**MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**DEPARTMENT OF MECHANICAL ENGINEERING**

# B.Tech. (Mechanical Engineering)
# Semester VII

# Syllabus

DUGC Convener | Curriculum Committee Convener | SUGB Chairman

Date:

| UG | Department: Mechanical Engineering |
|---|---|
| Course Code: ME-314 | Course Name: Power Plant Engineering |
| Credit: 4 | L-T-P: 3-1-0 |

## Syllabus

**Present Energy Scenario:** World, India, Rajasthan and future prospects.

**Power Plant Economics:** Various Terms and definitions, load curves, cost of electricity generation, performance and operating characteristics, combined operation of power plants, load division.

**Steam Power Plant:** Layout, site selection, coal burning methods, disposal of ash and dust, combined cycle power plants, integrated coal gasification, major plant components: condensers, cooling towers.

**Diesel and Gas Turbine Plant:** General Layout, plant components, comparison with steam plant.

**Nuclear Power Plants:** Location, component of nuclear plants, types of reactors, Uranium enrichment, safety, disposal of nuclear waste, comparison with thermal plants.

**Hydro-electric Power Plant:** Classification, layout, components and auxiliaries of hydro power plant, Selection of turbines, micro hydro plants, pumped storage.

**Other power plants:** Wind resource assessment, types and selection of wind turbines; operation and control of machines; Solar PV power plants: system components, selection criteria; Solar Thermal Power Pants: Types of solar thermal plants, component description, auxiliary heating requirement.

**Books:**


1. Frederick T. Morse “Power Plant Engineering” East West Press.
2. Skrotzki&Vopat. “Power Station Engineering & Economy” Tata McGraw Hill.
3. EI-Wakil M.M, “Power Plant Technology,” Tata McGraw-Hill
4. P.K. Nag “Power Plant Engineering” Tata McGraw Hill, New Delhi.


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG | Department: Mechanical Engg. |
|---|---|
| **Course Code: ME 411** | **Course Name: Air Conditioning System Design** |
| **Credit: 4** | **L-T-P: 3-1-0** |
| **Pre-requisite course:** Engg. Thermodynamics, Fluid Mechanics and Machines, Heat Transfer and Refrigeration and air conditioning | |

**Syllabus**

- Detail study of Load Estimating: comfort conditions, weather data, solar heat gain, cooling and heating loads
- Air conditioning systems: central and unitary systems, heating and cooling coil design, cooling tower design and selection, air cleaners and scrubbers, hydronic heating and cooling systems, humidification and dehumidification equipments, duct design and fan selection automatic controls, noise reduction,
- Energy conservations and air conditioning for special applications: waste heat recovery, cogeneration of power and refrigeration, industrial air conditioning for textile processing and other applications, clean spaces, passive cooling and heating, geothermal and earth air tunnel heat exchanger (EATHE) air conditioning system

**Books:**


1. Air conditioning principles and systems by Edward G. Pita, PHI (Prentice Hall of India)
2. Prasad, M., "Refrigeration and Air Conditioning", 2nd Ed., New Age International
3. Howell, R.H., Saucer, H.J., and Coad, W.J., "Principles of Heating, Ventilation and Air Conditioning", ASHRAE
4. Arora, C. P., "Refrigeration and Air Conditioning", Tata McGraw-Hill
5. ASHRAE Handbook (Fundamentals) 2005


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| | |
|---|---|
| **Program:** B.Tech. Mechanical Engineering | **Department:** Mechanical Engineering |
| **Course Code:** ME-404 | **Course Name: Gas Dynamics** |
| **Credit:** 4 | **L-T-P:** 3-1-0 |

**Syllabus**

Mach number; Mach angle and cone; types of flows; Isentropic one-D flows; Adiabatic and isentropic flows of a perfect gas; Choking and nozzle operation; Normal shock waves; Normal and oblique shocks; Governing equations of normal shocks; Convergent – Divergent nozzles; Constant area duct flows; Governing equation; Fanno and Rayleigh flows and lines; Steady isothermal flow in Long pipe lines; Governing equations and features.

