



**Dr.M.G.R.**  
**EDUCATIONAL AND RESEARCH INSTITUTE**  
**UNIVERSITY**  
(Decl. U/S 3 of UGC Act 1956)  
**DEPARTMENT OF MECHANICAL ENGINEERING**

**M.Tech – Design Engineering (Full Time)**  
**Curriculum and Syllabus**  
**2013 Regulation**

<b>I SEMESTER</b>						
<b>S.No</b>	<b>Subject Code</b>	<b>Title of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	MMA130002	Applied Mathematics For Design Engineers	3	1	0	4
2	MME13D001	Concepts of Engineering Design	3	0	0	3
3	MME13D002	Computer Aided Design and Manufacturing	3	1	0	4
4	MME13D003	Advanced Finite Element Analysis	3	1	0	4
5	MME13D004	Design for Manufacturing and Assembly	3	1	0	4
6	MME13D005	Advanced Materials Technology	3	0	0	3
7	MME13DL01	Design Analysis Lab	0	0	4	2
<b>Total</b>			<b>18</b>	<b>4</b>	<b>4</b>	<b>24</b>

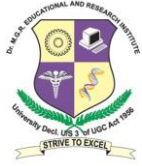
<b>II SEMESTER</b>						
<b>S.No</b>	<b>Subject Code</b>	<b>Title of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	MME13D007	Advanced Mechanism Design	3	1	0	4
2	MME13D008	Mechanical Vibrations	3	1	0	4
3	MME13D009	Advanced Strength of Materials	3	1	0	4
4	MME13D010	Creep, Fatigue and Fracture	3	1	0	4
5	MME13DEXX	Elective I	3	1	0	4
6	MME13DEXX	Elective II	3	1	0	4
7	MME13DL02	Vibration Analysis Lab	0	0	4	2
<b>Total</b>			<b>18</b>	<b>6</b>	<b>4</b>	<b>26</b>

<b>III SEMESTER</b>						
<b>S.No</b>	<b>Subject Code</b>	<b>Title of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	MME13D012	Design of Material Handling Equipments	3	1	0	4
2	MME13DEXX	Elective III	3	0	0	3
3	MME13DEXX	Elective IV	3	0	0	3
4	MME13DL03	Project Phase I	0	0	6	3
<b>Total</b>			<b>9</b>	<b>1</b>	<b>6</b>	<b>13</b>

<b>IV SEMESTER</b>						
<b>S.No</b>	<b>Subject Code</b>	<b>Title of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	MME13DL04	Project Phase II*	0	0	24	12
<b>Total</b>			<b>0</b>	<b>0</b>	<b>24</b>	<b>12</b>

\*Student should have presented a paper on the project area in National or International Conference/Journals and should attach the certificate in proof and the published paper in the project report.

**TOTAL NO. OF CREDITS : 75**



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<b>List of Electives (Elective – I &amp; II)</b>						
<b>S.No</b>	<b>Subject Code</b>	<b>Title of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	MME13DE01	Design and Analysis of Experiments	3	1	0	4
2	MME13DE02	Optimization in Design	3	1	0	4
3	MME13DE03	Computational fluid Dynamics	3	1	0	4
4	MME13DE04	Tribology in Design	3	1	0	4
5	MME13DE05	Advanced Machine Tool Design	3	1	0	4
6	MME13DE06	Product Design and Development Strategies	3	1	0	4

<b>List of Electives (Elective – III &amp; IV)</b>						
<b>S.No</b>	<b>Subject Code</b>	<b>Title of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	MME13DE07	Robotics and Sensors	3	0	0	3
2	MME13DE08	Composite Materials and Mechanics	3	0	0	3
3	MME13DE09	Mechatronics in Manufacturing Systems	3	0	0	3
4	MME13DE10	Theory of plasticity	3	0	0	3
5	MME13DE11	Product Life Cycle Management	3	0	0	3
6	MME13DE12	Quality Engineering and Non Destructive Testing	3	0	0	3



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**MMA130002                      APPLIED MATHEMATICS FOR DESIGN ENGINEERS                      3           1           0           4**

**OBJECTIVES:** At the end of this course the student will learn

- Analytical functions and different transform methods
- To solve the differential equations using finite difference methods

**UNIT I: ANALYTIC FUNCTIONS** **12Hrs**

Analytic functions – Cauchy Riemann equations – Construction of analytic functions – Conformal Mapping – Simple Transformations – Standard transformations :  $w = z^2$ ,  $w = e^z$ ,  $w = \sin z$ ,  $w = \cosh z$  – Bilinear transformations.

