## Proposed Scheme of Instruction and Evaluation

**TWO-YEAR M.TECH. PROGRAMME IN MECHANICAL ENGINEERING**  
**M.TECH. DESIGN ENGINEERING**  
**FIRST SEMESTER**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course</th>
<th>Hours of Instruction per week</th>
<th>Scheme of Evaluation</th>
<th>Credits</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lectures</td>
<td>Practicals</td>
<td>External Evaluation</td>
<td>Sessionals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Duration of Examination</td>
<td>Max Marks</td>
<td>Max Marks</td>
<td></td>
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<tr>
<td>MTDE 11</td>
<td>Optimization Methods in Engineering Design</td>
<td>4</td>
<td>-</td>
<td>3 Hrs</td>
<td>100</td>
</tr>
<tr>
<td>MTDE 12</td>
<td>Fundamentals Principles of Engineering Design</td>
<td>3</td>
<td>-</td>
<td>3 Hrs</td>
<td>100</td>
</tr>
<tr>
<td>MTDE 13</td>
<td>Stress Analysis</td>
<td>4</td>
<td>-</td>
<td>3 Hrs</td>
<td>100</td>
</tr>
<tr>
<td>MTDE 14</td>
<td>Mechanical Vibrations</td>
<td>4</td>
<td>-</td>
<td>3 Hrs</td>
<td>100</td>
</tr>
<tr>
<td>MTDE 15</td>
<td>Computer Aided Design and Graphics</td>
<td>3</td>
<td>-</td>
<td>3 Hrs</td>
<td>100</td>
</tr>
<tr>
<td>MTDE 16</td>
<td>ELECTIVE – I</td>
<td>3</td>
<td>-</td>
<td>3 Hrs</td>
<td>100</td>
</tr>
<tr>
<td>MTDE 17</td>
<td>Mechanical Vibrations Lab</td>
<td>-</td>
<td>3</td>
<td>3 Hrs</td>
<td>100</td>
</tr>
<tr>
<td>MTDE 18</td>
<td>CAD Lab</td>
<td>-</td>
<td>3</td>
<td>3 Hrs</td>
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<tr>
<td>MTDE 19</td>
<td>Seminar</td>
<td>-</td>
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<td>-</td>
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<td></td>
<td></td>
<td>21</td>
<td>7</td>
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</tr>
</tbody>
</table>

**Elective-I:**  
- MTDE 16 A: Smart Structures  
- MTDE 16 B: Design for Manufacture  
- MTDE 16 C: Design of Pressure Vessels and Piping
## Proposed Scheme of Instruction and Evaluation

**TWO-YEAR M.TECH. PROGRAMME IN MECHANICAL ENGINEERING**  
**M.TECH. DESIGN ENGINEERING**  
**SECOND SEMESTER**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course</th>
<th>Hours of Instruction per week</th>
<th>Scheme of Evaluation</th>
<th>Credits</th>
<th>Total Marks</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td></td>
<td>Lectures</td>
<td>Practicals</td>
<td>External Evaluation</td>
</tr>
<tr>
<td>MTDE 21</td>
<td>Finite Element Analysis</td>
<td>4</td>
<td>-</td>
<td>3 hrs.</td>
<td>100</td>
</tr>
<tr>
<td>MTDE 22</td>
<td>Advanced Mechanisms Design &amp; Analysis</td>
<td>4</td>
<td>-</td>
<td>3 hrs.</td>
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</tr>
<tr>
<td>MTDE 23</td>
<td>Advanced Materials Science and Engineering</td>
<td>3</td>
<td>-</td>
<td>3 hrs.</td>
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<tr>
<td>MTDE 24</td>
<td>Automation &amp; Robotics</td>
<td>3</td>
<td>-</td>
<td>3 hrs.</td>
<td>100</td>
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<tr>
<td>MTDE 25</td>
<td>MEMS &amp; Nano Technology</td>
<td>3</td>
<td>-</td>
<td>3 hrs.</td>
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<tr>
<td>MTDE 26</td>
<td>Elective – II</td>
<td>3</td>
<td>-</td>
<td>3 hrs.</td>
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</tr>
<tr>
<td>MTDE 27</td>
<td>FEM Lab</td>
<td>-</td>
<td>3</td>
<td>3 hrs.</td>
<td>100</td>
</tr>
<tr>
<td>MTDE 28</td>
<td>Automation &amp; Robotics Lab</td>
<td>-</td>
<td>3</td>
<td>3 hrs.</td>
<td>100</td>
</tr>
<tr>
<td>MTDE 29</td>
<td>Comprehensive Viva</td>
<td>-</td>
<td>-</td>
<td>3 hrs.</td>
<td>100</td>
</tr>
</tbody>
</table>

|               |                                       |                              | 20       | 6          |                          |            |           |           |

