

**Departments of Mechanical Engineering**

**Class: B.E**

**Program Outcome (PO's)**

At the end of the program, the graduates of B.E. Mechanical engineering department students have got following knowledge.

1. **Engineering Knowledge:** Utilized the principles of mathematics, science, and engineering fundamentals, along with specialized knowledge in a mechanical engineering field, to address intricate mechanical engineering challenges and devise effective solutions.
2. **Problem analysis:** Employed the skills to identify, formulate, review research literature, and analyze intricate engineering problems, resulting in substantiated conclusions drawn from the foundational principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Crafted solutions for intricate engineering problems and designed system components or processes that fulfilled specified requirements, all while giving due consideration to public health and safety, as well as cultural, societal, and environmental factors
4. **Conduct investigations of complex problems:** Applied research-based knowledge and methodologies, including the design of experiments, analysis and interpretation of data, and synthesis of information, to derive valid conclusions.
5. **Modern tool usage:** Utilized and applied appropriate techniques, resources, as well as modern engineering and IT tools, including prediction and modeling, to conduct complex engineering activities, acknowledging and understanding their limitations.
6. **The engineer and society:** Applied reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues, recognizing the associated responsibilities relevant to professional engineering practice.
7. **Environment and sustainability:** Demonstrated an understanding of the impact of professional engineering solutions in societal and environmental contexts, and exhibited knowledge of the necessity for sustainable development.
8. **Ethics:** Applied ethical principles, committed to professional ethics and responsibilities, and adhered to norms of engineering practice.
9. **Individual and team work:** Functioned effectively as an individual and as a member or leader in diverse teams, as well as in multidisciplinary settings.
10. **Communication:** Effectively communicated on complex engineering activities with the engineering community and society at large, including the ability to comprehend and produce effective reports and design documentation, deliver compelling presentations, and provide and receive clear instructions.
11. **Project management and finance:** Displayed knowledge and understanding of engineering and management principles, applying them to one's own work as a team member or leader to manage projects and contribute to multidisciplinary environments.
12. **Life-long learning:** Acknowledged the need for and demonstrated the preparation and ability to engage in independent and life-long learning within the broad context of technological change in the past.

**Subject: Internal Combustion Engine (ICE)**

**Subject Code: MED401**

**Course Outcome (CO's)**

1. Students understood various types of I.C. Engines, Cycles of operation and Identify fuel metering, fuel supply systems for different types of engines.
2. Students understood combustion phenomena in SI and CI engines and analyzed the effect of various operating variables on engine performance.
3. Students were capable to evaluate performance Analysis of IC Engine and justified the suitability for different applications.
4. Student understood the conventional and non-conventional fuels and effects of emission formation of IC engines, its effects and the legislation standards.
5. Students were capable to analyze the performance of Gas Turbine.
6. Students were capable to analyze the performance of IC Engine

