Sardar Patel University, Balaghat (M.P.)

Curriculum

For

B.Tech.

Mechanical Engineering

From Session: 2024-25

SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Subject Name: Automobile Engineering Subject Code: BME061

Course: B.Tech. Branch: Mechanical Semester: VI Sem

Academic Session: 2024-25

Course Content

Course Objectives:

1. Identify chassis type, body types and vehicle design.
2. Review steering system, wheel geometry and stability of vehicles.
3. Demonstrate transmission system, torque converters and fluid coupling.
4. Discuss suspension system, braking system, wheel and tyres.
5. Illustrate electrical system, trouble shooting and control system of automobile.

UNIT – I

Chassis & Body Engineering: Types, Technical details of commercial vehicles, types of chassis, layout, types of frames, testing of frames for bending & torsion on unutilized body frame, vehicle body and their construction, driver's visibility and methods for improvement, safety aspects of vehicles, vehicle aerodynamics, front wheel and rear wheel drive, four-wheel drive.

UNIT – II

Steering System: front axle beam, stub axle, front wheel assembly, principles of types of wheel alignment, front wheel geometry viz. camber, Kingpin inclination, castor, toe for true rolling motion, center point steering, directional stabi cornering power, over steer & under steer.

UNIT – III

Transmission System: Function and types of clutches, clutch lining and bonding, double declutching, types of gear Boxes, synchronizer, gear materials, determination for gear ratio for vehicles, automatic transmission, torque converters, fluid coupling, principle of hydrostatic drive, propeller shaft, differential gear box, rear axle construction.

UNIT – IV

Suspension system: Basic suspension movements, independent front and rear suspension, shock absorber, type of springs, location of shackles, power calculations, resistance to vehicle motion during acceleration and breaking, power & torque curve, torque & mechanical efficiency at different vehicle speeds. Brakes: Principle of braking system, braking mechanism, mechanical and hydraulic brakes, power brakes, vacuum and air brakes.

Wheels and Tyers: Wheel drum, tyre, materials and manufacturing of tyers, trouble shooting and maintenance.

UNIT – V

Electrical and Control Systems: construction and operation of lead acid battery, principle of operation of starting mechanism, different drive systems, starter relay switch, regulator electric fuel gauge, horn, wiper, Lighting system, head light dazzling, exhaust gas recirculation, electronic

control unit (ECU), turbo charging, Multi valve engines. Introduction of the latest technological developments which are being used in I.C. Engines.

Note – One assignment should be given to study and write the User's Manual of any four-wheeler of your interest. **(Hand written)**

Suggested list of Practical

1. Study of different types of vehicle chassis (ladder frame, monocoque, etc.) and their construction.
2. Study of vehicle aerodynamics and analysis of drag forces on different vehicle shapes.
3. Study and measurement of wheel alignment parameters (camber, castor, toe, and Kingpin inclination) for a vehicle.
4. Study of different types of clutches (single-plate, multi-plate) and their components.
5. Study of the construction and working of a propeller shaft and differential gearbox.
6. Study of independent front and rear suspension systems, and comparison with non-independent systems.
7. Study of mechanical and hydraulic braking systems, and analysis of braking efficiency.
8. Study of the construction and operation of a lead-acid battery, including charging and discharging cycles.

Reference Books:

- Crouse, Automotive Mechanics TMH.
- Automobile Engg. TR Banga & Nathu Singh
- Srinivasan S; Automotive engines; TMH
- Automobile Engg. GBS Narang
- Joseph Heitner, Automotive Mechanics, Principles and Practices, CBS Pub.
- Kripal Singh, Automotive Engineering Khanna Pub.
- Newton & Steeds, Automotive Engineering
- Automotive Mechanics Heitner

Course Outcomes:

1. Identify and categorize different chassis and body types, and explain key factors involved in vehicle design.
2. Analyze the steering systems and wheel geometry, and evaluate the factors influencing vehicle stability.
3. Demonstrate an understanding of transmission systems, including the function and working principles of torque converters and fluid coupling.
4. Discuss the components and functions of the suspension and braking systems, as well as the selection and maintenance of wheels and tires.
5. Illustrate the structure and functionality of the automobile electrical systems, troubleshoot common issues, and describe the control systems used in modern vehicles.

SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Subject Name: Theory of Machines-II Subject Code: BME062

Course: B.Tech. Branch: Mechanical Semester: VI Sem

Academic Session: 2024-25

Course Content

Course Objectives:

CO1: Systematic design and optimization of mechanisms to perform specified tasks.
CO2: Analyze and understand the dynamics i. e. position, velocity and acceleration characteristics, of mechanisms such as linkage and cams.
CO 3: understand basics of gear geometry and design procedures.
CO 4: develop the required analytical and practical capabilities to understand the dynamic working of mechanical machines that include most basic mechanisms.
CO 5: use methods of vector kinematics to analyze the translation and rotational rigid bodies and explain with appropriate visualization.

UNIT – I

Turning Moment and Flywheel: Turning Moment Diagram for a Four Stroke Cycle I.C. Engine and Multi Cylinder Engine, Fluctuation of Energy and Production of Energy and Co-Efficient of Fluctuation of Energy, Co-Efficient of Fluctuation of Speed, Energy Stored in a Flywheel,

UNIT – II

Governors: Functions Various Terms Used, Types of Governors- Watt, Porter, Proell & Hartnell, Inertia Governor, Sensitiveness and Stability of Governor; Isochronous Governor, Hunting, Effort and Power of a Porter Governor, Controlling Force Diagrams for Porter and Spring Controlled Governor, Coefficient of Insensitiveness.

