



Vishwabharati Academy's
COLLEGE OF ENGINEERING
Sarola Baddi, Jamkhed Road, AHMEDNAGAR-414201

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE OUTCOMES (CO's)

Semester VII

402041: Heating Ventilation Air-Conditioning and Refrigeration

- CO1. **ANALYSE** different air-craft refrigeration systems and **EXPLAIN** the properties, applications and environmental issues of different refrigerants.
- CO2. **ANALYSE** multi pressure refrigeration system used for refrigeration applications.
- CO3. **DISCUSS** types of compressors, condensers, evaporators and expansion valves along with regulatory and safety controls and **DESCRIBES** Trans critical and ejector refrigeration systems.
- CO4. **ESTIMATE** cooling load for air conditioning systems used with concern of design conditions and indoor quality of air.
- CO5. **DESIGN** air distribution system along with consideration of ventilation and infiltration.
- CO6. **EXPLAIN** the working of types of desiccants, evaporative, thermal storage, radiant cooling, clean room and heat pump systems.

402042: Dynamics of Machinery

- CO1. **APPLY** balancing technique for static and dynamic balancing of multi cylinder inline and radial engines.
- CO2. **ANALYZE** the gyroscopic couple or effect for stabilization of Ship, Airplane and Four wheeler vehicles.
- CO3. **ESTIMATE** natural frequency for single DOF un-damped & damped free vibratory systems.
- CO4. **DETERMINE** response to forced vibrations due to harmonic excitation, base excitation and excitation due to unbalance forces.
- CO5. **ESTIMATE** natural frequencies, mode shapes for 2 DOF un-damped free longitudinal and torsional vibratory systems.
- CO6. **DESCRIBE** noise and vibration measuring instruments for industrial / real life applications along with suitable method for noise and vibration control.

402043: Turbo machinery

- CO 1: **VALIDATE** impulse moment principle using flat, inclined and curved surfaces and **INVESTIGATE** performance characteristics of hydraulic turbines.
- CO 2: **DETERMINE** performance parameters of impulse and reaction steam turbine along with discussion of nozzles, governing mechanism & losses.

CO 3: **MEASURE** performance parameters of single & multistage centrifugal pumps along with discussion of cavitation and selection.

CO 4: **EXPLAIN** performance parameters of centrifugal compressor along with discussion of theoretical aspects of axial compressor.

402044: Elective – III

402044A: Automobile Design

CO1: **DESIGN** of Principal Engine Components

CO2: **DESIGN** of Drive train

CO3: **DESIGN** of brakes and Suspension

402044B: Design of Heat Transfer Equipment's

CO1: **EXPLAIN** the design aspect of heat exchanger considering fouling factor for Heat Transfer Applications

CO2: **SELECT** and **DESIGN** the double tube heat exchangers for process industry

CO3: **DESIGN** the Shell & Tube Heat Exchangers for specified conditions

CO4: **DESIGN** the condensers and evaporators for refrigeration applications

CO5: **DESIGN** the compact heat exchangers

CO6: **ANALYSE** the performance of counter and cross flow cooling tower.

402044C: Modern Machining Processes

CO1. **UNDERSTAND** and **ANALYZE** the mechanism, process parameters of mechanical assisted modern machining processes.

CO2. **UNDERSTAND** the mechanism, construction and working of laser, plasma and electron beam assisted machining.

CO3. **CLASSIFY** and **ANALYZE** the mechanism, process parameters of the chemical and electrochemical machining.

CO4. **RELATE** and **ANALYZE** the mechanism and select process parameters Electrical Discharge Machining for an application.

CO5. **ILLUSTRATE** the application of micromachining processes.

CO6. **SUGGEST** appropriate Nano machining process for the specific application.

402044D: Industrial Engineering

CO1. **EVALUATE** the productivity and **IMPLEMENT** various productivity improvement techniques.

CO2. **APPLY** work study techniques and **UNDERSTANDS** its importance for better productivity.

CO3. **DEMONSTRATE** the ability to **SELECT** plant location, appropriate layout and material handling equipment.

CO4. **USE** of Production is planning and control tools for effective planning, scheduling and managing the shop floor control.

CO5. **PLAN** inventory requirements and **EXERCISE** effective control on manufacturing requirements.
CO6. **APPLY** Ergonomics and legislations for human comfort at work place and **UNDERSTANDS** the role of value engineering in improving productivity.