**UNIT II: TRANSFORM METHODS** **12Hrs**

Laplace Transform methods for one dimensional wave equation – Displacements in a string – Fourier Transform methods – One dimensional heat conduction problems in infinite and semi- infinite rod.

**UNIT III: CALCULUS OF VARIATIONS** **12Hrs**

Variation and its properties – Euler’s equations – Functionals dependent on First and higher order derivatives – Functionals depend on functions of several independent variables – Problems with moving boundaries – Direct methods – Ritz and Kantorovich methods.

**UNIT IV: FINITE DIFFERENCE METHODS** **12Hrs**

Finite difference methods – Solution of Laplace and Poisson equation – Leibmann’s iteration process – Solution of heat equation: Schmidt explicit formula – Crank-Nicolson implicit scheme – Solution of wave equation.

**UNIT V: FAST FOURIER TRANSFORMS** **12Hrs**

Discrete Fourier transform – linearity and periodicity – Inverse N-point DFT – DFT approximation of Fourier coefficients – Sampled Fourier series – Approximations of Fourier Transform by an N-point DFT – FFT – Computational efficiency of FFT.

**Total No. of Hrs                      : 60**

**REFERENCES**

1. Grewal, B.S. (2012) *Higher Engineering Mathematics*. Khanna Publishers
2. Kreyszig, E. (2011) *Advanced Engineering Mathematics*. 9th.Ed. John Wiley & Sons
3. Sneddon, I.N. (2006) *Elements of Partial Differential Equations*. Dover Publications
4. SankaraRao, K. (2010) *Introduction to Partial Differential Equations*. 3rd.Ed. Prentice Hall of India
5. Gupta, A.S. (2004) *Calculus of variations with applications*. Prentice Hall of India
6. James, G. (2007) *Advanced modern Engineering Mathematics*. 3rd.Ed. Pearson
7. Sastry, S.S. (2003) *Introductory Methods of Numerical Analysis*. Prentice Hall of India















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**MME13DL01**

**DESIGN ANALYSIS LAB**

**0 0 4 2**

**OBJECTIVE:** At the end of this course the student will learn

- Design , modeling and analysis using computer softwares and tools

**I MODELLING:**

- Introduction to modelling techniques- Type of modelling- wire frame, surface and solid modelling — constructive solid modelling and B-rep modelling- Feature based and parametric modelling etc.
- Generation of surfaces of revolution, surfaces of extrusion, surfaces by skinning operation etc.
- Creation of different views-importing models from other soft wares-Data base management.

(Exercises will be given using packages like PROE/CATIA/ Unigraphics etc.)

**II. ANALYSIS:**

- Introduction to FEM-Analysis softwares -ANSYS / NASTRAN/NISA/COSMOS/I-DEAS etc.
- Structural and fluid analysis.- One dimensional, Two dimensional and Three dimensional Elements Based Problems.
- Thermal Analysis - Conduction, Convection and Radiation heat transfer Problems.

**III. MATLAB**

- Introduction to MATLAB
- Study of different MATLAB tools
- Arithmetic and logical operators
- Matrix operation using MATLAB
- Mathematical equations solution
- Generation of trigonometrically wave functions
- Introduction to SIMULINK
- Flow control statements and graphs

**Total No. of Hrs : 60**





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**MME13D008**

**MECHANICAL VIBRATIONS**

**3 1 0 4**

**OBJECTIVE:** At the end of this course the student will learn

- Various types of vibration and their analysis

**UNIT I: FUNDAMENALS OF VIBRATION**

**12Hrs**

Review of Single degree freedom systems - Response to arbitrary periodic executions - Duhamel's integral - Impulse response function - Virtual work - Lagrange's equations - Single degree freedom forced vibration with elastically coupled viscous dampers - System identification from frequency response - Transient vibration - Laplace transformation formulation.

