

**MEASUREMENTS & METROLOGY**

Course Code	:	*MA 4001(Same in ME 4001)
Course Title	:	MEASUREMENTS & METROLOGY
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

**COURSE OBJECTIVES:**

- To study advances in technology, measurement techniques, types of instrumentation devices, innovations, refinements.
- To study the principles of instrumentation, transducers & measurement of non-electrical parameters like temperature, pressure, flow, speed, force and stress.

**COURSE OUTCOMES**

At the end of the course, the student will be able to:

CO1	Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology.
CO2	Distinguish between various types of errors.
CO3	Understand the principle of operation of an instrument and select suitable measuring device for a particular application.
CO4	Appreciate the concept of calibration of an instrument.
CO5	Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form.

**COURSE CONTENT:****1. INTRODUCTION TO MEASUREMENTS**

- 1.1 measurement and its Significance.
- 1.2 Standards of measurements: Primary & Secondary.
- 1.6 Factors influencing selection of measuring instruments.
- 1.7 Terms applicable to measuring instruments: Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration.(Definition only)
- 1.8 Errors in Measurements.
- 1.9 Surface finish measurements

**2. TRANSDUCERS AND STRAIN GAUGES**

- 2.1 Introduction and Transducers
- 2.2 Strain gauge
- 2.3 Force measurement
- 2.4 Torque measurement
- 2.5 Pressure measurement: Mcloed gauge

**3. APPLIED MECHANICAL MEASUREMENTS**

- 3.1 Speed measurement
- 3.2 Displacement measurement
- 3.3 Flow measurement
- 3.4 Temperature measurement
- 3.5 Miscellaneous measurements
  - 3.5.1 Humidity measurement: hair hygrometer
  - 3.5.2 Density measurement: hydrometer
  - 3.5.3 Liquid level measurement: sight glass, Float gauge
  - 3.5.4 Biomedical measurement: Sphygmo monometer

**4. LIMITS, FITS & TOLERANCES**

- 4.1 Concept of Limits, Fits, and Tolerances
- 4.2 Selective Assembly

- 4.3 Interchangeability
- 4.4 Hole and Shaft Basis System
- 4.5 Taylor's Principle
- 4.6 Design of Plug
- 4.7 Ring Gauges
- 4.8 Concept of multi gauging and inspection
- 4.9 Angular Measurement
  - 4.9.1 Working and Use of Universal Bevel Protractor, Sine Bar, Spirit Level
  - 4.9.2 Principle of Working of Clinometers
  - 4.9.3 Angle Gauges (With Numerical on Setting of Angle Gauges)
- 4.10 Screw thread Measurements
  - 4.10.1 Two wire method
  - 4.10.2 Thread gauge micrometer
  - 4.10.3 Working principle of floating carriage dial micrometer

#### 5. GEAR MEASUREMENT AND TESTING

- 5.1 Analytical and functional inspection
- 5.2 Rolling test
- 5.3 Measurement of tooth thickness (constant chord method)
- 5.4 Gear tooth vernier
- 5.5 Errors in gears such as backlash, runout, composite
- 5.6 Machine tool testing
  - 5.6.1 Parallelism
  - 5.6.2 Straightness
  - 5.6.3 Squareness
  - 5.6.4 Coaxiality
  - 5.6.5 Roundness
  - 5.6.6 Run out
  - 5.6.7 Alignment testing of machine tools as per IS standard procedure

#### REFERENCE BOOKS:

1. Mechanical measurements – Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Metrology & Measurement – Anand K Bewoor, Vinay kulakarni, Tata McGraw Hill, New Delhi, 2009
3. Principles of Industrial instrumentation and control systems – Channakesava. R. Alavala, DELMAR cenage learning, 2009.
4. Principles of Engineering Metrology – Rega Rajendra, Jaico publishers, 2008
5. Dimensional Metrology – Connie Dotson, DELMAR, Cenage learning, 2007
6. Instrumentation measurement and analysis – B.C. Nakara, K.K. Chaudary, second edition, Tata Mcgraw Hill, 2005.
7. Engineering Metrology – R.K. Jain, Khanna Publishers, New Delhi, 2005.
8. A text book of Engineering Metrology – I.C. Gupta, Dhanpat Rai and Sons, New Delhi, 2005
9. Metrology for Engineers – J.F.W. Galyer and C. R. Shotbolt, ELBS
10. Engineering Metrology – K. J. Hume, Kalyani publishers

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**STRENGTH OF MATERIALS**

Course Code	:	**MA 4002 (Same in ME/MP 4002)
Course Title	:	STRENGTH OF MATERIALS
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	Engineering Mechanics (2005)
Course Category	:	PC

**COURSE OBJECTIVES:**

- To understand the concept of Simple Stresses and Strains.
- To understand the concept of Strain Energy.
- To understand the concept of Shear Force and Bending Moment Diagrams.
- To understand the concept of Theory of Simple Bending and Deflection of Beams.
- To understand the concept of Torsion in Shafts and springs.
- To understand the concept of Thin Cylindrical Shells.