UNIT – III

Balancing of Inertia Forces and Moments in Machines: Balancing of rotating masses, two plane balancing, determination of balancing masses (graphical and analytical methods), balancing of rotors, balancing of internal combustion engines (single cylinder engines, in-line engines, V-twin engines, radial engines, Lanchester technique of engine balancing.

UNIT – IV

Friction: Frictional torque in pivots and collars by uniform pressure and uniform wear rate criteria. Boundary and fluid film lubrication, friction in journal and thrust bearings, concept of friction circle and axis, rolling friction. Clutches: Single plate and multi plate clutches, Cone clutches.

UNIT – V

Belt drives; Velocity ratio, limiting ratio of tension; power transmitted; centrifugal effect on belts, maximum power transmitted by belt, initial tension, creep; chain and rope drives; Brakes: Band brake, block brakes, Internal and external shoe brakes, braking of vehicles. Dynamometer: Different types and their applications.

Note – YouTube sessions may be arranged.

Suggested list of Practical

1. Construction of a turning moment diagram for a four-stroke cycle internal combustion engine.
2. Construction of a turning moment diagram for a multi-cylinder engine.
3. Calculation of energy stored in a flywheel for different speeds and loads.
4. Study of different types of governors (Watt, Porter, Proell, and Hartnell) and their working mechanisms.
5. Study of the characteristics of an Isochronous governor and the occurrence of hunting in governors.
6. Determination of balancing masses for rotating parts using graphical methods.
7. Measurement of frictional torque in pivots and collars under uniform pressure and uniform wear rate conditions.
8. Analysis of single-plate and multi-plate clutches to determine frictional torque.
9. Study of different types of dynamometers (mechanical, hydraulic, and electrical) and their applications in measuring power and torque.
10. Determination of velocity ratio, power transmitted, and centrifugal effects in belt drives.

Reference Books:

- Ambekar, AG; Mechanism and Machine Theory; PHI
- Rattan SS; Theory of machines; TMH
- Sharma and Purohit; Design of Machine elements; PHI
- Bevan; Theory of Machines;
- Ghosh and Mallik; Theory of Mechanisms and Machines; Affiliated East-West Press, Delhi
- Norton RL; kinematics and dynamics of machinery; TMH
- Grover; Mechanical Vibrations
- Balaney; Theory of Machines
- Theory of Vibrations by Thomson

Course Outcomes:

1. Apply systematic design principles and optimization techniques to develop mechanisms capable of performing specific tasks efficiently.
2. Analyze and interpret the dynamic behaviour of mechanisms, including position, velocity, and acceleration characteristics, with a focus on linkages and cams.
3. Understand the fundamental concepts of gear geometry and apply design procedures for gears in mechanical systems.
4. Develop analytical and practical skills to comprehend the dynamic operation of mechanical machines, emphasizing the functionality of basic mechanisms.
5. Utilize vector kinematics to analyze the translational and rotational motion of rigid bodies, enhancing understanding through appropriate visualizations.

SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Subject Name: Machine Design-I Subject Code: BME063

Course: B.Tech. Branch: Mechanical Semester: VI Sem

Academic Session: 2024-25

Course Content

Course Objectives:

CO1: To introduce the fundamentals of machine design and its application in real-world machines.
CO2: To impart knowledge on limits, fits, tolerances, and their role in precision manufacturing and assembly.
CO3: To develop skills in solid modelling and its application in design and manufacturing processes.
CO4: To familiarize students with engineering analysis techniques, focusing on finite element analysis (FEA) for solving mechanical problems.
CO5: To introduce quality control tools such as FMEA, process control plans, and strategies for creating zero-defect products in industrial applications.

Unit-I

Introduction Anatomy of machines; Functional dissection of motorcycle, washing machine, sewing machine, etc. into machine elements. Design considerations – Limits, fits and standardization; Friction and lubrication. Different assessing agencies in industries like TUV etc.

Introduction of Pre-control Plan, Process control plan, FMEA, DFMEA, Identify the error in process and design using Fish Bone Diagram and other approach.

Unit-II

Limits, Fit and Tolerances: Definitions; Tolerance zone and grades, Hole and shaft system, Geometric tolerances, Tylor's principle of gauging, Design of tolerances for various applications; Tolerance analysis in manufacturing and assembly; Role of metrology in Design of Manufacturing.

Unit-III

Solid Modelling: Solid modelling techniques – sweep (linear and curved), Boolean (constructive solid geometry) and other techniques; Solid model representation (Boundary and Constructive Solid Geometry); Medical modelling (pixels, scans and voxels); Exchange standards (IGES, DXF, STEP, STL etc.).

Unit-IV

Engineering Analysis: Introduction to finite element method; Principle of potential energy; FE analysis of 1D element problems (spring, bar, truss elements); Development of element stiffness equation and their assembly; Plain strain and plain stress problems; Domain discretization, pre-

processing and post-processing; Verification and validation; Popular CAE software used in industry.

Unit-V

Case Study: How the product is manufactured from raw materials to final product and what is the role of design engineer in creating the zero-defect products.