**UNIT II: TWO DEGREE FREEDOM SYSTEM**

**12Hrs**

Free vibration of spring-coupled system - Mass coupled system - Bending vibration of two degree freedom system - Forced vibration - Vibration Absorber - Vibration isolation.

**UNIT III: MULTI DEGREE FREEDOM SYSTEM**

**12Hrs**

Normal mode of vibration - Flexibility matrix and stiffness matrix - Eigen value and Eigen vector – Orthogonal properties - Modal matrix - Modal analysis - Forced vibration by matrix inversion - Modal damping in forced vibration - Numerical methods of fundamental frequencies.

**UNIT IV: VIBRATION OF CONTINUOUS SYSTEMS**

**12Hrs**

Systems governed by wave equations - Vibration of strings - Vibration of rods - Euler 's equation for beams - Effect of Rotary inertia and shear deformation - Vibration of plates.

**UNIT V: EXPERIMENTAL METHODS IN VIBRATION ANALYSIS**

**12Hrs**

Vibration instruments - Vibration exciters Measuring Devices - Analysis - Vibration Tests - Free and Forced Vibration tests. Examples of vibration tests - Industrial case studies.

**Total No. of Hrs : 60**

**REFERENCES**

1. Rao, J. S. & Gupta, K. (1984) *Ind. Course on Theory and Practice Mechanical Vibration*. New Age International (P) Ltd
2. Thomson, W.T. (1990) *Theory of Vibration with Applications*. CBS Publishers and Distributers
3. Den Hartog, J.P. (1990) *Mechanical Vibrations*. Dover Publications
4. Rao, S.S. (1995) *Mechanical Vibrations*. Addison Wesley Longman





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**MME13D010**

**CREEP, FATIGUE AND FRACTURE**

**3 1 0 4**

**OBJECTIVE:** At the end of this course the student will learn

- The analyse the fracture mechanism under various conditions

**UNIT I: ELEMENTS OF SOLID MECHANICS**

**8Hrs**

The geometry of stress and strain, elastic deformation, plastic and elastoplastic deformation-limit analysis

**UNIT II: CRACK GROWTH**

**13Hrs**

Two dimensional elastic fields-Analytical solutions- Yielding near a crack front-Irwins approximation-plastic Zone size-Dugdaale model-J integral and its relation to crack opening displacement. Griffth analysis-Linear Fracture Mechanics-Crack opening displacement-Dynamic energy balance-crack arrest

**UNIT III: CREEP**

**13Hrs**

Mechanics of creep, inter-granular, trans-granular creep, Creep test, Creep strain rate-time curves, Deformation mechanism map; High temperature properties of materials; Long time creep-stress-time relations; Creep contribution to the fracture mechanism; DVM, DVL German-standard, Hatifield time yield test.

**UNIT IV: FATIGUE CRACK GROWTH CURVE**

**13Hrs**

Empirical relation describing crack growth by Fatigue-Life calculations for a given load amplitude-effects of changing the load spectrum-Effects of Environment

**UNIT V: ELEMENTS OF APPLIED FRACTURE MECHANICS**

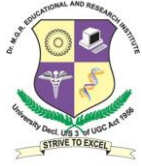
**13Hrs**

Examples of crack-growth Analysis for cyclic loading-leak before break- crack initiation under large scale yielding-Thickness as a Design parameter-crack instability in Thermal or Residual-stress fields.

**Total No. of Hrs : 60**

**REFERENCES**

1. David Broek, (1978) *Elementary Engineering Fracture Mechanics*. Fithoff and Noerdhoff International Publisher
2. Kare Hellan, (1985) *Introduction to Fracture Mechanics*. McGraw Hill Book Company
3. Preshant Kumar, (1999) *Elements of Fracture Mechanics*. Wheeler Publishing
4. Thomas Courtney, H. (2000) *Mechanical Behaviour of Materials*. 2nd. Ed. Long Grove, Waveland Press, Inc
5. William Hosford, F. (2010) *Mechanical Behaviour of Materials*. 2nd. Ed. Cambridge University Press
6. Keith Bowman, *Mechanical Behaviour of Materials*. John Wiley & Sons
7. <http://www.elsevier.com/locate/enfracmech>



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**MME13DL02**

**VIBRATION ANALYSIS LAB**

**0 0 4 2**

**OBJECTIVE:** At the end of this course the student will learn

- To measure and analyse various types of mechanical vibrations

**VIBRATION TYPES AND MEASUREMENTS:**

Study of types of vibration-Longitudinal, transverse and torsional vibration - degree of freedom.