**COURSE OUTCOMES:**

At the end of the course, the student will be able to:

CO1	Compute stress and strain values and find the changes in axial, lateral and volumetric dimensions of bodies of uniform section and of composite section under the influence of normal forces.
CO2	Calculate thermal stresses, in bodies of uniform section and composite sections.
CO3	Define resilience, proof – resilience and modulus of resilience and obtain expressions for instantaneous stress developed in bodies subjected to different loads.
CO4	Compute shear force and bending moment at any section of beam and draw the S.F. & B.M diagrams for UDL and Point loads.
CO5	Calculate the safe load, safe span and dimensions of cross section.
CO6	Compare strength and weight of solid and hollow shafts of the same length and material and compute the stress and deflection of the closed coil helical spring.

**COURSE CONTENT:****1 SIMPLE STRESSES AND STRAINS**

- 1.1 Types of forces; Stress, Strain and their nature
- 1.2 Mechanical properties of common engineering materials
- 1.3 Significance of various points on stress – strain diagram for M.S. and C.I. specimens
- 1.4 Significance of factor of safety
- 1.5 Relation between elastic constants
- 1.6 Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces
- 1.7 Thermal stresses in bodies of uniform section and composite sections
- 1.8 Related numerical problems on the above topics
- 1.9 Strain Energy and its significance
- 1.10 Derivation of strain energy for the following cases: Gradually applied load, Suddenly applied load, Impact/shock load

**2. SHEAR FORCE & BENDING MOMENT DIAGRAMS**

- 2.1 Types of beams
- 2.2 Types of Loads
- 2.3 SFD and BM Diagram for various types of beams
- 2.4 Analytical method for SF and BM of Simply supported beam
- 2.5 Over hanging beam with point loads,
- 2.6 Combination of point and UDL for the above; Related numerical problems

**3. THEORY OF SIMPLE BENDING AND DEFLECTION OF BEAMS**

- 3.1 Explanation of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of

- Resistance, Bending stress, Radius of curvature (Definition only)
- 3.3 Problems involving calculations of bending stress, modulus of section and moment of resistance
  - 3.4 Calculation of safe loads and safe span and dimensions of cross-section
  - 3.5 Definition and explanation of deflection as applied to beams (Standard cases only)
  - 3.6 Related numerical problems

#### 4. TORSION IN SHAFTS AND SPRINGS

- 4.1 Definition and function of shaft
- 4.2 Calculation of polar M.I. for solid and hollow shafts
- 4.3 Assumptions in simple torsion
- 4.4 Problems on design of shaft based on strength and rigidity
- 4.5 Numerical Problems related to comparison of strength and weight of solid and hollow shafts
- 4.6 Classification of springs
- 4.7 Deflection formula for closed coil helical spring (without derivation)
- 4.8 Stiffness of spring
- 4.10 Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils

#### 5. THIN CYLINDRICAL SHELLS

- 5.1 Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell
- 5.2 Derivation of expressions for the longitudinal and hoop stress for seamless and seam shells
- 5.3 Related numerical Problems for safe thickness and safe working pressure

#### REFERENCE BOOKS:

1. Strength of Materials – D.S. Bedi, Khanna Book Publishing Co. (P) Ltd., Delhi, 2017.
2. Strength of Materials – B.C. Punmia, Ashok Kumar Jain & Arun Kumar Jain, Laxmi Publications, New Delhi, 2013.
3. Strength of Materials – S. Ramamrutham, Dhanpat Rai & Publication New Delhi.
4. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi.
5. A Text Book strength of Material – R.K. Bansal, Laxmi Publication New Delhi.

