MED401-INTERNAL COMBUSTION (I. C.) ENGINES

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory: 80 Marks (3Hrs.)
Class Test: 20 Marks (1Hrs.)

Objectives:

- Students are expected to understand & analyze the fundamentals and working of Internal Combustion Engines to meet the modern requirements.

Course Contents:

Unit-I **(05Hrs)**

Introduction to IC Engines and cycle analysis: Basic of I.C. Engines, Details of two stroke and four stroke engines, Air standard cycles, Fuel air cycle and actual cycle. Variation in specific heat, Dissociation and their effect on engine performance. Review of other losses in IC engines.

Unit-II **(07Hrs)**

Fuels requirements and alternative fuels: Air-fuel mixture requirement, Carburetors, Studies of fuel injection systems: Fuel pump and their working, different types of fuel feed systems, studies of injector's nozzles, Bosch type fuel pump. Conventional fuels for IC engines, requirement, properties, limitations of fossil fuels, fuel additive and alternative fuels.

Unit-III **(08Hrs)**

Combustion SI Engine: Stages of combustion, factors influencing various stages, Normal and abnormal combustion, Detonation, Factors responsible for detonation. Effect of detonation. Octane rating of fuel, Requirement of combustion chambers for SI engines, important types, relative advantages and disadvantages and application.

Unit-IV **(08Hrs)**

Combustion in CI. Engines: Stages of combustion in CI Engines, Delay period, factor affecting delay period, diesel knock, cetane rating, Requirements of combustion chamber for CI Engines. Methods of generating turbulence in combustion chamber. Types of combustion chamber for CI Engines.

Unit-V **(05Hrs)**

Performance testing of IC Engines: Evaluation of various performance parameters of IC Engines including heat balance, excess air calculation. Methods of determination of friction power. Supercharging: Basic principles, objectives, arrangements for super charging, advantages and limitations of super charging.

Unit-VI **(07Hrs)**

Emission from IC Engines: Review, their effect on human health, cause of formation and approaches to control pollutants. Study of BIS, EURO emission norms, IC Engines Recent trends: Microprocessor based engines, multi-point fuel injection (MPFI) engines, common rail direct injections (CRDI) engines, variable valve timing engines and homogeneous charge compression ignition (HCCI) engines. Stratified engines, Wankel engine and Stirling engine.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1. Internal combustion Engines Fundaments- John B. Heywood, McGraw Hill.
2. Internal combustion Engines - M.L. Mathur & Sharma Dhanpatrai & Sons.
3. Internal combustion Engines – V. Ganeshan, McGraw Hill.
4. Internal combustion Engines- Collin R. Ferguson & Allan T. Kirkpatric.
5. An introduction to combustion- Stephen R. Turns, McGraw Hill.
6. Internal combustion engines & air pollution- Edward Obert, Intex Educational Pub.

Pattern of the Question Paper:

The units in the syllabus are divided in two equal sections. Question Pattern consist of two sections A and B. **Section A** questions shall be set on first **3 units(I, II and III)** and sections **B** questions on remaining **3 units (IV, V and VI).** Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Five questions in each section.
2. Attempt any three questions from each section.

MED402-AUTOMATIC CONTROL SYSTEM

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory: 80 Marks (3Hrs.)
Class Test: 20 Marks (1 Hrs.)

Objectives:

- Understand basic control concepts and basic control actions.
- Understand simple mathematical modeling and understand the concept of block diagram and signal flow graph.
- Study of system in time & frequency domain and understand concept of stability.

Course Content:

Unit - I **(08Hrs)**

Introduction: Need of control system, Manual vs. Automatic Control System, Advantages of Automatic Control System, Open Loop and Closed Loop Control System and their comparison, Concept of Feedback, Requirements of Ideal Control System, Generalized Control System, and Definition of Transfer Function.

Representation of Control System Components: Study of various types of control system components and their mathematical representation used in systems like Mechanical system, Electrical system, Thermal system, Fluid system, Grounded chair representation, Force-Voltage, Force-Current Analogy.

Unit – II **(06 Hrs)**

Block Diagram and Signal Flow Graph: Transfer function definition, Block representation of System Elements, Block Diagram Reduction, Conversion of Block Diagram to Signal Flow Graph and vice versa, Mason's Gain Formula, Comparison of Block Diagram and Signal Flow Graph, Finding Transfer Function of Control System by both methods.

Unit – III **(06 Hrs)**

Control Action and Controllers: Basic types of control action like ON/OFF, Proportional, Integral, Derivative type and their combinations, Pneumatic and Hydraulic (P, I, PI, PD and PID) controllers, Comparison of Pneumatic and Hydraulic Control system.

Electrical Systems: Detail study of A.C and D.C Servo Motor, Stepper motor Servomechanism, Position Control System

Unit – IV **(08 Hrs)**

Transient and Steady State Response Analysis: Introduction, Various types of standard input signals, First order response to Step, Ramp and Impulse Input, Response of second order system to step input, System specifications. Concept of time constant and its importance in speed response, Effect of Damping ratio on response of Second Order System.

Unit – V **(08 Hrs)**

Frequency Response Analysis : Stability Analysis, System Stability and Routh's Stability Criteria, Relative Stability Concepts, Nyquist stability criterion, Polar plots Phase and Gain margin Bode plot attenuation diagram, Stability Analysis using Bode plots, Simplified Bode plot.

Unit – VI **(04 Hrs)**

Root Locus Plots: Definition of Root loci, General Rules for constructing Root Locus, Analysis using Root Locus Plots, Use of MATLAB software in control system.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1. **Control System Engineering,** Ogatta, Prentice Hall of India Pvt. Ltd.
2. **Automatic Control Systems,** Kuo, Golnaraghi, Kunche, Wiley India.
3. **Automatic Control Engineering,** Francis H. Raven, McGraw Hill
4. **Control Systems- Principles and Design,** M.Gopal,McGraw Hill Education.
5. **Feedback Control System,** Dr. S.D. Bhide, S. Satyanarayan, N.A. Jalgaonkar: Technova Pub. [Pune]Pvt. Ltd.
6. **Control System Engineering,** I.J Nagrath,M.Gopal, New Age International Publishers.

Pattern of the Question Paper:

The units in the syllabus are divided in two equal sections. Question Pattern consist of two sections A and B. **Section A** questions shall be set on first **3 units(I, II and III)** and sections **B** questions on remaining **3 units (IV, V and VI).** Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Five questions in each section.
2. Attempt any three questions from each section.

MED403-METROLOGY & QUALITY CONTROL

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory: 80 Marks (3Hrs.)
Class Test: 20 Marks (1 Hrs.)

Objectives:-

- Understand the salient concept and principles required to develop the ability of using different types of measuring instrument.
- Understand the principles, construction, use, techniques of handling and maintenance of various measuring instruments.
- Develop the ability of analysis interpretation and drawing conclusions the data / instrument / graph / chart pertaining to the area of quality control.
- Develop an ability of problem solving and decision making.
- Plot and use of quality control charts and Suggest measures to improve the quality of product and reduce cost.

Course Contents:

Unit-I **(08Hrs)**

Measurement Standard & Comparators

Measurement Standard, Principles of Engineering Metrology, Line end, wavelength, Traceability of Standards. Types and Sources of error, Alignment, Temperature, Plastic deformation, Slip gauges and gauge block, Linear and Angular Measurement (Sine bar, Sine center, Autocollimator, Angle Décor and Dividing head), Calibration .Comparator – Mechanical, Pneumatic, Optical, Electronic (Inductive), Electrical (LVDT)

Unit-II **(08 Hrs)**

Interferometer- Principle, NPL Interferometer, Flatness measuring of slip gauges, Parallelism, Laser Interferometer Surface Finish Measurement – Surface Texture, Measuring Surface Finish by Stylus probe, Tomlinson and Taly – Surf, Analysis of Surface Traces: Methods Design of Gauges - Types of Gauges, Limits, Fits, Tolerance, Terminology for limits and Fits. Indian Standard(IS 919-1963) Taylor's Principle.

Unit-III **(04Hrs)**

Metrology of Screw thread

Gear Metrology – Gear error, Gear measurement, Gear Tooth Vernier, Profile Projector, Tool marker's microscope

Advancements in Metrology – Co-ordinate Measuring Machine, Universal Measuring Machine, Laser in Metrology.

Unit-IV **(07Hrs)**

Introduction to Quality and Quality Tools

Quality Statements, Cost of Quality and Value of Quality, Quality of Design Quality of Conformance, Quality of Performance Seven Quality Tools – check sheet, Flow chart, Pareto analysis, cause and effect diagram, scatter diagram, Brain storming, Quality circles.

Unit-V **(06Hrs)**

Total Quality Management

Quality Function Deployment, 5S, Kaizan, Kanban, JIT, Poka yoke, TPM, FMECA, FTA, Zero defects.

Unit-VI **(07Hrs)**

Statistical Quality Control

Statistical Quality Control – statistical concept, Frequency diagram, Concept of Variance analysis, Control chart for variable & attribute, Process Capability.

Acceptance Sampling: Sampling Inspection, OC curve and its characteristics, sampling methods.

Introduction to ISO 9000

Definition and aims of standardizations, Techniques of standardization, Codification system, Varity control and Value Engineering.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1. Jain R.K. – Engineering Metrology, Khanna Publication
2. Hume K.J. – Engineering Metrology – Mcdonald Publications
3. A.W.Judge – Engineering Precision Measurements, Chapman and Hall
4. Narayana K.L. – Engineering Metrology
5. Galyer J.F & Shotbolt C.R – Metrology for Engineers
6. I.C.Gupta – Engineering Metrology, Dhanpat rai Publications
7. Kulkarni V.A & Bewoor A.K – Metrology & Measurements, Tata McGraw hill Co. Ltd.
8. Statistical Quality Control – M.S.Mahajan. Dhanpat rai Publications
9. Fundamental of Quality Control and Improvement – Amitava Mitra. – Wiley Publication.
10. Quality Control – V.A.Kulkarni and A.K.Bewoor.-Wiley India Publication.
11. Theory and Design For Mechanical Measurements – Richard S.Figliola and D.E.Beasley. Wiley India Publication.
12. Statistical Quality Control – E.L.Grant –McGraw Hill.
13. Quality Planning and Analysis – J.M.Juran – Tata McGraw Hill

Pattern of the Question Paper:

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For 80 Marks Paper:

1. Five questions in each section.
2. Attempt any three questions from each section.

MED404- TURBO-MACHINES

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory: 80Marks (3Hrs.)
Class Test: 20 Marks (1 Hrs.)