**Books for Reference:**

1. Zucker: Fundamentals of Gas dynamics
2. Shiparo: Fundamentals of Compressible Fluid flow
3. Yahya, S.M. , Introduction to compressible fluid flow

DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG/PG:UG | Department: Mechanical Engineering |
|---|---|
| Course Code: ME-280 | Course Name: Renewable Energy Sources |
| Credit: 4 | L-T-P: 3-1-0 |

**Syllabus**

1. INTRODUCTION: Energy demand growth and supply : Historical Perspectives ; Fossil fuels: Consumption and Reserve ; Environmental Impacts of Burning of Fossil fuels ; Sustainable Development and Role of Renewable Energy
2. SOLAR ENERGY BASICS: Solar geometry; Primary and Secondary Solar energy and Utilization of Solar Energy. Characteristic advantages and disadvantages. Low temperature applications: solar water heating, space heating, drying.
3. SOLAR THERMAL ELECTRICITY GENERATION: Solar concentrators and tracking ; Dish and Parabolic trough concentrating generating systems, Central tower solar thermal power plants ; Solar Ponds.
4. SOLAR PHOTOVOLTAIC SYSTEMS: Basic principle of power generation in a PV cell ; Band gap and efficiency of PV cells ; Manufacturing methods of mono- and poly-crystalline cells ; Amorphous silicon thin film cells, Single and multi junction cells ; Application of PV ; Brief outline of solar, PV stand-alone system design ; Storage and Balance of system.
5. WIND Energy Systems: Types of turbines, Coefficient of Power, Betz limit, Wind electric generators, Power curve; wind characteristics and site selection; Windfarms for bulk power supply to grid; Potential of wind electricity generation in India and its current growth rate.
6. BIOMASS ENERGY: Biomass: Sources and Characteristics; Wet biogas plants ; Biomass gasifiers: Classification and Operating characteristics; Updraft and Downdraft gasifiers; Gasifier based electricity generating systems; Maintenance of gasifiers.
7. OCEAN ENERGY: Tidal power plants : single basin and two basis plants, Variation in generation level ; Ocean Thermal Electricity Conversion (OTEC) ; Electricity generation from Waves : Shoreline and Floating wave systems.
8. GEOTHERMAL ENERGY: Geothermal sites in India ; High temperature and Low temperature sites ; Conversion technologies- Steam and Binary systems ; Geothermal power plants.

**Books:**


1. Twidell J and Weir T., Renewable Energy Resources, Taylor & Francis
2. Godfrey Boyle, Renewable energy, Oxford Press
3. V.V.N. Kishore, Renewable Energy engineering and Technology: Principles and Practice, TERI Press.
4. Rai G.D., Non-Conventional Energy Sources, Khanna publication


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG | Department: Mechanical Engineering |
|---|---|
| Course Code: ME 417 | Course Name: Project Management |
| Credit: 4 | L-T-P: 3-1-0 |

**Syllabus**

Project Management Concepts, Project Planning, Resource Scheduling, Critical Chain Scheduling, Project Quality Management, Project performance Measurement and Control, Project Closure/ Termination, Managing Project Teams, IT in Projects, International Projects: Issues in managing international projects, Selection and training of employees, cross cultural considerations.

**Reference Books**


1. Clifford F Gray, Erik W Larson, "Project Management-The Managerial Process", Tata Mcgraw-Hill Publishing Co Ltd
2. Jack Meredith, Samuel J. Mantel Jr. "Project Management- A Managerial Approach", John Wiley and Sons
3. John M Nicholas "Project Management For Business And Technology" Prentice Hall of India Pvt Ltd
4. James P Lewis "Project Planning, Scheduling And Control" Tata Mcgraw-Hill Publishing Co Ltd.


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG | Department: Mechanical Engineering |
|---|---|
| Course Code: | Course Name: Lean Manufacturing |
| Credit:4 | L-T-P:3-1-0 |

**Syllabus**

Introduction to Lean Manufacturing, Value, The Value Stream, Flow, Pull, Kaizen Facilitation , Quick Changeover, Perfection, Value stream mapping, 5S and Visual Workplace, Agile manufacturing, Six Sigma.

**Reference Books:**


1. The transition to agile manufacturing staying flexible for competitive advantage-J. C. Montigomery, L.O.Levine-ASQC Quality press
2. Agile product development for mass customization –D. M. Anderson, Joseph Pine-Irwin Professional Publishing


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG | Department: Mechanical Engineering |
|---|---|
| Course Code: ME 422 | Course Name: Supply Chain Management |
| Credit: 4 | L-T-P:3-1-0 |

**Syllabus**

Supply Chain Management introduction, Strategic Fit & Scope, Supply Chain Drivers and Obstacles, Designing the distribution network , Planning demand and supply in supply chain, Planning and managing inventories in a supply chain, Transportation Sourcing, and pricing products, Coordination and Technology in the Supply Chain

**Reference Books**


1. Sunil Chopra & Peter Meindl: "Supply Chain Management: Strategy, Planning and Operation", Pearson Education, Third Edition 2007.
2. Donal J. Bowersox, David J. Closs, M. Bixby Cooper, "Supply Chain Logistics Management", Tata McGraw Hill, 2nd edition. 2007.
3. Ronald H. Ballou, " Business Logistics and Supply Chain Management", Pearson Education, 5th Edition, 2004.


