite Element Method – variational method and minimization of energy approach for element formulation – principles of finite element method – advantages & disadvantages – finite element procedure – finite elements both first and second order elements used for one, two and three dimensional problems.

Unit – II	**9 Hrs**

Nodal displacement parameters – convergence criteria – compatibility requirements – geometric invariance – shape function – polynomial form of displacement function – generalized and natural coordinates – Lagrangian interpolation function.

Unit – III	**10 Hrs**

Serendipity and Lagrangian family of elements – shape functions for one, two and three dimensional first and second order elements – Hermite shape function for beam formulation – Numerical problems to interpolate nodal variables using shape function. Formulation of one-dimensional bar element, two- and three-noded using Lagrangian shape function – numerical analysis of simple bars and plane trusses

Unit – IV	**10 Hrs**

Two noded beam element formulation using Hermite shape function – Jacobian transformation matrix – strain-displacement matrix – stiffness matrix – consistent load vector – Gauss quadrature for numerical integration – numerical analysis of simple beams. Iso-parametric elements – sub-parametric and super-parametric elements – Formulation of two-dimensional three-noded triangular (CST)

Unit – V	**9 Hrs**

Formulation of four-noded quadrilateral element, and its application to plane stress, plane strain and axis-symmetric problems – application of Gauss quadrature for numerical integration – Numerical problems. Element aspect ratio – mesh refinement vs. higher order elements – numbering of nodes to minimize bandwidth – static condensation technique – introduction to non-

linear analysis – geometric and material non-linearity with examples.

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1: Identify principles of various numerical methods.

CO2: Apply the knowledge of shape functions to analyze truss, beam and plate elements and to conduct research in addressing complex structures.

CO3: Analyze and interpret solutions of engineering problems with different loading and boundary conditions.

CO4: Formulate higher order elements for numerical analysis.

Reference Books:

1.	CS Krishnamoorthy, (1994) "Finite Element Analysis – Theory and Programming", Tata McGraw-Hill, ISBN 0-07-462210-2
2.	RD Cook, DS Malkus, ME Plesha and RJ Witt, (2002) "Concepts and applications of finite element analysis", Wiley
3.	OC Zienkiewicz and RL Taylor, (2005) "The Finite Element Method: Its Basis and Fundamentals", Butterwoth
4.	KJ Bathe, (2002), "Finite Element Procedures", Prentice Hall, ISBN 978-546-439-982
5.	DV Hutton, (2004) "Fundamentals of Finite Element Analysis", Tata McGraw

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	M	-	-	-	-	-	-	-	-	-
CO2	M	H	M	L	L	-	-	-	-	-	-
CO3	L	H	H	H	-	M	-	-	L	-	-
CO4	M	H	M	M	-	-	-	-	L	-	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	-
CO2	H	-
CO3	H	-
CO4	M	-

MINOR PROJECT						
Course Code	**:**	**16 MST 26**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**0:0:10:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**05**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives:

Students are able to

1. Understand the method of applying engineering knowledge to solve specific problems.
2. Apply engineering and management principles while executing the project
3. Demonstrate the skills for good presentation and technical report writing skills.
4. Identify and solve complex engineering problems using professionally prescribed standards.

GUIDELINES

1. Each project group will consist of maximum of two students.
2. Each student / group has to select a contemporary topic that will use the technical knowledge of their program of study after intensive literature survey.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The number of projects that a faculty can guide would be limited to four.
5. The minor project would be performed in-house.
6. The implementation of the project must be preferably carried out using the resources available in the department/college.

Course Outcomes:

After going through this course the students will be able to

CO1: Conceptualize, design and implement solutions for specific problems.

CO2: Communicate the solutions through presentations and technical reports.

CO3: Apply resource managements skills for projects

CO4: Synthesize self-learning, team work and ethics.

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in THREE Phases. The evaluation committee will comprise of FOUR members : guide, two senior faculty members and Head of the Department.

Phase	Activity	Weightage
I	Synopsis submission, Preliminary seminar for the approval of selected topic and Objectives formulation	20%
II	Mid-term seminar to review the progress of the work and documentation	40%
III	Oral presentation, demonstration and submission of project report	40%

****Phase wise rubrics to be prepared by the respective departments**

CIE Evaluation shall be done with weightage / distribution as follows:

- Selection of the topic & formulation of objectives 10%
- Design and simulation/ algorithm development/experimental setup 25%
- Conducting experiments / implementation / testing 25%
- Demonstration & Presentation 15%
- Report writing 25%

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

1. Brief write-up about the project 5%
2. Presentation / Demonstration of the project 20%
3. Methodology and Experimental Results & Discussion 25%
4. Report 20%
5. Viva Voce 30%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	M	H	H	H	---	---	M	---	H	H
CO2	----	---	----	---	H	----	---	H	H	H	----
CO3	H	H	M	---	M	M	H	H	---	M	H
CO4	---	H	----	---	----	H	M	M	M	H	---

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	M	L
CO3	-	M
CO4	-	H

Rashtreeya Sikshana Samithi Trust

R.V. College of Engineering

(Autonomous Institution Affiliated to VTU, Belagavi)

Department of Civil Engineering

Master of Technology (M. Tech.)