402044E: Internet of Things

CO1. **EXPLAIN** the Applications/Devices, Protocols and Communication Models of IoT
CO2. **DEMONSTRATE** small Mechanical Engineering IoT oriented applications using Sensors, Actuators, Microcontrollers and Cloud
CO3. **SELECT** commonly used IoT Simulation Hardware platforms
CO4. **APPLICATION** of Interfacing and Communication Technologies for IoT
CO5. **ILLUSTRATE** IoT Application Development and Security of IoT Ecosystem
CO6. **EVALUATE** Present and Future Domain specific Applications of IoT Ecosystem

402044F: Computational Fluid Dynamics

CO1. **DISTINGUISH** and **ANALYZE** the governing equations of fluid mechanics and heat transfer in various formulations
CO2. **ANALYZE** and **MODEL** the conduction and advection problems
CO3. **ANALYZE** and **MODEL** the Convection-Diffusion problems
CO4. **IDENTIFY** and **EVALUATE** the External/Internal flow and its simulation
CO5. **DISTINGUISH** and **COMPARE** concepts of stability and turbulence.
CO6. **USE** and **APPLY** a CFD tool for effectively solving practical Fluid-Structure Interaction problems

402045: Elective – IV

402045A: Product Design and Development

CO1. **UNDERSTAND** Product design and Product development processes
CO2. **UNDERSTAND** Processes, tools and techniques for Market Survey & Product Specification Finalization
CO3. **UNDERSTAND** Processes, tools and techniques for Concept Inception, Verification and selection
CO4. **UNDERSTAND** Processes, tools and techniques for Concept Exploration & Development
CO5. **UNDERSTAND** Processes, tools and techniques for Design Verification and Validation
CO6. **UNDERSTAND** Processes, tools and techniques for Robust Design and Development

402045B: Experimental Methods in Thermal Engineering

CO1. **IDENTIFY** the suitable instrument for measuring parameters as per performance characteristics
CO2. **ANALYZE** experimental data by using different statistical techniques and estimate error
CO3. **DISTINGUISH** different methods of temperature measurements and thermal radiation
CO4. **CLASSIFY** various pressure measurement instruments and their comparison
CO5. **EXPLAIN** different flow measurement methods and flow visualization techniques
CO6. **APPLY** knowledge of modern engineering experimentation, including calibration, data acquisition, analysis and interpretation using different AI and ML techniques

402045C: Additive Manufacturing

CO1. **USE** and **CLASSIFY** the fundamentals of Additive Manufacturing Technologies for engineering applications.

CO2. **IDENTIFY** and **CATEGORIZE** the methodology to manufacture the products using light-based photo-curing, LASER based technologies and **STUDY** their applications, benefits.

CO3. **IDENTIFY** and **CATEGORIZE** the methodology to manufacture the products using extrusion-based deposition, inkjet-based technologies and **STUDY** their applications, benefits.

CO4. **SYNTHESIZE, RECOMMEND** and **DESIGN** the suitable material and process for fabrication and build behavior of varieties of product.

CO5. **DESIGN** and **CONSTRUCT** the AM equipment's for appropriate applications and the input CAD model.

CO6. **DEVELOP** the knowledge of additive manufacturing for various real-life applications.

402045D: Operations Research

CO1. **EVALUATE** various situations of Games theory and Decision techniques and **APPLY** them to solve them in real life for decision making.

CO2. **SELECT** appropriate model for queuing situations and sequencing situations and **FIND** the optimal solutions using models for different situations.

CO3. **FORMULATE** various management problems and **SOLVE** them using Linear programming using graphical method and simplex method.

CO4. **FORMULATE** variety of problems such as transportation, assignment, travelling salesman and **SOLVE** these problems using linear programming approach.

CO5. **PLAN** optimum project schedule for network models arising from a wide range of applications and for replacement situations find the optimal solutions using appropriate models for the situation.

CO6. **APPLY** concepts of simulation and Dynamic programming

402045E: Augmented Reality and Virtual Reality

CO1. **UNDERSTAND** fundamental Computer Vision, Computer Graphics and Human-Computer Interaction Techniques related to VR/AR

CO2. **UNDERSTAND** Geometric Modeling Techniques

CO3. **UNDERSTAND** the Virtual Environment

CO4. **ANALYZE** and **EVALUATE** VR/AR Technologies

CO5. **APPLY** various types of Hardware and Software in Virtual Reality systems

CO6. **DESIGN** and **FORMULATE** Virtual/Augmented Reality Applications

402046: Data Analytics Laboratory

CO1: **UNDERSTAND** the basics of data analytics using concepts of statistics and probability.

CO2: **APPLY** various inferential statistical analysis techniques to describe data sets and withdraw useful conclusions from acquired data set.

CO3: **EXPLORE** the data analytics techniques using various tools

CO4: **APPLY** data science concept and methods to solve problems in real world context

CO5: **SELECT** advanced techniques to conduct thorough and insightful analysis and interpret the results

402047: Project (Stage I)

- CO1. Implement systems approach.
- CO2. To conceptualize a novel idea / technique into a product.
- CO3. To think in terms of a multi-disciplinary environment.
- CO4. To take on the challenges of teamwork, and document all aspects of design work.
- CO5. To understand the management techniques of implementing a project.