Reference Books:

- Machine Design: An Integrated Approach by Robert L. Norton
- Mechanical Tolerance Stackup and Analysis by Bryan R. Fischer
- Fundamentals of Solid Modeling and Graphics Communication by Gary R. Bertoline
- Finite Element Method: Its Basis and Fundamentals by O.C. Zienkiewicz, R.L. Taylor, and J.Z. Zhu
- Engineering Metrology and Measurements by R.K. Jain
- Product Design for Manufacture and Assembly by Geoffrey Boothroyd, Peter Dewhurst, and Winston A. Knight
- The Certified Quality Engineer Handbook by Donald W. Benbow and Ahmad K. Elshennawy
- Fundamentals of Machine Component Design by Robert C. Juvinall and Kurt M. Marshek

Course Outcomes (COs):

1. Understand the anatomy of machines by functionally dissecting common machines and recognizing the role of various machine elements in design.
2. Apply knowledge of limits, fits, and tolerances in the design and manufacturing processes, including tolerance analysis for optimized product performance.
3. Develop proficiency in solid modelling techniques and understand the role of model representation and data exchange standards in engineering applications.
4. Utilize finite element methods to analyze 1D element problems and apply them to real-world engineering challenges using CAE tools.
5. Implement process control methods like FMEA and pre-control plans to identify and eliminate errors in product design and manufacturing, ensuring zero-defect production.

SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Subject Name: Power Plant Engineering Subject Code: BME0641

Course: B.Tech. Branch: Mechanical Semester: VI Sem

Academic Session: 2024-25

Course Content

Course Objectives:

CO1: To provide knowledge of the fundamentals of power generation systems and their working principles.
CO2: To understand the operation, layout, and components of various types of power plants.
CO3: To study energy conversion processes and fuel utilization in thermal, hydroelectric, nuclear, and renewable energy-based power plants.
CO4: To explore modern trends in power plant technology, including efficiency improvement, environmental impact reduction, and smart grid integration.
CO5: To introduce economic analysis and safety considerations in power plant operations.

Unit I

Overview of power generation in the global and Indian context. Types of power plants: Thermal, Hydroelectric, Nuclear, and Renewable energy-based. General layout and components of power plants. Energy conversion processes and thermodynamic cycles used in power generation (Rankine, Brayton, and combined cycles). Introduction to smart grid technology.

Unit II

Steam Power Plants: General layout, working of boilers, superheaters, economizers, turbines, and condensers. Fuels used in thermal power plants and their properties. Combustion process and energy balance. Steam cycle efficiency and improvement techniques (reheating, regeneration).

Gas Turbine Power Plants: Layout and working, Brayton cycle, intercooling, reheating, and regeneration for efficiency improvement. Environmental impacts and emission control methods in thermal plants.

Unit III

Introduction and classification of hydroelectric power plants. Layout and components: Dams, reservoirs, turbines, penstocks, and spillways. Working principles of hydroelectric power generation. Pumped storage plants. Site selection and factors affecting the efficiency of hydro plants. Environmental impacts of hydroelectric power plants.

Unit IV

Introduction to nuclear energy and nuclear fission. Types of nuclear reactors: Pressurized Water Reactor (PWR), Boiling Water Reactor (BWR), and Breeder reactors. Nuclear fuel cycle, waste

disposal, and management. Nuclear power plant layout and components. Safety measures and radiation hazards. Current trends and future prospects in nuclear power generation.

Unit V

Solar Power Plants: Working principles of photovoltaic (PV) and concentrated solar power (CSP) plants. Solar energy conversion technologies.
Wind Power Plants: Layout, working principles of wind turbines, types of wind turbines, and factors affecting wind energy conversion.
Biomass Power Plants: Biomass combustion, gasification, and biogas generation technologies.
Geothermal and Ocean Energy Plants: Basics of geothermal energy extraction and ocean energy conversion systems (tidal, wave, OTEC).

Unit VI

Cost analysis of power generation: Initial investment, operating cost, and maintenance cost. Economic comparison of different power plants. Load curves, load factor, diversity factor, and their significance in power plant operation. Introduction to power plant safety: Hazard identification and risk assessment. Fire protection systems, occupational health and safety measures. Environmental regulations and sustainable power generation.

Reference Books:

- Power Plant Engineering by P.K. Nag.
- Power Plant Technology by M.M. El-Wakil.
- A Course in Power Plant Engineering by Arora and Domkundwar
- Nuclear Power Plants by J. Kenneth Shultis and Richard E. Faw.
- Renewable Energy Systems by Martin Kaltschmitt.
- Steam Power Plants by C.M. Feinstein.

Course Outcomes (COs):

1. Understand the working principles, layout, and components of thermal, hydroelectric, nuclear, and renewable energy power plants.
2. Analyze the energy conversion processes and thermodynamic cycles involved in power generation.
3. Evaluate the performance and efficiency of various power plants, considering fuel consumption, emissions, and waste management.
4. Apply modern techniques for improving power plant efficiency and reducing environmental impacts.
5. Conduct economic analysis and assess safety protocols for the operation of power plants.

SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Subject Name: Production Planning and Control Subject Code: BME0642

Course: B.Tech. Branch: Mechanical Semester: VI Sem

Academic Session: 2024-25

Course Content

Course Objectives:

1. To provide students with a fundamental understanding of production planning and control (PPC) in manufacturing and service industries.
2. To enable students to apply techniques for demand forecasting, production scheduling, and capacity planning.
3. To introduce the role of inventory management, materials requirement planning, and just-in-time (JIT) systems in production.
4. To explore the use of modern tools and software in production planning and control for enhanced productivity.
5. To equip students with knowledge of recent trends in lean manufacturing and agile production systems.