STRUCTURAL ENGINEERING

III and IV Semester
Scheme and Syllabus of
Autonomous System w.e.f 2016

R.V. College of Engineering, Bengaluru – 59

(Autonomous Institution Affiliated to VTU, Belagavi)

M. Tech. Structural Engineering

Department of Civil Engineering

Vision: Excel in Education, Research and Consultancy in Civil Engineering with emphasis on sustainable Development

Mission:

1. Disseminating and integrating the knowledge of structural, transportation, environmental and geotechnical engineering
2. Enhancing Industry – Institute interaction leading to Interdisciplinary research
3. Imbibing wide range of skills in cutting edge technology for sustainable development
4. Motivate entrepreneurship and professional ethics to serve the society

Program: STRUCTURAL ENGINERING

Program Educational Objectives (PEO)

After successful completion of structural engineering program, the post graduates will be able to

1. Independently analyze and design various forms of structures with sustainable materials.
2. Develop professionalism in academics, structural consultancy and entrepreneurship.
3. Pursue advanced research, career and participate in professional societies.
4. Address societal needs through interdisciplinary approach.

Program Outcomes (PO)

M. Tech. in Structural engineering graduates will be able to:

PO1: Scholarship of Knowledge – Acquire in depth knowledge of Structural Engineering, including wider and global perspective, with an ability to distinguish, evaluate, analyze and synthesize existing and new knowledge and integration of same for enhancement of knowledge.

PO 2: Critical Thinking – Analyze complex structural engineering problems critically, apply independent judgement for synthesizing information to make intellectual and creative advances for conducting research in the areas of wider theoretical, practical and policy context.

PO3: Problem Solving – Think laterally and originally, conceptualize and solve structural engineering problems, evaluate a wide range of potential solutions for those problems and arrive

at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of structural engineering.

PO4: Research Skill – Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually / in groups to the development of scientific / technological knowledge in domains of structural engineering such as alternate construction materials, techniques and structural masonry.

PO5: Usage of Modern tool – Create, select, learn and apply appropriate computational tools, techniques, resources, modern engineering and structural analysis and design software for prediction and modeling of complex engineering activities with an understanding of their limitations.

PO6: Collaborative and multidisciplinary research – Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative multi-disciplinary scientific research, demonstrate capacity for self-management and team work, decision making based on open mindedness, objectivity and rational analysis in order to achieve common goals and further learning of themselves as well as others.

PO7: Project management and Finance- Demonstrate knowledge and understanding of engineering and project management principles and apply the same to one's own work as a member and leader in team, manage projects efficiently in structural engineering and multi-disciplinary environments after consideration of economic and financial factors.

PO8: Communication – Communicate with the engineering community and with society at large, regarding complex structural engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate codal provisions, make effective presentations and give and receive clear instructions.

PO9: Life Long Learning – Recognize the need for, and have the preparation and ability to engage in lifelong learning independently, with high level of enthusiasm and commitment to improve knowledge and competence continuously.

PO10: Ethical Practices and Social responsibility – Acquire intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the society for sustainable development.

PO11 Independent and reflective thinking – Observe and examine critically, outcome of one's actions and make corrective measures subsequently and learn from mistakes without depending on external feedback.

Program Specific Criteria (PSC)

Lead Society: American Society of Civil Engineers

1. Curriculum

The program prepares students for professional, teaching and research careers. Emphasis is on the acquisition of knowledge concerning to analysis, design, construction, maintenance, management and performance of structural components and structures with due consideration to public governing policies and guidelines.

2. Faculty competency

Faculties are qualified with post graduate and doctoral degrees in the stream of structural engineering. The faculties are actively publishing research papers in peer reviewed national and international journals related to structural engineering and allied fields leading to sustainable development. The faculties are also actively involved in R&D activities, patenting and associated with professional bodies.

Program Specific Outcomes (PSO)

M. Tech. in Structural engineering graduates will be able to:

PSO 1. Apply knowledge of materials and analysis for design of RCC, steel and masonry structures.

PSO 2. Demonstrate the use of alternate engineering materials, technologies and management for sustainable environment.

R. V. College of Engineering, Bengaluru – 59.

(An Autonomous Institution affiliated to VTU, Belagavi)

Department of Civil Engineering

M. Tech. Structural Engineering

THIRD SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture **L**	**Tutorial** **T**	**Practical** **P**	**Experiential Learning** **S**	
1	16 MST 31	Special Construction Materials And Concrete	CV	4	0	1	0	5
2	16 MST 32X	Elective -5	CV	4	0	0	0	4
3	16 MST 33X	Elective -6	CV	4	0	0	0	4
4	16 MST34X/ 16MHT34X	Elective -7	CV	4	0	0	0	4
5	16MST35	Internship/ Industrial Training	CV	0	0	3	0	3
6	16MST36	Technical Seminar	CV	0	0	2	0	2
		Total		**16**	**0**	**6**	**0**	**22**

Elective 5			
16MST321	Earthquake Resistant Structures	16MST322	Precast Concrete Structures
Elective 6			
16MST331	Stability of Structures	16MST332	Advanced Structural Analysis
Elective 7			
16MHT341/ 16MST341	Design of Bridges, flyovers and grade separators	16MHT342/ 16MST342	Earth Retaining structures

FOURTH SEMESTER								
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**				**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	**Experiential Learning S**	
1	16MST41	Major Project	CV	0	0	26	0	26
2	16MST42	Seminar	CV	0	0	2	0	2
		Total		**0**	**0**	**28**	**0**	**28**

SPECIAL CONSTRUCTION MATERIALS AND CONCRETE						
Course Code	**:**	**16MST31**		**CIE Marks**	**:**	**100+50**
Hrs/Week	**:**	**L: T: P: S**	**4:0:2:0**	**SEE Marks**	**:**	**100+50**
Credits	**:**	**5**		**SEE Duration**	**:**	**3 +3 Hours**

Course Learning Objectives: Students are able to

1	Understand various modern construction materials and methods
2	Apply the knowledge of different materials to modify the properties
3	Select appropriate materials for particular application
4	Proportion and estimate materials for different mixes

UNIT – I **8 Hours**

Review of conventional concrete. Non-destructive methods of testing – Rebound hammer test, Pulse velocity method, Pullout test, Electrical methods, Penetration resistance techniques.
Importance of steel reinforcement in RCC, Types, testing methods.

