# Eighth Semester

| B. Tech. (8th Semester) Mechanical Engineering | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **MEC-402L** | **Project-IV** | | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time (Hrs.)** |
| **0** | **0** | **10** | **5** | **0** | **100** | **100** | **200** | **3** |
| **Purpose** | To implement the engineering principles and theories into innovative practical projects for solving real world problems. | | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO1** | Students will be able to apply the theoretical knowledge into practical/software projects. | | | | | | | |
| **CO2** | Students will be able to design new products using latest technologies. | | | | | | | |

The project work could be done for the problem statement of an industry or practical project in the institute. The students may also opt for the analysis based software projects with proper validation. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

**Note:** The maximum number of students in a group should not exceed four.

| B. Tech. (8th Semester) Mechanical Engineering | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MEO-402** | **SUPPLY CHAIN MANAGEMENT** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | The main objective of the course is to impart students with the knowledge of the performance, driver and metrics, network design, economies and uncertainties in Supply chain management. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to explain the basics of Supply chain management and its performance. | | | | | | |
| **CO2** | Students will be able to discuss supply chain metrics and the process of designing the supply chain networks. | | | | | | |
| **CO3** | Students will be able to explain various aspects and functions of the supply chain network. Also, they will be able to explain the design process of the Global supply chain network. | | | | | | |
| **CO4** | Students will be able to describe how to manage economies and uncertainties in the supply chain. | | | | | | |

**UNIT-I**

**Understanding the supply chain:** Introduction, definition, the objective of a supply chain, the importance of supply chain decisions, decision phases in a supply chain, process views of a supply chain, examples of supply chains.

**Supply chain performance:** Achieving strategic fit and scope: Competitive and supply chain strategies, achieving strategic fit, expanding strategic scope, challenges to achieving and maintaining strategic fit.

**UNIT-II**

**Supply chain drivers and metrics:** Financial measures of performance, drivers of supply chain performance, framework for structuring drivers, facilities, inventory, transportation, information, sourcing, pricing.

**Designing the supply chain network:** Designing distribution networks and applications to online sales: the role of distribution in the supply chain, factors influencing distribution network design, design options for a distribution network, online sales and the distribution network, distribution networks in practice.

**UNIT-III**

**Network design in the supply chain:** The role of network design in the supply chain, factors influencing network design decisions, framework for network design decisions, models for facility location and capacity allocation, making network design decisions in practice.

**Designing global supply chain networks:** The impact of globalization on supply chain networks, the offshoring decision: total cost, risk management in global supply chains, discounted cash flows, evaluating network design decisions using decision trees, to onshore or offshore: evaluation of global supply chain design decisions under uncertainty, making global supply chain design decisions under uncertainty in practice.

## UNIT-IV

**Managing economies of scale in a supply chain:** Cycle inventory, the role of cycle inventory in a supply chain, estimating cycle inventory–related costs in practice, economies of scale to exploit fixed costs, economies of scale to exploit quantity discounts, short-term discounting: trade promotions, managing multi-echelon cycle inventory.

**Managing uncertainty in a supply chain:** Safety inventory, the role of safety inventory in a supply chain, determining the appropriate level of safety inventory, impact of supply uncertainty on safety inventory, impact of aggregation on safety inventory, impact of replenishment policies on safety inventory, managing safety inventory in a multie-chelon supply chain, the role of IT in inventory management, estimating and managing safety inventory in practice.

**Text books:**

1. Supply chain Management: Strategy, Planning and Operations - Chopra, S., and Meindl, P., Fifth Edition, Pearson Education (Singapore) Pte. Ltd, 2004.
2. Designing & Managing the Supply Chain: Concepts, Strategies & Case studies - Simchi-Levi, P., Kaminsky, Ravi Shankar, E., Third Edition, Tata McGraw-Hill Edition, 2003.

**Reference books:**

1. Purchasing and Supply Chain Management: Text and Cases - Doebler, D.W. and Burt, D.N., McGraw-Hill Publishing Company Limited, New Delhi, 1996.
2. Supply Chain Management for Competitive Advantage - Rangaraj, TMH.

**Note: The paper setter will set the paper as per the question paper template provided.**

| B. Tech. (8th Semester) Mechanical Engineering | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MEO-404** | **COMPETITIVE MANUFACTURING SYSTEMS** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | The objective of this course is to make the students understand about the concepts of competitive manufacturing management systems. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to interpret the tactics, strategies and tools of continuous improvements of products and services. | | | | | | |
| **CO2** | Students will be able to implement the just in time and total quality management philosophy for continuous improvement and identify the elements of lean and wasteless production. | | | | | | |
| **CO3** | Students will be able to describe how to reduce the setup time and how to maintain and improve the equipment efficiency. | | | | | | |
| **CO4** | Students will be able to explain the pull-push production system and will be able to know the systems for eliminating defects. | | | | | | |

**UNIT-I**

**Fundamentals of continuous improvement:** Continuous improvement as tactics and strategy-Incremental improvement: Kaizen, improvement threshold, innovation improvement making the leap, improvement as strategy, finding and implementing improvements-PDCA cycle, value analysis/value engineering, process engineering.