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**AUTO THERMODYNAMICS - II**

Course Code	MA 4003
Course Title	AUTO THERMODYNAMICS - II
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Auto Thermodynamics – I (MA 3005)
Course Category	PC

**COURSE OBJECTIVES:**

- To understand combustion phenomenon and combustion chamber features of S.I. engines.
- To understand combustion phenomenon and combustion chamber features of C.I. engines.
- To understand the causes of air pollution by I.C. engines.
- To understand the refrigeration and air conditioning systems.
- To understand working of gas turbines and compressors

**COURSE OUTCOMES:**

At the end of the course, the student will be able to:

CO1	know combustion phenomenon and combustion chambers feature of S.I. engines
CO2	know combustion phenomenon and combustion chambers feature of C.I. engines
CO3	understand the causes of air pollution by I.C. engine
CO4	know the refrigeration and air conditioning systems.
CO5	know working of gas turbines and compressors

**COURSE CONTENT:****1. COMBUSTION IN S.I. ENGINE AND COMBUSTION CHAMBERS**

- 1.1 Required conditions of combustion
- 1.2 Air fuel ratio and ignition limit of I.C. engines
- 1.3 Normal combustion stages
- 1.4 Effect of engine variables on ignition lag
- 1.5 Effect of engine variables on flame propagation
- 1.6 Abnormal combustion
  - 1.6.1 Detonation
  - 1.6.2 Pre-ignition
- 1.7 Effect of engine variables on detonation
- 1.8 Rating of S.I. fuels
  - 1.8.1 Octane Number
  - 1.8.2 Sensitivity of the fuel
  - 1.8.3 Performance Number
  - 1.8.4 H.U.C.R.
- 1.9 Basic requirement of a good combustion chamber
- 1.10 Combustion chamber design principles
- 1.11 Comparison of various types of combustion chambers (only line sketches)

**2. COMBUSTION IN C.I. ENGINE AND COMBUSTION CHAMBERS**

- 2.1 Normal combustion stages
- 2.2 Comparison between combustion phenomenon of S.I. and C.I. engines
- 2.3 Delay period or ignition lag
  - 2.3.1 Physical delay

- 2.3.2 Chemical delay
- 2.3.3 Effect of engine variables on delay period
- 2.4 Rate of pressure rise
- 2.5 Diesel knock
- 2.6 Methods of controlling diesel knock
- 2.7 Cetane Number of the fuel
- 2.8 Methods of generating air swirl
- 2.9 Classification of C.I. engine combustion chambers

### 3. AIR POLLUTION BY AUTOMOBILE VEHICLES

- 3.1 Brief idea of air pollution
- 3.2 Gases exhausted by automobile vehicles
- 3.3 Smoke formation
- 3.4 Soot formation
- 3.5 Smog formation
- 3.6 Diesel odor
- 3.7 Pollutant control
  - 3.7.1 Catalytic converter
  - 3.7.2 Thermal converter
- 3.8 Exhaust Gas Recirculation (EGR)
- 3.9 Measurement of air pollution
  - 3.9.1 Smoke meter
  - 3.9.2 Exhaust gas analyzer

### 4. REFRIGERATION AND AIR CONDITIONING

- 4.1 Brief idea of cooling methods
- 4.2 Refrigerant
  - 4.2.1 Classification
  - 4.2.2 Nomenclature
  - 4.2.3 Properties of a good refrigerant
- 4.3 Vapour compression refrigeration system
  - 4.3.1 Layout diagram showing components, flow and state of refrigerant
  - 4.3.2 P.V. & T.S. diagram with showing sub-cooling, wet, dry and superheat compression
  - 4.3.3 Coefficient of performance (C.O.P.) and simple numerical problem using P-H chart
  - 4.3.4 Effect of varying temperature and pressure of condensing and suction side
- 4.5 Layout diagram of simple vapor absorption system with showing components, flow and state of refrigerants
- 4.6 Define and show psychrometric properties & processes on psychrometric chart-
  - 4.6.1 Dry Bulb, Wet Bulb and Dew Point Temperature (DBT, WBT & DPT)
  - 4.6.2 Specific humidity/ humidity ratio (w), Relative humidity (RH) and degree of saturation
  - 4.6.3 Sensible heating & cooling, humidification & dehumidification, heating & humidification heating & dehumidification, cooling & humidification, cooling & dehumidification
  - 4.6.4 Specific enthalpy of moist air, specific volume of moist air and mixing of moist air streams
- 4.7 Human comfort, comfort chart and effective temperature
- 4.8 Summer and winter air conditioning system
- 4.9 Working of automobile air conditioningsystem.