Objectives:

This course deals with the study of the principles of turbo machinery. The objectives of the course are to enable the student to:

- Understand and be familiar with the concepts of energy flow, including losses, in turbo machines, with both qualitative and quantitative approaches, to arrive at the different forms of efficiencies.
- Understand the different types of hydraulic turbines, their ranges of basic parameters and characteristics of hydraulic turbines.
- Understand the various types of centrifugal pumps and the terminology used in their practices and different heads and efficiencies.
- Understand the basic impulse and reactions turbines, their operating parameters and the effects of such parameters on their performance.

Course Content:

Unit – I **(04 Hrs)**

Introduction: Turbo-machines, parts of turbo-machines, comparison between positive displacement machines and turbo-machines, Types of turbo-machines, Application of dimensional analysis to turbo-machines.

Unit-II **(08 Hrs)**

Impact of Jets: Introduction, Force exerted by jet on stationary vertical plate, Force exerted by jet on stationary inclined plate, stationary curved plate, Force exerted by jet on moving plate (Flat vertical plate moving in the direction of the jet & away from the jet), Inclined plate moving in the direction of jet, Curved plate moving in the direction of jet.

Unit-III **(08 Hrs)**

Hydraulic Turbines: Introduction, Classification, Tangential Flow Impulse Turbines, Pelton Wheel – Construction, working, head, work done, efficiency, design aspects. Radial Flow Reaction Turbines, Francis Turbine - Construction, working, work done, efficiency, design

aspects. Axial Flow Reaction Turbines, Propeller Turbine, Kaplan Turbine, Run away speed, Draft tube, draft tube theory, types of daft tubes, Specific speeds, Unit Quantities, Performance characteristics of Hydraulic Turbines, Cavitations.

Unit-IV **(06 Hrs)**

Centrifugal Pumps: Introduction, working & construction of centrifugal pump, work done on impeller by water, Head & efficiency, effect of number of vanes of impeller on head & efficiency, Multistage centrifugal pumps, Pumps in series, pumps in parallel, minimum starting speed , specific speed, characteristics of centrifugal pump, NPSH, & priming, model testing & geometrically similar pumps.

Unit-V **(08 Hrs)**

Steam Turbines: Introduction to nozzles and diffusers, nozzle efficiency, condition for maximum discharge , Classification, advantages, Impulse & Reaction gas turbines, compounding of steam turbines, velocity diagrams, work done on turbine blades, turbine efficiency, losses in turbines, Governing of steam turbines – throttle governing, bypass governing, nozzle control governing.

Unit-VI **(06 Hrs)**

Gas Turbines: Simple Cycle, Brayton cycle, Performance evaluation parameters like force, work done, efficiency, air-fuel ratio, regeneration, reheating, intercooling, Numerical and applications, Ericsson cycle, Stirling cycle.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1. Hydraulic Fluid mechanics & machinery by Modi P.N. & Seth S.N., Standard book house, new Dehli
2. Theory of hydraulic machinery by V.P. VAsandani, Khanna publishers, Dehli
3. Hydraulic machines by Dr. J. Lal, Metropolitian book co. pvt.ltd Dehli
4. Hand book of pumps by Karrasik, Tata Mc Graw Hills Ltd. Dehli
5. Steam & Gas Turbines by R Yadav, Central Pub. Allahabad
6. Gas turbine theory & Jet propulsion by J K Jain, khanna Pub. New Dehli
7. Gas turbine theory by Cohen Rogers, Longman Publications
8. A Treatise on Turbo machines by Gopalkrishan, Scitech Publications Chennai
9. Fluid mechanics & Hydraulic machines by R K Bansal, Laxmi Publication
10. Turbomachinary by Kadambi V, New Age International Publications
11. Gas Turbines by V. Ganesan, Mc Graw Hill education
12. Turbomachines by B.U.Pai, Wiley India Pvt. Ltd

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The units in the syllabus are divided in two equal sections. Question Pattern consist of two sections A and B. **Section A** questions shall be set on first **3 units(I, II and III)** and sections **B** questions on remaining **3 units (IV, V and VI).** Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Five questions in each section.
2. Attempt any three questions from each section.

Elective-I

MED441-ENERGY CONSERVATION AND MANAGEMENT

Teaching Scheme	**Examination Scheme**
Lectures: 4 Hrs/week	**Theory: 80Marks (3Hrs.)**
	Class Test: 20 Marks (1Hrs.)

Objective:

- Students are expected to understand the importance of Energy Conservation and apply the knowledge of various Energy Conservation methodologies and Management techniques adopted in Industries.

Course Content:

Unit-I **(08Hrs)**

Energy Scenario: Commercial and Non-Commercial Energy, Primary Energy Resources, Commercial Energy Production, Final Energy Consumption, Energy Needs of Growing Economy, Long Term Energy Scenario, Energy Pricing, Energy Conservation and its Importance, Energy Strategy for the Future, Energy Conservation Act and its Features.

Global Environmental Concerns: United Nations Framework Convention on Climate Change (UNFCC), Kyoto Protocol, Clean Development Mechanism (CDM)

Unit-II **(10Hrs)**

Mechanical System – Thermal Basics, Energy conservation opportunities in Boilers, Steam distribution system, Compressed air systems, refrigeration and air-conditioning system, pumps and fans.

Unit-III **(02Hrs)**

Co-generation- Concept options (steam / gas / turbine / diesel engine basis), selection criteria, control strategy.

Unit-IV **(10Hrs)**

Electrical system- Electricity Basics, Demand control, Demand Side Management (DSM), Power Factor Improvement, benefits and ways of improvement, Load scheduling, Electric motors, losses, efficiency, energy-efficient motors, motor speed control, variable speed drive. Lighting- energy efficient illumination, Electricity Act.

Unit-V **(04Hrs)**

Energy Management & Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Energy audit instruments.

Unit-VI **(06Hrs)**

Financial Management: Investment-need, Appraisal and criteria, Financial analysis techniques- Simple pay- back period, Return on investment, Net present value, Internal rate of return, Cash flows, Life cycle costs, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs, Sankey Diagrams.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1. Bureau of energy efficiency, Hand outs New Delhi
2. Energy Management Hand Book, W. C. Turner. - John Wiley and sons
3. Handbook on Energy Efficiency, TERI, New Delhi, 2009
4. Energy conservation-related booklets Published by National productivity Council (NPC) & Petroleum Conservation Research Assn.(PCRA)
5. Energy Auditing and Conservation; Methods, Measurements, Management & Case Study, Hamies, - Hemisphere Publishing, Washington, 1980.
6. Energy conservation Guide book, Patrick Steven R, Patric Dale R, and Fordo Stephen

Pattern of the Question Paper:

The units in the syllabus are divided in two equal sections. Question Pattern consist of two sections A and B. **Section A** questions shall be set on first **3 units(I, II and III)** and sections **B** questions on remaining **3 units (IV, V and VI).** Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Five questions in each section.
2. Attempt any three questions from each section.

Elective-I

MED442-POWER PLANT ENGINEERING

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory: 80Marks (3Hrs.)
Class Test: 20 Marks (1Hrs.)

Course Content:

Unit-I **(06Hrs)**

Introduction: Generation of Electricity and sources of energy, future trends in power industry, coordination of power from different source**.**
Load estimation, load duration curve, load factor, capacity factor, use factor, diversity factor, and demand factor, effect of variable load on power plant, selection of the number and size of units.

Unit-II **(08Hrs)**

Thermal Power Plant : General layout of modern Thermal power plant ,Working of Thermal power plant, Site Selection for Thermal power plant, thermodynamic cycles, Coal handling, storage, Preparation & Feeding, combustion and combustion Equipments, Ash handling and dust collection, draught system.

Unit-III **(06Hrs)**

Diesel Engine Power Plant : Layout of Diesel engine Power Plant, Type of Engines used for Diesel power plants, cooling & lubrication system for the diesel engines, filters, supercharging of Diesel engines , performance of diesel plant, advantages and limitations of diesel plant over thermal plant , Present Trends in Diesel research .

Unit-IV **(04Hrs)**

Economic Analysis Of Power Plants: Cost of energy production, selection of plant and generating equipment, performance and operating characteristics of power plants, Tariffs for electrical energy. Environmental aspects of power generation

Unit-V **(08Hrs)**

Hydroelectric Power Plant: Hydrograph, flow duration & mass curves. General arrangement of an hydroelectric project and its operation , site selection, Storage and pond age, classification of hydro stations, selection of prime movers Governing of turbines, operation of different components of hydro station reservoirs .Dams, spill ways, canals, penstock, water hammering effects, surge tank, draft tube, Specific speed of turbine, advantages of hydro station

Unit-VI **(08Hrs)**

Nuclear Power Plant: Principle of release of nuclear energy fusion & fission reaction, nuclear fuels used in reactors ,multiplication and thermal utilization factors, elements of nuclear reactor ,moderators ,control rod ,fuel rods ,coolants ,brief description of reactor PWR , BWR ,sodium graphite reactor, fast breeder reactor ,Homogenous reactor and gas cooled reactors, radiation hazard , shielding, radioactive waste disposal.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1. A Course in Power Plant engineering by Arora and Domkundwar.
2. Power station Engineering Economics by Skrotizke and Vopat.
3. Power Plant engineering by P K Nag.
4. Modern Power Plant Engineering, Joel Weisman & Ray Eckart Prentice hall, International Inc.
5. Power Plant Technology, by M.M.El-Wakil, Mc Graw Hill Education (India) Pvt Ltd.
6. Power Station Engineering and Economy Barnhardt G. Askratzki & William A Vopa TMH Publications co Ltd.
7. Power Plant Engineering by Fredrick T Mores Affiliated East West press private Ltd.
8. Power Plant Engineering by Black & Veatch.

Pattern of the Question Paper:

The units in the syllabus are divided in two equal sections. Question Pattern consist of two sections A and B. **Section A** questions shall be set on first **3 units(I, II and III)** and sections **B** questions on remaining **3 units (IV, V and VI).** Question paper should cover the entire syllabus.

For 80 Marks Paper:

1. Five questions in each section.
2. Attempt any three questions from each section.

Elective-I

MED443-PRODUCTION PLANNING AND CONTROL

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory: 80Marks (3Hrs.)
Class Test: 20 Marks (1Hrs.)

Objectives:

- To understand the various components and functions of production planning and control
- To know the recent trends like manufacturing requirement Planning (MRP) and Enterprise Resource planning (ERP).
- To understand the lean approach in production system.

Course Content:

Unit - I **(4Hrs)**

Introduction : Definition – Objectives of production Planning and Control – Functions of production planning and control – Elements of production control – Types of production – Organization of production planning and control department – Internal organization of department.

Unit – II **(8Hrs)**

Forecasting – Importance of forecasting – Types of forecasting, their uses – General principles of forecasting – Forecasting techniques – qualitative methods and quantitive methods.

Unit - III **(8Hrs)**

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).

Unit - IV **(4Hrs)**

Routing – Definition – Routing procedure –Route sheets – Bill of material – Factors affecting routing procedure. Schedule –definition – Difference with loading.