1. Damped free vibration of a single degree of freedom spring mass system.
2. Transverse Free vibration of a cantilever beam.
3. Transverse free vibration of a simply supported beam.
4. Determination of critical speed of a shaft.
5. Torsional vibration of a single rotor system.
6. Balancing of rotating masses using Dynamic balancing Machine.
7. Lab view for vibration and noise.

**VIBRATION ANALYSIS USING FFT ANALYSER IN THE FOLLOWING AREAS:**

1. Power train.
2. Motor, Pumps.
3. Machine tools like Lathe, Milling, drilling etc.,

**Total No. of Hrs : 60**



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**MME13D012                      DESIGN OF MATERIAL HANDLING EQUIPMENTS                      3    1    0    4**

**OBJECTIVE:** At the end of this course the student will learn

- Design of different types of material handling systems used for engineering and process industries

**UNIT I: INTRODUCTION TO MATERIALS HANDLING EQUIPMENT                      12Hrs**

Overview - consideration in material handling system design, ten principles of material handling. Types of material handling equipments-trolleys, industrial trucks, AGV, monorails and other rail guided vehicles, conveyors, cranes, hoists and elevators.

**UNIT II: DESIGN OF HOISTS                      12Hrs**

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types.

**UNIT III: DRIVES OF HOISTING GEAR                      12Hrs**

Hand and power drives - Travelling gear - Rail travelling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

**UNIT IV: CONVEYORS                      12Hrs**

Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

**UNIT V: ELEVATORS                      12Hrs**

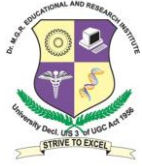
Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

**Total No. of Hrs                      : 60**

**\*NOTE:** Use of Approved Data Book is permitted in examination

**REFERENCES**

1. Rudenko, N. (1970) *Materials handling equipment*. ELnvee Publishers
2. Mikell Groover, P. (2006) *Automation, Production system and computer integrated Manufacturing*. Second Edition, Prentice Hall of India Pvt. Ltd
3. Alexandrov, M. (1981) *Materials Handling Equipments*. MIR Publishers
4. Boltzharol, A. (1958) *Materials Handling Handbook*. The Ronald Press Company
5. P.S.G. Tech, (2003) *Design Data Book*. Kalaikathir Achchagam
6. Lingaiah. K. and Narayana Iyengar, (1983) *Machine Design Data Hand Book*. Vol.1 & 2, Suma Publishers
7. Spivakovsy, A.O. and Dyachkov, V.K. (1985) *Conveying Machines*. Volumes I and II, MIR Publishers



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**MME13DL03**

**PROJECT PHASE I**

**0 0 6 3**

- Students should select the area of the project work and complete the literature survey.
- Student should identify the problem of study and start the work.
- Students are expected to do the project work individually.
- A guide will be allotted to each student based on the area of the Project work.
- Project reviews will be conducted once in a fortnight to assess the development of the project work.
- At the end of the semester students should submit a report of the work completed and should appear for a Project Viva-voce examination conducted by the internal examiner.
- Continuous assessment mark (50 marks) will be awarded based on the performance in the reviews.
- End semester mark (50 marks) will be awarded for project viva voce examination.





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**MME13DL04**

**PROJECT PHASE II**

**0 0 24 12**

- Students are expected to do a Project work either in an Industry or at the University in the area of specialization individually.
- Each student will be allotted a guide based on the area of Project work

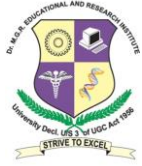
Number of reviews will be conducted during the semester to monitor the development of project. Students have to submit the thesis at the end of the semester and appear for the Project Viva-Voce examination conducted by one internal examiner and one external examiner.