**Total:** 3800

**Elective-II:**  
- MTDE 26 A: Fault Diagnosis of Machines  
- MTDE 26 B: Fatigue, Fracture & Failure Analysis  
- MTDE 26 C: Design of Material Handling Equipment
### Proposed Scheme of Instruction and Evaluation

**TWO-YEAR M.TECH. PROGRAMME IN MECHANICAL ENGINEERING**  
**M.TECH. DESIGN ENGINEERING**

#### THIRD SEMESTER

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Name of the Course</th>
<th>Duration</th>
<th>Sessionals</th>
<th>External</th>
<th>Credits</th>
<th>Total marks</th>
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</thead>
<tbody>
<tr>
<td>MTDE 31</td>
<td>Industrial Training</td>
<td>8 Weeks</td>
<td>50</td>
<td>-</td>
<td>2</td>
<td>100</td>
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<tr>
<td>MTDE 32</td>
<td>Dissertation</td>
<td>16 Weeks</td>
<td>100</td>
<td>100</td>
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#### FOURTH SEMESTER

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Name of the Course</th>
<th>Duration</th>
<th>Sessionals</th>
<th>External</th>
<th>Credits</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTDE 32</td>
<td>Dissertation</td>
<td>24 Weeks</td>
<td>100</td>
<td>100</td>
<td>4</td>
<td>800</td>
</tr>
</tbody>
</table>
1. Introduction: Classification of optimization problems, mathematical models in engineering optimization


TEXT BOOK:
2. J.C.Pant, *Introduction to Optimization*, Jain Brothers, New Delhi, 1983

REFERENCE BOOKS:
MTDE 12 FUNDAMENTAL PRINCIPLES OF ENGINEERING DESIGN

Class: M.Tech. I Semester
Duration of University Examination: 3 hours

Lectures: 3
University Examination: 100 marks
Sessionals: 50 marks

1. **Design Process**: Describing mechanical design problems and processes – Types of mechanical design problems, Languages of mechanical design, constraints, goals and design decisions, Designers and design teams.

2. **Planning of design process**: overview of the design processes, organization techniques, developing design project plans, steps in planning, case studies

3. **Design concept generation and evaluation**: Technique for functional decomposition, generating and developing concepts, evaluation based on feasibility judgment, technology – readiness assessment, Go/No Go screening, decision matrix.


5. **Product Evaluation**: Importance and goals of Performance evaluation, robust design, sensitivity analysis, cost estimation in design, design for reliability, environment and maintenance

**TEXT BOOKS**
2. George E. Dieter, “Engineering Design”,

**REFERENCE BOOKS**
MTDE 13 STRESS ANALYSIS

Class: M.Tech. I Semester  Lectures: 4
Duration of University Examination: 3 hours  Sessionals: 50 marks

1. **Analysis of Stress**: Definition and notation of stress, Differential equations of equilibrium, specification of stress at a point, Principal stresses and the Mohr Diagram, three dimensional stress at a point, Boundary conditions in terms of given surface forces.

2. **Analysis of Strain**: Strain components, Specification of strain at a point, Compatibility equations, three-dimensional strains, Mohr’s circle for strains, Measurement of strains bonded strain gages.


4. **Plane-Stress and Plane-Strain Problems**: The governing differential equations, Thick cylinder under uniform pressure, shrink and force fits. The effect of small circular holes in strained plates, Stress concentration **Thermal Stresses**: Thermoelastic stress-strain relations,


6. 

**TEXT BOOKS**

**REFERENCE BOOKS**


TEXT BOOK

REFERENCES
MTDE 15 COMPUTER AIDED DESIGN & GRAPHICS

Class: M.Tech. I Semester

Lectures: 3
University Examination: 100 marks
Duration of University Examination: 3 hours
Sessionals: 50 marks

1. **Overview of Computer Aided Drafting:** Applications, fundamentals of computer architecture, Input-Output devices, Interactive display devices.

2. **Graphics Primitives:** Monitor pixels, generation of points, lines, and circles, algorithms of line and circle.

3. **Transformations:** 2D and 3D transformations scaling, translation, shearing, Rotation, Reflection, homogeneous transformation, Matrix operations, concatenation, isometric, orthographic and perspective projections.

4. **Generation of Curves:** Cubic splines, Bezier Curves, B-spline curve, NURBS.