Unit - V **(8Hrs)**

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.

Unit - VI **(8Hrs)**

Lean production system-Just in time Production systems- Eliminating waste- JIT purchasing- Techniques for mistake proofing processes- Economics and technology of setup time reduction- Improving product flow- The transition to lean.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1. Modern Production/ operation managements / Baffa & Rakesh Sarin/Wiley & Sons.
2. Elements of Production Planning and Control / Samuel Eilon/ Collier Macmillan Ltd.
3. Manufacturing Planning and control/ Partik Jonsson & Stig-Arne Mattsson/ TATA Mc Graw – HILL Edition.
4. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller/ Prentice-Hall.
5. Design and Analysis of Lean Production systems/ Ronald G Askin & Goldberg/ Wiley India
6. Production Control A Quantitative Approach / John E. Biegel/ Prentice-Hall.
7. Production Control / Franklin G. Moore, Ronald Jablonski/ McGraw-Hill.

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For 80 Marks Paper:

1 Five questions in each section.

2 Attempt any three questions from each section.

Elective-I

MED444-ADVANCED MATERIALS AND MANUFACTURING

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory: 80Marks (3Hrs.)
Class Test: 20 Marks (1Hrs.)

Objective:

- Students are expected to understand & analyze the engineering materials and advances in manufacturing processes.

Course Content:

Unit-I **(08Hrs)**

Composites: Classifications, properties, application of composites, polymer matrix materials, metal matrix materials, ceramic matrix materials, carbon materials, glass materials, fiber reinforcements, types of fibers, whiskers, laminar composite, filled composites, particulate reinforced composites, design of composites materials, hybrid composites, angle plied composites, mechanism of composites, calculation of properties, unidirectional fiber composites, critical volume fraction, discontinuous fiber composites, rule of mixtures equation, critical angle.

Unit-II **(08Hrs)**

Organic Materials: Introduction, Thermoplastics ,Thermosets, Types of Polymers, Mechanical characteristic, Forming Techniques, applications of polymers, plastics and elastomers.

Ceramics: Introduction, Classifications, properties, structures, Processing of Ceramics, Refractory materials, electronic ceramics, cement and concrete.

Unit-III **(04Hrs)**

Miscellaneous Materials: Classification, applications and properties of cutting tool materials, semi conducting materials, dielectric materials, magnetic materials, ferroelectrics materials. Smart materials, Super alloys.

Unit-IV **(08Hrs)**

Advances In Casting Processes: Sheet molding casting V -Process, flask less molding, evaporative casting, plaster mould casting design for plaster mould casting, quality-accuracy-uniformity & other considerations in casting and molding.

Unit-V **(04Hrs)**

Metallic Coating: Importance, principle, applications of; Chemical vapor deposition, physical vapor deposition, Thermal spray coating, Electro plating, Electro less coating.

Unit-VI **(08Hrs)**

Non-traditional Machining Process: Introduction, Chemical machining, Electro Chemical machining, Electro discharge machining, Wire EDM, Magneto abrasive finishing, Abrasive flow machining, Water jet machining, Micro drilling by different processes like laser beam, ion beam, electro jet, etc, electro stream drilling. Non-traditional Deburring process.

Rapid Prototyping (RP): Principle and elements of RP. Advantages & applications of RP, Introduction to regenerative manufacturing process like SLS, LOM, FDM.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1) The Nature and Properties of Engineering Materials by Z.D. Jastrezebski.
2) Introduction to Physical Metallurgy by S.H. Avner.
3) Composites Materials by S.C. Sharma.
4) Materials Science and Engineering by R.K. Rajput.
5) Materials and Processes in Mfg. by E.P. DeGarmo, J.T. Black,R.A. Kosher.
6) Modern Manufacturing process Engineering by Benjamin W. Niebel,Allen B. Draper, Richard A. Wysk, McGraw Hill.
7) Non Traditional Manufacturing processes by Garry F. Benedict Marcel, Dekker Inc., New York.
8) Production Technology Hand Book by H.M.T. Tata McGraw Hill.
9) Non Traditional Machining Processes by E.J. Weller, Society of Manufacturing Engineers,Dearban Michigan.

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For 80 Marks Paper:

1. Five questions in each section.
2. Attempt any three questions from each section.

Elective-I

MED445 MODERN MANAGEMENT TECHNIQUES

Teaching Scheme	**Examination Scheme**
Lectures: 4 Hrs/week	**Theory: 80Marks (3Hrs.)**
	Class Test: 20 Marks (1Hrs.)

Objectives:

- To comprehend quality management and its practices;
- To understand new dimensions or issues in modern management theory and practice;
- To develop managerial skills/techniques.

Course Content:

Unit-I **(10Hrs)**

Total Quality Management: Introduction, Basic approach for TQM, Dimensions of Quality, New and Old Quality Cultures.

Problem solving Tools:- Seven Old and New Quality tools

Six Sigma:- Evolution of Six Sigma, Phases of Six Sigma.

Unit-II **(04Hrs)**

Just in Time: Types of wastes, Basic Elements of JIT, Role of set-up time and lot size in JIT, Benefits of JIT, Implementation issues.

Unit-III **(06Hrs)**

Methods Engineering: KAIZEN, Five -Why Process, Business Process Reengineering, POKAYOKE, Workplace layout & Work station design, Single Minute Exchange of Dies (SMED).

Unit-IV **(08Hrs)**

Value Engineering: Value-types, Value analysis, Value Engineering, Steps in Value Analysis, FAST analysis, Ten Commandments (Principles) of Value Analysis.

Quality Function Deployment (QFD):- Introduction, Voice of Customer, House of Quality, QFD Process, Merits and Demerits.

Unit-V **(05Hrs)**

Total Productive Maintenance: Introduction, Definition, Distinctive features, Four development striving for overall equipment effectiveness, the five TPM development activities, the twelve steps of TPM, stages of TPM development.

Unit-VI **(07Hrs)**

Creativity and Innovation: - Definition, Characteristics, Significance, Role of management.

Types of thinking: Vertical Thinking, Parallel Thinking, Practical Thinking Techniques, Six thinking hats, Concept of Lateral Thinking.

Quality of Work Life (QWL): - Definition, Features, Elements/Factors, Positive Effect/Outcomes, Managerial role for improving QWL, Relationship between QWL and Work Life Balance (WLB)

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1. Total Quality Management by Dale Besterfield and et.al, Prentice Hall.
2. Total Quality Management by Dr. Gunmala Suri andDr. Puja Sharma, Biztantra.
3. Industrial Engineering & Production Management by Maratand Telsang, S.Chand.
4. Competitive Manufacturing management by John M.Nicholas, Tata McGraw Hill.
5. Just-In Time by M G Korgaonkar, Macmillan Publishers India.
6. Six Thinking Hats by Edward De Bono.
7. Principles of Management by Ramesh B Rudani, McGraw Hill.

Journals/Magazines:- Harvard Business Review, Industrial Management, TQM Journal, International Journal of Quality and Reliability

Pattern of the Question Paper:

The units in the syllabus are divided in two equal sections. Question Pattern consist of two sections A and B. **Section A** questions shall be set on first **3 units(I, II and III)** and sections **B** questions on remaining **3 units (IV, V and VI).** Question paper should cover the entire syllabus.

For 80 marks Paper:

1. Minimum ten questions
2. Five questions in each section

LAB-I MED421- INTERNAL COMBUSTION (I.C.) ENGINES

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Term Work: 25 Marks
Practical Exam: 25 Marks

List of Experiments:

Any seven of the following practical should be performed and recorded in a laboratory book.

1. Performance test on a single cylinder diesel engine.
2. Performance test on a single cylinder petrol engine.
3. Evaluation of the heat balance for single cylinder diesel engine.
4. Performance test on a multi-cylinder petrol engine.
5. Mors test on multi-cylinder engine.
6. Measurement of exhaust gas emission from S.I. engine.
7. Measurement of exhaust gas emission from CI engine.
8. Study of Bosch type single plunger fuel pump.
9. Study of various types of fuel injectors and nozzles.
10. Study of different types of carburetor.

The assessment of term work shall be on the following criteria:

- Continuous assessment
- Performing the experiments in the laboratory.

Practical Examination :

The practical examination shall be consisting of Viva- Voce based on the practical work done during the course and on the syllabus.

LAB-II MED422- AUTOMATIC CONTROL SYSTEM

Teaching Scheme **Examination Scheme**
Practical: 2 Hrs/week **Term Work: 25 Marks**

Term Work: Term work shall consist of record book on the following-

Practical (Any 04):

1. Study of control system components.
2. An experiment on speed control of stepper motor.
3. An experiment on a level control system.
4. An experiment on ON-OFF temperature controller.
5. An experiment on various modes of control action P, I, P+I, P+D, and P+I+D.
6. Experiment based on DC/AC servomotor.
7. Practical study of any one control systems.

Assignments (Any 04):

1. Four Assignments based on syllabus.
2. One assignment based on SCILAB/MATLAB programming.

The assessment of term work shall be on the following criteria:

- Continuous assessment
- Performing the experiments in the laboratory

LAB-III MED423- METROLOGY & QUALITY CONTROL

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Term Work: 25 Marks
Practical Exam: 25 Marks

Term Work
Experiments (Any Eight)

1) Determination of Linear / Angular dimensions of a part using precision / non-precision measuring instruments.
2) Precision Angular Measurement using Sine bar / sine Center, Autocollimator, Angle Dekkor.
3) Measurement of screw thread using Floating carriage Micrometer.
4) Measurement of Gear Tooth thickness by Gear tooth Vernier Caliper / Constant chord / Span micrometer
5) Assignment on Acceptance Sampling.
6) Interferometer – Study of Surfaces using Optical flat.
7) Study and application of Profile projector and Tool Maker's Microscope.
8) Inspection of Production job by Statistical Process control.
9) Case Study of ISO system Implementation.
10) Machine Tool alignment test on any two Machines like – Lathe, Drilling, Milling

The assessment of term work shall be on the following criteria:

- Continuous assessment
- Performing the experiments in the laboratory

Practical Examination:

The practical examination shall be consisting of Viva- Voce based on the practical work done during the course and on the syllabus.

LAB-IV MED424- TURBO MACHINES

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Practical Exam: 25 Marks

Practical:

List of experiments:

1. To study impact of jet to find the force exerted on plate.
2. Trial on Pelton wheel turbine.
3. Trial on Francis turbine test rig.
4. Trial on Kaplan turbine test rig.
5. Trial on Centrifugal Pump
6. Trial on gear pump
7. Technical reports on visits to hydro power/ steam/ gas turbine power plant
8. Study of nozzles and diffusers.
9. Assignment on chapter no. 5 and 6 with at least five numerical.

Note: Six experiments [excluding assignments] from above list should be performed out of Which at least three trials should be conducted.