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG | Department: Mechanical Engineering |
|---|---|
| Course Code: | Course Name:Total Productive Maintenance |
| Credit:4 | L-T-P:3-1-0 |

**Syllabus**

Introduction to Maintenance Systems, Maintainability, Condition-Based Maintenance (CBM), Reliability – Centred Maintenance (RCM), Asset and Spare Parts Management, Maintenance Lubricants and Their Applications, Safety Engineering and Fault Tree Analysis, Total Productive Maintenance, Maintenance Planning and Scheduling, Computer Applications in Maintenance Management, Statistical Distribution in Preventive Maintenance, Maintenance Integration, Maintenance Effectiveness

**Reference Books:**


1. Mishra R.C. & K. Pathak, Maintenance Engineering and Management, Prentice-Hall of India., 2002
2. Sushil Kumar Srivastava, Industrial Maintenance Management, S. Chand & Company, 2002.
3. Krishnan N.V., Safety Management in Industry, Jaico Publishing House, 1993.
4. L M Deshmukh, Industrial Safety Management, TMH, 2006.


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG | Department: ME |
|---|---|
| Course Code: ME-405 | Course Name: Finite Element Methods |
| Credit: 4 | L-T-P: 3-1-0 |

**Syllabus**

(i) Introduction, Fundamentals of continuum mechanics, Boundary conditions, Rayleigh-Ritz Method, Galerkin's Method.

(ii) One Dimensional Problems: Finite Element Modeling, Coordinates and Shape Functions, Galerkin's approach, Assembly of the Global stiffness Matrix and Load Vector, Treatment of Boundary Conditions – Elimination Approach, Penalty Approach, Multipoint Constraint, Quadratic Shape Functions, Temperature Effects.

(iii) Plane Trusses: Local and Global Coordinate System, Element Stiffness Matrix, Stress Calculations, Temperature Effects.

(iv) Two Dimensional Problems using Constant Strain Triangle Element: Isoparametric Representation, Potential Energy Approach, Element Stiffness Matrix, Force Terms, Galerkin's Approach, Stress Calculations, Temperature Effects.

(v) Axisymmetric Solids Subjected to Axisymmetric Loading: Formulation, Potential Energy Approach, Body Force, Rotating Flywheel, Surface Traction, Galerkin's Approach, Stress Calculations, Temperature Effects.

(vi) Two Dimensional Isoparametric Elements and Numerical Integration: Four nodded quadrilateral, Numerical Integration, Higher Order Elements

(vii) Beams and Frames: Finite Element Formulation using Potential Energy Approach and Galerkin's Approach, Load Vector, Boundary Conditions, Shear Force and Bending Moment, Beams on Elastic Supports, Plane Frames.

(viii) Dynamic Considerations: Formulation, Element Mass Matrix, Eigenvalue and Eigenvector evaluation, Determination of Critical Speeds, Guyan Reduction, Rigid Body Modes.

**Books**

(i) C.S. Krishnamurthy, "Finite Element Analysis", Tata McGraw Hill, New Delhi.

(ii) TripathiR , "Introduction to Finite Element Engineering", Prentice Hall of India, Pvt.Ltd New Delhi.

(iii) Klaus, Jurgen Bathe, "Finite Element Procedures in Engineering Analysis", Prentice Hall of India Pvt. Ltd. New Delhi.

DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG | Department: ME |
|---|---|
| Course Code: ME-414 | Course Name: CAD |
| Credit: 4 | L-T-P: 3-1-0 |

**Syllabus**

Introduction to Computer Graphics Fundamentals: Output primitif (points, lines, curves etc.,), 2-D & 3-D transformation (Translation,scaling,rotators) windowing - view ports - clipping transformation. Representation of curves – Bezier curves - cubic spline curve - B – Spline curves - Rational curves –Surface Modeling techniques - surface patch – Coons patch- bi-cubic patch – Bezier and B-spline surfaces – Volume modeling – Boundary models – CSG- other modeling techniques.