UNIT – II **7 Hours**

Geopolymers – Paste, mortar, concrete and masonry units. Concept, advantages, Proportioning, Geopolymer masonry, Applications. Ready Mixed Concrete, Advantages, Components of RMC Plant, Quality aspects of RMC.

UNIT – III **7 Hours**

Fibre reinforced concrete, Behaviour in compression and flexure. Types of fibres, Action of fibres, Failure of fibres, Simple Design and Application.
Light weight concrete, types, Materials used, Design of light weight concrete, Properties and Applications.

Unit – IV **7 Hours**

Ferro cement- Concept, materials, construction methods, Behaviour in tension, Simple design, Applications.
High Density concrete- Necessity, Radiation shielding, materials, methods of placement.

UNIT-V **7 Hours**

Nanotechnology and Concrete – Nono-Engineering, Manipulation of materials at nano scale, hydrate-hybridization, nano materials in concrete – Nano SiO_2, NanoTiO_2, Nano Al_2O_3, Nano clay, Carbon nano tubes, nanofibres, Properties and applications.

UNIT-VI (Lab Component)

1) Proportion concrete mix using BIS and ACI method and compare the properties.
2) Testing of concrete by Schimdt's hammer.
3) Testing of concrete by Pulse velocity method.
4) Location of rebars using profometer
5) Modulus of elasticity of concrete cylinder
6) Flexural strength of concrete.
7) Deflection of RCC beam
8) Preparation of alkaline solution and Casting of geopolymer concrete/Masonry block

Course Outcomes:
After going through this course the student will be able to

CO1:	Explain the properties of modern construction materials.
CO2:	Illustrate the use of construction materials

CO3:	Identity suitable materials for specific application.
CO4:	Design and conceptualize mixes for structural components.

Reference Books:

1	P. Kumar Mehta, Paulo J. M. Monteiro, Concrete Microstructure, properties and Materials, McGraw Hill Education India Private Limited, New Delhi, Fourth Edition, 2015. ISBN-13: 978-93-393-0476-1.
2	A R Santhakumar, Concrete Technology ,Oxford University Press, 2012,ISBN-13:978-0-19-567153-7.
3	Neville. A.M, Properties of concrete IV Edition, Pearson Education, Inc, and Dorling Kindersley Publishing Inc. 1995.
4	Shetty. M.S., Concrete Technology Theory and Practice, S.Chand & Co Ltd., New Delhi, 2007.

Code Books:

1	IS 10262 : 2009, Concrete Mix proportioning guidelines, First Revision.2009. ACI Committee 211, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete, ACI 211.1-91, American Concrete Institute, Farmington Hills, Michigan, 1991

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Continuous Internal Evaluation (CIE) for Practical

CIE for the practical courses will be based on the performance of the student in the laboratory, every week. The laboratory records will be evaluated for 40 marks. One test will be conducted for 10 marks. The total marks for CIE (Practical) will be for 50 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Practical

SEE for the practical courses will be based on conducting the experiments and proper results for 40 marks and 10 marks for viva-voce. The total marks for SEE (Practical) will be 50 marks.

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	L	-	L	-	-	-	-	L	-	-
CO2	L	L	-	L	-	M	-	-	-	-	-
CO3	L	L	-	L	-	L	-	-	H	-	-
CO4	L	H	L	-	-	-	-	M	-	M	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	M	H
CO2	H	H
CO3	M	M
CO4	H	L

EARTHQUAKE RESISTANT STRUCTURES (Elective 5)						
Course Code	**:**	**16MST321**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S :: 4:0:0:0**		**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives (CLO):

1	Discuss the concepts in Engineering Seismology, response spectrum, structural configuration, ductility and seismic analysis
2	Classify lateral load resisting structural systems.
3	Assess and develop earthquake resistant structures.
4	Test the structural response of building under seismic loads

UNIT – I	**09Hrs**

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

UNIT – II	**10Hrs**

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 multistoreyed buildings – using procedures (Equivalent lateral force and dynamic analysis) as per IS-1893

UNIT – III	**10Hrs**

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 and flexure, Slenderness concept of masonry walls, concepts for earthquake resistant masonry buildings – Codal provisions

UNIT – IV	**10Hrs**

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. Structural behavior, design and ductile detailing of shear walls.

UNIT – V	**09Hrs**

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

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1	Explain the concepts in Engineering Seismology, response spectrum, structural configuration, ductility and seismic analysis
CO 2	Apply and illustrate lateral load resisting structural systems using codal provisions and seismic response control concepts.
CO 3	Formulate and design earthquake resistant structures.
CO 4	Evaluate the structural response of building under seismic loads

Reference Books:

1	Dynamics of Structures – Theory and Application to Earthquake Engineering- 2nd ed. – Anil K. Chopra, Pearson Education, 2011, ISBN-10: 0132858037; ISBN-13: 978-0132858038
2	Earthquake Resistant Design of Building Structures, Vinod Hosur, WILEY (India), 2013, ISBN 13, : 9788126538591
3	Earthquake resistant design of structures – Pankaj Agarwal, Manish Shrikande - PHI India, 2006, ISBN 10: 8120328922
4	IS – 1893 (Part I): 2002, IS – 13920: 1993, IS – 4326: 1993, IS-13828: 1993
5	Seismic Design of Reinforced Concrete and Masonry Buildings, T Paulay and M J N Priestley, John Wiley and Sons, 1992, ISBN 0-471-54915-0

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	-	-	-	-	-	-	-	-
CO2	H	H	M	-	L	-	-	L	-	-	-
CO3	H	H	-	-	-	-	-	-	H	-	-
CO4	H	H	M	H	-	-	-	L	H	-	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	M	-
CO2	M	-
CO3	H	-
CO4	H	-

PRECAST CONCRETE STRUCTURES(Elective 5)						
Course Code	**:**	**16MST322**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives (CLO):

1	Ability to understand precast technologies.
2	Ability to understand the manufacturing process and its transportation.
3	Ability to design precast concrete elements.