**It is mandatory that the student should have presented his project work as a technical paper in National/international conference /Journals. A copy of the certificate in proof of paper presentation should be enclosed in the project report.**

50% weightage (100 marks) will be given for the continuous assessment and 50% weightage (100 marks) for the Project viva a voce examination.







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**MME13DE03**

**COMPUTATIONAL FLUID DYNAMICS**

**3 1 0 4**

**OBJECTIVE:** At the end of this course the student will learn

- Formulation and analysis of problems on fluid dynamics

**UNIT I: GOVERNING DIFFERENTIAL EQUATIONS AND FDM**

**12Hrs**

Classification, Initial and Boundary Conditions, Initial and Boundary value problems. Finite Difference Method, Central, Forward, Backward Difference, Uniform and Non-uniform Grids, Numerical Errors, Grid Independence Test.

**UNIT II: CONDUCTION HEAT TRANSFER**

**12Hrs**

Steady one-dimensional conduction, Two and Three dimensional Steady state problems, Transient One dimensional and Two dimensional problems.

**UNIT III: INCOMPRESSIBLE FLUID FLOW**

**12Hrs**

Governing Equations, Stream function – Vorticity Method, Determination of Pressure for Viscous flow, Simple procedure of Patankar and Spalding, Computation of Boundary layer flow, Finite Difference Approach.

**UNIT IV: CONVECTION HEAT TRANSFER AND FEM**

**12Hrs**

Steady One Dimensional and Two Dimensional Convection-Diffusion, Unsteady One Dimensional Convection-Diffusion, Unsteady Two Dimensional Convection – Diffusion – Introduction to Finite Element Method-Solution of Steady Heat Conduction by FEM- Incompressible flow – Simulation by FEM.

**UNIT V: TURBULENCE MODELS**

**12Hrs**

Algebraic models –One Equation model, K- $\epsilon$  Models, Standard, High and Low Reynolds Number models, Prediction of Fluid flow and Heat transfer using Standard Codes.

**Total No. of Hrs : 60**

**REFERENCES**

1. Muralidhar, K. and Sundararajan, T. (1995) *Computational Fluid Flow and Heat Transfer*. Narosa Publishing House
2. Ghoshdasdar, P.S. (1998) *Computer Simulation of Flow and Heat Transfer*. Tata McGraw Hill Publishing Company Limited
3. Subhas, V. Patankar, (1980) *Numerical Heat Transfer Fluid Flow*. Hemisphere Publishing Corporation
4. Taylor, C. and Hughes, J.B. (1981) *Finite Element Programming of Navier Stoke Equation*. Pine Ridge Press Ltd
5. Anderson, D.A. Tannehill, J.C. and Pletcher, R.H. (1984) *Computational Fluid Mechanics and Heat transfer*. Hemisphere Publishing Corporation
6. Fletcher, C.A.J. (1987) *Computational Techniques for Fluid Dynamics-Fundamental and General Techniques*. Springer –Verlag
7. Fletcher, C.A.J. (1987) *Computational Techniques for Different Flow Categories*. Springer –Verlag
8. Bose T.K. (1997) *Numerical Fluid Dynamics*. Narosa Publishing House



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**MME13DE04**

**TRIBOLOGY IN DESIGN**

**3 1 0 4**

**OBJECTIVE:** At the end of this course the student will learn

- Influence of behaviour of friction, wear and lubrication on design

**UNIT I: SURFACES, FRICTION AND WEAR**

**12Hrs**

Topography of the surfaces - Surface features - Surface interaction - Theory of Friction - Sliding and Rolling Friction, Friction properties of metallic and non-metallic materials - friction in extreme conditions - Wear, types of wear - Mechanism of wear - Wear resistance materials - Surface treatment - Surface modifications - Surface coatings.

**UNIT II: LUBRICATION THEORY**

**12Hrs**

Lubricants and their physical properties, lubricants standards - Lubrication regimes- Hydrodynamic lubrication - Reynolds Equation, thermal, inertia and turbulent effects - Elasto hydrodynamic and plasto hydrodynamic and magneto hydrodynamic lubrication - Hydro static lubrication .