**Subject :Internal Combustion Engine (ICE)**

**Subject Code : MED401**

**Program Specific Outcome (PSO's)**

1. Students understood Basic Engine components and Nomenclature, Classification of Engines
2. Students understood the working principle of I.C. Engines, Comparison of 2-Stroke and 4-Stroke Engines; CI, and SI Engines.
3. Students understood Air standard cycles, Fuel air cycle and actual cycle, Valve timing Diagram.
4. Students understood Conventional fuels for IC engines, requirement, Qualities of engine fuels, fuel additive and alternative fuels, Air Fuel Mixture Requirements, Carburetors, requirement of Injection Systems.
5. Students understood Classification of Injection Systems, Fuel Feed pump, Injection Pumps, Working principles of Governors, Types of Nozzles.
6. Student's understood Stages of combustion, Factors influencing various stages, Normal and abnormal combustion.
7. Students understood detonation, Effect of detonation, Factors responsible for detonation, Octane rating of fuel, Requirement of combustion chambers for SI engines, important types, relative advantages and disadvantages and application.
8. Student capable to determine Stages of combustion in CI Engines, Delay period, Factor affecting delay period.
9. Students understood Diesel knock, cetane rating, Requirements of combustion chamber for CI Engines.
10. Students understood methods of generating turbulence in combustion chamber, Types of combustion chamber for CI Engines, Engine Power, and Engine Efficiencies.
11. Student's understood Performance Characteristics, Variables Effecting Performance Characteristics, Methods of Improving Engine Performance.
12. Students understood Heat Balance, Supercharging: Basic principles, objectives.
13. Students understood Study of BIS, EURO emission norms, IC Engines Recent trends: Microprocessor based engines, Variable valve timing engines and homogeneous charge compression ignition (HCCI) engines Stratified engines, Wankel engine and Stirling engine.
14. Students understood Introduction to Gas Turbines, Development, Classification and Application of Gas Turbines, Ideal and Actual Cycles; Analysis of constant pressure closed cycle.
15. Students understood Advantages and disadvantages of closed cycle over open cycle gas turbine
16. Students understood Methods for improvement of thermal efficiency of gas turbine, Effect of Inter cooling, Reheating and Regeneration.
17. Students understood Advantages and disadvantages of gas turbine over I.C. Engines.
18. Students understood Review, their effect on human health cause of formation and approaches to control pollutants.
19. Students understood Study of BIS, EURO emission norms.
20. Students understood IC Engines Recent trends: Microprocessor based engines.
21. Students understood Multi-point fuel injection (MPFI) engines, common rail direct injections (CRDI) engines
22. Students understood Variable valve timing engines and homogeneous charge compression ignition (HCCI) engines Stratified engines, Wankel engine and Stirling engine.
23. Students understood IC Engines Recent trends: Microprocessor based engines.

**Subject: Automatic Control System**

**Subject Code: MED402**

**Course Outcome (CO's)**

1. Students Understood basic control system components, types of control systems and their representation.
2. Students found Transfer Function of Control System by both block diagrams and signal flow graphs.
3. Students Understood and developed Characterization of performance of PID Controller and stability of controller
4. Students Understood and analyzed transient and steady State Responses.
5. Students Understood and analyzed Frequency Responses by Routh's criteria, Nyquist criteria and Bode plots.
6. Students Understood and analyzed Root Locus Plots.

**Subject: Automatic Control System**

**Subject Code: MED402**

**Program Specific Outcome (PSO's)**

1. Students understood Need of control system, Manual vs. Automatic Control System, Advantages of Automatic Control System.
2. Students Studied of various types of control system components and their mathematical representation used in systems like Mechanical system, System, Thermal System, Fluid System.
3. Students understood Grounded chair representation, Force-Voltage and Force-Current Analogy
4. Students understood Transfer function definition, Block representation of System Elements.
5. Students were able to reduce block diagrams, Convert Block Diagram to Signal Flow Graph (SFG) and vice versa, and understood use of Mason's Gain Formula.
6. Students were able to Find Transfer Function of Control System by both methods.
7. Students understood Basic types of control action like ON/OFF, Proportional, Integral, Derivative type and their combinations (P, I, PI, PD and PID)
8. Students understood pneumatic and Hydraulic Controllers, Comparison of Pneumatic and Hydraulic Control System.
9. Students Studied AC and DC Servo motors, Stepper motors, Servomechanism, Position Control System.
10. Students understood various types of standard input signals.
11. Students understood First order response to Step, Ramp and Impulse Input, Response of second order system to step input.
12. Students understood concept of time constant and its importance in speed response, Effect of Damping ratio on response of Second Order System.
13. Students understood Stability analysis.
14. Students understood use of Routh's Stability Criteria & Relative Stability Concepts.
15. Students understood use Nyquist stability criterion, Polar plots.
16. Students understood use bode plots.
17. Students understood Definition of Root loci, General Rules for constructing Root Locus.
18. Students understood root locus plots.
19. Students understood Use of MATLAB software in control system.