Unit I

Introduction to Production Planning and Control: Overview of PPC: Definition, objectives, and importance. Functions of PPC: Planning, routing, scheduling, dispatching, and follow-up. Types of production systems: Job shop, batch production, mass production, and continuous production. Role of PPC in different types of production systems.

Unit II

Demand Forecasting and Aggregate Planning: Demand forecasting: Purpose, methods (qualitative and quantitative), and accuracy assessment. Time series analysis, regression analysis, moving averages, and exponential smoothing. Aggregate planning: Objectives, strategies (chase, level, and mixed), and capacity management. Tools and techniques for aggregate planning.

Unit III

Inventory Control and Materials Requirement Planning (MRP): Inventory management: Objectives and importance. Types of inventories: Raw materials, work-in-progress (WIP), finished goods, and safety stock. Inventory control techniques: Economic order quantity (EOQ), ABC analysis, VED analysis, and FSN analysis. Introduction to Materials Requirement Planning (MRP) and its components. MRP calculations: Bill of materials (BOM), lead time, lot sizing, and MRP outputs. Recent trends: Just-in-Time (JIT) inventory systems, Kanban, and vendor-managed inventory (VMI).

Unit IV

Production Scheduling and Sequencing: Objectives and importance of scheduling in production systems. Scheduling techniques for job shop and batch production. Sequencing: Priority rules (FCFS, SPT, EDD), Johnson's rule for two-machine sequencing problems. Gantt charts and their application in production scheduling. Advanced scheduling tools: Finite Capacity Scheduling (FCS), Theory of Constraints (TOC), and their industrial applications.

Unit V

Capacity Planning and Control: Capacity planning: Short-term and long-term capacity decisions. Measurement of capacity and capacity utilization. Capacity planning techniques: Rough-cut capacity planning (RCCP) and capacity requirement planning (CRP). Balancing capacity with demand, bottleneck management, and theory of constraints. Case studies on capacity planning in manufacturing industries.

Unit VI

Modern Production Planning and Control Systems: Introduction to Lean Manufacturing: Principles, tools (5S, Kaizen, Value Stream Mapping), and benefits. Agile Manufacturing: Characteristics and application in modern industries. Integration of Enterprise Resource Planning (ERP) systems with PPC. Role of Information Technology (IT) and software tools in PPC (SAP, Oracle, etc.). Recent trends: Digital twins in manufacturing, Industry 4.0, and smart manufacturing.

Reference Books:

- Production Planning and Control: Text and Cases by S.C. Sharma.
- Production and Operations Management by Buffa and Sarin.
- Manufacturing Planning and Control for Supply Chain Management by Thomas E. Vollmann, William L. Berry, and David C. Whybark.
- Operations Management: Processes and Supply Chains by Lee J. Krajewski, Larry P. Ritzman, and Manoj K. Malhotra.
- Just-in-Time Manufacturing by Korgaonker.
- ERP: A Manager's Guide to Implementing Enterprise Resource Planning by Marianne Bradford.

Course Outcomes (COs):

1. Understand the concepts and importance of production planning and control in manufacturing systems.
2. Apply techniques of demand forecasting and aggregate planning for effective production management.
3. Analyze inventory control systems and material requirements planning (MRP) techniques.
4. Develop scheduling, sequencing, and capacity planning strategies for efficient production operations.
5. Implement modern production control systems like JIT, lean manufacturing, and ERP for improved productivity.

SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Subject Name: Turbo Machines Subject Code: BME0643

Course: B.Tech. Branch: Mechanical Semester: VI Sem

Academic Session: 2024-25

Course Content

Course Objectives:

CO1: Apply thermodynamics first, second law, energy and momentum equation in the turbo machinery, and classify the turbo machinery also.

CO2: Analyze the steam turbine by velocity and pressure compounding. Also analyze various efficiency associated in impulse and reaction stages.

CO 3: Classify water turbines and centrifugal pumps, access the performance and characteristics of these rotary equipment and analyze the vector diagrams of these equipment also

CO 4: Classify the rotary fans, blowers and compressors, analyze the vectors diagrams, efficiency and dimensional analyses etc.

CO 5: Demonstrates the power transmitting turbo machines with their application, discuss the characteristics and other performance parameter related to it.

UNIT – I

Energy transfer in turbo machines: application of first and second laws of thermodynamics to turbo machines, moment of momentum equation and Euler turbine equation, principles of impulse and reaction machines, degree of reaction, energy equation for relative velocities, one dimensional analysis only.

UNIT – II

Steam turbines: impulse staging, velocity and pressure compounding, utilization factor, analysis for optimum U.F Curtis stage, and Rateau stage, include qualitative analysis, effect of blade and nozzle losses on vane efficiency, stage efficiency, analysis for optimum efficiency, mass flow and blade height.

Reactions staging: Parson's stages, degree of reaction, nozzle efficiency, velocity coefficient, stator efficiency, carry over efficiency, stage efficiency, vane efficiency, conditions for optimum efficiency, speed ratio, axial thrust, reheat factor in turbines, problem of radial equilibrium, free and forced vortex types of flow, flow with constant reaction, governing and performance characteristics of steam turbines.

UNIT – VI

Water turbines: Classification, Pelton, Francis and Kaplan turbines, vector diagrams and work done draft tubes, governing of water turbines. Centrifugal Pumps: classification, advantage over reciprocating type, definition of mano-metric head, gross head, static head, vector diagram and work done.