Practical Examination

The practical examination shall be consisting of Viva- Voce based on the practical work done during the course and on the syllabus.

SEMINAR

(Term Work 50 marks)

Every individual student shall work on a recent topic selected or assigned from any engineering/allied/applied fields for the seminar of academic or industrial interest. It is expected that the student has to collect information on a topic which is not covered in curriculum of the under graduate course. Student has to refer hand book, research journals, reference books, proceeding of conference through library or internet and record of references considered for seminar is to preserved in hard copy or soft copy, which shall be produced at the time of seminar.

The report of seminar should be submitted in printed volume duly certified by guide, HOD and Principal in prescribed format given below. The student should deliver a seminar talk at least for 20 minutes based on the work done by him/her. The performance will be judged by his guide and another expert appointed by HOD.

INSTRUCTIONS TO PREPARE REPORT AND PPT

1. Seminar report shall be typed on A-4 size white bond paper.
2. Typing shall be with line spacing of 1.5using black inkjet print on one side of the paper.
3. Margins a) Left 37.5mm b) Right, Top and Bottom 25mm.
4. Page number - At the bottom center aligned 12 point font size.
5. Header and Footer (12 point font size - Times New Roman)
    a) Header - Right side at top stating title of the seminar.
    b) Footer - Right side at bottom stating institute name.
6. Font
    a) Main title font - 14 point - bold - Times New Roman - Upper case
    b) Sub title font - 12 point - bold - Times New Roman - Title case
    c) Text font - 12 point - normal - Times New Roman - Running
    d) Graph / Figure / Table titles - 12 point - normal - Times New Roman - Title case
7. Graph / Figure / Table: - shall be located at the center along with its title and Graph No. / Figure No. / Table No.

If Graph / Figure / Table or any information is copied from any of the references, reference no. is to be shown at the end of its title / statement in square bracket superscripted form

8. Seminar report shall consists of at least following contents
    a. First page.
    b. Certificate.
    c. Acknowledgement.
    d. Index page (Chapter wise)
    e. Graph index (Graph no., Title, Page no.)
    f. Figure index (Figure no., Title, Page no.)
    g. Table index (Table no., Title, Page no.)
    h. Introduction /Abstract of seminar.
    i. Literature review.
    j. Core content of seminar.
    k. Merits and demerits of subject.
    l. Future scope.
    m. Conclusion.
    n. References.
    o. Appendix
    p. Compact Disc.
9. Format of seminar report
    a. First page (Title page) and cover of seminar report.

(Institute logo)

Seminar Report

on

"Title of Seminar"

By

Name of student

Submitted in partial fulfillment of the requirement for the degree of

Bachelor of Engineering (Mechanical)

Department of Mechanical Engineering

Name of Institute

Year 2014-15.

b. Certificate

(Institute logo)

CERTIFICATE

This is to certify that the seminar report entitled

"Title of Seminar"

Submitted by

Name of student

has completed as per the requirement of Dr. Babasaheb Ambedkar Marathwada University in partial fulfillment of degree

B.E.(Mechanical)

Guide	Head of Department	Principal
(Name)	(Name)	(Name)

Department of Mechanical Engineering

Name of Institute

Year 2014-15

c. Acknowledgement:- Acknowledgement shall consists of students opinion related to the seminar topic and his gratitude towards his guide, other staff, social members and his friends those who have really helped him to complete seminar report.

d. Chapter Index: - Shall have title as "INDEX" in bold - 14 point aligned at top center and page consisting of table with three columns as Chapter No., Chapter particulars, and Page No. Chapter No. and Page No shall be aligned at center of cell
and chapter particulars left aligned in the cell.

e. Graph Index / Figure Index / Table Index: - Shall have title as "GRAPH INDEX / FIGURE INDEX / TABLE INDEX" in bold - 14 point center aligned at top of page. Page consisting of three column table as Graph No. / Figure No. / Table No. in first column, Title of Graph / Figure / Table in second column and Page No. in third column. (Similar to chapter index.)

10. Sketches:-Shall be drawn on separate sheet, center aligned with Figure No. and Title of sketch at its bottom.
11. Table shall preferably be typed in text format only with table no. and its title at the top, centrally aligned.
12. Standard mathematical symbols and notations shall be used.
13. The last item on Index should be references.
14. Compact Disc (C.D.) consisting of soft copy of seminar report, PPT, and supporting literature shall be affixed at back cover of report.
15. Presentation shall be made with help of Power point.

a. Preferably each slide shall have plain white or faint yellow or navy blue or maroon colored back ground with contrast matching font.

b. Each slide shall be numbered and header - footer shall be added similar to report.

c. Figure / Graph / Table shall be labeled with Figure No. / Graph No. / Table No. and with reference nos. shown in seminar report

d. Only brief points are to be highlighted on slides

e. Information copied from references shall be numbered with reference number.

f. Points are not to be read directly from slide at the time of presentation.

g. Presentation shall be based on Figure, Graph, Table, Charts and points etc.

h. First slide shall be identical to cover page of report.

i. Second slide should contain introduction / abstract of seminar and content of presentation with bullets.

j. Third slide shall focus on literature review.

k. Fourth slide on wards core content of presentation shall be discussed.

l. Slides at the end shall consist of merits, demerits, future scope, conclusion and references.

The Term work marks for seminar will be allotted based on the following

1. Seminar Report	10 Marks	
2. Literature Review	08 Marks	
3. Technical Content	10 Marks	
4. Presentation Skill (Aids used)	14 Marks	
5. Question Answer	08 Marks	**Total 50 Marks**

PROJECT - I

(Practical Examination 50 Marks.)

1. Every student or group of maximum Five students should undertake a project work under the guidance of teacher allotted.
2. The project work could be theoretical work on trouble shooting, design, development, fabrication of prototype / model, Implementing a research paper or application of advanced software.
3. Preferably project shall be useful to the general community such as rural, former community and small scale industry etc.
4. If the project is based on software, it shall impart sufficient knowledge of software and its application to the students. The software used should not be among the software recommended in undergraduate curriculum. It should be entirely new to the students.
5. If the project is based on fabrication, it shall be supported by design and development.
6. It is essential that the student/s should concentrate on need, feasibility, economy, usefulness, effects on environment and global warming.
7. The student/s should get their project topic approved by the project committee under the leadership of project in charge / HOD appointed by Principal.
8. Student has to collect information from hand book, research journals, reference books, proceeding of conference through library or internet.
9. Student/s should prepare a spiral bound report with detail schedule of activities planned for completion of project and its presentation similar to the seminar report and shall be presented by all the partners dividing presentation among them at the time of examination in presence of guide and external examiner.
10. It is compulsory to continue with same project in next semester and copy of report shall be produced at the time of final dissertation. Theme of project defined in 7 th semester and its achievement must be compared.
11. Students shall prepare paper / project to participate in State level / National / International competition. The projects participated shall get additional benefit in final semester based on certificate of participation.

The practical examination shall be based on presentation and marks shall be allotted on following points.

1. Report 5 Marks.

2. Literature Review 5 Marks.

3. Technical Content 5 Marks.

4. Regency of topic 5 Marks.

5. Usefulness 5 Marks.

6. Feasibility 5 Marks.

7. Presentation 5 Marks.

8. Economy 5 Marks.

9. Merits 5 Marks.

10 Question / Answer 5 Marks. **Total 50 Marks**

MED451-AUTOMOBILE ENGINEERING

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory: 80Marks (3Hrs.)
Class Test: 20 Marks (1Hrs.)

Objectives:

- Students are expected to understand & analyze the fundamentals of Automobile Engineering.

Course Contents:

Unit-I **(04Hrs)**

Introduction: Classification of automobiles, main components of automobile. Layout of with different engine positions and drive arrangements. Types of engines and other power plants used in Automobile. Recent developments in engines. Engine selection criteria. Chassis and Super structure (Body).

Unit-II **(10Hrs)**

Transmission System

Clutches: Purpose of clutch, classification, single plate clutch coil spring, diaphragm spring and semi centrifugal clutch, clutch plates. Multiple plate clutch, centrifugal clutch.

Gearbox: Function, various resistances, tractive effort, performance curves. Sliding mesh gear arrangement, constant mesh gear arrangement and synchromesh arrangement, epicyclic gears, layout of gear arrangement in a gearbox for forward and reverse gears, over drive. Gear selector mechanisms. Automatic transmission- types, torque converter. Differential and their types. Propeller shaft, universal joints.

Unit-III **(06Hrs)**

Suspension System:

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), independent suspension systems- Wish bone parallel link, Mac-Pherson strut and trailing arm suspension. Air suspension. Telescopic suspension in two wheelers. Stabilizer or anti roll bar. Introduction to electronic suspension, ride control and active suspensions.

Unit-IV **(08Hrs)**

Axle, Steering System And Tyres

Front axle types, final drive, rear axle arrangements. Steering geometry, caster, camber, toe-in toe-out, included angle, scrub radius, turning radius, thrust angle. Effects of these angles. Wheel

alignment and wheel balancing. Under steer, over steer. Steering system, steering columns, steering effort, components of steering system (one with gear box and tie rods and another with rack and pinion), Various types of steering gearboxes. Power steering- hydraulic and electronic. Wheels: Wheel rims. Tyres – function, construction, types of tyres, tubeless tyres.

Unit-V **(06Hrs)**

Braking Systems:

Purpose, classification. Drum and disc brake systems, brake shoes, leading- trailing drum brake. Mechanical brakes, hydraulic brake system- layout, tandem master cylinder, slave cylinders. Air brake systems. Antilock brake systems (ABS). Parking brakes.

Unit-VI **(06Hrs)**

Automotive Electricals And Additional Systems:

Battery, ignition system, starting systems, charging system, dashboard instruments. Electrical and electronics in the doors.(window, central locking, etc) Automobile air-conditioning systems, components, layout. Safety systems in automobile. Pollution control norms and pollution control devices.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1 Automotive Mechanics by Crouse & Anglin, Tata McGraw Hill.
2 Automotive Mechanics by Joseph Heitner, C.B.S.Publisher and Distributors
3 Automobile Engineering by R.K.Rajput, Luxmi Publications.
4 Automobile Engineering, Vol.I & II by K.K.Jain ,R.B.Asthana, McGraw Hill Education (India)

Pattern of the Question Paper:

The units in the syllabus are divided in two equal sections. Question Pattern consist of two sections A and B. **Section A** questions shall be set on first **3 units(I, II and III)** and sections **B** questions on remaining **3 units (IV, V and VI).** Question paper should cover the entire syllabus.

For 80 Marks Paper:

1 Five questions in each section.

2 Attempt any three questions from each section.

MED452-PROJECT MANAGEMENT AND OPERATIONS RESEARCH

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory: 80Marks (3Hrs.)
Class Test: 20 Marks (1 Hrs.)