**UNIT III: DESIGN OF FLUID FILM BEARINGS**

**12Hrs**

Design and performance analysis of thrust and journal bearings - Full, partial, fixed and pivoted journal bearings design - Lubricant flow and delivery - power loss, Heat and temperature, rotating loads and dynamic loads in journal bearings - Hydrostatic Bearing design.

**UNIT IV: ROLLING ELEMENT BEARINGS**

**12Hrs**

Geometry and Kinematics - Materials and manufacturing processes - contact stresses - Hertzian stress equation - Load divisions - Stresses and deflection - Axial loads and rotational effects, Bearing life capacity and variable loads - ISO standards - Oil films and their effects - Rolling Bearings Failures.

**UNIT V: TRIBO MEASUREMENT IN INSTRUMENTATION**

**12Hrs**

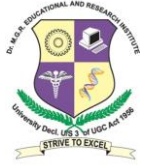
Surface topography measurements - Electron microscope and friction and wear measurements - Laser method - Instrumentation - International standards -Bearings performance measurements - Bearing vibration measurement.

**Total No. of Hrs : 60**

**REFERENCES**

1. Cameron, A. (1981) *Basic Lubrication Theory*. Ellis Herward Ltd.
2. Hulling, J. (Editor), (1984) *Principles of Tribology*. MacMillan.
3. Williams, J.A. (1994) *Engineering Tribology*. Oxford Univ. Press.
4. Neale, M.J. (1995) *Tribology Hand Book*. Butterworth Heinemann.
5. <http://www.csetr.org/link.htm>
6. <http://www.me.psu.edu/research/tribology.htm>





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**MME13DE06                      PRODUCT DESIGN AND DEVELOPMENT STRATEGIES                      3   1   0   4**

**OBJECTIVE:** At the end of this course the student will learn

- Product design considerations and strategies of innovative product development

**UNIT I: INTRODUCTION** **11Hrs**

Essential factors of product design- requirements of good design- factors affecting product design- product development process tools- Design by evolution and innovation- Asimow's model- Journeys in product development- product engineering – nature and scope- Product design practice in industry.

**UNIT II: CREATIVITY** **12Hrs**

Creative thinking and organizing for product innovation criteria – method and tools for directed creativity – challenges of quality management – Case studies – Mumbai's Dabbawalas – creativity by less learned- Creativity on wheel chair – MARICO (case study)- Patent –design patents- patent application steps – sale of patent rights.

**UNIT III: DESIGN CONSIDERATIONS** **14Hrs**

Functional and production design – form design – influence of basic design, mechanical loading and material on form design – Design for manufacture and assembly – Design for robustness – Design for production – Design for stiffness and rigidity – strength consideration in product design – optimization in design – Project analysis – Mechanical estimating and costing.

**UNIT IV: PRODUCT DEVELOPMENT STRATEGIES** **11Hrs**

Planning and preparation – Resources – Talent –striving, thinking, relating – Quality assurance in product design – Strategy for product development – Case studies.

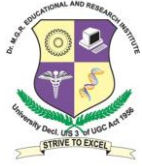
**UNIT V: HUMAN AND VALUE ENGINEERING** **12Hrs**

Human beings as applicator of forces – Anthropometry – design of controls and displays – man/machine information exchange – aesthetic and ergonomic considerations – Value engineering – maximum value-Normal degree of value – value analysis of job plan – Idea generation check-list – Cost reduction through value engineering case study on tap switch control assembly – Economic factors influencing design – Material and process selection.

**Total No. of Hrs                      : 60**

**REFERENCES**

1. Kavin & Krishn, *Product Design Techniques in reverse engineering & New product development*, Pearson Education
1. Paul Plsek, E. *Creativity, Innovation and Quality*. Prentice - Hall of India Private Limited
3. Jones, J.C. (1970) *Design Methods*. Interscience
4. Buhl, H. (1960) *Creative Engineering Design*. Iowa State University Press
5. Dieter, G.E. (1983) *Engineering Design*. McGraw Hill
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7. Harry Peck, (1973) *Designing for Manufacturing*. Sir Issac Pitman and Sons Ltd



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**DEPARTMENT OF MECHANICAL ENGINEERING**

**MME13DE07**

**ROBOTICS AND SENSORS**

**3 0 0 3**

**OBJECTIVE:** At the end of this course the student will learn

- Concepts, design, application and control of robotics

**UNIT I: INTRODUCTION**

**9Hrs**

Basic concepts-Robot anatomy-robot configurations-Basic Robot motions-Types of drives-Applications-Material Handling-Processing-Assembly and Inspection -Safety considerations.