Performance and characteristics: Application of dimensional analysis and similarity to water turbines and centrifugal pumps, unit and specific quantities, selection of machines, Hydraulic, volumetric, mechanical and overall efficiencies, Main and operating characteristics of the machines, cavitations.

UNIT – IV

Rotary Fans, Blowers and Compressors: Classification based on pressure rise, centrifugal and axial flow machines. Centrifugal Blowers Vane shape, velocity triangle, degree of reactions, slip coefficient, size and speed of machine, vane shape and stresses, efficiency, characteristics, fan laws and characteristics. Centrifugal Compressor- Vector diagrams, work done, temp and pressure ratio, slip factor, work input factor, pressure coefficient, Dimensions of inlet eye, impeller and diffuser. Axial flow Compressors- Vector diagrams, work done factor, temp and pressure ratio, degree of reaction, Dimensional Analysis, Characteristics, surging, Polytrophic and isentropic efficiencies.

UNIT – V

Power Transmitting turbo machines: Application and general theory, their torque ratio, speed ratio, slip and efficiency, velocity diagrams, fluid coupling and Torque converter, characteristics, Positive displacement machines and turbo machines, their distinction. Positive displacement pumps with fixed and variable displacements, Hydrostatic systems hydraulic intensifier, accumulator, press and crane.

Reference Books:

- Venkanna BK; Turbomachinery; PHI
- Shepherd DG; Turbo machinery
- Csanady; Turbo machines
- Kadambi V Manohar Prasad; An introduction to EC Vol. VI -Turbo machinery; Wiley Eastern Delhi
- Bansal R. K; Fluid Mechanics & Fluid Machines;
- Rogers Cohen & Sarvan Multo Gas Turbine Theory
- Kearton W. J; Steam Turbine: Theory & Practice

SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Subject Name: Internet of Things (IoT) Subject Code: BME0651

Course: B.Tech. Branch: Mechanical Semester: VI Sem

Academic Session: 2024-25

Course Content

Course Objectives:

1. To provide an introduction to IoT and its applications in mechanical engineering.
2. To understand the architecture, protocols, and technologies of IoT.
3. To learn how to integrate IoT with mechanical systems and smart manufacturing.
4. To apply IoT concepts in industrial automation, predictive maintenance, and data monitoring.

Unit I

Introduction to IoT and Applications: Introduction to the Internet of Things (IoT): Definitions, Scope, and Evolution. Components of IoT: Sensors, Actuators, and Controllers.
Applications of IoT in Mechanical Engineering: Smart Manufacturing (Industry 4.0), Industrial IoT (IIoT), Smart Maintenance and Monitoring of Machinery, Automated Vehicles and Robotics, Building Energy Management Systems.

Unit II

IoT Architecture and Technologies: IoT Architecture: Edge, Fog, and Cloud Computing. IoT Communication Models: Device-to-Device, Device-to-Gateway, and Device-to-Cloud. Networking and Communication Protocols for IoT: Wired and Wireless Technologies (Wi-Fi, Bluetooth, Zigbee, LoRa, 6LoWPAN, NB-IoT), IP-based Protocols: IPv6, MQTT, CoAP, HTTP. Data Acquisition and Management for IoT: Sensors, Signal Conditioning, Data Logging. Security and Privacy in IoT: Authentication, Data Encryption, and Threat Management.

Unit III

Sensors and Actuators for Mechanical IoT Applications: Types of Sensors Used in Mechanical Systems: Temperature, Pressure, Vibration, Position, Proximity, Flow Sensors. Strain Gauges, Accelerometers, Gyroscopes, and Load Cells. Actuators: Relays, Solenoids, Motors, and Control Valves. Integration of Sensors and Actuators in Mechanical Systems. Interfacing Sensors and Actuators with Microcontrollers (Arduino, Raspberry Pi).

Unit IV

IoT in Industrial Automation and Smart Manufacturing: Introduction to Industry 4.0 and Smart Factories. Role of IoT in Industrial Automation: Real-time Data Monitoring, Condition-based and Predictive Maintenance, Robotics and Machine-to-Machine (M2M) Communication.
Case Studies: IoT in CNC Machines, 3D Printing, and Assembly Lines. Supervisory Control and Data Acquisition (SCADA) Systems. Integration of IoT with PLM (Product Lifecycle Management) Systems.

Unit V

IoT Platforms and Cloud Integration: IoT Platforms for Data Analytics and Visualization (AWS IoT, Google Cloud IoT, IBM Watson IoT). Cloud Storage and Analytics for IoT Data. IoT Dashboards and Visualization Tools for Mechanical Systems. Real-time Monitoring and Control using IoT Platforms. Case Studies: Cloud-based Solutions for Predictive Maintenance and Remote Diagnostics.

Unit VI

IoT in Vehicle Engineering and Mobility: Introduction to Connected and Autonomous Vehicles. IoT in Fleet Management and Vehicle Health Monitoring. Integration of IoT with Telematics Systems. Role of IoT in Energy Efficiency and Emission Control in Vehicles. Case Study: IoT-based Traffic Management and Smart Parking Solutions.

Reference Books:

- Internet of Things: A Hands-on Approach by Arshdeep Bahga and Vijay Madisetti.
- Internet of Things (IoT): Principles, Paradigms, and Applications of IoT by Raj Kamal.
- Building the Internet of Things by Maciej Kranz.
- The Fourth Industrial Revolution by Klaus Schwab.
- Industrial Internet of Things: Cybermanufacturing Systems by Sabina Jeschke, Christian Brecher, Houbing Song.