**Basic problem solving and improvement tools:** Check list, histogram, Pareto analysis, scatter diagram, process flow chart, cause and effect analysis, run diagram.

**UNIT-II**

**JIT: value added and waste elimination:** Value added focus- necessary and unnecessary activities, support organization, sources of waste-Toyota's seven wastes, Canon's none wastes, JIT principles-simplification, cleanliness and organization, visibility, cycling time, agility, variation reduction, ,measurement, Meaning of JIT-philosophy, method, JIT limitations and implementation barriers, social impact of JIT.

**Total quality management (TQM):** Quality, Framework for managing total quality, employee involvement, benchmarking, quality certification, implementing TQM.

**Elements of lean production:** Lot size basics-lot size and setup reduction, kinds of lots, Lot sizing-process and purchase batches, EOQ based methods, transfer batches, Lot size reduction- Effect of lot size reduction on competitive criteria, cases for larger process batches, minimum lot size, small buffer stock, EOQ models for lot sizing.

**UNIT-III**

**Setup time reduction:** Setup reduction methodology-Shingo and SMED, SMED methodology for setup reduction, techniques for setup reduction-separate internal and external activities, improve internal setups, improve external setups.

**Maintaining and improving equipment:** Equipment maintenance-breakdown repair, equipment problems and competitiveness, preventive maintenance, total predictive maintenance, Equipment effectiveness-equipment losses, maintainability, reliability, availability, efficiency, quality rate, preventive maintenance programs, Total productive maintenance-perform TPM preventive maintenance, develop in house quality to restore and redesign equipment, eliminate human error in operation and maintenance, Implementing TPM-program feasibility, master plan, target areas, management support.

**UNIT-IV**

**Pull production systems:** Production control systems, Pull systems and Push systems- pull production process, push production process, rules for pull production, process improvement, necessary conditions for pull production systems, pull system as a fixed quantity/reorder point system, conveyance Kanbans, production Kanbans, Signal Kanbans, CONWIP method of pull production.

**Systems for eliminating defects:** Inspection (screening), self-checks and successive checks, requirements for self-checking, successive checkings, automation, cycle time, limits of inspection, source inspection and POKAYOKE: POKAYOKE functions, ideas, continuous improvements, JIDOKA-autonomation, andons.

**Text Books:**

1. Competitive Manufacturing Management – John M. Nicholas, TMH.
2. Manufacturing Management – Principles and Concepts, Gibson, Greenhalgh and Kerr, Champan and Hall.

**Reference Books:**

1. Production and Operation Management – K.C. Jain, Dreamtech Press.
2. Operations management-William J. Stevenson, McGraw Hill Education.

**Note: The paper setter will set the paper as per the question paper templates provided.**

| B. Tech. 8TH Semester Mechanical Engineering | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MEO-406** | **CONCURRENT ENGINEERING** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | The objective of this course is to familiarize students with the concepts, approaches and implementation techniques related to concurrent engineering. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to describe the basic concepts of concurrent engineering and implement concurrent engineering techniques. | | | | | | |
| **CO2** | Students will be able to identify the concept of life cycle management. | | | | | | |
| **CO3** | Students will be able to analyze reengineering and system engineering approaches and processes. | | | | | | |
| **CO4** | Students will be able to appraise different information modeling systems and product realization taxonomy. | | | | | | |

**UNIT – I**

**Concurrent engineering concept:** Concurrent engineering definitions, basic principles of CE, components of CE, concurrency and simultaneity, modes of concurrency, modes of cooperation, CE design methodologies, benefits of concurrent engineering,

**Review of CE technique:** Design for manufacture (DFM), design for assembly (DFA), quality function deployment (QFD), rapid prototyping (RP), total design (TD), organizing for CE, CE tool box.

**UNIT – II**

**Life-cycle management:** Introduction, shrinking life-cycle, product development cycle, product-life cycle, life-cycle management, new product introduction, strategic technology insertions, managing continuity, managing revision changes, life-cycle cost drivers, life-cycle management tools, sequential versus concurrent engineering.

**UNIT – III**

**Process-reengineering:** Introduction, understanding and managing change, reengineering approaches work-flow mapping, information flow-charting, process improvement methodology, change management methodology, concurrent process reengineering.

**System engineering:** System engineering process, systems thinking, approaches to system complexity, sharing and collaboration in CE, system integration, management and reporting structure.

**UNIT – IV**

**Information modeling systems:** Information modeling, modeling methodology, foundation of information modeling, concurrent engineering process invariant, enterprise model-class, specification model-class, product model-class, process model-class, cognitive models, merits and demerits.

**Product realization taxonomy:** Development methodology for CPRT, concurrent product realization taxonomy, pull system of product realization, description of parallel tracks, description of 2-T loops, description of 3-T loop.