UNIT – I	**09Hrs**
Concept of precast, precast products, standardization, precast accessories, types of precast constructions, methodologies, equipments and machineries, economy in comparison with cast in situ.	
UNIT – II	**10Hrs**
Precast and pre-stress plant setup production and storage systems, batching plant setup, logistic or transportation system.	
UNIT – III	**10Hrs**
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.	
UNIT – IV	**10Hrs**
Pre stress beams, TT slabs, manufacturing methods, production, loading transportation and erection applications.	
UNIT – V	**09Hrs**
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.	

Expected Course Outcomes(CO):

After successful completion of this course the student will be able to:

CO1	Demonstrate the precast concrete concepts, types of precast construction and its advantages
CO2:	Identify precast plant set up for production and storage systems, plan logistics of precast elements
CO3:	Examine different types of pre-cast elements.
CO4:	Design of precast elements, manufacturing methods.

Reference Books:

1	Kim.S.Elliott, Precast Concrete Structures, Butterworth-Heinemann, An imprint of Elsevier Science,2002.

2	Hubert Bachmann and Alfred Steinle' Precast concrete structures' First edition,2011, Ernst &Sohn, GmbH &Co., ISBN978-3-433-60096-2.
3	Kim.S.Elliot and Colin K Jolly,'Multi –Storey Precast Concrete Framed Structures', 2nd Edition November 2013, Wiley-Blackwell , ISBN: 978-1-4051-0614-6
4	Prestressed Concrete Institute ,PCI Journal– Proposed Design Requirements for Precast Concrete, PCI Committee on Building Code and PCI Technical Activities Committee

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	-	L	H	-	-	L	-	H	-	L
CO2	H	M	-	H	-	-	M	-	M	H	L
CO3	H	-	M	-	-	-	-	-	H	L	L
CO4	H	H	M	M	-	-	-	-	H	H	L

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	-	L
CO2	-	M
CO3	-	H
CO4	H	-

STABILITY OF STRUCTURES (Elective 6)						
Course Code	**:**	**16MST331**		**CIE Marks**	**:**	100
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	100
Credits	**:**	**04**		**SEE Duration**	**:**	**3Hrs**

Course Learning Objectives (CLO): Graduates shall be able to

1	Learn principles of stability of structures
2	Study the concept of buckling
3	Analyse the structural elements for stability.
4	Evaluate the use of strain energy in plate bending and stability.

UNIT – I **9Hrs**

Buckling of columns: Eulers 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.

UNIT – II **10Hrs**

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.

UNIT – III **10Hrs**

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.

UNIT – IV **9Hrs**

Lateral buckling of beams: Lateral buckling of beams in pure bending, Lateral buckling of cantilever beam and narrow rectangular beams. Pure Torsion of thin – walled bars of open cross section. Non – uniform Torsion of thin – walled bars of open cross section

UNIT – V **10Hrs**

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

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1:	Explain the principles of strength, stability and phenomenon of buckling
CO2:	Apply the principles of stability to calculate buckling load.
CO3:	Calculate the buckling load on column, beam – column, frames and plates using classical and approximate methods.
CO4:	Develop analytical skills.

Reference Books:

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.	F.Bleich Buckling strength of Metal structures, Tata McGraw Hill,1952
3.	N.Subramanian, Design of steel structures, Oxford University Press,2011, ISBN: 9780198068815.
4.	T.V.Galambos, Guide to stability design criteria for metal structures,5th Edition, John Wiley&Sons,Newyork,1998. ISBN 1-4196-5207-9.
5.	F.R.Shanley,Strength of Materials,Tata McGraw Hill,1957,ISBN-0-471-46890-8

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with POs

	Programme outcomes										
CO/ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	M	L	M	L	-	-	-	L	L	-	-
CO2	H	H	H	L	-	-	-	M	L	-	-
CO3	M	H	H	M	L	-	-	M	L	-	-
CO4	M	H	H	M	L	-	-	L	L	-	-

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	**PSO2**
CO1	L	-
CO2	M	-
CO3	H	-
CO4	H	-

ADVANCED STRUCTURAL ANALYSIS (Elective 6)						
Course Code	**:**	**16MST332**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**4:0:0:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives (CLO): Student shall be able to

1	Discuss concepts of stresses, moments, deformation and pressure in beams and columns
2	Interpret the influence of stresses, moments, deformation and pressure on beams and columns
3	Apply concepts of mathematics to solve problems related to beams and columns
4	Calculate stresses, moments, deformation and pressure in beams and columns

UNIT – I	**09Hrs**

Beams on elastic foundations: Differential equations of elastic line interpretation of constants of integration, infinite beam with c

oncentrated 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.

UNIT – II	**10Hrs**

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.

UNIT – III	**10Hrs**

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.

UNIT – IV	**10Hrs**

Unsymmetrical bending of beams: Introduction, stresses in beams, deflections of beams subjected to unsymmetrical bending, problems related to unsymmetrical bending.