Writing interactive programs to solve design problems and production of drawings - using any languages like Auto LISP/C/FORTRAN etc.- creation of surfaces - solids etc. using solid modeling packages (prismatic and revolved parts).

Solid Modeling:Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations - constructive solid Geometry - comparison of representations - user interface for solid modeling. Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc– Communication standards.

Assembly of Parts:Assembly modeling - interferences of positions and orientation - tolerances analysis - mass property calculations - mechanism simulation.

Product Dissection:Experiments using building blocks, mechanisms, small motor mechanisms and build a product working model etc; Dissection using dissection modules. Dissection of common consumer product and mapping of function, concept and form.

**References:**


1. William M Neumann and Robert F.Sproul “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.
2. Donald Hearn and M. Pauline Baker “Computer Graphics”, Prentice Hall, Inc., 1992.
3. Ibrahim Zeid Mastering CAD/CAM – McGraw Hill, International Edition, 2007.
4. Foley, Wan Dam, Feiner and Hughes – Computer graphics principles & practices, Pearson Education – 2003.
5. Donald Heam and M. Pauline Baker “Computer Graphics”, Prentice Hall, Inc., 1992.
6. YousefHaik, Engineering Design Process, Vikas Publishing house, New Delhi, 2003.
7. G. Pahl, and W. Beitz, Engineering Design – A Systematic Approach, Springer – Verlag, 1996.
8. K. Otto and K. wood, Product Design – techniques in reverse engineering and new product development, Pearson Education, New Delhi, 2004.


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG | Department: ME |
|---|---|
| Course Code: ME-416 | Course Name: Design of Mechanisms |
| Credit: 4 | L-T-P: 3-1-0 |
| **Pre-requisite course: Engineering Mechanics, Kinematics and Dynamics of Machines** | |

**Syllabus**

Study of existing mechanisms used in industry, machine tools, vehicles, high speed machinery. Classification of mechanisms. Structural analysis and synthesis for conceptual design. Theory of path curvature and finitely movements. Kinematic and dynamic design. Spatial Mechanisms. Errors in mechanisms and machines. Coding, evaluation and dimensional synthesis of mechanisms.

**Text Books:**


1. Mechanism Design: Analysis and Synthesis, Vol. I & II, A.G. Erdman and G.N. Sandor, Prentice-Hall
2. Geometric Design of Linkages, J.M. McCarthy, Springer
3. Kinematic Synthesis of Linkages, R. S.Hartenberg, and J Denavit,., McGraw-Hill


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG/PG : UG | Department: Mechanical Engineering |
|---|---|
| Course Code: | Course Name: Advanced Metal Forming |
| Credit: 4 | L-T-P:3-1-0 |

**Syllabus**

**UNIT I:**

Fundamentals of Metal Forming: Classification of forming processes, mechanism of metal forming, temperature of metal working, hot working, cold working, friction and lubricants.

**UNIT II:**

Rolling of metals: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations.

**UNIT III:**

Forging: Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging.

**UNIT IV:**

Extrusion: Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes, production of seamless pipes.

**UNIT V:**

Drawing: Drawing of tubes, rods, and wires: Wire drawing dies, tube drawing process,analysis of wire, deep drawing and tube drawing.

**UNIT VI:**

Sheet Metal forming: Forming methods, Bending, stretch forming, spinning and Advanced techniques of Sheet Metal Forming, Forming limit criteria, defect in formed parts. Advanced Metal forming processes: HERF, Electromagnetic forming, residual stresses, in-process heat treatment and computer applications in metal forming.

**UNIT VII:**

Introduction to Press tool design: Design of various press tools and dies like piercing dies, blanking dies, compound dies and progressive blanking dies, design of bending, forming and drawing dies.

**UNIT VIII:**

Analysis of Forming Process, Slab method, Upper & lower bound, FEM based simulation, slip line theory, Use of CAE platform for Die Design & Simulation.

**Books:**


1. Mechanical Metallurgy / G.E. Dieter / Tata McGraw Hill, 1998. III Edition2. Principles of Metal Working / Sunder Kumar
2. Principles of Metal Working processes / G.W. Rowe
3. ASM Metal Forming Hand book


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG/PG : UG | Department: Mechanical Engineering |
|---|---|
| Course Code: | Course Name: Design for Manufacturing |
| Credit: 4 | L-T-P: 3-1-0 |

**Syllabus**

**Introduction:** Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design.

**Selection of Materials and Shapes**: Properties of Engineering Materials, Selection of Materials, Use of software database for material selection e.g. Plastic Adviser, Selection of Shapes, Co-selection of Materials and Shapes, Case Studies.