Objectives:

- To create awareness about optimization in utilization of resources.
- To understand and apply operations research techniques to industrial operations and Institutes.

Course Contents:

Unit I: **(02Hrs)**

Introduction: Operations Research: Development, history, definitions, objectives, characteristics, limitations, phases and applications. Optimization models and their classifications

Unit II: **(12Hrs)**

Linear Models: Formation of an L.P model- graphical solution – simplex algorithm – artificial variables technique– Big M method, two phase method, Duality in LPP.

Replacement Models: Replacement of items that deteriorates with time, Value of money changing with time and not changing with time, Optimum replacement policy , Individual and group replacement.

Unit III: **(06Hrs)**

Assignment Problems: Introduction. Solution methods, Variations of the assignment problem, Traveling salesman problem.

Transportation Problems: Introduction, Methods for finding initial solution, Test of optimality, Maximization and Minimization Transportation problems, Transshipment problems, Degeneracy.

Unit IV: **(05Hrs)**

Queuing Theory: Queuing models – queuing systems and structures – notation –parameter – single server and multiserver models – Poisson input – exponential service – constant rate service – infinite population.

Game Theory: Introduction, Two-person zero-sum game, Minimum and Maximum principle, Saddle point, Methods for solving game problems with pure and mixed strategies.

Unit VI: **(08Hrs)**

Sequencing Models: Scheduling and sequencing. Assumptions in sequencing models, Processing 'n' jobs on 'm' machines. Processing of two jobs on machines with each having different processing order.

Inventory Models: Types of Inventory- EOQ –ERL- Deterministic inventory problems, Price breaks, stochastic inventory problems, Selective inventory control techniques.

Unit VII: (07Hrs)

Network Models : Introduction to PERT/CPM & its importance in project management. Concept & construction of network diagrams. Critical path & project duration, floats, network crashing, optimum project duration & cost, PERT activity, time estimate, probability of completion of a project on or before specified time.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1. Wayne.L.Winston, Operations research applications and algorithms, Thomson learning,4th edition 2007.
2. Taha H.A, "Operation Research", Pearson Education sixth edition, 2003
3. S. D. Sharma, "Introduction to Operations Research", Discovery Publishing House, New Delhi
4. P. K. Gupta, D. S. Hira, "Operations Research", S Chand and Co. Ltd., ISBN 81-219-0281-9.

Journals/Magazines:

1. Frederick.S.Hiller and Gerald.J.Lieberman, "Operations Research Concepts and Cases", TMH (SIE) 8th Edition.
2. J.K.Sharma, "Operations research theory and applications", Macmillan India .3rd Edition 2007,
3. Hira and Gupta " Problems in Operations Research", S.Chand and Co,2002.
4. Panneerselvam, "Operations Research" Prentice Hall of India, 2003.
5. G Srinivasan, "Operations research principles and applications", PHI (EEE) 2007.
6. Wagner, "Operations Research", Prentice Hall of India, 2000.
7. F. S. Hillier, G. J Lieberman, "Introduction to Operations Research", Tata McGraw-Hill, ISBN 0-07-047387-0.
8. H. M. Wagner, "Principles of Operations Research", Prentice-Hall India, ISBN 81-203-0162-5.
9. A. Ravindran, "Operations Research", Tata McGraw-Hill.
10. S. K. Basu, D. K. Pal, H. Bagchi, "Operations Research for Engineers", Oxford and IBH Publishing Co. Pvt. Ltd., ISBN 81-204-1251-6.
11. R. Panneerselvam, "Operations Research", Prentice Hall of India Ltd., ISBN 81-203- 1923-0.
12. H. A Taha., "Operations Research - An introduction", Prentice Hall Pvt. Ltd., ISBN 81-203-1222-8.
13. H. M. Wagner, Principles of Operation Research, Prentice Hall, 1976. F. S. Hillier and G. J. Lieberman Introduction to OR, Holden ? Day 1978. D. M. Miller and J. W. Schmidt, Industrial

Engineering and Operations Research John Wiley, 1984. H. A. Taha, Operations Research - An Introduction, Macmillan Company, Fourth Edition, 1987.

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For 80 Marks Paper:

1. Five questions in each section.
2. Attempt any three questions from each section.

MED453-REFRIGERATION AND AIR CONDITIONING

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory: 80Marks (3Hrs.)
Class Test: 20 Marks (1Hrs.)

Objective:

This course deals with the design and implementation of refrigeration and air conditioning systems. The objectives of the course is to enable the student:

1. Understand the basic thermodynamic cycles in refrigeration.
2. Understanding and analyzing modern variants of the vapor compression & absorption systems in refrigeration.
3. Apply psychromertic analysis to various air conditioning systems.

Acquiring the necessary skills to experimentally investigate the performance of refrigeration and air conditioning systems and evaluate the actual performance of their components.

Course Content:

Unit-I **(08Hrs)**

A. **Introduction:** Fundamentals of thermodynamics, Refrigerator, heat pump, coefficient of performance, unit of refrigeration, Exegetic efficiency, Carnot cycle for refrigeration and its performance.
B. **Simple Vapour Compression Cycle:** Modification of Carnot cycle, vapor compression cycle and its components, representation on T-s and P-h planes. Effect of operating condition on performance of VCC, sub cooling & superheating of refrigerant, methods to improve cop of VCC, regeneration and its importance in VCC, actual VCC.

Unit-II **(06Hrs)**

Multistage Vapour Compression Cycle: Limitations of simple VCC for achieving low temperatures, intercooling, popular arrangements of intercooling with multi compression; multi eveaparator, System; individual compressors, compound. Compression; cascade systems.

Unit-III **(06Hrs)**

Gas Cycle Refrigeration: Comparison of air refrigeration with VCC, components, Bell Coleman cycle, regenerative BCC, Necessity of aircraft refrigeration; Advantages of air cycle for aircraft refrigeration, classification of aircraft refrigeration system and their analysis; Dry air rated temperature (DART).

Unit-IV **(06Hrs)**

Vapour Absorption System: Principal of absorption system; common refrigerant absorbent pairs; comparison between absorption and compression system; simple absorption system; modification to simple vapour absorption system; Use of temperature concentration diagram (T - C) and enthalpy concentration diagram (h-c) Lithium- Bromide water vapour absorption system.

Unit-V **(09Hrs)**

A. **Introduction To Psychromaetry:** Psychrometry and Air composition, psychometric properties, psychometric relations, Adiabatic saturation and thermodynamic wet bulb temperature; psychomotor
B. **Applied Psychrometry:** Psychometric processes: its representation psychometric chart; Adiabatic mixing of air streams; coil bypass factor, Air conditioning process; ADP, ventilation and infiltration. Use of Air conditioning calculation format.

Unit-VI **(05Hrs)**

A. **Refrigerants:** Properties of refrigerants; classification of refrigerants, Designation of refrigerants; Selection of refrigerants; ODP and GWP of CFC's refrigerants; substitutes for CFC refrigerants, Azeotropic mixtures, Secondary refrigerants.
B. **Application Of Refrigeration And Air Conditioning:** Domestic refrigerator, water cooler, Ice plant, cold storage, Steam jet refrigeration system, defrosting in refrigerators, Mine air conditioning and ventilation.
C. **Section – A** Unit I, II and III
D. **Section – B** Unit IV, V and VI

References:

1. Refrigeration and Air conditioning by Arora C.P, Tata Mc Graw Hill Pub.1985.
2. Refrigeration and Air conditioning by P. L. Ballaney, Hanna pub.
3. Refrigeration and Air conditioning by Manohar Prasad, Wiley Eastern pub.
4. Refrigeration and Air conditioning by Domkundwar, Dhanpat Rai Pub. 1998.
5. Principles of Refrigeration by Dossat R.J, Prentice Hall pub.1997.
6. Refrigeration and Air conditioning by, Anantnarayan, Tata MC Graw Hill Pub.1987.
7. Refrigeration and Air conditioning by Jain V. K.
8. ASHARE: Handbook.
9. Air-conditioning System Design- Handbook, Carrier corp, USA.
10. Heating, Ventilating and Air conditioning by McQuiston, Wiley publication,2005.

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For 80 Marks Paper:

1 Five questions in each section.

2 Attempt any three questions from each section.

Elective-II

MED491-ROBOTICS AND INDUSTRIAL AUTOMATION

Teaching Scheme	**Examination Scheme**
Lectures: 4 Hrs/week	**Theory: 80 Marks (3Hrs.)**
	Class Test: 20 Marks (1 Hrs.)

Objectives:

- To understand the fundamentals of Robotics.
- To identify and apply automation system in various applications.
- To expose students to fundamentals of PLC.

Course Content:

Unit-I **(08Hrs)**

Introduction: Definition, Robot anatomy, Work envelope geometries, Motion control methods, Robot specifications – Payload, Reach, Precision, Accuracy and Repeatability, Drives: Drives used in robots- Hydraulic, Pneumatic and Electric drives, Comparison, merits and demerits, Types of Robot controls, Controllers, Robot Programming methods, Robot programming language - VAL II, Robot Applications - Material handling, Machine loading/unloading, Assembly, Inspection, Welding, Spray painting.

Unit-II **(06Hrs)**

Robot Kinematics: Matrix representations of coordinate transformation, Transformation about reference frame and moving frame, Forward & Inverse Kinematics. Examples of 2R, 3R & 3P manipulators, RPY and Euler's angle. Homogeneous coordinate transformation and examples, D-H representation of kinematics linkages. Forward and Inverse kinematics of various manipulators using D-H representations, Trajectory Planning **-** General considerations in path description and generation, Joint space verses Cartesian Space.

Unit-III **(06Hrs)**

Robotic End Effectors and Sensors:

End Effectors**:** Types of end effectors, Mechanical, Vacuum, Magnetic, Adhesive grippers, Tools as end effectors, Gripper force analysis and design.

Sensors: Need of sensors in the working and control of a robot, Robotic sensors – Types of sensors based on working principle, various sensing devices used in robot work cells, sensor characteristics, selection of sensors, Photo-sensors, Limit switches, Range sensors, Proximity sensors, Touch sensors, Remote Center Compliance (RCC) device.

Vision Systems: Need of vision in a Robotic system, Image acquisition, Illumination Techniques, Image conversion, Cameras, sensors, Camera and system interface, Frame buffers and Grabbers.

Unit-IV **(04Hrs)**

Industrial Automation: Types of Automation– Fixed, Programmable, Flexible Automation, Reasons for automating, Automation strategies, Benefits of automation, Designing for Automation, Building blocks of Automation – Sensors, Analyzers, Actuators, Drives, Ethics – Unemployment, Labor's Attitude, Automation Integrity.

Unit-V **(10Hrs)**

Automated Manufacturing Systems:

Computer controlled machines – CNC, Machine centers and its components.