Shear Centre: introduction, shear center for symmetrical and unsymmetrical sections, problems related to shear center.

UNIT – V	**09Hrs**

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.

Expected Course Outcomes:

After successful completion of this course the student will be able to:

CO1	Explain concepts of stress, moment, deflection in beams, columns and beam columns.
CO2	Examine the influence of deflection, moments and shear force on beams and columns.
CO3	Analyze beams on elastic foundation, beam column and unsymmetrical bending of beams.
CO4	Evaluate stresses, moments and deflections in beams and columns

Reference Books:

1	Boresi A.P., and Sidebottom O.M., (1985), Advanced Mechanics of Materials, John Wiley and sons in N.Y., ISBN 10: 0471843237 ISBN 13: 9780471843238
2	Den Hartog, (1952), Advanced Strength of Materials, McGraw Hill, N.Y.,ISBN:9780486654072
3	N. Krishna Raju and D.R. Gururaja, (1997), Advanced Mechanics of solids and structures, Narosa Publishing House, New Delhi, ISBN, 8173190666, 9788173190667
4	N.Subramanian, Design of steel structures, Oxford University Press, ISBN-13:978-0-19-567681-5,ISBN-10:0-19-567681-5.
5	William F. Riley, Leroy D. Sturges and Don H. Morris, (2001), Mechanics of Materials, John Wiley & Sons, New Delhi, ISBN: 978-0-471-43446-7

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	-	-	-	-	-	-	-	-
CO2	H	H	M	-	L	-	-	L	-	-	-
CO3	H	H	-	-	-	-	-	-	H	-	-
CO4	H	H	M	H	-	-	-	L	H	-	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	M	-
CO2	M	-
CO3	H	-
CO4	H	-

DESIGN OF BRIDGES, FLYOVERS AND GRADE SEPARATORS (Elective 7)			
Course Code:	**16MST341/16MHT341**		**CIE Marks: 100**
Hrs/Week:	**L:T:P:S**	**4:0:0:0**	**SEE Marks: 100**
Credits:	**4**		**SEE : 3 Hrs**

Course objectives: This course will enable students to

1	Describe the types and components of a bridge with specifications for designing them for highways.
2	Discuss the use of different types of bridge bearings, their installation and maintenance aspects under the action of vehicular loads.
3	Examine the design aspects of bridge approaches for RCC, PSC and Steel bridges.
4	Analyze the loading conditions on the bridges and design the elements as per IRC load specifications.
5	Identify the quality control measures during the execution of bridges both for substructure and super structure portions of the bridge.

UNIT – I	
Introduction: Historical Developments, Site Selection for Bridges, Classification of Bridges Forces on Bridges. Bridge substructures: Abutments, wing walls	**09 Hours**
UNIT – II	
Box Culvert: Different Loading Cases IRC Class AA Tracked, Wheeled and Class A Loading, working out the worst combination of loading, Moment Distribution, Calculation of BM & SF, Structural Design of Slab Culvert, with Reinforcement Details.	**10 Hours**
UNIT – III	
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.	**10 Hours**
UNIT – IV	
Importance of Bearings – Types of bearings, Bearings for slab bridges – Bearings for girder bridges – Design of Elastomeric bearing – Joints – Expansion joints, repair and rehabilitation of concrete bridges.	**10 Hours**
UNIT – V	
PSC Bridges: Introduction to Pre and Post Tensioning, Proportioning of Components, Analysis and Structural Design of Slab, Analysis of Main Girder using COURBON's Method for IRC Class AA tracked vehicle, Calculation of pre-stressing force and eccentricity, cable profile and calculation of stresses, Design of End block and detailing of main girder	**09 Hours**

Course outcomes:

After studying this course, students will be able to:

CO1	Explain the components of a bridge following the specifications for highways.
CO2	Compare different types of bridge bearings, their installation and maintenance aspects under the

	action of vehicular loads.
CO3	Analyse the IRC loading conditions for the design of bridges.
CO4	Evaluate the design aspects of bridge approaches for RCC, PSC and Steel bridges.

Scheme of Continuous Internal Evaluation (CIE)

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Reference Books:

1	D.Johnson Victor, "Essentials of bridge Engineering"- Oxford, IBH publishing company, ISBN, 8120417178, 9788120417175
2	Ponnuswamy, "Bridge Engineering"-McGraw Hill Publication, 1989, ISBN-10: 0070656959
3	Vazirani Ratwani & M.G.Aswani, "Design of Concrete Bridges"- Khanna Publishers, 2004 New Delhi, ISBN-13. 978-81-7409-117-3. ISBN-10
4	Design of Bridges"- Dr. Krishna Raju, Oxford & IBH Publishing company Limited, 2001, ISBN978-81-204-1741-0 788120 114 17410

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	-	-	-	-	-	L	-	-	-
CO2	H	M	H	-	-	-	-	-	-	H	-
CO3	H	H	H	-	-	-	-	-	-	H	H
CO4	H	H	H	H	-	-	-	-	-	-	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	H	-
CO3	H	-
CO4	H	-

EARTH RETAINING STRUCTURES (Elective 7)			
Course Code:	**16MST342/16MHT342**		**CIE Marks: 100**
Hrs/Week:	**L:T:P :S**	**4:0:0:0**	**SEE Marks: 100**
Credits:	**04**		**SEE : 3 Hrs**

Course Learning Objectives:

1	Understand the significance of earth retaining structures in Civil Engineering applications
2	Evaluate the lateral earth pressures associated with different earth systems
3	Analyse the different types of earth retention system
4	Design the earth retaining structures used for support of fills and excavations