**Subject : Metrology and Quality Control (MQC)**

**Subject Code : MED403**

**Course Outcome (CO's)**

1. Student Understand the methods of measurement and selection of measuring instrument,
2. Student abled to understand the standards of measurement and understand the principles, construction, use of various measuring instruments.
3. Student had understanding of Identify and applies various measuring instruments.
4. Student abled to explain tolerance limits of size, fits, geometric and position tolerances and gauge design.
5. Student got familiar with the various Quality Control Techniques and Statistical Tools appropriately
6. Students are able to Analyze the Data collected and Develop an ability of problem solving and decision making by identifying and analyzing the cause for variation and recommend suitable corrective actions for quality improvement



**Subject: Metrology and Quality Control (MQC)**

**Subject Code : MED403**

**Program Specific Outcome (PSO's)**

1. Students understood the concept of metrology and need of inspection
2. Students understood terms accuracy and different types of error during measurement.
3. Students understood Line standard and End standards measurements.
4. Students understood various linear and angular measurement instruments (Sine bar , Autocollimator, Angle Décor and Dividing head)
5. Students understood the construction, working and different types of comparator.
6. Students understood the principle, construction & working of Interferometer (NPL & Laser Interferometer)
7. Students understood different surface finish measurement instruments and methods. (Stylus and probe, Tomlinson and Taly-Surf )
8. Student understood the Types of Gauges: Slip gauges, Limits, Fits and Tolerance and Taylor's principle.
9. Student understood the Gear Terminology , Gear error, Gear measurement
10. Student able to familiar with the advancement in meteorology: CMM and Universal Measuring machine (UMM) and laser in metrology.
11. Student able to understand the Meaning of quality of produce and services, Quality of Design, Quality of Conformance
12. Student able to understand the seven quality tools.
13. Student understood the quality Function Deployment, 5S, Kaizan, Kanban, Just In Time, Poka yoke, TPM, FMECA, FTA, Zero defects
14. Student should understand the Statistical Quality Control – Basic statistical concept, Meaning and importance of SQC, Frequency diagram.
15. Student should understand the Concept of Variance analysis, Control chart for variable & attribute, Process Capability
16. Students understood Acceptance Sampling: Concept, comparison with 100% inspection, OC curve and its characteristics, sampling methods.
17. Students understood OC curve and its characteristics, sampling methods.
18. Students understood Introduction to ISO 9000: Definition and aims of standardizations,
19. Student understood the Techniques of standardization, Codification system, Varity control and Value Engineering
20. Student understood the Codification system
21. Student understood the concept of Varity control and Value Engineering

**Subject : Energy Conservation and Management**

**Subject Code : MED 404**

**CO's:**

1. Students understood the basic knowledge of different terms, principles & act of energy conservation.
2. Students Knew the energy saving & conservation in different thermal mechanical systems.
3. Students studied the different Case study of Cogeneration in Sugar Factories and various options of cogeneration in Industries
4. Students understood Electrical system and E-vehicle power storage options, Power factor improvement.
5. Students applied the principles of energy management, conservation policy and auditing in Electrical utilities.
6. Students Capability to integrate various options and assess the business and policy environment regarding energy conservation and energy auditing



**Subject: Energy Conservation and Management**

**Subject Code : MED 404**

**Program Specific Outcome (PSO's)**

1. Students Understood the Basic Concept of Commercial and Non-Commercial Energy, Primary Energy Resources.
2. Students able to Describe Importance of Energy Conservation
3. Students Understood and Explained the Kyoto Protocol and Clean Development Mechanism.
4. Students understood the basic of Thermal Energy Systems & Classify the different types of boilers and explain it.
5. Students understood the concept of refrigeration and air-conditioning system.
6. Students able to explain International recent advances in Biodiesel, its resources for production.
7. Students able to explain Case study of Cogeneration in Sugar Factories.
8. Students Understood factors for selection and control strategies for the cogeneration.
9. Students able to explain Classification of aircraft refrigeration system and their analysis.
10. Students able to explain E-vehicle for emission control and discuss E-vehicle power storage options merits and demerits of E-vehicle.
11. Students able to describe Requirement of Charging station for E vehicle.
12. Students Understood the Demand Side Management (DSM), Different types of Energy-efficient electric motors, Strategy for daylight control and artificial energy efficient illumination.
13. Students Understood the Need of Energy audit & Discuss about Types of energy audit.
14. Students Understood the Energy audit steps/methodologies, Need of different types of instrument for energy audit.
15. Students able to discuss Case study of Energy Audit at household and Case study of Sugar/Glass/Paper.
16. Students Understood the Energy flow Sankey Diagrams and Energy conservation options for household and industry.
17. Students Understood the Investment on energy efficient appliances.
18. Students Understood the renewable energy system payback period, Return on investment, Net present value and internal rate of return.