Course Outcomes:

1. Explain the fundamentals of IoT and its components.
2. Understand various communication protocols and IoT platforms.
3. Integrate sensors and actuators with IoT devices for mechanical systems.
4. Develop IoT-based applications for industrial and mechanical systems.
5. Analyze data from IoT devices for predictive maintenance and real-time monitoring.

SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Subject Name: Basic Electronics Subject Code: BME0652

Course: B.Tech. Branch: Mechanical Semester: VI Sem

Academic Session: 2024-25

Course Content

Course Objectives:

1. To introduce the fundamentals of electronic components and circuits.
2. To understand the working of diodes, transistors, and operational amplifiers.
3. To learn the basics of digital electronics and its applications in mechanical systems.
4. To develop the ability to analyse and design simple electronic circuits relevant to mechanical engineering.

Unit I

Introduction to Electronics: Overview of electronics and its importance in mechanical engineering. Introduction to passive components: Resistors, Capacitors, and Inductors. Ohm's Law, Kirchhoff's Laws, and basic circuit analysis. Concept of voltage, current, and power in AC and DC circuits.

Unit II

Diodes and Applications: Semiconductor materials: P-N junction diode and its characteristics. Diode types: Zener, LED, Photodiode, and Schottky diodes. Applications of diodes: Rectifiers (Half-wave, Full-wave, Bridge), Clipping and Clamping circuits, Voltage regulation using Zener diodes. Introduction to Diode-based Sensors (IR sensors, Photodiodes).

Unit III

Bipolar Junction Transistors (BJT) and Field-Effect Transistors (FET): Bipolar Junction Transistor (BJT): Types (NPN, PNP), working principles, and characteristics. BJT Configurations: Common Emitter, Common Base, and Common Collector. Transistor as a switch and amplifier. Field-Effect Transistor (FET): Introduction, types (JFET, MOSFET), and characteristics. Application of transistors in mechanical control systems and actuators.

Unit IV

Operational Amplifiers and Their Applications: Introduction to operational amplifiers (Op-Amps). Ideal vs practical Op-Amp characteristics. Op-Amp configurations: Inverting, Non-Inverting, Summing Amplifier, Differential Amplifier. Applications of Op-Amps: Signal conditioning for sensors, Comparators, Integrators, and Differentiators, Voltage followers and amplifiers in control systems.

Unit V

Digital Electronics Basics: Number systems and binary arithmetic (binary, octal, hexadecimal). Logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR): Truth tables and applications. Boolean algebra and simplification of logic expressions. Introduction to combinational and sequential logic circuits: Adders, Subtractors, Multiplexers, Encoders, Decoders, Flip-Flops,

Counters, and Registers. Application of digital electronics in automation and mechanical control systems.

Unit VI

Introduction to Sensors and Actuators: Types of sensors used in mechanical systems: Temperature, Pressure, Proximity, Vibration, and Speed sensors. Working principles of common sensors (thermistors, strain gauges, piezoelectric sensors). Overview of actuators: Solenoids, Relays, DC and Stepper Motors. Integration of sensors and actuators in mechanical systems for control and automation.

Reference Books:

- Electronic Devices and Circuit Theory by Robert Boylestad and Louis Nashelsky.
- Integrated Electronics by Jacob Millman and Christos Halkias.
- Operational Amplifiers and Linear Integrated Circuits by Robert F. Coughlin and Frederick F. Driscoll.
- Digital Design by M. Morris Mano and Michael D. Ciletti.
- Basic Electronics for Scientists and Engineers by Dennis L. Eggleston.

Course Outcomes:

1. Understand the principles and functioning of basic electronic components.
2. Analyze and design electronic circuits using diodes, transistors, and op-amps.
3. Apply digital logic circuits in automation and control systems.
4. Utilize basic electronics knowledge in industrial applications, including sensors and actuators.

SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Subject Name: Electric Drive and Control Code: BME0653

Course: B.Tech. Branch: Mechanical Semester: VI Sem

Academic Session: 2024-25

Course Content

Course Objectives:

1. To understand the principles of electrical drives and their applications in mechanical systems.
2. To analyze different types of electric motors used in industrial drives.
3. To explore the control methods of electrical drives and their integration with mechanical systems.
4. To study the performance characteristics of electric drives under various load conditions.

Unit I

Fundamentals of Electrical Drives: Introduction to Electrical Drives: Definition, advantages, and applications in mechanical engineering. Basic components of an electric drive: Power converter, electric motor, control system, and load. Types of loads and drive characteristics: Speed-torque characteristics of mechanical loads, Steady-state and dynamic performance of electrical drives. Selection of drives based on mechanical system requirements: Torque, speed, power ratings.

Unit II

DC Drives: Types of DC motors: Series, shunt, and compound motors. Speed-torque characteristics of DC motors. Principles of DC motor control: Armature control and field control. Starting, braking, and speed control methods. Control of DC drives using power electronics: Controlled rectifiers, choppers. Applications of DC drives in mechanical systems: Elevators, rolling mills, cranes, etc.

Unit III

AC Drives: Introduction to AC motors: Induction motors and synchronous motors. Speed-torque characteristics of AC motors. Control methods for induction motors: Voltage control, frequency control, and voltage/frequency (V/F) control. Slip power recovery schemes. Introduction to synchronous motor drives. Control of AC drives using inverters and cycloconverters. Applications of AC drives in mechanical systems: Pumps, fans, conveyors, etc.