**Text Books:-**


1. Concurrent Engineering Fundamental, (Vol 1) integrated Product and Process Organization - Biren Prasad.
2. Concurrent Engineering - G.S. SAWHNEYUNIVERSITY SCIENCE PRESS (An Imprint of Laxmi Publications Pvt. Ltd.) An ISO 9001:2008 Company.
3. Concurrent Engineering Fundamentals: Integrated Product Development - Prasad, Prentice hall India


**Reference Books:**


1. Design for Concurrent Engineering - J. Cleetus, CE Research Centre, Morgantown
2. Concurrent Engineering in Product Design and Development - I. Moustapha, New Age International
3. Concurrent Engineering: Automation Tools and Technology - Andrew Kusiak - , Wiley Eastern


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| B. Tech. (8th Semester) Mechanical Engineering | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MEO-408** | **LUBRICANTS AND LUBRICATION** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | The purpose of the course is to make the students aware of the different properties and composition of lubricants and understand the fundamental concepts of hydrodynamic, hydrostatic and extreme pressure lubrication. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to describe properties and composition of lubricants. | | | | | | |
| **CO2** | Students will be able to understand the basics of hydrodynamic lubrication and analyse the thermal and non-Newtonian effects in hydrodynamic lubrication. | | | | | | |
| **CO3** | Students will be able to explain and analyze the hydrostatic lubrication, and extreme pressure lubrication at different temperature-load combinations. | | | | | | |
| **CO4** | Students will be able to understand and analyze the elastohydrodynamic lubrication. | | | | | | |

**UNIT-I**

**Physical properties of lubricants:** Introduction, relationship of viscosity with temperature, pressure and shear rate, viscosity index, viscosity measurement, viscosity of mixtures; Viscosity classification, thermal properties of lubricants, temperature characteristics of lubricants, neutralization number, carbon residue, optical properties, additive compatibility and solubility, lubricant impurities and contaminants.

**Lubricants and their composition**: Mineral oil based liquid lubricants – sources, types, synthetic oils – manufacturing of synthetic oils, hydrocarbon synthetic lubricants, silicon analogues of hydrocarbons, organohalogens; new developments in synthetic lubricants, emulsions and aqueous lubricants, greases, grease characteristics, lubricant additives.

**UNIT-II**

**Hydrodynamic lubrication:** Introduction, Reynolds equation, pressure distribution, load capacity, coefficient of friction, lubricant flow; converging diverging wedges, journal bearings, thermal effects in bearings, isoviscous and non-isoviscous thermal analysis, hydrodynamic lubrication with non-Newtonian fluids, squeeze films.

**UNIT–III**

**Hydrostatic lubrication:** Introduction, hydrostatic bearing analysis, general approach, optimization of bearing design, aerostatic bearings, stability.

**Extreme pressure lubrication:** Lubrication mechanisms for low temperature-low load, low temperature - high load, high temperature – medium load and high temperature – high load, boundary and EP lubrication of non-metallic surfaces.

**UNIT–IV**

**Elastohydrodynamic lubrication:** Introduction, contact stresses, geometry of contacting bodies, contact area, pressure, maximum deflection and position of maximum shear stress, EHL of lubricating films,

pressure distribution, film thickness formulae, effect of non-dimensional parameters, lubrication regimes, partial EHL, surface temperature at conjunction.

**Text books:**

1. Engineering Tribology - Gwidon W. Stachowiak, Andrew W. Batchelor, Butter worth, Heinemann.
2. Introduction to Tribology of Bearings - B.C. Majumdar, S. Chand Co.

**Reference books:**

1. Friction and Lubrication - E.P. Bowden and Tabor. D., Heinemann Educational Books Ltd.
2. Engineering Tribology - Ross Beckett, Larsen and Keller Education
3. Fundamentals of Fluid Film Lubrication - Bernard Hamrock, Bo Jacobson, and Steven R. Schmid, Taylor and Francis.

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| B. Tech. 8th Semester) Mechanical Engineering | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MEO-410** | **TOTAL QUALITY MANAGEMENT** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | The purpose of this course is to develop an understanding of quality management framework, philosophies, in-depth knowledge of various tools and techniques with their application in the manufacturing and service industry. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to understand quality management philosophies and frameworks. | | | | | | |
| **CO2** | Students will be able to describe various tools and techniques of quality management. | | | | | | |
| **CO3** | Students will be able to explain the applications of quality tools and techniques in both manufacturing and service industry | | | | | | |
| **CO4** | Students will be able to describe various quality systems like ISO and its standards. | | | | | | |

**UNIT-I**

**Introduction and philosophies of quality management:** introduction, need for quality ,evolution of quality, definitions of quality, dimensions of product and service quality, basic concepts of TQM, TQM framework, benefits, awareness and obstacles, quality, vision, mission and policy statements, contributions of Deming, Juran and Crosby , barriers to TQM, quality statements, customer focus, customer orientation, customer satisfaction, customer complaints, and customer retention, costs of quality.

**UNIT-II**

**Principles of quality management:** Leadership, strategic quality planning, quality councils, employee involvement, motivation, empowerment, team and teamwork, quality circles recognition and reward, performance appraisal, continuous process improvement , PDCA cycle, 5S, Kaizen , supplier partnership, partnering, supplier selection, supplier rating.