UNIT – I	**10 Hrs**
Earth Pressure Theories : Introduction – State of stress in retained soil mass – Earth pressure theories –Classical and graphical techniques – Active and passive cases – Earth pressure due to external loads, empirical methods, Wall movement.	
UNIT – II	**09 Hrs**
Compaction, Drainage and Stability of retaining Structures Retaining structure – Selection of soil parameters , Lateral pressure due to compaction, strain softening, wall flexibility, drainage arrangements and its influence. Earth pressure due to earthquake forces , Stability of retaining structure.	
UNIT – III	**09 Hrs**
Sheet Pile Walls Retaining structure – Selection of soil parameters – Analysis and design of cantilever and anchored sheet pile walls. Dead man and continuous anchor. Diaphragm and bored pile walls – Design requirements.	
UNIT – IV	**10Hrs**
Supported Excavations Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving. Earth pressure around tunnel lining, shaft and silos ,Soil anchors, Soil pinning , Soil nailing – Basic design concepts	
UNIT – V	**10Hrs**
Design Of Reinforced Earth Retaining Wall Reinforced earth retaining wall – principles, Concepts and mechanism of reinforced Earth – Design consideration of reinforced earth – Materials used in reinforced earth - Geotextile – Geogrids, Metal strips, facing elements.	

Course outcomes:

After going through this course the student will be able to:

CO1	Enumerate the types of earth retention system
CO2	Predict the Suitability of earth system for a particular project
CO3	Quantify the lateral earth pressures associated with different earth systems.

CO4	Select the most technically appropriate and cost-effective type of retaining wall for the application

Reference Books

1	R F Craig, "Soil Mechanics", Van Nostrand Reinhold International publication, ISBN 10: 0278000193 ISBN 13: 9780278000193
2	Chris R.I. Clayton, Rick I. Woods, Andrew J. Bond, Jarbas Milititsky "Earth pressure and Earth retaining structures", Third edition, CRC Press, 2014 ISBN 9781466552111
3	Koerner, R.M., "Design with Geosynthetics" Sixth Edition, Prentice Hall, 2012. ISBN-13: 978-1462882892 ,10: 1462882897
4	Das, B.M.," Principles of Geotechnical Engineering" Fourth Edition, The PWS series in Civil Engineering, 1998 ISBN-10: 0534951791 ,ISBN-13: 978-0534951795

Scheme of Continuous Internal Evaluation (CIE) for Theory

CIE will consist of TWO Tests, TWO Quizzes and ONE assignment. The test will be for 30 marks each and the quiz for 10 marks each. The assignment will be for 20 marks. The total marks for CIE (Theory) will be 100 marks.

Scheme of Semester End Examination (SEE) for Theory

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one question from each unit. The total marks for SEE (Theory) will be 100 marks.

Mapping of COs with Pos

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	H	-	-	-	-	L	-	-	-
CO2	H	M	H	-	-	-	-	-	-	H	H
CO3	H	H	H	H	-	-	-	-	-	H	H
CO4	H	M	H	H	-	-	-	-	-	H	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	-	M
CO3	M	-
CO4	L	-

INTERNSHIP / INDUSTRIAL TRAINING						
Course Code	**:**	**16MST35**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**0:0:6:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**3**		**SEE Duration**	**:**	**30 min**

GUIDELINES FOR INTERNSHIP

Course Learning Objectives (CLO):

The students shall be able to:

1	Understand the process of applying engineering knowledge to produce product and provide services.
2	Explain the importance of management and resource utilization
3	Comprehend the importance of team work, protection of environment and sustainable solutions.
4	Imbibe values, professional ethics for life long learning.

1) The duration of the internship shall be for a period of 8 weeks on full time basis between II semester final exams and beginning 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 or the M.Tech program in which the student has enrolled.
4) Students undergoing internship training are advised to use ICT tools such as skype to report their progress and submission of periodic progress reports to the faculty members.
5) Every student has to write and submit his/her own internship report to the designated faculty.
6) Students have to make a presentation on their internship activities in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the internship final report. However interim or periodic reports and reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
7) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding –

A4 size with 1.5 spacing and times new roman font size 12.

8) 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:

After going through the internship the student will be able to:

CO1	Apply engineering and management principles
CO2	Analyze real-time problems and suggest alternate solutions
CO3	Communicate effectively and work in teams
CO4	Imbibe the practice of professional ethics and need for lifelong learning

Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of the Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

(1) Explanation of the application of engineering knowledge in industries 35%

(2) Ability to comprehend the functioning of the organization/ departments 20%

(3) Importance of resource management, environment and sustainability 25%

(4) Presentation Skills and Report 20%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	M	H	M		M	-	-	-	L	-
CO2	-	-	-	H	M	M	-	L	-	-	-
CO3	-	-	-	-	L	-	M	H	H	-	-
CO4	-	-	-	-	L	-	H	-	-	M	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	H
CO2	H	H
CO3	-	M
CO4	H	H

GUIDELINES FOR INDUSTRIAL TRAINING

Course Learning Objectives (CLO):

The students shall be able to:

1	Understand the process of applying engineering knowledge to industrial products & processes
2	Explain the importance of skilling, training and resource management.
3	Comprehend the importance of team work, communication and sustainable solutions.
4	Imbibe values, professional ethics for life long learning.

1) The duration of industrial training must be for a minimum of 1 week and maximum of 8 weeks on full time basis.
2) Industrial Training in which students pays a fee to the organization / industry will not be considered.
3) He/she can undergo training in one or more industry /organization.
4) The student must submit letters from the industry clearly specifying his / her name and the duration of the training provided by the company with authorized signatures.
5) Industrial training must be related to the field of specialization or the M.Tech program in which the student has enrolled.
6) Students undergoing industrial training are advised to use ICT tools such as Skype to report their progress and submission of periodic progress reports to the faculty members.