Automated Inspection Systems - Inspection Metrology, Contact vs. Non contact inspection, Coordinate Measuring Machines, Optical Inspection Methods, Non-contact Inspection Methods.

Automated Material Handling and Storage Systems – Overview, Conveyor Systems, Automated Guided Vehicle Systems, Automated Storage / Retrieval Systems, Carousel Storage Systems.

Automated Assembly Systems – Types, Part Feeding Devices.

Control Technologies in Automation - Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process Control and its forms.

Unit-VI **(06Hrs)**

Sequence Control and Programmable Controllers: Logic Control and Sequencing, Logic Control Elements, Sequencing Elements, Ladder Logic Diagrams, Programmable Logic Controllers – Components, Input / Output Analog and ON/OFF Devices, Basic PLC Programming, PLC Timer/Counter/Arithmetic Functions, PLC interfacing to SCADA/DCS, Industrial Control Applications - Cement, Thermal, Water Treatment & Steel Plants.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1. M. P. Groover, M. Weiss R.N. Nagel, N.G. Odrey, "Industrial Robotics-Technology, Programming and Applications, 2e (SIE)", McGraw, Hill, Special Indian Edition 2012.
2. S.R.Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill 2nd Edition,1994.
3. K. S. Fu, R.C. Gonzalez and C. S.G. Lee, "Robotics: Control, Sensors, Vision and Intelligence ", McGraw-Hill.1987.
4. R. K. Mittal and I J Nagrath, "Robotics and Control", Tata McGraw Hill, 2003.
5. Saeed B Niku, "Introduction to Robotics, Analysis, Systems, Applications", Prentice Hall of India Pvt. Ltd.
6. S.K.Saha, "Introduction to Robotics" McGraw-Hill, 2008.
7. J.J.Craig , "Introduction to Robotics" , Pearson Publications, 1989.
8. Klafter, Richard D., "Robotics Engineering", PHI Publication, 1996.
9. Webb John W., "Programmable Logic Controllers: Principles and Applications", Prentice Hall, 2003.
10. Hackworth John R. "Programmable Logic Controller – Programming methods and Applications", Pearson Education LCE.

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For 80 Marks Question paper

1. Five questions in each section.
2. Attempt any three questions from each section.

Elective-II

MED492-MACHINE TOOL DESIGN

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory: 80 Marks (3Hrs.)
Class Test: 20 Marks (1Hrs.)

Objectives:

1) To know the basic concepts of practical part of machine tools, their profile selection, metal cutting operations and drives in machine tools.
2) To understand speed/feed box design.
3) To know the recent trends in machine tools and online requirements in the field.
4) To learn and understand the machine tool structure design.

Course Content:

Unit I: (10Hrs)

Introduction to machine tool drive and mechanism: Basic requirements of machine tool drives, various motions used in machine tools, hydraulic transmission and its elements, Design process as applied to machine tools, layout of machine tools. Automation to machine tools, Economics of machine tool selection, Acceptance tests for machine tools, Trends of development of future machine tools, forces acting on cutting tools in turning, drilling, milling process, power requirement/consumption in turning, drilling, milling process.

Unit II: (06Hrs)

Regulation of Speed and Feed Rates: Aim of speed and feed rate regulation, stepped regulation of speed. Design of Speed Box, Design of Feedbox. Special cases of gear box design stepless regulation of speed and feed rates.

Unit III: (04Hrs)

Design of Machine Tool Structures: Functions, requirements, materials, static and dynamic stiffness, Profiles, Design criteria of machine tool structures,, basic design procedure of machine tool structures, Design of Bed, Design of Column.

Unit IV: (07Hrs)

Design of Guide ways: Functions, requirements, types, materials, methods of adjusting clearances in slideways, Design criteria and calculation for slideways, design of antifriction slideways, combination ghuideways.

Unit V: **(07Hrs)**

Design of Spindle and Spindle Supports: Functions, requirements, materials, effect of machine tool compliance on machining accuracy, Design calculation of spindle. Anti-friction bearings, Sliding bearings.

Unit VI: **(06Hrs)**

Dynamics of Machine Tools:

Machine tool elastic system-cutting process closed loop system, Dynamic characteristics of elements and systems, equivalent elastic system, cutting process, forced vibration of machine tools.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

Text Books:

1) Machine Tool Design and Numerical Control , 3rd Edition, N.K.Mehta, Mcgraw Hill Education India Ltd, New Delhi.
2) Design of machine Tools, S.K.Basu and D.K.Pal, New Central Book Agency P.Ltd.Kolkata, India.

Reference Books:

1) Principles of Machine Tools, G.C.Sen and A.Bhattacharya, New Central Book Agency P.Ltd.Kolkata, India.
2) Machining and Machine Tools, A.B.Chattopadhyay, Wiley India P. Ltd, New Delhi India.
3) Metal Cutting, 4th Edition, Edward M.Trent and Paul K.Wright, Elsevier Publication, P.Ltd., New Delhi, India P.Ltd.
4) Metal Cutting Principles, 3rd Edition, Milton C.Shaw, Oxford Indian Edition.

Pattern of Question Paper

The units in the syllabus are divided in two equal sections. Question Pattern consist of two sections A and B. **Section A** questions shall be set on first **3 units(1,2 and 3)** and sections **B** questions on remaining **3 units (4,5 and 6).** Question paper should cover the entire syllabus.

For 80 Marks Question paper

1. Five (5) questions in each section.
2. Attempt any three questions from each section.

Elective-II

MED493-COMPUTATIONAL FLUID DYNAMICS

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory: 80 Marks (3Hrs.)
Class Test: 20 Marks

Objectives:

- To introduce fundamentals of fluid dynamics
- To introduce concept of FEM

Unit - I

Fundamental Concepts **(08Hrs)**

Introduction - Basic Equations of Fluid Dynamics - Incompressible inviscid Flows: Source, vortex and doublet panel, methods - lifting flows over arbitrary bodies. Mathematical properties of Fluid Dynamics Equations - Elliptic, Parabolic and Hyperbolic equations - Well posed problems - discretization of partial Differential Equations. Explicit finite difference methods of subsonic, supersonic and viscous flows.

Unit -II

Grid Generation and Discretization **(08Hrs)**

Structured grids, Types and transformations, Generation of structured grids, Unstructured grids. Delany triangulation. Boundary layer equations and methods of solution - Implicit time dependent methods for inviscid and viscous compressible flows - Concept of numerical dissipation – Stability properties of explicit and implicit methods - Conservative upwind discretization for Hyperbolic systems - Further advantages of upwind differencing.

Unit - III

Finite Element Techniques **(05Hrs)**

Overview of finite element techniques in computational fluid dynamics. Strong and Weak formulations of a boundary value problem.

Unit - IV

Finite Volume Techniques **(08Hrs)**

Finite Volume Techniques - Cell Centered Formulation - Lax - Vendoroff Time Stepping -Runge - Kutta Time Stepping - Multi - stage Time Stepping - Accuracy -. Cell Vertex Formulation - Multistage Time Stepping - FDM -like Finite Volume Techniques – Central and Up - wind Type

Discretizations - Treatment of Derivatives. Flux – splitting schemes.Pressure correction solvers – SIMPLE, PESO. Vorticity transport formulation.Implicit/semi-implicit schemes.

Unit – V

Heat Conduction **(06Hrs)**

Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, source term linearization, incorporating boundary conditions, finite volume formulations for two and three dimentional conduction problems

Unit –VI

Convetion And Diffusion **(05Hrs)**

Finite volume formulation of steady one-dimensional convection and diffusion problems, central, upwind, hybrid and power law schemes-discritization equations for two dimensional convection and diffusion.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

Text Books:

1. Versteeg, H.K**,** and **M**alalasekera." An introduction to computational fluid dynamics**"**

References:

1. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw-Hill Publishing.
2. Philip J. Pritchard, Johan C Leylegian., “Fluid Mechanics”, Wily Publication.
3. Fletcher, C.A.J., “Computational Techniques for Fluid Dynamics”, Vols. I and II, Springer - Verlag, Berlin, 1988.
4. Muralidar k and Biswas "Advanced Engineering Fluid Mechanics ". Narosa publishing house New delhi 1995.
5. John F. Wendt (Editor), “Computational Fluid Dynamics - An Introduction”, Springer – Verlag, Berlin, 1992.
6. Charles Hirsch, “Numerical Computation of Internal and External Flows”, Vols. I and II. John Wiley & Sons, New York, 1988.

7. Klaus A Hoffmann and Steve T. Chiang. “Computational Fluid Dynamics for Engineers”, Vols. I & II Engineering Education System, P.O. Box 20078, W. Wichita,K.S., 67208 - 1078 USA, 1993.
8. Anderson, Jr.D. “Fundamentals of Aerodynamics”, McGraw-Hill, 2000.
9. Patankar S.V "Numerical heat transfer and fluid flow"McGraw hill 1980.
10. Jagdeesha .T., Thammaiah Gowad, “ Fluid Power”, Wily Publication.

Pattern of Question Paper: The units in syllabus are divided in two equal sections. Question paper consists of section A and B. Section A includes first three units (I, II and III) and Section B includes remaining three units (IV, V and VI). Question paper should cover entire syllabus. In each section five questions are to be set, out of which three questions are to be attempted.

Elective-II
MED494- INDUSTRIAL ENGINEERING

Teaching Scheme	**Examination Scheme**
Lectures: 4 Hrs/week	**Theory: 80 Marks (3Hrs.)**
	Class Test: 20 Marks (1Hrs.)

Objectives:

At the completion of the course, students should be able to:

- Construct operations process charts, models and diagrams for manufacturing and operations planning.
- Use flow process charts, time study and occurrence sampling for methods improvement and work measurement applications.
- Perform job evaluation and merit rating, Kaizen and SMED.
- Evaluate and apply the techniques used in Industrial and Systems where productivity stems from efficient technology, and demonstrate this in labs and projects.
- Students are expected to understand various concepts in Industrial Engineering.

Unit-I **(03Hrs)**

Introduction: Productivity, definitions of work study, scope, applications, relationship, between productivity & standard of living, basic work content, excess work content, Management, techniques to reduce excess work content due to product process and ineffective time in control of workers and Management.

(Numerical and Cases on Productivity)

Unit-II **(03Hrs)**

Work Study: Definition, concept, and relation with Productivity, human factors, work study versus Management, supervisor, and work study man, qualities of work study man, working conditions, prevention accidents and hazards.

Unit-III **(07Hrs)**

Method Study: Definition, objectives, procedure of method study, selection of job, recording techniques, micro-memo motion study, developing new layout materials handling its principles and equipment, movement of workers and materials in working area, string diagram and its significance, multiple activity chart and their significance, two handed process chart, principles, therbligs, SIMO chart, cycle graph in method study. Critical examination, installation and maintain of proposed method.