Unit IV

Stepper Motors and Servo Drives: Introduction to stepper motors: Types, construction, and operation. Stepper motor characteristics and control techniques. Introduction to servo motors: AC and DC servo motors. Servo motor control: Position, speed, and torque control. Application of stepper and servo drives in CNC machines, robotics, and automation systems.

Unit V

Power Electronics for Drives: Overview of power electronic converters used in electrical drives. Types of converters: Rectifiers, inverters, choppers, and cycloconverters. Introduction to Pulse

Width Modulation (PWM) techniques for drive control. Harmonics and power factor considerations in electrical drives. Energy-efficient drive systems and the role of power electronics in reducing energy consumption.

Unit VI

Control of Electrical Drives: Closed-loop control of electrical drives: Block diagram representation. Feedback control of speed and torque. Introduction to controllers: Proportional (P), Integral (I), Derivative (D), and PID control in drives. Digital control of electrical drives using microcontrollers and programmable logic controllers (PLCs). Industrial applications of electrical drives with control systems.

Reference Books:

- Fundamentals of Electric Drives by G.K. Dubey.
- Electric Drives: Concepts and Applications by Vedam Subrahmanyam.
- Power Electronics: Circuits, Devices, and Applications by Muhammad H. Rashid.
- Control of Electrical Drives by Werner Leonhard.
- Modern Power Electronics and AC Drives by Bimal K. Bose.

Course Outcomes:

1. Understand the working principles of different types of electrical drives.
2. Analyze and select suitable electrical drives for specific mechanical applications.
3. Implement control techniques for efficient operation of electric drives.
4. Integrate electrical drives with mechanical systems for automation and industrial applications.

SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Subject Name: Minor Project Subject Code: BME067P

Course: B.Tech. Branch: Mechanical Semester: VI Sem

Academic Session: 2024-25

Course Content

Course Objectives:

1. To provide students with a comprehensive experience for applying the knowledge gained so far by studying various courses.
2. To develop an inquiring aptitude and build confidence among students by working on solutions of small industrial problems.
3. To give students an opportunity to do something creative and to assimilate real life work situation in institution.
4. To adapt students for latest development and to handle independently new situations.
5. To develop good expressions power and presentation abilities in students.

The focus of the Major Project is on preparing a working system or some design or understanding of a complex system using system analysis tools and submit it the same in the form of a write up i.e. detail project report. The student should select some real-life problems for their project and maintain proper documentation of different stages of project such as need analysis market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan. Each student is required to prepare a project report and present the same at the final examination with a demonstration of the working system (if any)

Working schedule: The faculty and student should work according to following schedule: Each student undertakes substantial and individual project in an approved area of the subject and supervised by a member of staff. The student must submit outline and action plan for the project execution (time schedule) and the same be approved by the concerned faculty.
Action plan for Major Project work and its evaluation scheme

Task/Process	Week	Evaluation	Marks For Term Work
Orientation of students by HOD/Project Guide	1st	-	-
Literature survey and resource collection	2nd	-	-
Selection and finalization of topic before a committee*	3rd	Seminar-I	5

Detailing and preparation of Project (Modeling, Analysis and Design of Project work	4th to 5th	0	5
Development stage	-	-	-
Testing, improvements, quality control of project	6th to 10th 11th		5
Acceptance testing	12th	-	-
Report Writing	13th to 15th	-	5
Presentation before a committee (including user manual, if any)	16th	Seminar-II	10

* Committee comprises of HOD, all project supervisions including external guide from industry (if any) # The above marking scheme is suggestive, it can be changed to alternative scheme depending on the type of project, but the alternative scheme should be prepared in advance while finalizing the topic of project before a committee and explained to the concerned student as well.

NOTE: At every stage of action plan, students must submit a write up to the concerned guide:

SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Subject Name: Seminar and Group Discussion Subject Code: BME068P

Course: B.Tech. Branch: Mechanical Semester: VI Sem

Academic Session: 2024-25

Course Content

Course Objectives:

1. To develop students' skills in researching, analysing, and presenting technical topics.
2. To encourage independent learning and critical thinking on contemporary issues in mechanical engineering.
3. To enhance communication skills, both verbal and written, within a technical context.
4. To foster teamwork and collaboration among students.

Unit-I

Introduction to Seminar Course: Overview of seminar objectives, expectations, and evaluation criteria. Guidelines for selecting seminar topics. Introduction to research methodologies and sources of information.

Topic Selection and Approval: Students select seminar topics based on recent trends in mechanical engineering, industry developments, or research interests. Approval of selected topics by the faculty supervisor.

Unit-II

Research and Literature Review: Conducting a literature review on the chosen topic. Identifying key papers, articles, patents, and industry reports relevant to the topic. Understanding the state-of-the-art and challenges in the selected area.

Unit-III

Seminar Outline and Draft Preparation: Preparing an outline of the seminar, including key points, objectives, and structure. Developing a draft of the seminar presentation and report. Faculty feedback and revisions.

Presentation Skills and Visual Aids: Workshops on effective presentation techniques, including body language, voice modulation, and audience engagement. Training on creating effective visual aids (PowerPoint, posters, etc.). Practice sessions for peer and faculty feedback.

Unit-IV

Seminar Presentations (Part 1): Students present their seminars in front of peers and faculty members. Each presentation followed by a Q&A session to test the depth of understanding. Peer and faculty evaluation based on content, delivery, and engagement.

Seminar Presentations (Part 2): Continuation of student presentations. Emphasis on improving based on feedback from earlier sessions.