**Subject: Elective-II- PRODUCTION PLANNING AND CONTROL**

**Subject Code: MED 407**

**Course Outcome (CO's)**

1. Student understood Functions of production planning and control –Types of production – Organization of production planning and control department – Internal organization of department – Information required for Production Planning.
2. Student understood Forecasting – Importance of forecasting – Types of forecasting, their uses – General principles of forecasting – Forecasting techniques – qualitative methods and quantitative methods.
3. Student understood the Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P-Systems and Q-Systems – Introduction to MRP & ERP, LOB (Line of Balance).
4. Student understood Routing – Definition – Routing procedure –Route sheets – Bill of material – Factors affecting routing procedure. Schedule –definition – Difference with loading.
5. Student understood Scheduling Policies – Techniques, Standard scheduling methods, Line Balancing, Aggregate planning, Chase planning, Expediting, controlling aspects. Dispatching – Activities of dispatcher – Dispatching procedure – followup – definition – Reason for existence of functions – types of followup - applications of computer in production planning and control.
6. Student understood the Selection of materials, methods, machines and manpower: Factors / restrictions to be considered while selecting materials, Process / Method selection, Machine selection: factors to be considered while selecting a machine. Recruitment and selection of manpower: sources of recruitment, scientific selection, transfer, promotion, control of absenteeism, tardiness and labour turnover.

**Subject: Elective-II- PRODUCTION PLANNING AND CONTROL**

**Subject Code: MED 407**

**Program Specific Outcome (PSO's)**

1. Students understood the Objectives and functions of production Planning and Control.
2. Students understood Elements & types of production.
3. Students understood Organization of production planning and control department.
4. Students understood the internal organization of department.
5. Students understood Importance of Forecasting.
6. Students understood the Forecasting techniques
7. Students understood the Qualitative methods.
8. Students studied the Qualitative methods.
9. Students understood the functions of inventory.
10. Students understood the ABC and VFD analysis
11. Students understood the EOQ model.
12. Students understood the Inventory control system.
13. Students understood the study MRP & MRP-II.
14. Students Explained the Line of balance.
15. Students studied the routing.
16. Students studied the Route sheets and Bill of material.
17. Students studied the Factors affecting routing procedure and schedule.
18. Students understood the scheduling and its policies.
19. Students understood Line Balancing and aggregate planning.
20. Students understood the Dispatching and activities of dispatcher.
21. Students understood the Followup.
22. Students understood the Lean production system.
23. Students understood the Techniques for mistake proofing processes.
24. Students understood the Economics and technology of setup time reduction.
25. Students understood the JIT.

**Subject :Automobile Engineering (AE)**

**Subject Code : MED451**

**Course Outcome (CO's)**

1. Students understood the basic of automobile and study the principles and working of different transmission system of automobiles.
2. Students studied the principles and working of different transmission system.
3. Students understood and studied suspension system of automobiles.
4. Students understood and studied axle, Steering System and tyres.
5. Students understood and studied the principles and working of steering system and braking system of automobiles.
6. Students understood the principles and working of Electrical systems of automobiles.