Semester VIII

402048: Computer Integrated Manufacturing

- CO1. **EXPLAIN** CIM and factory automation.
- CO2. **UNDERSTAND** the integration of hardware and software elements for CIM
- CO3. **APPLY** CNC program for appropriate manufacturing techniques.
- CO4. **ANALYZE** processes planning, quality and MRP integrated with computers.
- CO5. **INTERPRET** flexible, cellular manufacturing and group technology.
- CO6. **ANALYZE** the effect of IOT, Industry-4.0 and cloud base manufacturing.

402049: Energy Engineering

- CO1: **EXPLAIN** the power generation scenario, the layout components of thermal power plant and **ANALYZE** the improved Rankin cycle.
- CO2: **ANALYZE** the performance of steam condensers, cooling tower system; **RECOGNIZE** an environmental impact of energy systems and methods to control the same.
- CO3: **EXPLAIN** the layout, component details of diesel engine plant, hydel and nuclear energy systems.
- CO4: **ANALYZE** gas and improved power cycles.
- CO5: **EXPLAIN** the fundamentals of renewable energy systems.
- CO6: **EXPLAIN** basic principles of energy management, storage and economics of power generation.

402050: Elective – V

402050A: Quality and Reliability Engineering

- CO1. **UNDERSTAND** basic concepts of quality and **RELATE** various quality tools
- CO2. **DEVELOP** analytical competencies to **SOLVE** problems on control charts and process capability.
- CO3. **UNDERSTAND** fundamental concepts of reliability.
- CO4. **EVALUATE** system reliability.
- CO5. **IDENTIFY** various failure modes and **CREATE** fault tree diagram.
- CO6. **UNDERSTAND** the concept of reliability centered maintenance and **APPLY** reliability tests methods.

402050B: Energy Audit and Management

- CO1. **EXPLAIN** the energy need and role of energy management
- CO2. **CARRY OUT** an energy audit of the Institute/Industry/Organization
- CO3. **ASSESS** the ENCON opportunities using energy economics
- CO4. **ANALYSE** the energy conservation performance of Thermal Utilities
- CO5. **ANALYSE** the energy conservation performance of Electrical Utilities
- CO6. **EXPLAIN** the energy performance improvement by Cogeneration and WHR method

402050C: Manufacturing System and Simulation

- CO1. **UNDERSTAND** the concepts of manufacturing system, characteristics, type, etc.
- CO2. **UNDERSTAND** the concepts of Facilities, manufacturing planning & control and Support System.
- CO3. **UNDERSTAND** the concepts of manufacturing towards solving productivity related problems.
- CO4. **DEVELOP** a virtual model to solve industrial engineering related issues such as capacity, utilization, line balancing.
- CO5. **BUILDING** tools to view and control simulations and their results.
- CO6. **PLAN** the data representation & evaluate the results of the simulation.

402050D: Engineering Economics and Financial Management

- CO1. **UNDERSTAND** the business environment, concepts of economics and demand-supply scenario.
- CO2. **APPLY** the concepts of costing and pricing to evaluate the pricing of mechanical components.
- CO3. **UNDERSTAND** accounting systems and analyze financial statements using ratio analysis
- CO4. **SELECT** and **PREPARE** the appropriate type of budget and understand the controlling aspects of budget.
- CO5. **UNDERSTAND** the international business and trade system functioning
- CO6. **DEMONSTRATE** understanding of financing decisions of new ventures and performance

402050E: Organizational Informatics

- CO1. **Demonstrate** an understanding of the scope, purpose and value of information systems in an organization.
- CO2. **Understand** the constituents of the information system.
- CO3. **Demonstrate** the Understanding of the management of product data and features of various PLM aspects.
- CO4. **Relate** the basic concepts of manufacturing system and the ERP functionalities in context of information usage.
- CO5. **Understand** the manufacturing execution system and it's applications in functional areas.
- CO6. **Outline** the role of the information system in various types of business and allied emerging technologies.