### 5. GAS TURBINES AND AIR COMPRESSORS

- 5.1 Classification of gas turbines
- 5.2 Application of gas turbines
- 5.3 Description of constant pressure and constant volume gas turbines
- 5.4 Methods of increasing thermal efficiency of gas turbines
  - 5.4.1 Regeneration
  - 5.4.2 Inter cooling
  - 5.4.3 Re-heating
- 5.5 Classification of compressors

- 5.6 Uses of compressed air
- 5.7 Working of single stage reciprocating compressors with line diagram and P.V. diagram
- 5.8 P.V. diagram and line diagram of multi-stage reciprocating compressors with inter-cooling
- 5.9 Rotary compressors
  - 5.9.1 Centrifugal compressor
  - 5.9.2 Axial flow type compressor
  - 5.9.3 Vane type compressors
- 5.10 Comparison between reciprocating and rotary air compressors

**Reference Books:**

1. Internal Combustion Engines- M.L. Mathur & R. P. Sharma
2. Automobile Engineering (Hindi & English) - Kirpal Singh
3. Automobile Engineering - R.B. Gupta
4. Thermal Engineering (Hindi) - Verma & Gulecha
5. Refrigeration & Air Conditioning - C.P.Arora
6. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi.

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(SEMESTER SCHEME-2020-21)

**BASIC VEHICLE TECHNOLOGY**

Course Code	MA 40041
Course Title	Basic Vehicle Technology
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Basic Mechanical Engineering (MA 3001)
Course Category	PE

**COURSE OBJECTIVES:**

- To know about the basic structure of conventional vehicle
- To understand the conventional suspension system
- To know about the major components of engine
- To understand the flow of power from engine to wheels in conventional vehicle
- To understand the mechanical and hydraulic braking system
- To understand the steering system of conventional vehicle.

**COURSE OUTCOMES:**

At the end of the semester students will learn about

CO1	Basic structure of conventional vehicle
CO2	Conventional leaf spring suspension system
CO3	Major components of engine
CO4	Power transmission system of conventional vehicle
CO5	Braking and steering system of conventional vehicle.

**COURSE CONTENT:****1. BASIC STRUCTURE OF VEHICLE:**

- 1.1 Classification of Automobiles
- 1.2 Chassis and body
- 1.3 Layout of conventional type vehicle (front engine rear wheel drive)
- 1.4 Vehicle specifications – Vehicle dimensions, Vehicle weights and spaces
- 1.5 Frame
  - 1.5.1 Function of frame, loads on frame
  - 1.5.2 Frame construction, sub-frame
  - 1.5.3 Defects in frame chassis repair and alignment
  - 1.5.4 Frame less construction
- 1.6 Wheels and Tyres
  - 1.6.1 Requirements of wheel
  - 1.6.2 Types of wheels - pressed steel disc, wire, light alloy cast wheels
  - 1.6.3 Tyre Types (Tubed, Tubeless, Cross ply, Radial ply, Belted biasd)
  - 1.6.4 Cross section of a pneumatic tyre
  - 1.6.5 Construction and Comparison of cross ply and radial ply tyres
  - 1.6.6 Specification of tyres, Factor affecting tyre life.

**2. SUSPENSION SYSTEM:**

- 2.1 Basic functions of suspension system
- 2.2 Types - Independent and rigid, coil, leaf, torsion bar, air, rubber suspension (Elementary idea)
- 2.3 Conventional leaf spring rigid beam suspension for light vehicle and with helper spring for heavy vehicles.
- 2.4 Function, construction and working of Telescopic type shock absorber. Gas filled shock absorber
- 2.5 Sprung and unsprung weight.

**3. ENGINE COMPONENTS:**

Types, functions, constructional details, materials and defects in following engine components-

- 3.1 Cylinder, cylinder liner, block and head
- 3.2 Piston, piston rings, gudgeon pin
- 3.3 Connecting rod, lubrication of big end and small end
- 3.4 Crank shaft, Flywheel, Ring gear, Vibration damper
- 3.5 Cam shaft, Valves, valve operating mechanisms, Tappet clearance and it's adjustment
- 3.7 Gaskets and oil seals
- 3.8 Bearings
  - 3.8.1 Main bearing, Big end bearing
  - 3.8.2 Bearing failures and causes