**Subject :Automobile Engineering (AE)**

**Subject Code : MED451**

**Program Specific Outcome (PSO's)**

1. Students understood Classification of automobiles, main components of automobile, Layout of with different engine positions and drive arrangements, Types of engines.
2. Students understood power plants used in Automobile, Recent developments in engines, Engine selection criteria. Chassis and Super structure (Body).
3. Students understood Clutches: Purpose of clutch, classification single plate clutch coil spring, diaphragm spring, semi centrifugal clutch, clutch plates, Multiple plate clutches, centrifugal clutch.
4. Students understood Gearbox: Function, various resistances, tractive effort, performance curves, Sliding mesh gear arrangement, constant mesh gear arrangement and synchromesh arrangement, epicycles gears, layout of gear arrangement in a gearbox for forward and reverse gears.
5. Students understood over drive, Gear selector mechanisms, Automatic transmission- types, torque converter, Differential and their types, Propeller shaft, universal joints.
6. Students understood Objectives, various types of springs and shock absorbers used in suspension, rigid axle suspension system, H frame twist-beam rear suspension (used in recent cars), and independent suspension systems- Wish bone parallel link.
7. Students understood Mac-Pherson strut and trailing arm suspension, Air suspension, Telescopic suspension in two wheelers, Stabilizer or anti roll bar.
8. Students understood Introduction to electronic suspension, ride control and active suspensions.
9. Students understood Front axle types, final drive, and rear axle arrangements. Steering geometry, caster, camber, toe-in toe-out, and included angle.
10. Students understood scrub radius, turning radius, thrust angle, Effects of these angles. Wheel alignment and wheel balancing, Under steer, over steer in Steering system.
11. Students understood steering columns, steering effort, components of steering system, various types of steering gearboxes. Power steering- hydraulic and electronic.
12. Students understood Wheels: Wheel rims. Tyres – function, construction, types of tyres, tubeless tyres.
13. Students understood Purpose, classification of Drum and disc brake systems, brake shoes, leading- trailing drum brake. Mechanical brakes.
14. Students understood hydraulic brake system- layout, tandem master cylinder, and slave cylinders.
15. Students understood Air brake systems, Antilock brake systems (ABS), Parking brakes.
16. Students understood Ignition system, starting systems, dashboard instruments.
17. Students understood Electrical and electronics in the doors. (Window, central locking, etc.), Automobile air-conditioning systems.
18. Students understood Safety systems in automobile, Pollution control norms and pollution control devices.

**Subject: Project Management and Operations Research**

**Subject Code: MED452**

**Course Outcome (CO's)**

1. Students understood how to translate a real-world problem, given in words, into a mathematical formulation using LPP and optimize it.
2. Students were able to Solve and optimize transportation problems.
3. Students were able to Solve and optimize assignment and replacement problems.
4. Students were able to solve and optimize queuing and sequencing problems.
5. Students were able to solve and optimize game and inventory problems.
6. Students were able to Use critical path analysis and programming evaluation and review techniques for timely project scheduling and completion & analyze and solve integer programming and project network models arising from a wide range of applications

**Subject: Project Management and Operations Research**

**Subject Code: MED452**

**Program Specific Outcome (PSO's)**

1. Students understood Operations research development, history, definitions, objectives, characteristics, limitations, phases and applications.
2. Students understood how to solve LPP by graphical method and simplex algorithm.
3. Students understood how to solve LPP by artificial variables techniques
4. Students understood Methods for finding initial solution
5. Students understood Test of optimality, Maximization and Minimization Transportation problems
6. Students understood Test of optimality, Transshipment problems, Degeneracy in problems.
7. Students understood Assignment Problems and Solution methods.
8. Students understood Variations of the assignment problem, and Traveling salesman problem.
9. Students understood Replacement Models and its solutions.
10. Students understood Queuing models, queuing systems and structures, notation, parameter, single server and multiserver models, Poisson input, exponential service, constant rate service, infinite population.
11. Students understood Scheduling and sequencing, assumptions in sequencing models, processing 'n' jobs on 'm' machines.
12. Students understood processing of two jobs on machines with each having different processing order.
13. Students understood Game Theory and its solutions.
14. Students understood inventory models and its solutions.
15. Students understood PERT/CPM & its importance in project management
16. Students understood Concept & construction of network diagrams,
17. Students understood Critical path & project duration, floats, network crashing, optimum project duration & cost.
18. Students understood PERT activity, time estimate, probability of completion of a project on or before specified time.