7) Every student has to write and submit his/her own industrial training report to the designated faculty.

8) Students have to make a presentation on their industrial training in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the final report.

9) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.

10) The broad format of the industrial training report shall be as follows

- Cover Page
- Certificate from College
- Training Certificate from Industry / Organization
- Acknowledgement
- Executive Summary
- Table of Contents
- Chapter 1 - Profile of the Organization –Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices
- Chapter 2 – Details of the Training Modules
- Chapter 3 – Reflections – Highlight specific technical and soft skills that you acquired

References & Annexure

Course Outcomes:

After going through the industrial training the student will be able to:

CO1:	Understand the process of applying engineering knowledge to solve industrial problems
CO2:	Develop skills through training relevant to industrial requirement
CO3:	Communicate effectively and work in teams
CO4:	Imbibe ethical practices and develop it as life skill.

Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

(1) Explanation on the application of engineering knowledge 25%

(2) Ability to comprehend the importance of skilling and training 25%

(3) Importance of communication, professional ethics, sustainability 20%

(4) Oral Presentation and Report 30%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	M	H	M		M	-	-	-	L	-
CO2	-	-	-	H	M	M		L	-	-	-
CO3	-	-	-	-	L	-	M	H	H	-	-
CO4	-	-	-	-	L	-	H	-	-	M	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	H	-
CO3	-	M
CO4	H	H

GUIDELINES FOR INDUSTRIAL VISITS

Course Learning Objectives (CLO):

The students shall be able to:

1	Understand the role of industries and service organization in meeting the demands of the society.
2	Explain the working of different industries and organizations with an engineering perspective
3	Comprehend the importance of team work, communication and sustainable solutions.
4	Imbibe values, professional ethics for life long learning.

1) Student must visit a minimum of THREE organizations/industry. The duration of the visit per organization must be for ONE full day, during which he/she must comprehend the importance of organization structure, function of various departments, application of engineering knowledge, resource management, importance to environment and safety, professional ethics.

2) It is mandatory to visit ONE private multi-national company or public sector industry / organization, ONE medium-small enterprise and ONE rural based or NG organization.

3) The student must submit letter from the industry clearly specifying his / her name and the date of visit to the industry with authorized signatures.

4) Industrial visit must be related to the field of specialization or the M.Tech program in which the student has enrolled.

5) Every student has to write and submit his/her own report on each industrial visit and submit the report to the designated faculty advisor for evaluation.

6) A photograph outside the industry with the name and logo of the industry in the background along with the students and faculty members could be included in the report.

7) Students have to make a presentation on their industrial visit in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the final report.

8) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.

9) The broad format of the industrial visit report shall be as follows

- Cover Page
- Certificate from College
- Acknowledgement
- Synopsis / Executive Summary
- Table of Contents
- Chapter 1 - Profile of the PSU or MNC – must include Organizational structure, Products, Services, Financials, Manpower, Societal Concerns, Professional Practices
- Chapter 2 – Profile of the SME – must include Organizational structure, Products, Services, Financials, Manpower, Societal Concerns, Professional Practices
- Chapter 3 - Profile of the NGO – must include Organizational structure, services, Manpower, Societal Concerns, Professional Practices
- Chapter 4 – Comparative Analysis of PSU/MNC – SME – NGO
- References & Annexure (Permission letters from the organizations for the visit & photographs)

Course Outcomes:

After going through this course the student will be able to:

CO1:	Classify the role of different industries and organization in addressing the needs of the society.
CO2:	Explain the process of applying engineering knowledge in industries and organizations.
CO3:	Describe the importance of communication and team work
CO4:	Recognize the importance of practicing professional ethics and need for life skills.

Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

(1) Explanation of the application of engineering knowledge in industries 25%

(2) Ability to comprehend the functioning of the organization/ departments 30%

(3) Importance of resource management, environment and sustainability 20%

(4) Presentation Skills and Report 25%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	M	H	M	-	M	-	-	-	L	-
CO2	-	-	-	H	-	M	-	L	-	-	-
CO3	-	-	-	-	L	-	-	H	H	-	-
CO4	-	-	-	-	L	-	H	-	-	-	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	H	H
CO3	-	M
CO4	H	H

TECHNICAL SEMINAR

Course Code	**:**	**16MST36**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L:T:P:S**	**0:0:4:0**	**SEE Marks**	**:**	**50**
Credits	**:**	**2**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives (CLO):

The students shall be able to:

1	Understand the technological developments in their chosen field of interest
2	Explain the scope of work and challenges in the domain area
3	Analyze these engineering developments in the context of sustainability and societal concerns
4	Improve his/her presentation skills and technical report writing skills

GUIDELINES

1) The presentation will have to be done by individual students.

2) The topic of the seminar must be in one of the thrust areas with in-depth review and analysis

on a current topic that is relevant to industry or on-going research.

3) The topic could be an extension or complementary to the project

4) The student must be able to highlight or relate these technological developments with sustainability and societal relevance.

5) Each student must submit both hard and soft copies of the presentation.