**4. TRANSMISSION SYSTEM:**

- 4.1 Clutch:
  - 4.1.1 Purpose and requirements of clutch
  - 4.1.2 Construction of working detail of single plate coil spring and diaphragm spring clutch, multi plate clutch, centrifugal clutch.
  - 4.1.3 Dry and wet clutch
  - 4.1.4 Construction of clutch plate
- 4.2 Gear Box:
  - 4.2.1 Functions and types of gear boxes
  - 4.2.2 Constructional and working of sliding mesh, constant mesh and synchronismesh gear boxes
  - 4.2.3 Construction and working of selector and inter locking mechanism
- 4.3 Final Drive:
  - 4.3.1 Function and constructional details of - Propeller shafts, Universal joints, Sliding joint
  - 4.3.2 Differential - Principles, function, construction and working of conventional differential
  - 4.3.3 Different types of rear axles according to methods of supporting.

**5. CONTROL SYSTEMS:**

- 5.1 Purpose, principle and classification of brakes.
- 5.2 Layout and description of mechanical brakes.
- 5.3 Hydraulic brakes
  - 5.3.1 Principle, layout
  - 5.3.2 Construction & working of single and tandem master cylinder, wheel cylinder
  - 5.3.3 Bleeding of hydraulic brakes
  - 5.3.4 Brake fluids and characteristics
- 5.4 Hand brakes
- 5.5 Front axle and Steering
  - 5.5.1 Front axle - types and construction, front wheel stub axle assembly
  - 5.5.2 Purpose and requirements of steering system
  - 5.5.3 General arrangement of steering systems steering gear ratio
  - 5.5.4 Steering system components – steering wheel, steering column, conventional steering linkage, steering and ignition lock, Adjustable and Collapsible steering column
  - 5.5.5 Construction and working details of different types of steering gear boxes

**REFERENCE BOOKS :**

1. Automotive Chassis & Body. P.L.Kohli.
2. Vehicle & Engine Technology (Vol. I & II) Heinz Heisler.
3. Basic Automobile Engineering C.P.Nakra.
4. Automobile Engineering. R.B.Gupta
5. Automobile Engineering H.S. Reyat
6. Automobile Engineering (Hindi & English) Kirpal Singh
7. ऑटोमोबाइल अभियांत्रिकी एस.एम.पाण्डेय ( दीपक प्रकाशन म.प्र.)

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**MATERIAL HANDLING SYSTEMS**

Subject Code	:	MA 40042 (Sane as MP/ME 40042)
Course Title	:	MATERIAL HANDLING SYSTEMS
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites (Course code)	:	NIL
Course Category	:	PE

**Course Learning Objectives:**

- To know the operational features of the material handling equipment & its practical applications.
- To understand, select, operate and maintain the material handling equipments.
- To understand different material handling processes used in industries.
- To understand & appreciate safety instrumentation for equipment.

**COURSE OUTCOMES:**

At the end of the course, the student will be able to:

CO1	Understand constructional & operational features of various materials handling systems.
CO2	Identify, compare & select proper material handling equipment for specified applications.
CO3	Know the controls & safety measures incorporated on material handling equipment.
CO4.	Appreciate the role of material handling devices in mechanization & automation of industrial process.
CO5	Understand & appreciate safety instrumentation for equipment

**COURSE CONTENT:****1. Introduction to Material Handling System:**

- 1.1. Main types of Material handling equipments & their applications
- 1.2. Types of load to be handled
- 1.3. Types of Movements, Methods of stacking, loading & unloading systems
- 1.4. Principles of Material Handling Systems; Modern trends in Materials handling.

**2. Hoisting Machinery & Equipments:**

- 2.1. Construction and Working of different types of hoists such as Lever operated hoist, Portable hand chain hoist, Electric & Pneumatic hoists;
- 2.2. Construction and Working of different types of cranes such as Mobile cranes, Bridge cranes, Cable cranes, & Cranes traveling on guide rails;
- 2.3. Construction and Working of Elevating equipments such as Stackers, Industrial lifts, Freight elevators, Passenger lifts.