**Selection of Manufacturing Processes:** Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Design for Polymer Processing , Co-selection of Materials and Processes, Case-Studies, DFM module of CAD/CAM/CAE Tools e.g. DFM Pro etc..

**Design for Assembly:** Review of Assembly Processes, Design for Welding, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment, Case-Studies.

**Design for Reliability and Quality**: Failure Mode and Effect Analysis(FMEA), Design for Quality, Design for Reliability, Approach to Robust Design, Design for Optimization

**Books:**


1. M F Ashby and K Johnson, Materials and Design - the art and science of material selection in product design, Butterworth-Heinemann, 2003.
2. G Dieter, Engineering Design - a materials and processing approach, McGraw Hill, NY, 2000.
3. M F Ashby, Material Selection in Mechanical Design, Butterworth-Heinemann, 1999.
4. T H Courtney, Mechanical Behavior of Materials, McGraw Hill, NY, 2000.
5. K G Swift and J D Booker, Process selection: from design to manufacture, London: Arnold, 1997.
6. S SRao, Engineering Optimization: theory and practice, John Wiley, NY, 1996.
7. G Boothroyd, P Dewhurst and W Knight, Product design for manufacture and assembly, John Wiley, NY: Marcel Dekkar, 1994.
8. J G Bralla, Handbook for Product Design for Manufacture, McGraw Hill, NY, 1998.
9. Houldcroft, Which Process – an introduction to welding and related processes and guide to their selection, Cambridge, Abington Pub., 1990.
10. ASTM Design handbook.
11. Engineering Design and Design for Manufacturing by Dixen& Poly, University of Mas. Press


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Date:

| UG/PG : UG | Department: Mechanical Engineering |
|---|---|
| Course Code: | Course Name:Product Engineering |
| Credit: 4 | L-T-P:3-1-0 |

**Syllabus**

**UNIT-I – Project Management**

Introduction to Project Management (PM), Collaborative Working, PM Tutorials and their implementation for the same in their projects in tools such as Microsoft Projects.

**UNIT-II – Ideation & conceptual Design**

Elements of design; Product development cycle overview; Market demands and trends for products; Product Lifecycle Management (PLM) overview; Ideation and conceptual design phase introduction; Benefits and use cases of ideation and conceptual design, Capturing Voice of the customer (VOC), Use of Trizz in ideation, Intellectual Property Rights (IPRs).

**UNIT-III - Product Engineering – Component Design**

Product Design Phase – I: The evolution of CAD: Benefits of Digital Prototyping Design: General 3D Design Concepts.

Product Design Phase–Part 2; Design for manufacturing, introduction; Design styled components.

Product Design Phase – Part 3; Top Down and Bottom Up Design Methods; Manufacturing and Engineering Bill of Materials (BOMs); Team and Collaborative based Design.

**UNIT-IV - Product Engineering – Documentation (Drawings)**

Design Documentation Requirements; Importance and benefits of design documentation; When do you need documentation and when do you not; Drawings requirements (Detailed drawings & Assembly Drawings), Design changes and Automation & Visualization Extending DesignData.

**UNIT – V – Prototyping, Testing & User Trials**

Need - Development of RP systems, RPT Technologies, Rapid Tooling & Case Studies.

**Books:**


1. Joseph E. Shigley& Larry D. Mitchell, "Mechanical Engineering Design", Fourth Edition, McGraw-Hill International Book Company.
2. Machine Design - An Integrated Approach -- Robert L. Norton – Pearson Education.
3. Mastering Autodesk Inventor by Sybex
4. Autodesk Inventor 2012 for Designers by CADCIM Technologies
5. Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003.
6. Rapid Prototyping and Engineering applications : A tool box for prototype development, LiouW.Liou, Frank W.Liou, CRC Press, 2007.
7. Rapid Prototyping: Theory and practice, Ali K. Kamrani, EmadAbouel Nasr, Springer, 2006
8. Engineering Design and Design for Manufacturing by Dixen& Poly, University of Mas. Press


DUGC Convener Curriculum Committee Convener SUGB Chairman

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