5. **Geometric Modeling:** Modeling of surfaces, coon’s patch, Bezier surfaces, B-spline Surfaces, Solid models, wire frame models, solid modeling techniques, constructive solid Geometry, Boolean operations, hybrid modeling.

6. Engineering Data Management Systems: Need for standards, Graphic standards, Data Exchange standards,

**TEXT BOOK**

**REFERENCE BOOKS**
1. Smart structures and Materials: Definitions, instrumented materials-basic considerations, functions and responses, structural responses, sensing systems, self-diagnosis, signal processing considerations, Actuating systems and effectors, applications.

2. Sensing Technologies: Specifications and terminology for sensors in smart structures, physical measurements-piezoelectric strain measurement, inductively read transducers-the LVDT, fiber optic sensing techniques.

3. Actuator techniques; Mechanical impedance, conversion efficiencies and matching. Actuators and actuator materials, piezo electric and electro restrictive materials, magnetorestrictive materials, shape memory alloys, electrorheological fluids, electromagnetic actuation.

4. Signal processing and control of smart structures: Sensors as geometrical processors, signal processing, control systems, the linear and the non-linear.

5. Smart structures-Some applications: Smart composites, Mechanical analysis and self testing structures.

TEXT BOOK


REFERENCE BOOKS

MTDE 16B DESIGN FOR MANUFACTURE

Class: M.Tech. I Semester

Duration of University Examination: 3 hours

Lectures: 3
University Examination: 100 marks
Sessionals: 50 marks

1 INTRODUCTION TO DESIGN FOR MANUFACTURE (DFM): Design concepts considerations like part count, product weight, manufacturing costs, assembly time etc., concurrent engineering – definition and concepts, improving competitiveness with concurrent engineering, implementation methodologies.

2. MATERIALS AND PROCESSES: Material selection and its inter relationship with process selection, comparison of various processes for productivity and producibility machining process, casting join processes, deformation processes.

3. GENERAL CONSIDERATIONS IN DFM: Performance considerations, Manufacturability considerations, Testability consideration, Serviceability considerations, Computer aided engineering and testing.


TEXTBOOK
1. **Introduction:** Methods for determining stresses – Terminology and Ligament Efficiency – Applications.


4. **Supports for Vessels:** introduction, bracket or lug supports, leg supports, skirt supports, saddle supports.

5. **Buckling and Fracture Analysis in Vessels:** Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.


**TEXTBOOKS**


**REFERENCE BOOKS**

MTDE 17 MECHANICAL VIBRATIONS LAB

Class: M.Tech. II Semester
Duration of University Examination: 3 hours

University Examination: 100 marks
Sessionals: 50 marks

Lectures: 3

LIST OF EXPERIMENTS

1. Determination of Radius of Gyration of given Var by using Bi-fillar suspension.
2. Study of Longitudinal Vibrations of helical spring.
3. Study of undamped free vibrations of equivalent spring mass system
4. Study of Forced vibrations of equivalent spring mass system
5. Study of Torsional vibrations of Single rotor shaft system.
6. Study of free vibrations of two rotor shaft system.
7. Study of damped Torsional oscillations.
8. Verification of Dunkerlay’s rule.

TEXT BOOK


REFERENCES

LIST OF EXPERIMENTS

PART –A

2-D and 3-D Modelling using AutoCAD, ProE/CATIA

1. 2-D Drawing generation.
2. Layout as per standard.
3. Simple 3 D geometry creation.
4. Complex 3 D generation with Boolean operations.
5. Viewports-Named viewports.
6. Project Work.

PART-B

1. Implementation of Bresenham’s Line Algorithm using C / C++
2. Implementation of Bresenham’s Circle Algorithm using C / C++
3. Cubic Spline generation using C / C++

REFERENCE BOOKS

2. Learners Manual AutoCAD.
The student is required to go through the current developments in the design and analysis procedures for materials and structures, biomechanics, MEMS and nanotechnology, Advanced materials, failure analysis, dynamics of mechanical systems, robotics, microprocessor applications in mechanical engineering, noise and vibration analysis, friction and wear of materials, etc.

Under the guidance of the assigned faculty, the students will submit a brief report as per specified format and present before the evaluation committee.

The seminar evaluation will be based on the day to day work, report submission and presentation before the evaluation committee.
1. The Finite Element Method: Introduction, steps of the finite element method, historical background, advantages and limitations of the finite element method, basic concepts-nodes, equilibrium, continuity, degrees of freedom, boundary conditions, derivation of element stiffness equation by direct method: spring and spring assemblage, properties of stiffness matrix, stiffness matrix for an arbitrarily oriented bar, tensile and torsion loads on tapered bar, stepped bar, handling of distributed tensile loads-lumped loads, stress calculations in bar, thermal loads.