**Subject: Refrigeration & Air Conditioning**

**Subject Code: MED453**

**CO's:**

1. Students understood the fundamental principles and obtained cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration systems.
2. Student could evaluated COP of Multistage Vapour Compression Cycle by arranging different inter cooling system and compare it with VCC.
3. Students got to know classification of aircraft refrigeration system and their analysis with regenerative system.
4. Students understood the comparison between absorption and compression system and Principal of absorption system.
5. Students studied the psychometric properties of air and utilized the principles of psychometric in the design of air conditioning equipment
6. Students understood the properties, applications and environmental issues of different refrigerants

**Subject: Refrigeration & Air Conditioning**

**Subject Code: MED453**

**Program Specific Outcome (PSO's)**

1. Students understood the Basic Concept of Thermodynamics Definition of Refrigerator and how to calculate unit of refrigeration
2. Students got to know the Exegetic efficiency and its performance & modification Carnot cycle and its application in VCC
3. Students understood effect of operating condition of VCC How to improve the COP of VCC by different effect.
4. Students understood the actual VCC and its importance & Explain the limitation of VCC
5. Students understood Function of Different types of Intercooling Understand the popular arrangements of intercooling with multi compression
6. Students understood the multi evaporator system & Explain cascade systems
7. Students understood Differentiation between individual compressors, compound Compression
8. Students understood Comparison air refrigeration with VCC & Explain the components, Bell Coleman cycle.
9. Students understood the Necessity of aircraft refrigeration.
10. Students understood Advantages of air cycle for aircraft refrigeration.
11. Students understood classification of aircraft refrigeration system and their analysis. Explain DART.
12. Students understood Principal of absorption system. Describe common refrigerant absorbent pairs
13. Students understood the comparison between absorption and compression system.
14. Students understood simple absorption system; modification to simple vapour absorption system.
15. Students understood Lithium- Bromide water vapour absorption system.
16. Students understood the basic of Psychometric Explain the different types of psychometric properties.
17. Students understood relation between psychometric relations, Adiabatic saturation
18. Students understood thermodynamic wet bulb temperature; psychometric
19. Students understood the types of Psychometric processes To Know the representation psychometric chart.
20. Students understood the bypass factor and ADP. Describe ventilation and infiltration
21. Students understood Properties of refrigerants; classification of refrigerants
22. Students understood how to find Designation of refrigerants and explain ODP and GWP of CFC's refrigerants.
23. Students understood different Substitutes for CFC refrigerants.
24. Students understood Application of Refrigeration and Air Conditioning
25. Students understood Steam jet refrigeration system and explain defrosting in refrigerators, Mine air conditioning and ventilation.

**Subject: ELECTIVE-III: INDUSTRIAL ENGINEERING**

**Subject Code: MED 456**

**Course Outcome (CO's)**

1. Student understood Construct operations process charts, models.
2. Student understood manufacturing and operations planning.
3. Student understood the Use flow process charts, time study.
4. Student understood occurrence sampling for methods improvement and work measurement applications.
5. Student understood Perform job evaluation and merit rating, Kaizen and SMED.
6. Student understood various concepts in Industrial Engineering.

**Subject: ELECTIVE-III: INDUSTRIAL ENGINEERING**

**Subject Code: MED 456**

**Program Specific Outcome (PSO's)**

1. Students understood the work study.
2. Students understood productivity & standard of living.
3. Students understood Management, techniques to reduce excess work content due to product process and ineffective time in control of workers and Management.
4. Students understood the Productivity.
5. Students understood human factors, work study versus Management, supervisor.
6. Students understood the working conditions, prevention accidents and hazards.
7. Students understood the method study, selection of job.
8. Students studied the recording techniques, micro-memo motion study.
9. Students understood the developing new layout materials handling its principles and equipment.
10. Students understood the movement of workers and materials in working area, string diagram and its significance.
11. Students understood the various charts.
12. Students understood the Motion Economy principles.
13. Students understood the Design approach.
14. Students Explained the Human anthropometry and its use in work place layout.
15. Students steps in time study.
16. Students studied the Work sampling.
17. Students studied the standard data, PMTS and MTM.
18. Students understood the Measuring work by physiological methods.
19. Students understood Different techniques of job evaluation and Merit rating.
20. Students understood the Kaizen.
21. Students understood the JIT.
22. Students understood the Aspects of setup activities.
23. Students understood the Setup improvement, conceptual stages.
24. Students understood the Techniques for, streamlining the aspect of set up, effects of SMED.