**Process capability:** Meaning, significance and measurement, six sigma concepts of process capability.

**UNIT–III**

**Tools and techniques for quality management**: Quality functions development (QFD), benefits, voice of customer, information organization, house of quality (HOQ), building a HOQ, QFD process.

**Failure mode effect analysis (FMEA):** Requirements of reliability, failure rate, FMEA stages, design, process and documentation, seven old (statistical) tools, seven new management tools, bench marking and POKAYOKE.

**UNIT–IV**

**Quality systems organizing and implementation:** Need for ISO: 9000, ISO: 9001-2008 quality system, elements, documentation, quality auditing, QS: 9000, ISO: 14000, concepts, requirements and benefits, TQM implementation in manufacturing and service sectors, quality audits, TQM culture.

**Text Books:**

1. Total Quality Management-Dale H. Besterfield, Pearson Education (First Indian Reprints 2004).

2. Total Quality Management-Shridhara Bhat K, Himalaya Publishing House, First Edition 2002.

**Reference Books:**

1. Competitive Manufacturing Management – John M. Nicholas, TMH.
2. Total Quality Management- R Kesavan, C Elanchezhian, B Vijaya Ramnath, IK International.
3. Total Quality Management: Principles, Methods, and Applications-Sunil Luthra, Dixit Garg, Ashish Agarwal, Sachin K. Mangla, CRC Press.
4. Total Quality Management-Poornima M. Charantimath, Pearson Pub.

**Note: The paper setter will set the paper as per the question paper template provided.**

| B. Tech. 8th Semester) Mechanical Engineering | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MEO-412** | **ENERGY CONSERVATION AND MANAGEMENT** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Objective** | To impart students, the knowledge of various energy management and conservation techniques, building audit and survey procedures for energy management. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to describe various renewable sources of energy and the technicalities, operating principles and classification of HVAC Systems. | | | | | | |
| **CO2** | Students will be able to describe the methodology of Site and Building Surveys. | | | | | | |
| **CO3** | Students will be able to explain various energy analysis techniques and the principle and classification of Process Energy. | | | | | | |
| **CO4** | Students will be able to discuss the implementation of various energy management techniques in building designs. | | | | | | |

**UNIT-I**

**Renewable energy:** Introduction; solar energy; wind energy; energy from water; energy from earth; energy from biomass.

**Heating, venting and air conditioning systems:** General principles; the requirements for human comfort; description of typical systems-dual duct HVAC system; multi zone HVAC systems: variable and volume systems, terminal repeat system, evaporative systems, package system; basic principle governing HVAC system, package system; energy management opportunities in HVAC systems; modeling of heating and cooling loads in buildings; problems.

**UNIT-II**

**Site and building surveys:** Phases involved in surveys: initiation phase, audit and analysis phase, implementation phase; general methodology for building and site energy audit; site survey: methodology, site survey-electrical system, steam and water systems; building survey: methodology, basic energy audit instrumentation, measurement for building surveys.

**UNIT-III**

**Energy analysis techniques:** Introduction; annual energy consumption; normalized performance indicators; time-dependent energy analysis; linear regression; single independent; correlation coefficients; multivariable analysis; CUSUM.

**Process energy:** General principles; process heat; energy saving in: condensate return, steam generation and distribution, automotive fuel control, hot water and water pumping; direct and indirect fired furnaces over process electricity; other process energy forms-compressed air and manufacturing processes; problems.

**UNIT-IV**

**Waste heat recovery:** Introduction, recuperative heat exchangers, heat exchanger theory; number of transfer units (NTU) concept, run-around coils, regenerative heat exchangers, heat pumps, energy

efficient heating: thermal comfort, building heat loss; U values, heat loss calculations, heating energy calculations; intermittent heating; radiant heat; radiant heating; low-emissivity glazing.

**Passive solar and low energy building design:** Introduction, passive solar heating, direct gain techniques, indirect gain techniques, isolated gain techniques, thermosiphon systems, passive solar cooling, shading techniques, solar control glazing, advanced fenestration, natural ventilation, thermal mass, night venting, termodeck, building form, building operation.

**Text Book:**


1. Energy Management and Conservation Handbook, Second Edition - Frank Kreith, D. Yogi Goswami.
2. Energy Management, Supply and Conservation, Second Edition - Clive Beggs
3. Energy Management Principles - Criag B. Smith, Published by Pergamon Press.
4. Energy Systems and Developments – Jyoti Parikh, Oxford University Press.


**Reference Books:**


1. Energy, Resources, Demand and Conservation with reference to India – Chaman Kashkari, Tata Mc Graw Hill Co. Ltd.
2. Integrated Renewable Energy for Rural Development–Proceedings of Natural Solar Energy Convention, Calcutta.