2. Truss element: Plain stress and plane strain conditions-biaxial stress and strain transformations, displacement transformation, stiffness matrix for truss element by equations of transformation, thermal load on truss element, stress calculation in a truss member, matrix sparsity, banded matrix, semi-band width, node numbering for reduction of band width and sparsity, equation solvers.

3. Beam element: Derivation of stiffness matrix for a beam element-direct method, plane frame element, space frame element, mechanical loads-reduced and consistent loads, fixed and cantilever beams with u.d.l. and point loads, roller, spring supports.

4. basic Elements: Interpolation and Shape functions: Linear, quadratic and cubic interpolations, C₀, C₁ continuity-derivation of stiffness matrix using the principle of virtual work-bar, beam element, constant strain triangle, linear strain triangle, bilinear rectangle, quadratic rectangle, Q₉ element, rectangular solid element, 20-node rectangular solid element, comparison of various elements, choice of interpolation functions, consistent nodal loads, stress calculation.

5. Isoparametric elements: Bar element, triangles, bilinear quadrilateral(Q4), numerical integration, quadratic quadrilateral, static condensation, choices in numerical integration, load considerations, stress calculations, effect of element geometry, validity of isoparametric elements, patch test.


7. Solids of Revolution: Elasticity relations, axisymmetric solid elements, loads without axial symmetry.

8. Dynamics and Vibrations: Dynamic equations, mass and damping matrix, mass matrices-consistent, diagonal and combination matrices, HRZ lumping, optimal lumping, natural frequencies and modes, damping, reduction of number of d.o.f., response history: modal methods, component mode synthesis.
TEXT BOOKS

REFERENCE BOOKS
MTDE 22 ADVANCED MECHANISMS DESIGN AND ANALYSIS

Class: M.Tech. II Semester                  Lectures: 4
Branch: Mech. Engg. (Design Engg).          University Examination: 100 marks
Duration of University Examination: 3 hours  Sessionals: 50 marks


3. **Synthesis of Mechanisms:** Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation. Graphical methods..

4. **Dynamic of Mechanisms:** Static force analysis with friction – Inertia force analysis – combined static and inertia force analysis, shaking force. Kineto-static analysis. Introduction to force and moment balancing of linkages

**TEXT BOOK**

**REFERENCE BOOKS**

2. **Non-crystalline Solids:** Types and their structures, Importance of non-crystalline structure. Role of bonding on structures. Multi component phases and their structures. Effect of various factors on phase formation, phase diagrams and their significance. Non-equilibrium structures.

3. **Structural Modifications:** Atomic movement in solid state. Transformation kinetics. Tailoring of macrostructures. Typical heterogeneous transformations.


**TEXT BOOK**


**REFERENCE BOOKS**


MTDE 24 AUTOMATION AND ROBOTICS

Class: M.Tech. I Semester
Branch: Mech. Engg. (Design Engg.),
Duration of University Examination: 3 hours

Lectures: 3
University Examination: 100 marks
Sessionals: 50 marks


3. Basic concepts in robotics: classification of robotics, Drives and control system for robotics, Robot work cell design and applications

4. Robot arm kinematics: Direct kinematics, transformation matrices for rotations, combined rotations, Denavit -Hartenberg representation.

5. Control of robot manipulators: control of robot arm, computed torque technique, feed back control, resolved motion control,

6. Robot vision and sensing: Different types of sensors, proximity, touch, force and torque sensors, low level and high level vision, vision systems

TEXT BOOK

REFERENCES


8. Nanotechnology, Nanomachines, Nanorobots, Nanotubes, Nanowires, Nanomechanical amplifiers, Nanotransistors, tera-storage devices, Molecular engineering, DNA computing, Nanomedicine, Smart pills, Nanofabrication of structures.

TEXT BOOK

REFERENCE BOOKS
1. **Introduction**: System failure, component failure, failure decisions, failure classifications, types of failure, failure investigations, causes of failure, Methods of maintenance - condition based maintenance, preventive maintenance, proactive maintenance, time based maintenance, predictive maintenance.

2. **Condition Monitoring**: Need and importance of condition monitoring, the decision to monitor, common monitoring techniques, online/off-line monitoring, commonly measured operating characteristics, condition monitoring/predictive maintenance as used in industry.


5. **Data Processing & Vibration Analysis**: Fourier analysis, frequency analysis techniques, vibration signature, vibration monitoring equipment, system monitors and vibration limit detectors.