(***Review of Cases in Method Study)***

Unit-IV **(05Hrs)**

Motion Economy And Ergonomics Practices: Motion Economy principles. Introduction to ergonomics, man/machine/environment systems concept. Design approach: A new design, modification of existing design, assessment of a design, limitations of man and machine with respect to each other, Posture – standing at work, seated at work, work station heights and seat geometry. Human anthropometry and its use in work place layout. ***(Work Efficiency and Ergonomics, Effect of Light, Noise, Temperature on Human Performance)***

Unit-V **(04Hrs)**

Time Study: Technique, Purpose, use and basic procedure time study equipment selection of jobs for time study, approach to workers, and steps in time study, data collection about jobs, operator & surroundings breaking down jobs into elements, types of elements, selection and measurement of each element. Time study rating and allowances.

(Numerical and Cases on time study)

Unit-VI **(06Hrs)**

Works Measurement Techniques: Work sampling - need, establishing confidence levels, determination of sample size, random observation, and conduct of study. General study of standard data, PMTS and MTM. Methods of Improving Materials Productivity, factors affecting

materials productivity. Measuring work by physiological methods – heart rate measurement – measuring oxygen consumption– establishing time standards by physiology methods.

(Comparison between Time Study, Work Sampling & MTM)

Unit-VII **(02Hrs)**

Job Evaluation And Merit Rating: Different techniques of job evaluation and Merit rating. Merits, Demerits, Significance of Job evaluation / merit rating with work measurement.

Unit-VIII **(03Hrs)**

Kaizen: Kaizen concept, Kaizen umbrella for quality improvement. Kaizen and management, implications of QC for Kaizen, kaizen and TQC, Kaizen and suggestion systems, Kaizen and competition, Kaizen and innovation, measurement, PDCA cycle.

(***Review of Cases in Kaizen)***

Unit-IX **(05Hrs)**

Just In Time: Concept, scope, objectives, push & pull system, reduced inventories and improved set up times, TOYOTA production system, basic assumptions of TOYOTA production system, leveling, smoothing out the production system, JIT and automation. Introduction to Business Process Reengineering, MOST.

(***Review of Cases in JIT)***

Unit-X **(02Hrs)**

Single Minute Exchange Of Dies (Smed): Aspects of setup activities, internal and external setup. Setup improvement, conceptual stages. Techniques for, streamlining the aspect of set up, effects of SMED.

Section – A Unit I, II and III
Section – B Unit IV, V and VI

References:

1. Work Measurement and Methods Improvement, Lawrence S. Aft, John Wiley and Sons, New York, 2000
2. Work Design and Industrial Ergonomics, Konz & Johnson, Holcomb Hathaway, 2000
3. Motion and Time Study – Design and Measurement of Work, Barnes, Raeph.m. John Wiley &sons, New York, 1990.
4. Human Factors in Engineering and Design, Mc.Cormick, E.J., Mc.Graw Hill.
5. Introduction to Work study, ILO, Geneva.
6. Human Factors Engineering and Design, M. S. Sanders and Ernest J. McCormick, McGraw-Hill Inc.
7. Hand Book of Industrial Engineering by Irson & Grant
8. Just In Time by David Hukins.
9. Kaizen (Ky'zen), the key to Japan's competitive success, Masaaki Imai, McGraw-Hill, 1986
10. A Revolution in manufacturing: The SMED system, Shino Shingo, productivity council.
11. Industrial Engineering and Production Management by Martand Telsang, S. Chand

Pattern of Question Paper

The units in the syllabus are divided in two equal sections. Question Pattern consist of two sections A and B. **Section A** questions shall be set on first **3 units(I, II and III)** and sections **B** questions on remaining **3 units (IV, V and VI).** Question paper should cover the entire syllabus.

For 80 Marks Question paper

1. Five (5) questions in each section.
2. Attempt any three questions from each section.

Elective-II
MED495- TRIBOLOGY

Teaching Scheme	**Examination Scheme**
Lectures: 4 Hrs/week	**Theory: 80 Marks (3Hrs.)**
	Class Test: 20 Marks (1Hrs)

Objectives:

- To make students conversant with fundamental aspect of Tribology and its importance
- To make students conversant with different types of loads , friction and wear
- To make students well aware of types of lubrication their types and types of lubricating oil.
- Having developed the above concept, make them competent in selecting the proper material and proper lubricating oil.

Course Content:

Unit-I **(06Hrs)**

Introduction to Tribology: History of Tribology, Need of Tribology as subject :(Solid Mechanics, Fluid Mechanics: Material Science, Chemistry, Role of surface roughness, Economic benefits.

Unit-II **(07Hrs)**

Friction : Concept of friction, causes of friction, Adhesion theory, Abrasive theory, Junction growth theory, Laws of Rolling Friction, Sliding friction, Rolling friction characteristics of common metals and non-metals , friction under extreme environment, Engine friction – Losses and Engine design parameters.

Unit-III **(07Hrs)**

Wear: Wear mechanism, Adhesive Wear, Abrasive Wear, Corrosive Wear, Fretting Wear, Economic role of wear, wear mechanism, factors affecting wear, selection of materials for different Wear situations, measurement of wear, Engine wear mechanism, wear resistance and coatings and failure mode analysis.

Unit-IV **(10Hrs)**

Lubrication and Bearings

Importance of lubrication, Requirements of a good lubricant,

Hydrodynamic Bearings: Mechanism of fluid flow, Reynolds equation and its limitations, idealized bearings, infinitely long plane pivoted and fixed show sliders, infinitely long infinitely long

Unit-V **(06Hrs)**

Surface Roughness and its standardization measurement techniques:
Standardization: Introduction M and E system
Measurement: Measurement techniques and Instruments.

Unit-VI **(04Hrs)**

Applications of Tribology.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1. Basu S.k., Sengupta S. N., Ahuja B.B. "Fundamentals of Tribology" PHI Ltd.
2. Friction Wear Lubrications Tribology Handbook Vol.1 Kragelsky I.V. Affiliated East-West Press.
3. B. C. Majumdar "Introduction to Tribology and Bearings", H. Whecier and Company Pvt. Ltd.
4. Cameron A. "Basic Lubrication Theory", Wiley Eastern Ltd.

Pattern of Question Paper

The units in the syllabus are divided in two equal sections. Question Pattern consist of two sections A and B. **Section A** questions shall be set on first **3 units(I, II and III)** and sections **B** questions on remaining **3 units (IV, V and VI).** Question paper should cover the entire syllabus.

For 80 Marks Question paper

1. Five questions in each section.
2. Attempt any three questions from each section.

Elective-II
MED496- PIPING SYSTEM ENGINEERING

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory: 80 Marks (3Hrs.)
Class Test: 20 Marks (1 Hrs.)

Objective:

- Students are expected to understand various concepts in piping System Engineering

Course Content:

Unit-I **(06 Hours)**

Basics of Piping: Evolution of piping, introduction of a pipe and a tube, definition of pipe & atube and their differences, scope of piping engineering, pipe dimensioning, common piping abbreviations, major organizations for piping standards, ASME/ANSI/API/B31.1/B31.2/B31.3/B31.4/B31.5 codes for piping, Schedule numbers for piping,Nominal Pipe Size (NPS), pipe manufacturing methods, pipe specification, pipe presentation, steps in pipeline design. Piping symbols.

Unit-II **(08 Hours)**

Piping Components:

- Elbows, weld tee, stub in, couplings, reducers, weld cap, screwed and socket welded fittings, Pipe nipples, flanged fittings their uses and std. dimensions.
- Flange -Types, P-T ratings and facings.
- Gaskets, bolts and nuts.
- Valves - Types, operations, applicability, codes and specifications.Control Valves, Safety Valves, Constructional features, Criteria for selection. Piping components. Safety valves and other pressure relieving devices, constructional features, selection criteria.

Type of pipe joints

Unit-III **(06 Hours)**

Line sizing and optimization: A brief revision covering friction factor, pressure drop for flow of non-compressible and compressible fluids, (Newtonian Fluids), pipe sizing, economic velocity. Pipe line networks and their analysis for flow in branches, orifice sizing.

Unit-IV **(06 Hours)**

Materials for Piping system: Desirable properties of piping materials, materials for low, normal and high temperature services, materials for corrosion resistance. Common ASTM and IS specifications for: Seamless / ERW pipes, pipe fittings, flanges, and fasteners, materials for valves.

Unit-V **(10 Hours)**

Flow diagrams& instrumentation/ pipe routing concepts: Uses of flow diagrams, process flow diagrams, mechanical flow diagrams, utility flow diagrams, piping symbols, line symbols, valve symbols, piping isometrics, general arrangement drawings- sections/elevations/ detail drawings, plot plan procedures.pipe routing according to GEP rules,

Piping Layouts: Introduction to P & I Diagrams, Process flow diagrams, standard symbols and notations. Introduction to various facilities required guidelines for Plot Plan / Plant Layout. Introduction to equipment layout, piping layout, piping isometrics and bill of material (Material take off exercise).Typical piping system layout considerations for following systems:

(i) Distillation systems and heat exchangers
(ii) Reactors
(iii) Pipe racks
(iv) Storage tanks
(v) Pumps

Unit- VI **(04 Hours)**

(Thermal Insulation for Piping) / Costing of Piping: Purposes of Thermal Insulation. Principles of conductive and convective heat transfer to the extent of application to heat loss / gain through bare pipe surfaces. Critical thickness of insulation, estimating thickness of insulation, optimum thickness of insulation. Insulation for hot and cold materials and their important properties, insulation material selection criteria, typical insulation specification – hot and cold materials.

Mechanical design of piping system including various stress in pipes, thermal stresses, Water Hammer and stress analysis.

Section – A Unit I, II and III

Section – B Unit IV, V and VI

References:

1. Piping Design Handbook by John J. Mcketta
2. Process plant layout and piping design by Ed Bausbacher & Roger Hunt
3. Piping Design Handbook by Mohinder Nayyar
4. Pipe Drafting and Design by Roy A Parisher & Robert A. Rhea.

Pattern of Question Paper

The units in the syllabus are divided in two equal sections. Question Pattern consist of two sections A and B. **Section A** questions shall be set on first **3 units(I, II and III)** and sections **B** questions on remaining **3 units (IV, V and VI).** Question paper should cover the entire syllabus.

For 80 Marks Question paper

1. Five questions in each section.
2. Attempt any three questions from each section

LAB-V MED471- AUTOMOBILE ENGINEERING

Teaching Scheme **Examination Scheme**

Practical: 2 Hrs/week **Term Work: 25 Marks**

Practical Exam: 25 Marks

Practical: Conduct at least 8 practical's demonstration and study on the actual component models from the following. Term work shall consist of record book on the experiments studies.