Unit-V

Report Writing and Submission: Preparing a comprehensive technical report based on the seminar topic. Guidelines for structuring the report: Abstract, introduction, methodology, findings, conclusion, and references. Submission of the final report for evaluation.
Feedback and Reflection: Individual feedback sessions with faculty on seminar performance. Reflection on strengths and areas for improvement in research and presentation skills. Discussion on how to apply these skills in future academic and professional settings.

Reference Books:

- The Craft of Research by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams
- Engineering Communication: A Practical Guide to Workplace Communications for Engineers by David Ingre
- Technical Communication: A Practical Approach by William S. Pfeiffer
- Presentation Zen: Simple Ideas on Presentation Design and Delivery by Garr Reynolds
- How to Write and Publish a Scientific Paper by Robert A. Day and Barbara Gastel
- A Student's Guide to Presentations: Making Your Presentation Count by Barbara Chivers and Michael Shoolbred

Course Outcomes:

1. Demonstrate the ability to research and understand a specific mechanical engineering topic.
2. Present technical content effectively using appropriate visual aids and communication techniques.
3. Engage in technical discussions, provide constructive feedback, and respond to questions confidently.
4. Prepare well-structured technical reports and documentation.

SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Subject Name: CFD Analysis (OpenFOAM/Fluent) Subject Code: BME069P

Course: B.Tech. Branch: Mechanical Semester: VI Sem

Academic Session: 2024-25

Course Content

Course Objectives:

1. To provide hands-on experience with CFD tools such as **OpenFOAM** and **ANSYS Fluent**.
2. To bridge the gap between theoretical knowledge and practical applications in the industry.
3. To develop skills in pre-processing, solving, and post-processing CFD problems.
4. To enable students to perform industry-relevant simulations and analyze the results for real-world applications.

Unit-I

Introduction to CFD and Software Overview: Overview of CFD, governing equations (Navier-Stokes), discretization methods. Introduction to OpenFOAM and Fluent interfaces. Setting up simple simulations in both software.

Meshing Techniques and Geometry Creation: Geometry creation in CAD tools and importing into OpenFOAM/Fluent. Grid generation and mesh quality assessment (structured and unstructured meshing). Hands-on with blockMesh and snappyHexMesh (OpenFOAM) and meshing in Fluent. Industrial relevance: Importance of meshing in product design and troubleshooting.

Unit-II

Steady-State Flow Simulation (Internal Flow): Problem setup: Simulation of pipe flow or duct flow (internal flow). Boundary conditions, solver settings, and convergence criteria. Simulation in OpenFOAM and Fluent. Industrial relevance: Flow through pipes, pumps, and valves.

External Aerodynamics Simulation: Simulation of external flow over objects (air-foil, cylinder, car body). Setting up incompressible and compressible flows in OpenFOAM and Fluent. Post-processing (pressure, velocity contours, lift and drag calculation). Industrial relevance: Aerodynamic design in automotive, aerospace industries.

Unit-III

Heat Transfer and Conjugate Heat Transfer (CHT) Analysis: Simulation of heat transfer in solid and fluid domains (e.g., heat exchanger). Understanding thermal boundary conditions in OpenFOAM/Fluent. Conjugate heat transfer problems and industrial applications. Industrial relevance: Heat exchangers, electronics cooling, HVAC systems.

Multiphase Flow Simulation: Introduction to multiphase flow: Eulerian and Lagrangian methods. Simulation of multiphase flows (e.g., bubble column, droplet breakup). Industrial relevance: Applications in oil and gas, chemical process industries.

Turbulence Modeling: Overview of turbulence models (RANS, LES, DNS). Simulating turbulent flows using standard turbulence models (k-ε, k-ω) in OpenFOAM/Fluent. Comparison of results with experimental data. Industrial relevance: Turbulence modeling in automotive, aerospace, and marine applications.

Unit-IV

Non-Newtonian Flow Simulation: Simulation of non-Newtonian flows (e.g., polymer flow, blood flow). Introduction to non-Newtonian fluid models in OpenFOAM and Fluent. Industrial relevance: Polymers, biofluid mechanics, food processing industries.

Compressible Flow Simulation: Simulation of compressible flows (e.g., nozzle flow, shock waves). Setup of compressible solvers in OpenFOAM and Fluent. Industrial relevance: Aerospace, gas turbine engines, supersonic flow.

Unit-V

CFD Optimization Techniques: Introduction to design optimization using CFD. Parametric studies and optimization of flow-related problems. Hands-on experience in setting up optimization cases. Industrial relevance: Product design and performance enhancement.

Case Study and Project Discussion: Introduction to industry-driven case studies (e.g., automobile aerodynamics, HVAC system design). Students to choose projects based on real-world problems. Industrial relevance: Collaborative approach to CFD projects in various sectors.

Final Project and Report Presentation: Students to present their final CFD projects. Focus on problem-solving, simulation setup, result interpretation, and report writing. Emphasis on technical documentation for industry standards.

Tools and Software:

- **OpenFOAM**: Open-source CFD tool for flow simulation.
- **ANSYS Fluent**: Commercial CFD software widely used in industries.
- **Gmsh/ParaView**: For geometry creation, meshing, and visualization of results.

Reference Books:

- Versteeg, H.K. & Malalasekera, W., An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson Education.
- Ferziger, J.H. & Peric, M., Computational Methods for Fluid Dynamics, Springer.
- Moukalled, F., Mangani, L., & Darwish, M., The Finite Volume Method in Computational Fluid Dynamics, Springer.