**Note: The paper setter will set the paper as per the question paper templates provided.**

| B. Tech. 8th Semester) Mechanical Engineering | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MEP-402** | **Non-Conventional Machining** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | This course provides comprehensive knowledge about the advanced technologies and different Non-conventional machining processes. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO 1** | Students will be able to compare conventional and non-conventional machining processes and recognize the need for Non-conventional machining processes. | | | | | | |
| **CO 2** | Students will be able to know about the constructional features, performance parameters, process characteristics, applications, advantages and limitations of USM. | | | | | | |
| **CO 3** | Students will be able to know about the constructional features, performance parameters, process characteristics, applications, advantages and limitations of AJM, WJM and AWJM. | | | | | | |
| **CO 4** | Students will be able to identify the need of chemical and electro-chemical machining processes along with the constructional features, process parameters, process characteristics, applications, advantages and limitations. | | | | | | |
| **CO 5** | Students will be able to explain the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM, LBM and EBM. | | | | | | |

**UNIT-I**

**Introduction to non-conventional machining:** Introduction to non-conventional machining(NCM) processes, characteristics of conventional machining processes, characteristics of non-conventional machining processes, need for development of non-conventional machining processes, comparison of conventional and non-conventional machining processes, , classification of non-conventional machining processes, history of non-conventional processes, advantages of non-conventional machining processes, disadvantages of non-conventional machining processes, applications of non-conventional machining processes.

**Ultrasonic machining (USM):** process principle, equipment, design consideration for tool, tool feed mechanism, abrasive slurry, Liquid media, operation of USM, process parameters, process capabilities, mechanics of cutting in USM applications of USM, advantages of USM, disadvantages of USM, Mechanics of cutting in USM, ultrasonic welding

**UNIT-II**

**Abrasive jet machining (AJM)**: process principle, equipment, process parameters, process capabilities, applications of AJM, advantages of AJM, disadvantages of AJM, Mechanics of cutting in AJM.

**Water jet machining (WJM):** process principle, equipment, process parameters, process capabilities, Metal removal rate, applications of WJM, advantages of WJM, disadvantages of WJM.
**Abrasive water jet machining (AWJM)**: process principle, equipment, process parameters, process capabilities, Metal removal rate, applications of AWJM, advantages of AWJM, disadvantages of AWJM.

**UNIT-III**

**Chemical machining:** Introduction, process principle, five steps of chemical machining, elements of process, Influence of etchant medium, selection of maskant and etchants, chemical blanking, accuracy of chemical blanking, applications of chemical machining, advantages of chemical machining, disadvantages of chemical machining, chemical milling, photochemical machining.
**Electrochemical machining (ECM):** classification of ECM processes, fundamental principles of ECM, elements of ECM process, electro-chemistry of ECM process, process parameters, process characteristics, tool design, accuracy, determination of metal removal rate, evaluation of metal removal rate of an alloy, surface finish and work material characteristics, economic consideration, advantage, limitation and application, basics of electrochemical grinding, deburring and honing.

**UNIT-IV**

**Electric discharge machining (EDM)**: Principal and metal removal mechanism, generators, electrode feed control, electrode material, tool electrode tool design, EDM wire cutting, surface finish, accuracy and application.
**Laser beam machining (LBM):** Introduction, generation of LASER, Equipment and mechanism of metal removal, LBM parameters and characteristics, Applications, Advantages & limitations.
**Electron beam machining (EBM):** Introduction, Principle, equipment and mechanism of metal removal, applications, advantages and limitations.

**Text Books:**


1. Unconventional Machining processes- T. Jagdeesha, I.K. International Publishing house
2. Advanced Machining processes- V.K. Jain, Allied Publishers private Ltd.
3. Unconventional Manufacturing process- M.K. Singh, New Age International
4. Modern machining processes – P.C. Pandey and M.S. Shan, TMH


**Reference Books:**


1. Non-traditional Manufacturing Processes –G.F. Benedict, Marcel Dekker,Inc.
2. Advanced Method of Machining –J.A. McGeough, Chapman and Hall.
3. Electrochemical Machining of Metals –Ruryantsev & Davydov, Mir Pub.


**Note: The paper setter will set the paper as per the question paper template provided.**

| B. Tech. (8th Semester) Mechanical Engineering | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MEP-404** | **AUTOMOBILE ENGINEERING** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | The objective of this course is to enable the students to understand various automobiles and their components. Also to describe the steering geometry, components and the mechanism involved in the automobile. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to understand the basics of the engine cylinder and functions of the clutch. | | | | | | |
| **CO2** | Students will be able to explain the working of the gearbox, transmission, and new safety features etc. | | | | | | |
| **CO3** | Students will be able to describe how the rear axle, brake systems and wheel operate. | | | | | | |
| **CO4** | Students will be able to understand the steering geometry and suspension system. | | | | | | |

**UNIT-I**

**Introduction:** Classification of automobile engines, use of engines, merits and demerits of vertical and horizontal engines, reasons for using single-cylinder two-stroke air-cooled petrol engine on two-wheelers, reasons for using multi-cylinder diesel engine for commercial vehicles, merits and demerits of two-stroke and four-stroke cycle engines, advantages of a multi-cylinder engine for the same power.

**Clutch:** Introduction, function of a clutch, main parts of a clutch, clutch types, clutch actuating mechanism, clutch construction, driven member-(friction or clutch disc), automatic transmission devices, troubleshooting/service procedures.

