**COURSES OUTCOMES**

## Semester I

### 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 **DESCRIBE** 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 andradial engines.

CO2.**ANALYZE** the gyroscopic couple or effect for stabilization of Ship, Airplane and Fourwheeler vehicles.

CO3.**ESTIMATE** natural frequency for single DOF un-damped & damped free vibratorysystems.

CO4.**DETERMINE** response to forced vibrations due to harmonic excitation, base excitation andexcitation due to unbalance forces.

CO5.**ESTIMATE** natural frequencies, mode shapes for 2 DOF un-damped free longitudinal andtorsional vibratory systems.

CO6.**DESCRIBE** noise and vibration measuring instruments for industrial / real life applications along with suitable method for noise and vibration control.

**402043: Turbomachinery**

CO1: **VALIDATE** impulse moment principle using flat, inclined and curved surfaces and **INVESTIGATE** performance characteristics of hydraulic turbines.

CO2: **DETERMINE** performance parameters of impulse and reaction steam turbine along with discussion of nozzles, governing mechanism & losses.

CO3: **MEASURE** performance parameters of single & multistage centrifugal pumps along with discussion of cavitation and selection.

CO4: **EXPLAIN** performance parameters of centrifugal compressor along with discussion of theoretical aspects of axial compressor.

**402044A: Automobile Design**

CO1:**COMPREHEND** the steps involved in the design process of Principal Engine Components.CO2:**GAIN** the knowledge and design of Engine Sub-Systems.

CO3:**COMPUTE** the critical dimensions of chassis components involved in the Steering System and Differential and final drive of a vehicle.

CO4:**SELECT** the tyres and wheels required for automobile vehicle and design the various types automotive brakes.

CO5:**UNDERSTAND** the design concepts of Automotive Suspension system

CO6:**POSSES** the knowledge of Vehicle Packaging and System Integration, NVH.

**402044B: Design of Heat Transfer Equipments**

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**

**Course Outcomes**

On completion of the course, learner will be able to

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 electronbeam assisted machining.

CO3. **CLASSIFY** and **ANALYZE** the mechanism, process parameters of the chemical andelectrochemical 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 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** therole of value engineering in improving productivity.

## 402044E: Internet of Things

CO1. **EXPLAIN** the Applications/Devices, Protocols and Communication Models of IoT

CO2. **DEMONSTARTE** small Mechanical Engineering IoT oriented applications usingSensors, 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 **ANALYSE** the governing equations of fluid mechanics and heattransfer 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 Interactionproblems

### 402045A: Product Design and Development

CO1. **UNDERSTAND** Product design and Product development processes

CO2. **UNDERSTAND** Processes, tools and techniques for Market Survey & ProductSpecification Finalization

CO3. **UNDERSTAND** Processes, tools and techniques for Concept Inception, Verification andselection

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 performancecharacteristics

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, dataacquisition, 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 forfabrication and build behavior of verities of product.

CO5. **DESIGN** and **CONSTRUCT** the AM equipment's for appropriate applications and theinput 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 Linearprogramming using graphical method and simplex method.

CO4. **FORMULATE** variety of problems such as transportation, assignment, travellingsalesman 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 usingappropriate 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 andwithdraw 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 interpretthe results

**402047: Project (Stage I)**

CO1. **IMPLEMENT** systems approach.

CO2. **CONCEPTUALIZE** a novel idea / technique into a product.

CO3. **THINK** in terms of a multi-disciplinary environment.

CO4. **TAKE ON** the challenges of teamwork, and **DOCUMENT** all aspects of design work.

CO5. **UNDERSTAND** the management techniques of implementing a project.

CO6. **DEMONSTRATE** the final product for Functionality, Designability, & Manufacturability.

# Semester II

**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 plantand **ANALYZE** the improved Rankine 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 energysystems.

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 powergeneration.

**402050A: Quality & Reliability Engineering**

On completion of the course the learner will be able to:

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 SupportSystem.

CO3. **UNDERSTAND** the concepts of manufacturing towards solving productivity relatedproblems.

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-supplyscenario.

CO2.**APPLY** the concepts of costing and pricing to evaluate the pricing of mechanicalcomponents.

CO3.**UNDERSTAND** accounting systems and analyze financial statements using ratioanalysis

CO4.**SELECT** and **PREPARE** the appropriate type of budget and understand the controllingaspects 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 inan organization.

CO2. Understand the constituents of the information system.

CO3. Demonstrate the Understanding of the management of product data and features of variousPLM aspects.

CO4. Relate the basic concepts of manufacturing system and the ERP functionalities in contextof 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 solvevarieties of motion related applications

CO2. **IDENTIFY and EVALUATE** the types of joints, its kinematics and relevanttransformations

CO3. **DISTINGUISH and COMPARE** the formulation methods

CO4. **DERIVE** equations of motion and **EVALUATE** the kinematics and dynamics of rigidPlanar 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 practicalMultibody Dynamics problems and its solutions

## 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 highpressure vessels

CO4. **DESIGN** different process Equipments and select pump, compressor etc. andauxiliary services

CO5. **EVALUATE** Process parameters and their correlation

CO6. **APPLY** the concepts of process equipment design for specific applications

## 402051B: Renewable Energy Technologies

CO1. **DESCRIBE** fundaments, needs and scopes of renewable energy systems.

CO2. **EXPLAIN** performance aspects of flat and concentric solar collectors along withapplications.

CO3. **DESIGN** solar photovoltaic system for residential applications.

CO4. **DESIGN AND ANALYSIS** of wind energy conversion system.

CO5. **APPLY** Installation practices of Wind and Solar Photovoltaic Systems for grid connection.

**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. To develop an understanding of the nature, functioning and design of organization as social collectivities.

CO2. To orient the students to the application of principles of psychology in an industrial and organizational workplace

CO3. To demonstrate the understanding of job requirement and related fatigue, boredom and ways to handle it.

CO4. To develop the insights into performance management and understanding related improvement strategies.

CO5. To have an understanding of human behavior in groups and develop knowledge and skills in leadership, power, communication, negotiation and conflict management.

CO6. To develop the acumen to understand the organizational culture, change management and organizational development.


**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 toPropulsion, 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 oftechnological systems.

CO2. **ILLUSTRATE** the concepts and USE the developed skill-set of use of computational tools (FEA, CFD, MBD, FSI, 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. **CONCEPTUALIZE** a novel idea / technique into a product.

CO3. **THINK** in terms of a multi-disciplinary environment.

CO4. **TAKE ON** the challenges of teamwork, and **DOCUMENT** all aspects of design work.

CO5. **UNDERSTAND** the management techniques of implementing a project.

CO6. **DEMONSTRATE** the final product for Functionality, Designability, and Manufacturability.