1. Layout of the automobiles, front in line, cross engine, rear engine, 2W and 4W drives.
2. Construction and working of petrol and diesel engines used in the automobile. Study of conventional and MPFI and CRDI systems.
3. Construction and working of single plate, multiple plate and centrifugal clutches used in the automobile.
4. Construction and working of a four wheeler, manual shift gear box used in the automobile.
5. Construction and working rigid axle and independent suspension (Wish bone parallel link, Mac-Pherson and Trailing arm) system used in the automobile, balance rod and shock absorber.
6. Construction and working of steering assembly, one steering gear box, and rack and pinion steering systems used in the automobile.
7. Construction and working differential used in the automobile for rigid axle and independent suspension vehicle.
8. Construction and assembly of the braking systems used in the automobile. Study of tandem master cylinder, slave cylinder.
9. Construction and working of starting system, ignition systems and charging system used in the automobile.
10. Study of air conditioning system in a car. Also Study the various components and controls.

The assessment of term work shall be on the following criteria:

- Continuous Assessment of the assignment based on the syllabus
- Performing the experiments in the laboratory i.e. demonstration and working of the different components as mentioned above, also assembling and dissembling the parts for knowing the details.

Practical Examination

The practical examination shall be consisting of Viva- Voce based on the practical work done during the course and on the syllabus.

LAB-VI MED472- PROJECT MANAGEMENT AND OPERATION RESEARCH

Teaching Scheme
Practical: 2 Hrs/Week

Examination Scheme
Term work: 25 Marks
Practical: 25 Marks

Practicals:
At least 08 assignments from the following list should be studied during the course and record for the same should be submitted:

1. Assignment based on Introduction to Operations Research.
2. Assignment based on at least five numericals from Linear Models.
3. Assignment based on at least five numericals from Assignment Problems.
4. Assignment based on at least five numericals from Transportation Problems.
5. Assignment based on at least five numericals from Replacement Models.
6. Assignment based on at least five numericals from Queuing theory.
7. Assignment based on at least five numericals from Game Theory.
8. Assignment based on at least five numericals from Sequencing Models.
9. Assignment based on at least five numericals from Network Models.
10. Assignment based on at least five numericals from Inventory Models.
11. Assignment based on Simulation

Term work:

The term work will consist of submitting a file for all the assignments with neatly written records. The term work will be assessed by the subject teacher.

Practical Examination:

- The Practical Examination will comprise of write-up of assignments and viva voce on the Syllabus.
- The practical examination will be assessed by two examiners, one will be the subject teacher and other examiner appointed by Dr. B.A.M.U. Aurangabad.

LAB-VII MED473- REFRIGERATION AND AIR CONDITIONING

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Term Work: 25 Marks
Practical Exam: 25 Marks

Term work shall consist of Any FIVE experiments from the following:

Practical:

1. Study of Various Tools used in Refrigeration Air Conditioning practice.
2. Study of Domestic Refrigerator.
3. Study of Different types of Air-Conditioning systems.
4. Study of Controls used in Refrigeration & Air conditioning such as expansion devices. Thermostat, HP, LP cut out, OHP, Relays, Solenoid valves. Humidity measurement.
5. Study of Leak detection & procedure for charging of Refrigerant.
6. Trials on following test rigs (any three)
   - **a)** Refrigeration test rig.
   - b) Air-conditioning test rig.
   - c) Heat pump.
   - **d)** Cascade refrigeration system.
   - **e)** Ice plant test rig.
   - **f)** Water Cooler Test rig.
   - **g)** Vapour absorption Test Rig
   - **h)** Window air conditioning Test Rig.
7. Technical reports on visits to refrigeration and air-conditioning establishments. (Any two)

Practical Examination:

The practical examination shall be consisting of Viva- Voce based on the practical work done during the course and on the syllabus.

LAB-VIII A MED474-ROBOTICS AND INDUSTRIAL AUTOMATION

Teaching Scheme **Examination Scheme**
Practical: 2 Hrs. /Week **Term Work: 50 Marks**

Term work shall consist of following Assignments, Programming and Case Studies. (Any Eight)

1. Assignment on "Introduction to Robot Configuration"
2. A demonstration of Robot with 2 DOF, 3 DOF, 4 DOF, etc.
3. Assignment on Programming the Robot for Applications
4. Assignment on Programming the Robot for Applications in Val II
5. Case studies of applications of Robot in industries.
6. Exercise on robotic simulation software.
7. Experiments on ladder applications using basic PLC programming
8. Experiments on timer and counter applications.
9. Assignment on SCADA applications for simple problems.

The assessment of term work shall be on the following criteria:

- Continuous assessment
- Performing the experiments in the laboratory

LAB-VIII B MED475-MACHINE TOOL DESIGN

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Term Work: 50 Marks

Term work:

Term work shall consist of record book on laboratory experiments, studies on the following:

Practical:

1. Design and drawing of speed gear and feed gearbox.
2. Design and drawing of four machine tool mechanisms.
3. Design of bed or column.
4. Design of Guide ways.
5. Preparation layout of machine tools.
6. Preparation of standard test charts for general purpose machine tools.
7. Design of Spindle and Spindle Supports.
8. Acceptance tests for machine tools.

The assessment of term work shall be on the following criteria:

- Continuous assessment
- Performing the experiments in the laboratory

LAB-VIII C MED476-COMPUTATIONAL FLUID DYNAMICS

Teaching Scheme **Examination Scheme**
Practical: 2 Hrs. /Week **Term Work: 50 Marks**

Term Work: Term work shall consist of at least 08 Assignments/ Practicals from the list given below:

1. Assignment based on Unit-I consisting of any four numerical.
2. Assignment based on Unit-II.
3. Assignment based on Unit-III.
4. Assignment based on Unit-IV consisting of any four numerical.
5. Assignment based on Unit-V.
6. Assignment based on Unit-VI.
7. Study analysis of CFD softwares.
8. Study of various mesh generation schemes.
9. Analysis of Internal Flow by using any CFD software.
10. Analysis of External Flow by using any CFD software.

The assessment of term work shall be on the following criteria:

- Continuous assessment
- Performing the experiments in the laboratory

LAB-VIII D MED477 – INDUSTRIAL ENGINEERING

Teaching Scheme **Examination Scheme**
Practical: 2 Hrs. /Week **Term Work: 50 Marks**

Term work:

Term work shall consist of eight assignments based on the syllabus which shall include the following:

1. Case study/numericals on productivity.
2. Prepare operation process chart (OPC) for given assembly.
3. Prepare flow process chart and flow diagram for given task.
4. Prepare man and machine chart/SIMO chart for given situation.
5. Calculate co-efficient of co-relation for time study person using performance rating technique.
6. Calculate standard time for a given job using decimal minute stop watch techniques.
7. Case study on Kaizen
8. Demonstrate the difference between maximum and minimum working area by assembly of 4-5 components.

The assessment of term work shall be on the following criteria:

- Continuous assessment
- Performing the experiments in the laboratory

LABVIII E MED478-TRIBOLOGY

Teaching Scheme
Practical: 2 Hrs. /Week

Examination Scheme
Term Work: 50 Marks

Term work:

Assignments Problems on -
Problem in hydrodynamic bearing
Reynolds equation
Derivation of squeeze film lubrication on rectangular plate and

Practical On (Any FOUR)
Journal Bearing apparatus.
Tilting pad thrust bearing apparatus
Friction in journal bearing
Break line friction test rig.
Coefficient of friction using pin on disc test rig.

The assessment of term work shall be on the following criteria:

- Continuous assessment
- Performing the experiments in the laboratory

LABVIII F MED479-PIPING SYSTEM ENGINEERING

Teaching Scheme **Examination Scheme**
Practical: 2 Hrs. /Week **Term Work: 50 Marks**

Term work:

Term work shall consists of Eight Assignments

1. Assignment on pipe Sizing and Network Analysis.
2. Assignment on Pipe Materials (properties & Selection)
3. Assignment on piping equipments and accessories
4. Assignment on Structural and Thermal Analysis of Pipes using Software Tools.
5. Assignment on **Costing and estimation** for piping Networks
6. Assignment on developing P&I Diagrams
7. Assignment on Material Trade off and Process Diagrams
8. Assignment on topic of subject teacher's choice on syllabus.
9. Designing a piping System Layout for (Any One)
    a) Distillation systems and heat exchangers
    b) Reactors
    c) Water pipelines
    d) Air Conditioning System
    e) Other (Subjected to Teacher's choice)

The assessment of term work shall be on the following criteria:

- Continuous assessment
- Performing the experiments in the laboratory

Project - II
(Term Work 50 Marks, Practical Examination 100 Marks.)

1. Student/s shall have to continue with the projects approved in last semester.
2. It is recommended to follow schedule of activities planned and accordingly have to work for completion of project under the guidance of allotted teacher.
3. Regular monitoring and guidance are expected to complete project in specified duration.
4. Student/s will have to prepare report of project similar to the seminar report with hard binding and golden embossing. Report shall consist of at least contents as that of seminar report.
5. Pre-demonstration session shall be arranged at the term end, in order to observe completion of project, corrections, proofreading of report shall be done by guide and committee. Suggestions are to be given for minor improvements in the project/project report. (If any)
6. Projects / Project report must be ready in all respect at the time of final dissertation.

Term work marks will be allotted based on pre-demonstration performance, presentation and percentage of theme achieved.
Practical examination shall be based on final demonstration / presentation. Performance and percentage of theme achieved.

Note: Additional weight age shall be given to the projects participated in State / National / International competition.

Instructions:

1. The project report shall be typed on A-4 size white bond paper.
2. Typing shall be with spacing of 1.5 or 2.0 using black ribbon or carbon on one side of the paper.
3. Margins: (i) Left 37.5 mm. (ii) Right, top and bottom 25 mm.
4. Binding: Hard with golden embossing on the front cover of blue colour or soft comb binding with transp8.rent front cover and non transparent plastic blue/black cover.
5. From: cover in case of hard bound report: It should be identical to first title page.
6. Format for title page (First Page)

Report of the project

on

(Title of Project)

by

(Name of student)

Submitted in partial fulfillment of the requirements for the degree of

Bachelor of

Engineering (Mechanical)

Department of Mechanical Engineering

(Name of the college)

7. Format for Certification page (i.e. Second page)

CERTIFICATE

This is to certify that the project entitled

"Title of Project"

Submitted by

(Name of Student/s)

is completed as per the requirements of the Dr. Babasaheb Ambedkar

Marathwada

University in partial fulfillment of degree of

B.E.(Mechanical)

For the academic year--------

Guide Head of Department Principal

8. The third page would be for acknowledgements which would be followed by index page.

9. Sketches should be drawn on separate sheet (minimum A4 size) and be inserted at proper places. The sketches should be drawn in black ink and be numbered.

10. Tables should preferably typed in the text only.

11. The mathematical symbol should be typed or neatly written so as to match darkness of the text.

12. The last item on the index should be references.