**UNIT-II**

**Gear box:** Introduction, type of gear boxes, three speed gearbox, merits and demerits of gear boxes, gear shifting mechanisms, epicyclic gearbox, gear reduction, overdrive, Maruti 800 gear box, five-speed gearbox, six speed gearbox.

**Propeller shaft, universal joint and other features:** Introduction, drive mechanism from gearbox to final drive in cars, propeller shaft (constructional features), shaft, universal joints, centre bearing in propeller shaft drive, propeller shaft, problems, ABS, GPS vehicle tracking, autonomous emergency braking (AEB), automatic transmission, electronic stability control (ESC), forward collision warning.

**UNIT-III**

**Rear axle assembly:** Introduction, purpose of the final drive, final drive requirements, the final drive, the differential, axle housing, maintenance of rear axle, troubleshooting in differentials.

**Brake system:** Introduction, functions of a brake, requirements of a brake system, brake actuating mechanism, leading and trailing shoes, classification of brakes, tandem master cylinder, drum brakes, self-energized brakes, disc brakes, floating-caliper brakes, power brakes, air-hydraulic brakes, air brake system, emergency and parking brakes.

**Wheel and tyre:** Introduction, types of automobile wheels, tyres, types of tyres, tyre tread, tyre selection, tyre service parameters, tyre maintenance.

**UNIT-IV**

**Suspension system:** Introduction, brief history, need for a good suspension system, stages in suspension system, elements of a suspension system, suspension systems, suspension system maintenance and troubleshooting, inspection and service of suspension system (general), troubleshooting of suspension systems.

**Steering and front axle:** Function of the steering system, steering gears, steering mechanisms used in some Indian vehicles, steering linkage, steering wheel and column, front axle, steering heads, steering geometry, wheel alignment, adjusting steering angles, Ackerman linkage, power Steering, under steering and over steering, steering lock, turning radius.

**Text Books:**

1. Automobile Engineering -By K.M. Gupta, Umesh Publications.
2. Automobile Engineering- Sudheer kumar, University Science Press.
3. Automobile Engineering- K.K Jain, Tata McGraw-Hill Publishing Company Limited.

**Reference Books:**

1. The Motor Vehicle - By Newton, Steeds and Garrett Basic.
2. Automobile Engineering - By Kirpal Singh, Standard Publication.

**Note: The paper setter will set the paper as per the question paper template provided.**

| B. Tech. (8th Semester) Mechanical Engineering | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MEP-406** | **PRODUCT DESIGN AND MANUFACTURING** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | The objective of the course is to understand the importance of design factors, manufacturing, assembly and environmental guidelines, prototyping and patenting requirements in product design, manufacturing, development and economics. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to describe the concept of product design, design considerations, design practiced by the industry, production and marketing, and aesthetics. | | | | | | |
| **CO2** | Students will be able to explain and apply manufacturing, assembly and environmental guidelines in product design, manufacturing and development. | | | | | | |
| **CO3** | Students will be able to apply the value engineering concepts in product designing and will be able to understand the application of prototyping in product design. | | | | | | |
| **CO4** | Students will be able to explain the patenting, and intellectual property. They will also be able to understand the manufacturing and economic aspects related to a product. | | | | | | |

**UNIT-I**

**Introduction:** Introduction to product design, design by evolution and innovation, essential factors of product design, production consumption cycle, flow and value addition in production consumption cycle, morphology of design (the seven phases)

**Product design practice and industry:** Product strategies, time to market, analysis of the product, the three s's, designer and his role, myth and reality, basic design considerations, problems faced by industrial designer, role of aesthetics in product design.

**UNIT-II**

**Design for manufacture and assembly:** Overview and motivation, basic method: design guidelines: design for assembly, design for piece part production, advanced method: manufacturing cost analysis, cost driver modeling, critique for design for assembly method.

**Design for the environment:** Environmental objectives, basic DFE methods, design guidelines, life cycle assessment, techniques to reduce environmental impact.

**UNIT-III**

**Value engineering:** Value, nature and measurement of value, maximum value, normal degree of value, importance of value, value analysis job plan, creativity, steps to problem solving and value analysis, value analysis tests, value engineering idea generation checklist, cost reduction through value engineering-case study, materials and process selection in value engineering.

**Prototyping:** Prototyping essentials, types of prototypes, uses of prototypes, reverse engineering, rapid prototyping techniques, scale, dimensional analysis, and similitude, basic method: physical prototype design and planning- guidelines for prototype design, sample prototype application, 3-D printing.

## UNIT-IV

**Patents and intellectual property:** What is intellectual property? Overview of patents, utility patents, invention disclosure.

**Product development economics:** Elements of economic analysis, base case financial model, sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.

**Text Books:**

1. Product Design and Development-Karl T. Ulrich and Steven D Eppinger, TMH.
2. Product Design and Engineering-A. K. Chitale and Gupta, PHI.