**UNIT II: TRANSFORMATIONS AND KINEMATICS**

**9Hrs**

Vector operations-Translational transformations and Rotational transformations-Properties of transformation Matrices-Homogeneous transformations and Manipulator-Forward solution-Inverse solution

**UNIT III: CONTROLS AND END EFFECTORS**

**9Hrs**

Control system concepts-Analysis-control of joints-Adaptive and optimal control-End effectors-Classification-Mechanical-Magnetic-Vacuum-Adhesive-Drive systems-Force analysis and Gripper design

**UNIT IV: ROBOT PROGRAMMING**

**6Hrs**

Methods -Languages-Computer control and Robot Software-VAL system and Language

**UNIT V: SENSORY DEVICES**

**12Hrs**

Non-optical and optical position sensors-Velocity and Acceleration-Range-Proximity-touch-Slip-Force-Torque-Machine vision-Image components-Representation - Hardware-Picture coding-Object recognition and Categorization-Software consideration- Case Studies

**Total No. of Hrs : 45**

**REFERENCES**

1. Fu, K.S. Gonzalez, R. and Lee, C.S.G. (1987) *Robotics control, sensing, vision, and Intelligence*. McGraw Hill Book Co
2. Klafter, R.D. Cmielewski, T.A. and Negin, M. (1994) *Robot Engineering an Integrated approach*. New Prentice Hall of India
3. Deb, S.R. (1994) *Robotics Technology and Flexible Automation*. Tata McGraw Hill Publishing Co, Ltd
4. Craig J.J. (1999) *Introduction to Robotics Mechanics and Control*. Addison Wesley
5. Groover, M.P. (1995) *Industrial robotics Technology, programming and applications*. McGraw Hill Book Co
6. <http://www.robotics.com>





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**MME13DE08**

**COMPOSITE MATERIALS AND MECHANICS**

**3 0 0 3**

**OBJECTIVE:** At the end of this course the student will learn

- To understand the properties, manufacturing and mechanics of composite materials

**UNIT I: INTRODUCTION**

**9Hrs**

Definition of Composite materials- Need – General characteristics – Classifications – Applications

**UNIT II: CONSTITUENT MATERIALS**

**9Hrs**

Fibres – Matrices – Fibre reinforced plastics – Thermoset polymers –Coupling agents –Filters and additives –Metal matrix and ceramic composites.

**UNIT III: MANUFACTURING**

**9Hrs**

Bag moulding – Compression moulding – Pultrusion – Filament winding – Other manufacturing processes – Quality inspection and testing.

**UNIT IV: MECHANICS AND PERFORMANCE**

**9Hrs**

Introduction to micro mechanics – Unidirectional laminar – inter laminar stresses – static mechanical properties, fatigue properties – impact properties – Environmental effects – Fracture –damage and failures.

**UNIT V: DESIGN**

**9Hrs**

Failure predictions-Design considerations – Joint design – Codes – Design examples

**Total No. of Hrs : 45**

**REFERENCES**

1. Mallick, P.K. (1993) *Fiber-Reinforced composites:Materials. Manufacturing and Design* , Marcel Dekker Inc
2. Halpin, J.C. (1984) *Primer on Composite Materials, Analysis*. Techomic Publishing Co
3. Agarwal, B. and DandBroutman, L.J. (1990) *Analysis and Performance of Fiber Composites*. John Wiley and Sons
4. Mallick, P.K. and Newman, S. (1990) *Composite Materials Technology: Processes and Properties* .
5. Hansen Publisher





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**MME13DE10**

**THEORY OF PLASTICITY**

**3 0 0 3**

**OBJECTIVE:** At the end of this course the student will learn

- To understand the concepts and theories of elastic and plastic deformation

**UNIT I: INTRODUCTION**

**9Hrs**

Modeling Uniaxial behaviour in plasticity. Index notation, Cartesian tensors. Yield and failure criteria Stress, stress deviator tensors. Invariants, principal, mean stresses. Elastic strain energy. Mohr's representation of stress in 2 & 3 dimensions. Haigh-Westergaard stress space. Equilibrium equations of a body. Yield criteria: Tresca's, von Mises rules, Drucker-Prager criterion, anisotropic yield criteria.