6. **Performance Trend Monitoring**: Primary and secondary performance parameters, performance monitoring systems.

**TEXT BOOKS**

**REFERENCE BOOKS**
MTDE 26B  FATIGUE, FRACTURE AND FAILURE ANALYSIS

Class: M.Tech. II Semester                Lectures:3
Branch: Mech. Engg. (Design Engg).       University Examination: 100 marks
Duration of University Examination: 3 hours  Sessionals: 50 marks

1. Introduction to fatigue and fracture mechanics, ductile and brittle fractures.
3. Factors influencing fatigue strength, life prediction, prevention of fatigue failures, corrosion fatigue.
4. Linear elastic fracture mechanics, determination of fracture toughness, elastic plastic fracture mechanics, sub-critical growth in reactive environment.
5. Fatigue and fracture safe designs.

TEXTBOOK

REFERENCES
MTDE 26C  DESIGN OF MATERIAL HANDLING EQUIPMENT

Class: M.Tech. II Semester  
Branch: Mech. Engg. (Design Engg.)

Lectures: 3  
University Examination: 100 marks

Duration of University Examination: 3 hours  
Sessionals: 50 marks

1. Objectives of material handling systems and the basic principles, classification and selection of material handling equipment, characteristics and applications.

2. Discussion of various material handling equipment functions and parameters effecting service, packaging and storage of materials and their relations with material handling.

3. Theory, construction and design of various component parts of mechanical handling devices, wire ropes, chains, hooks, shackles, grabs, ladles, and lifting electromagnets, pulleys, sheaves, shears, sprockets and drums, winches, brakes and ratchet stops, gears and power transmission systems, runner wheels and rails, buffers and controls of travel mechanisms.


5. Discussion of principles and application of conveyors and related equipment. Design of various types of conveyors and their elements. Fault finding and failure analysis of material handling systems.

TEXT BOOKS

REFERENCE BOOKS
MTDE 27  FEM LAB

Class: M.Tech. II Semester
Duration of University Examination: 3 hours

Lectures: 3
University Examination: 50 marks
Sessionals: 50 marks

List of Exercises

Part A:
Students will be allotted individual course projects that involve development of code using MATLAB. At the end of the Semester, each student will be required to present the results of the problem obtained from the code.

Part B:
1. Statically indeterminate reaction force analysis
2. Beam stresses and deflections
3. Thermally loaded support structure
4. Deflection of a hinged support
5. Residual stress problem
6. Combined bending and torsion
7. Bending of a solid beam (Plane elements)
8. Tie rod with lateral loading
9. Thermal structural contact of two bodies
10. Stresses in a long cylinder

Exercises from Part B will be solved using ANSYS package during regular class work in each week.

REFERENCE BOOKS
2. ANSYS 5.6, Verification Manual.
3. ANSYS Structural Analysis Guide.
MTDE28  AUTOMATION & ROBOTICS LAB

Class: M.Tech. I Semester  
Duration of University Examination: 3 hours

Lectures:3  
University Examination: 50 marks  
Sessionals: 50 marks

LIST OF EXPERIMENTS

1. Controlling of AC Non Servo motors using LS controller
2. Controlling of DC Servo motors using LS controller
3. Integration of PLC and PMC.
4. Simulation of Robot Motion using Robo X software
5. Study of Automated machines.
6. Simulation of Manufacturing and Material handling systems.
MTDE 29 COMPREHENSIVE VIVA

Class: M.Tech. II Semester

University Examination: 100 marks

The viva includes questions from all the subjects of first and second semesters with more emphasis on Design concepts and procedures.
MTDE 31 INDUSTRIAL TRAINING

Class: M.Tech. III Semester  Sessionals: 50 marks

The candidate should submit the report and present talk on the training undergone highlighting the contents of the Report before the internal evaluation committee.
The candidate will choose the topic of the Project Work in consultation with the Guide allotted. A report in the prescribed format is to be submitted that includes an extensive survey of literature on the topic, highlighting the scope of the work. It should also state the methodology to be adopted and work involved in different modules of the Project Work. The report should clearly specify the expected outcome.

The candidate should submit the report and present a talk on the work done, highlighting the contents of the Report before the internal evaluation committee.
MTDE 41 DISSERTATION & VIVA-VOCE

Class: M.Tech. III Semester

Sessionals: 100 marks
University Examination: 100 marks

The candidate should submit the report and present a talk on the work done, highlighting the conclusions drawn and outcome of the work before the evaluation committee.