**Reference Books:**

1. Product Design and Process Engineering-Niebel and Draper, McGraw-Hill.
2. Product Design-Techniques in Reverse Engineering and New Product Development- Kevin Otto and Kristin Wood, Pearsons.

**Note: The paper setter will set the paper as per the question paper templates provided.**

| B. Tech. (8th Semester) Mechanical Engineering | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MEP-408** | **WELDING TECHNOLOGY** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | To expand the student's knowledge base and practical aspects in various areas of welding processes. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO 1** | Students will be able to explain the applications of welding and allied processes in various industries. | | | | | | |
| **CO 2** | Students will be able to select arc welding power source and process parameters based on particular applications. | | | | | | |
| **CO 3** | Students will be able to describe working of various gas welding equipment and will be able to suggest weld positions based on the application. | | | | | | |
| **CO 4** | Students will be able to test weld for different defects and learn about the performance of TIG welding of aluminium and MIG welding of steels. | | | | | | |

**UNIT-I**

**Introduction to welding technology:** History of metal-working, early developments in welding, development of modern welding, functions of welding in industries, application of welding in different industries

**Welding and allied processes:** Fusion welding, electric resistance welding, solid phase welding, braze welding, thermal cutting, thermal spraying, welding compared to riveting and casting.

**UNIT-II**

**Arc welding process and equipment:** Working principle of arc welding processes, static characteristics curves, open circuit voltage, current rating and duty cycles, classes of insulation, power factor.

Different types of AC and DC power sources, arc welding transformers; methods to control welding current in welding transformers, arc welding generators, arc welding rectifiers comparison of power source, factors for selection of power sources.

Special power sources; universal type, multi-operator type, solid state power source, inverter based multi-process power source units.

**UNIT–III**

**Gas welding process and equipment:** Working principle of gas welding process, gases used, welding flames, setup and equipment, gas cylinders, handling fuel and oxygen cylinders, pressure regulators, hoses, welding torch; selection of welding torch tip size, torch lighters, lighting equal pressure type torch, lighting injector type welding torch, torch adjustments, shutting off torch, torch position and movements, puddling, types of oxy-acetylene welds made without the use of welding rod and with the use of welding rod, selection of welding rod size, welding positions, trolleys, filler rod and fluxes, protective equipment and clothing.

## UNIT–IV

**Inspection and testing welds**: Non-destructive tests, destructive tests, visual inspection, magnetic particle inspection, liquid particle inspection, ultrasonic inspection, X-ray inspection, eddy current inspection, inspecting welds using pneumatic and hydraulic pressure, bend tests, impact tests, laboratory methods of testing welds

**TIG welding of aluminum and magnesium**: TIG equipment for aluminium, clean the parts using caustic cleaners and scouring pads, heat transfer in aluminium, aluminium arcing, balling tungsten, welding machine settings, striking the arc, aluminium weld procedure, square wave welders, TIG welding magnesium, TIG welding aluminium cylinder heads, weld fixture.

**MIG welding of steel and stainless steel**: Metal transfer modes, wire size, starting to MIG weld, aircraft seat welding, stress relieving, MIG welding tips, MIG welding stainless steel, backside protection, MIG welding titanium

**Text books:**


1. Welding Principle and Practices- Edward R. Bohnart, McGraw-Hill Publications.
2. Modern Arc Welding Technology -S.V. Nadkarni, Oxford and IBH Publishing Pvt. Ltd.
3. Modern Welding - Althouse, Goodheart Willcox co. Inc.
4. Performance Welding Handbook - Robert Finch, MBI publishing company.
5. Welding Processes and Technology - O.P. Khanna, Dhanpat rai publications
6. Welding Science and Technology- Ibrahim Khan, New Age International Publishers.
7. Welding Processes and Technology - R.S. Parmar, Khanna Publishers


**Reference books:**


1. Welding - A.C. Davies, Cambridge University Press.


**Note: The paper setter will set the paper as per the question paper template provided.**

| | B. Tech. (8th Semester) Mechanical Engineering | | | | | | |
|---|---|---|---|---|---|---|---|
| **MEP-410** | **DESIGN OF PRESSURE VESSELS AND PIPING** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | The course aims to impart basic knowledge of design of pressure vessels and piping system. It is also aimed to introduce various standards used for the pressure vessel design. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to analyze thin plates and shells for various types of stresses. | | | | | | |
| **CO 2** | Students will be able to design shells, end closures and tall cylinder columns of pressure vessels. | | | | | | |
| **CO 3** | Students will be able to explain the buckling and fracture in the pressure vessel. | | | | | | |
| **CO 4** | Students will be able to design piping systems and explain the piping code, behavior and support. | | | | | | |

**Unit-I**

**Stresses in pressure vessels:** General theory of membrane stresses in vessel under internal pressure and its application to shells (cylindrical, conical and spherical) and end closures, bending of circular plates and determination of stresses in simply supported and clamped circular plate, thermal stresses, stress concentration in plate having circular hole due to bi-axial loading, excessive elastic deformation, plastic instability, brittle rupture and creep, theory of reinforced opening and reinforcement limits.