**UNIT II: STRAIN AT POINT**

**9Hrs**

Cauchy's formulae for strains, principal strains, principal shear strains, derivative strain tensor. Strain-displacement relationships. Linear elastic stress strain relations, Generalized Hooke's law, nonlinear elastic stress strain relations

**UNIT III: STRESS STRAIN RELATIONSHIPS**

**9Hrs**

Prandtl-Reuss material model. J2 deformation theory, Drucker-Prager material, General Isotropic materials. Drucker's stability postulate, normality, convexity and uniqueness for an elastic solid. Incremental stress strain relations.

**UNIT IV: CRITERIA FOR LOADING AND UNLOADING**

**9Hrs**

Elastic and plastic strain increment tensors, Plastic potential and flow rule associated with different Yield criteria, Convexity, normality and uniqueness considerations for elastic-plastic materials. Expansion of a thick walled cylinder.

**UNIT V: THEORY OF PLASTICITY AND BOUNDING SURFACES**

**9Hrs**

Loading surface, Hardening rules. Flow rule and Druckers stability postulate. Concept of effective stress and effective strain, mixed hardening material. Problems.

Uniaxial and multiaxial loading anisotropic material behaviour, Theorems of limit analysis, Statically admissible stress field and kinematically admissible velocity field, Upper and lower bound theorems, examples and problems.

**Total No. of Hrs : 45**

**REFERENCES**

1. Chens, W.F. and Han, D.J. (1987) *Plasticity for structural engineering*. Springer – Verlag.
2. Victor E.S. *Mechanics of Materials –II*.





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**MME13DE12      QUALITY ENGINEERING AND NON DESTRUCTIVE TESTING      3   0   0   3**

**OBJECTIVES:** At the end of this course the student will learn

- TQM and its implementations
- Non destructive testing methods

**UNIT I: STATISTICAL QUALITY CONTROL 9Hrs**

Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - Reliability and life testing.

**UNIT II: TQM SYSTEMS AND IMPLEMENTATION 9Hrs**

Quality policy deployment, quality function deployment, standardization, designing for quality, manufacturing for quality. TQM IMPLEMENTATION - Steps, KAIZEN, 5S, JIT, POKAYOKE, Taguchi methods, case studies. Total Productive Maintenance (TPM) : Philosophy and Implementation Benchmarking- Type - Applications.

**UNIT III: LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS 9Hrs**

Characteristics of liquid penetrants -different washable systems-Developers-applications -Methods of production of magnetic fields - Principles of operation of magnetic particle test -Applications – Advantages and Limitations.

**UNIT IV: RADIOGRAPHY 9Hrs**

Sources of ray-x-ray production - properties of d and x rays- film characteristics - exposure charts -contrasts - operational characteristics of x ray equipment - applications.

**UNIT V: ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES 9Hrs**

Production of ultrasonic waves - different types of waves - general characteristics of waves-pulse echo method - A,B,C scans - Principles of acoustic emission techniques - Advantages and limitations - Instrumentation - Applications.

**Total No. of Hrs      : 45**

**REFERENCES**

1. Rose, J.E. (1993) *Total Quality Management*. Kogan Page Ltd
2. Barry Hull and Vernon John, (1988) *Non Destructive Testing*. MacMillan
3. (1976) *American Society for Metals, Metals Hand Book*. Vol. II
4. (1990) *Progress in Acoustic Emission*. Proceedings of 10th International Acoustic Emission Symposium, Japanese society for NDI
5. [Http://www.sisndt.com](http://www.sisndt.com)
6. [Http://www.iuk'tu-harburg.de](http://www.iuk'tu-harburg.de)