Course Outcomes:

After going through this course the student will be able to:

CO1:	Identify topics that are relevant to the present context of the world
CO2:	Perform survey and review relevant information to the field of study.
CO3:	Enhance presentation skills and report writing skills.
CO4:	Develop alternative solutions which are sustainable

Scheme of Continuous Internal Evaluation (CIE): Evaluation would be carried out in TWO phases. The evaluation committee shall comprise of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

Rubrics for Evaluation:

1) Topic – Technical Relevance, Sustainability and Societal Concerns 15%
2) Review of literature 25%
3) Presentation Skills 35%
4) Report 25%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	H	M	M	L	H	H	-	-	-	M
CO2	L	M	-	-	-	-	-	-	-	H	-
CO3	-	-	-	-	-	-	L	M	H	-	-
CO4	-	L	M	-	H	H	-	-	-	-	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	L	H
CO2	-	M
CO3	M	M
CO4	-	H

IV SEMESTER

MAJOR PROJECT						
Course Code	**:**	**16MST41**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L:T:P:S**	**0:0:52:0**	**SEE Marks**	**:**	**100**
Credits	**:**	**26**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives:

The students shall be able to

1	Understand the method of applying engineering knowledge to solve specific problems.
2	Apply engineering and management principles while executing the project
3	Demonstrate good verbal presentation and technical report writing skills.
4	Identify and solve complex engineering problems using professionally prescribed standards.

GUIDELINES

1. Major project will have to be done by only one student in his/her area of interest.
2. Each student has to select a contemporary topic that will use the technical knowledge of their program of specialization.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The number of projects that a faculty can guide would be limited to three.
5. The project can be carried out on-campus or in an industry or an organization with prior approval from the Head of the Department.
6. The standard duration of the project is for 16 weeks, however if the guide and the evaluation committee of the department, after the assessment feel that the work is insufficient and it has to be extended, then the student will have to continue as per the directions of the guide and the committee.
7. It is mandatory for the student to present his/her work in one of the international conferences or publish the research finding in a reputed unpaid journal with impact factor.

Course Outcomes:

After going through this course the students will be able to

CO1:	Conceptualize, design and implement solutions for specific problems.
CO2:	Communicate the solutions through presentations and technical reports.
CO3:	Apply project and resource managements skills, professional ethics, societal concerns
CO4:	Synthesize self-learning, sustainable solutions and demonstrate life long learning

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in THREE Phases. The evaluation committee will comprise of: guide, two senior faculty members, one industry member and Head of the Department.

Phase	Activity	Weightage
I 5^{th} week	Synopsis, Preliminary report for the approval of selected topic along with literature survey, objectives and methodology.	20%

II 10th week	Mid-term progress review shall check the compliance with the objectives and methodology presented in Phase I, review the work performed.	40%
III 15th week	Oral presentation, demonstration and submission of project report. After this presentation, the student will have one week time to correct / modify his report to address the issues raised by the committee members.	40%

CIE Evaluation shall be done with marks distribution as follows:

- Selection of the topic & formulation of objectives 10%
- Design and simulation/ algorithm development/experimental setup 25%
- Conducting experiments / implementation / testing / analysis 25%
- Demonstration & Presentation 20%
- Report writing 20%

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

1. Brief write-up about the project 5%
2. Formulation of Project Objectives & Methodology 20%
3. Experiments / Analysis Performed; Results & Discussion 25%
4. Report 20%
5. Viva Voce 30%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	H	M	L	M	L	-	-	-	-
CO2	-	-	-	L	-	-	-	M	H	-	-
CO3	-	-	-	-	L	M	M	-	-	H	-
CO4	-	-	-	-	L	M	H	M	-	-	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	H	-
CO2	-	M
CO3	H	H
CO4	-	H

SEMINAR						
Course Code	**:**	**16MST42**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L:T:P:S**	**0:0:4:0**	**SEE Marks**	**:**	**50**
Credits	**:**	**2**		**SEE Duration**	**:**	**3 Hrs**

Course Learning Objectives (CLO):

The students shall be able to:

1	Understand the technological developments in their chosen field of interest
2	Explain the scope of work and challenges in the domain area
3	Analyze these engineering developments in the context of sustainability, societal concerns and project management.
4	Improve his/her verbal presentation and report writing skills

GUIDELINES

1) The presentation will have to be done by individual students.
2) The topic of the seminar must be in one of the thrust areas with in-depth review and analysis on a current topic that is relevant to industry or on-going research.
3) The topic could be an extension or complementary to the project topic.
4) Topics could be in multidisciplinary areas and strongly address the technical design issues.
5) The student must be able to highlight or relate these technological developments with sustainability and societal relevance.
6) The students must mandatorily address legal, ethical issues as related to the topic of study.
7) The student shall make an attempt to perform financial / cost analysis or apply project management tools as related to his/her topic of study.
8) Each student must submit both hard and soft copies of the presentation.

Course Outcomes:

After going through this course the student will be able to:

CO1:	Identify topics that are relevant in the present context of the world and relate it to sustainability and societal relevance
CO2:	Perform literature/market/product survey and analyse information to the field of study
CO3:	Enhance presentation and report writing skills.
CO4:	Develop creative thinking abilities

Scheme of Continuous Internal Evaluation (CIE): Evaluation would be carried out in TWO phases. The evaluation committee shall comprise of TWO senior faculty members. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

Rubrics for Evaluation:

- Topic – Technical Relevance, Sustainability and Societal Concerns 15%
- Literature Review 25%
- Presentation Skills 35%
- Report 25%

Mapping of Course Outcomes (CO) to Program Outcomes (PO)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	H	M	M	L	H	H	-	-	-	M
CO2	L	M	-	-	-	-	-	-	-	H	-
CO3	-	-	-	-	-	-	L	M	H	-	-
CO4	-	L	M	-	H	H	-	-	-	-	H

Mapping of Course Outcomes (CO) to Program Specific Outcomes (PSO)

	PSO1	PSO2
CO1	-	M
CO2	-	H
CO3	-	M

	CO4	H	H	