**Unit-II**

**Design of vessels:** Design of tall cylindrical self-supporting process columns, supports for short vertical vessels, stress concentration: at a variable thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings, theory of reinforcement, pressure vessel design.

**Unit-III**

**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, control and significance of fracture mechanics in vessels, FEM application

**UNIT-IV**

**piping design:** Flow diagram, Piping layout and piping stress analysis; Flexibility factor and stress intensification factor; Design of piping system as per B 31.1 piping code. Piping components - bends, tees, bellows and valves. Types of piping supports and their behaviour; Introduction to piping Codes and Standards.

**Text Book:**


1. Theory and Design of Pressure Vessels-John F. Harvey, CBS Publishers and Distributors, 1987.
2. American Standard Code for Pressure Piping, B 31.1", ASME.

3. Pressure Vessel Design Handbook-Henry H Bednar, CBS publishers and distributors
4. Chemical Process Equipment, Selection and Design-Stanley M Wales, Butterworths, Series in Chemical Engineering, 1988. Elsevier.
5. Pressure Vessels: ASME Code Simplified-J. Phillip Ellenberger, ASME.
6. Fundamentals of Piping Design-Smith P, Elsevier.

**Reference Books:**

1. Pressure Vessels, Design Hand Book-Henry H. Bedner, CBS Publishers and Distributors, 1987.
2. Chemical Process Equipment, Selection and Design-Butterworths series in Chemical Engineering", Stanley, M. Wales, 1988
3. Pressure Vessel Design-Harvey J F, CBS Publication.
4. Process Equipment Design-Brownell L. E and Young. E. D, Wiley Eastern Ltd., India
5. ASME Pressure Vessel and Boiler Code-Section VIII Div. 1, 2, and 3", ASME.

**Note: The paper setter will set the paper as per the question paper template provided.**

| B. Tech (8th Semester) Mechanical Engineering | | | | | | | |
|---|---|---|---|---|---|---|---|
| **MEP-412** | **QUALITY AND RELIABILITY ENGINEERING** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | The purpose of this course is to provide students with an in-depth knowledge of quality and reliability. The course addresses the principles and techniques of Statistical Quality Control and their practical uses as well as give insight to modern reliability engineering tools. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Students will be able to understand the concept of quality value and engineering and application of statistical methods for quality control. The student will also be able to solve the problems related with dispersion of data. | | | | | | |
| **CO2** | Students will be able to understand different control charts and will solve the problems on control charts. They will also understand various sampling plans and design sampling plans. | | | | | | |
| **CO3** | Students will be able to explain the loss function and tolerance design for online quality control. They will come to know the concept of reliability and will be able to understand the mathematical derivations of different failure rates. | | | | | | |
| **CO4** | Students will be able to describe various hazard models and solve problems for finding reliability of complex systems. | | | | | | |

**UNIT-I**

**Quality value and engineering**: Quality systems, quality engineering in product design and production process, system design, parameter design, tolerance design, statistical methods for quality control and improvement, mean, median, mode, standard deviation, calculating area, Normal distribution tables, finding the Z score, Central limit theorem.

**UNIT-II**

**Variation in process:** Control charts for variables: X-bar and R charts, Control charts for attributes P, C and U-Chart, Establishing and interpreting control charts process capability, Quality rating, Short run SPC.

Acceptance sampling by variables and attributes, single, double, sequential and continuous sampling plans, design of various sampling plan.

**UNIT–III**

**Loss function, tolerance design:** N type, L type, S type; determination of tolerance for these types, online quality control – variable characteristics, attribute characteristics, parameter design.

**Concept and definition of reliability**: Reliability Parameters: Reliability as a function of time, failure rate as a function of time, Bath-tub curve, constant failure rate, increasing failure rate, mean time to failure (MTTF), MTTF as a function of failure rate, mean time between failure (MTBF), mean down time (MDT), maintainability & availability

**UNIT–IV**

**Brief discussion on hazard models:** Constant hazard model, linearly increasing hazard model, nonlinear hazard model and Weilbull distribution, Advantages of weibull distribution, System reliability models: series system, parallel system, series-parallel system

**Complex system:** Reliability of series, parallel & standby systems & complex systems & reliability prediction and system effectiveness, reliability testing

**Text books:**


1. Reliability Engineering, (3rdEdition) - LS Srinath, Affiliated East West Pvt Ltd, 1991..
2. Reliability Engineering- E. Bala Guruswamy, Tata McGraw Hill, 1994.
3. Statistical Quality Control- M. Mahajan, Dhanpat Rai & Co., 2018.
4. Statistical Process Control- Eugene Grant, Richard Leavenworth, McGraw Hill.


**Reference books:**


1. Introduction to Reliability Engineering- Lewis E. E., John Wiley & Sons - 1987
2. Reliability Based Design-Rao S. S., McGraw Hill - 1992
3. Practical Reliability Engineering- O'cconer P. D. T., John Wiley & Sons Ltd. - 2003
4. Statistical Quality Control-Eugene G. L., McGraw-Hill - 1996


**Note: The paper setter will set the paper as per the question paper template provided.**