**MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

**DEPARTMENT OF MECHANICAL ENGINEERING**

# B.Tech. (Mechanical Engineering)
# Open Electives

# Syllabus

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/PG : UG | Department: Mechanical Engineering |
|---|---|
| Course Code: Open Electives | 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

Date:

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

**Syllabus**

**Unit-1 Introduction:** Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc. Types of Reinforcements/Fibers: Role and Selection or reinforcement materials, Types of fibres, Glass fibers, Carbon fibers, Aramid fibers , Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc., Mechanical properties of fibres. Material properties that can be improved by forming a composite material and its engineering potential

**Unit-2 Various types of composites:** Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites

**Unit-3 Fabrication methods:** Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression molding, resin-transplant method, pltrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films

**Unit-4 Testing of Composites:** Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.

**Books:**


1. Materials characterization, Vol. 10, ASM hand book
2. Mechanical Metallurgy by G. Dieter Mc-Graw Hill
3. Thermal Analysis of Materials by R.F. Speyer, Marcel Decker
4. Engineering Materials: Polymers, Ceramics and Composites A.K Bhargava Prentice Hall of India


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG/PG | Department: ME |
|---|---|
| Course Code: | Course Name: Robotics |
| Credit: 3 | L-T-P: 3-1-0 |

**Syllabus**

Automation and Robotics, Robot Anatomy – Links, Joints and Joint Notation scheme, Degrees of Freedom (DOF), Required DOF in a Manipulator, Precision of Movement, The kinematic Modeling of Manipulator, Direct kinematics model mechanical structure & Notations Description of links & Joints, The Inverse kinematics manipulator: workspace, solvability of inverse kinematic model. Solution technique, closed form solutions. Types of end-effector, methods of holding, Mechanical grippers, Mechanisms for grippers.

Differential kinematics, linear and angular velocity of a Rigid Body, Relationship between Transformation matrix and angular velocity, mapping velocity vectors, velocity propagation along links. Manipulator Jacobian, Jacobian Inverse, Jacobian singularities, Static Analysis. Jacobian, Examples.

Lagrangian Mechanics, Lagrange – Euler formulation - Velocity of a point on the manipulator, The inertia tensor, The kinetic energy, the potential energy. Equations of Motions, the Lagrangian-Euler (LE) Dynamic model algorithm. Examples on Dynamic modeling.

Control of movements of mechanical joints, control sequence, n-joints manipulator control system, system performance, control system with damping, control strategy, Architecture of control systems.

Robot Programming issues, optimization position definitions, interpolation language command, data object command, motion commands, gripper command, tool commands, sensors command, other command, Writing programs for different tasks.

**Text Book:**


1. (Mittal R. K. &Nagrath I. J., "Robotics and Control", TMH, 2003 (Reprint 2007 or later).
2. Groover, M. P., et al., "Industrial Robotics", MGHISE, 1986.
3. Fu, K. S., et al., Robotic: Control, Sensing, Vision & Intelligence, MGHISE, 1987.
4. Robert J., Schilling, Fundamentals of Robotics: Analysis and Control, Prentice Hall, NJ, 2002.


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG/PG | Department: ME |
|---|---|
| Course Code: | Course Name: Finite Element Methods |
| Credit: 3 | L-T-P: 2-1-0 |

**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: Mechanical Engineering |
|---|---|
| Course Code: ME 418 | Course Name: Total Quality Management |
| Credit:4 | L-T-P: 3-1-0 |

**Syllabus**

Definition, History, Framework and Benefits of TQM, Characteristic and roles of a successful quality leader, Voice of customer and retention of customer, Employee involvement, teamwork, performance appraisal and rewards, Juran Trilogy, PDSA, Kaizen, Six-sigma, Selection, certification and rating of suppliers, Quality costs, Malcolm Baldrige National Quality Award, benchmarking, Spider chart and comparison with competitors products, ISO 9000+ certifications, quality audits, Quality Management Systems, ISO14000+ certifications, Environmental Management System, Voice of customer, house of quality, Quality Function Deployment, Rationale and methods Quality by Design, Methodology and documentation, Failure Mode and Effect Analysis, Liability laws and defense, Products Liability, Affinity diagram, interrelations digraph, tree and matrix diagrams, Management Tools, Charts and techniques for statistical process control, Statistical Process Control

**Reference Books**


1. Besterfield, Dale H., Total Quality Management, Pearson Education, 3rd Revised Edition, 2011.
2. Sharma D.D., Total Quality Management, Principles, Implementation & Cases, Sultan Chand & Sons, New Delhi, 2000
3. James R. Evans, Total Quality Management, Organization, and Strategy, Thomson, 4th Ed., 2007.
4. Besterfield, D.H., Quality Control, Pearson, 7th Ed., 2004.


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG | Department: Mechanical Engineering |
|---|---|
| Course Code:ME 340 | Course Name: Six Sigma (open elective) |
| Credit:4 | L-T-P:3-1-0 |

**Syllabus**

Introduction to six sigma, Indicators of requirement of Six sigma, Elements of six sigma, Six sigma process – Define phase, Six sigma tools (QFD, SIPOC) – Define phase, Six sigma process – Measure phase, Six sigma tools (CTQ tree, Process capability calculation, Measurement system analysis using gauge R&R) – Measure phase, Six sigma process – analyse phase, Six sigma tools (Histogram, box plot, control chart, scatter chart, fish bone diagram, pareto analysis chart, interrelations diagram) – analyse phase, Six sigma special tools (Regression analysis, Hypothesis testing, ANOVA, Multivariate analysis), Six sigma – process improvement, Six sigma tools (Affinity diagram, FMEA, DOE), Six sigma process – control phase, Six sigma tools (Value stream mapping, control charts, TPM, Poka – yoke), Implementing six sigma

**Reference Books**

Henderson, G. R. (2007), Six Sigma Quality Improvement with MINITAB, WileY

DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG/PG | Department: Mechanical Engineering |
|---|---|
| Course Code: | 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:

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|---|---|
| **Program:** B.Tech. Mechanical Engineering | **Department:** Mechanical Engineering |
| **Course Code:** | **Course Name:** Automobile Engineering |
| **Credit:** 3 | **L-T-P:** 3-0-0 |

**Syllabus**

Power plants for automotive vehicles, Layout of different kinds of vehicles, Resistance to vehicle motion and need for a gear box, various types of gear boxes including automatic transmission systems, clutches including fluid couplings, torque converters, rear axle and final drive - differential, front axle construction, steering systems, suspension systems, tyres, springs and shock absorbers, brakes and their actuations, ignition systems recent developments. Vehicle electrical & electronic systems. Automotive pollution and its control strategies.

**Books for Reference:**


(i) Newton, K., Steeds, W., & Garret, T.K., The Motor Vehicle, Butterworth Heinemann, Oxford, UK, 1997.

(ii) Reimpell, J., and Stall, H., Automotive Chassis Engineering Principles, Society of Automotive Engineers Inc., USA, 1998.

(iii) Judge, W., Motor Manuals; Vol.1 - Automobile Engines in Theory, Design, Construction, Operation and Testing, Chapman and Hall -London, 1973.

(iv) Crouse, W.H., Automotive Mechanics, International Student Edition, McGraw Hill Inc., USA, 1970.


DUGC Convener Curriculum Committee Convener SUGB Chairman

Date:

| UG/PG | Department: Mechanical Engineering |
|---|---|
| Course Code: | 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


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