402050F: Computational Multi Body Dynamics

- CO1. **APPLY** the basic terminology and concepts used in Multibody Dynamics to solve varieties of motion related applications
- CO2. **IDENTIFY and EVALUATE** the types of joints, its kinematics and relevant transformations
- CO3. **DISTINGUISH and COMPARE** the formulation methods
- CO4. **DERIVE** equations of motion and **EVALUATE** the kinematics and dynamics of rigid Planar inter-connected bodies
- CO5. **DERIVE** equations of motion and **EVALUATE** the kinematics of rigid spatial inter-connected bodies
- CO6. **APPLY** MBD tool effectively and **SIMULATE** it to solve and validate practical Multibody Dynamics problems and its solutions

402051: Elective - VI

402051A: Process Equipment Design

- CO1. **INTERPRET** the different parameters involved in design of process Equipments.
- CO2. **ANALYZE** thin and thick walled cylinder
- CO3. **DESIGN** cylindrical vessel, spherical vessel, tall vessels and thick walled high pressure vessels
- CO4. **DESIGN** different process Equipments and select pump, compressor etc. and auxiliary services
- CO5. **EVALUATE** Process parameters and their correlation
- CO6. **APPLY** the concepts of process equipment design for specific applications

402051B: Renewable Energy Technologies

- 1. **DESCRIBE** fundamentals, needs and scopes of renewable energy systems.
- 2. **EXPLAIN** performance aspects of flat and concentric solar collectors along with applications.
- 3. **DESIGN** solar photovoltaic system for residential applications.
- 4. **DESIGN AND ANALYSIS** of wind energy conversion system.
- 5. **APPLY** Installation practices of Wind and Solar Photovoltaic Systems for grid connection.
- 6. **DETERMINE** performance parameters of bio-energy conversion systems.

402051C: Automation and Robotics

- CO1. **UNDERSTAND** the basic concepts of Automation
- CO2. **UNDERSTAND** the basic concepts of Robotics
- CO3. **IDENTIFY and EVALUATE** appropriate Drive for Robotic Applications
- CO4. **COMPARE and SELECT** End-effectors and Sensors as per Application
- CO5. **DEVELOPE** the Mathematical Modeling Approaches of Robot
- CO6. **EVALUATE** the fundamentals of robot programming and **CLASSIFY** the Applications

402051D: Industrial Psychology and Organizational Behavior

- CO1. **DEMONSTRATE** fundamental knowledge about need and scope of industrial - organizational psychology and behavior.
- CO2. **ANALYZE** the job requirement, have understanding of fatigue, boredom and improve the job satisfaction.
- CO3. **UNDERSTAND** the approaches to enhance the performance.
- CO4. **KNOWLEDGE** of theories of organizational behavior, learning and social-system.
- CO5. **UNDERSTAND** the mechanism of group behavior, various aspects of team, leadership and conflict management.
- CO6. **EVALUATE** the organizational culture, manage the change and understands organizational development approaches.

402051E: Electric and Hybrid Vehicle

- CO1. **UNDERSTAND** the basics related to e-vehicle
- CO2. **CLASSIFY** the different hybrid vehicles
- CO3. **IDENTIFY** and **EVALUATE** the Prime Movers, Energy Storage and Controllers
- CO4. **DISCOVER** and **CATAGORIZE** the Electric Vehicle Configuration with respect to Propulsion, Power distribution and Drive-Train Topologies
- CO5. **DEVELOP** body frame with appropriate suspension system and **TESTING** of for e-Vehicles
- CO6. **CLASSIFY** and **EVALUATE** Battery Charging techniques and management

402052: Mechanical Systems Analysis Laboratory

- CO1. **DEVELOP** an understanding of the Systems Engineering Process and the range of factors that influence the product need, problem-specific information collection, Problem Definition, Task Specification, Solution Concept inception, Concept Development, System's Mathematical Modelling, Synthesis, Analysis, final solution Selection, Simulation, Detailed Design, Construction, Prototyping, Testing, fault-finding, Diagnosis, Performance Analysis, and Evaluation, Maintenance, Modification, Validation, Planning, Production, Evaluation and use of a system using manual calculation, computational tools
to automate product development process, redesign from customer feedback and control of technological systems.
- CO2. **ILLUSTRATE** the concepts and **USE** the developed skill-set of use of computational tools (FEA, CFD, MBD, FSI, and CAE) to automate the complete product development process.
- CO3. **EVALUATE** the knowledge of new developments and innovations in technological systems to carry forward to next stage of employment after passing your Undergraduate Degree Examination.
- CO4. **APPRAISE** how technologies have transformed people's lives and can be used to **SOLVE** challenges associated with climate change, efficient energy use, security, health, education and transport, which will be coming your ways in the coming future.
- CO5. **PRIORITIZE** the concept of quality and standards, including systems reliability, safety and fitness for the intended purpose.
- CO6. **INVENT** yourself to face the challenges of future technologies and their associated Problems.

402053: Project (Stage II)

CO1. Implement systems approach.

CO2. To conceptualize a novel idea / technique into a product.

CO3. To think in terms of a multi-disciplinary environment.

CO4. To take on the challenges of teamwork, and document all aspects of design work.

CO5. To understand the management techniques of implementing a project.