**3. Conveying Machinery:**

- 3.1. Construction and Working of Traction type conveyors such as Belt conveyors, Chain conveyors, Bucket elevators, Escalators;
- 3.2. Construction and Working of Traction less type conveyors such as Gravity type conveyors, Vibrating & Oscillating conveyors, Screw conveyors, Pneumatic & Hydraulic conveyors, Hoppers gates & Feeders.
- 3.3. Surface Transportation Equipment: Construction, Function, Working of Trackless equipment such as Hand operated trucks, Powered trucks, Tractors, Automatic Guided vehicle

**4. Components of Material Handling Systems:**

- 4.1. Flexible hoisting appliances such as Welded load chains, Roller chains, Hemp ropes, Steel wire ropes, Fastening methods of wire & chains, Eye bolts, Lifting tackles, Lifting & Rigging practices;
- 4.2. Load handling attachments: a) Various types of hooks-Forged, Triangular eye hooks, Appliances for suspending hooks b) Crane grab for unit & piece loads c) Electric lifting magnet, vacuum lifter. d) Grabbing attachment for loose materials e) Crane attachment for handling liquids/molten metals;

**5. Mechanism used in Material Handling Equipment:**

- 5.1. Steady state motion; Starting & stopping of motion in following mechanisms: Hoisting mechanism, Lifting Mechanism, Traveling Mechanism.

- 5.2. Selection of Material Handling Equipment: Factors affecting choice of material handling equipment such as Type of loads, Hourly capacity of the unit, Direction & length of travel,

**Reference Books:**

1. Material Handling (Principles & Practice) – Allegri T. H., CBS Publisher, New Delhi.
2. Plant Layout & Materials Handling – Apple J. M., John Wiley Publishers.
3. Material Handling Equipment – N. Rundenko, Peace Publisher, Moscow.
4. Material Handling Equipment – M. P. Alexandrov, MIR Publisher, Moscow.
5. Material Handling Equipment – Y. I. Oberman, MIR Publisher, Moscow.

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(SEMESTER SCHEME-2020-21)

### REFRIGERATION AND AIR-CONDITIONING

Course Code	:	*MA 40051(Same in ME 40051)
Course Title	:	REFRIGERATION AND AIR-CONDITIONING
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	Thermal Engineering - I (ME 305)
Course Category	:	PE

#### COURSE OBJECTIVES:

- To understand the basics of Refrigeration cycles.
- To understand basics of vapour compression and vapour absorption systems.
- To identify components and refrigerants and lubricants of a refrigeration system.
- To understand control strategies for refrigeration system.
- To understand the basics about air conditioning systems.

#### COURSE OUTCOMES

At the end of the course, the student will be able to:

CO1	Define refrigeration and types of Refrigeration cycles
CO2	Explain Vapour Compression and Vapour Absorption System working principles
CO3	Identify the components required for refrigeration system.
CO4	Identify the controlling components for a refrigeration system.
CO5	Explain the working principles of Air-conditioning.

#### COURSE CONTENT:

##### UNIT-I: INTRODUCTION TO REFRIGERATION

Definition of Refrigeration; Refrigerating effect-unit of refrigeration- Coefficient of performance; Types of Refrigeration-Ice, dry ice, Steam jet, Throttling, Liquid nitrogen refrigeration; Carnot refrigeration Cycle(Introduction only); Air refrigeration- Bell - Coleman cycle, Advantage and disadvantages in air refrigeration; Simple problems

##### UNIT-II: REFRIGERATION SYSTEMS

Working of Vapour compression refrigeration cycle with expansion; Representation of the vapour compression cycle on P-H, T-S & P-V Diagram; Types of Vapour Compression cycle and its advantages and disadvantages; Simple Vapour absorption cycle(Basic Introduction only); Simple Electrolux system for domestic units; Comparison of Vapour absorption and vapour compression system; Simple problems on vapour compression cycle.

##### UNIT-III: REFRIGERATION EQUIPMENTS

Types of compressors used in refrigeration

Types of Condensers used in refrigeration

natural and forced draught cooling system(Only Basic Introduction); Advantages and disadvantages of air cooled and water-cooled condensers;Types of Evaporators.

**Refrigerants and lubricants:** Introduction and Properties of good refrigerants; Classification of refrigerants Detection of refrigerants leakage; Charging the system with refrigerant; Lubricants used in refrigeration

##### UNIT-IV: REFRIGERANT FLOW CONTROLS

Types of Expansion devices used in refrigeration; High side and low side float valve; Solenoid valve; Evaporator pressure regulator.

**Application of refrigeration:** Slow and quick freezing; Cold storage and Frozen storage; Dairy refrigeration; Ice making industry; Water coolers.

##### UNIT-V: AIR CONDITIONING

Introduction to Air conditioning; Psychometric chart and its use for various processes; Equipments used in air

conditioning units and plants.

**Refrigeration and Air-conditioning tools:** Tools used in refrigeration and Air conditioner installation; Installation procedure; Faults in refrigeration and air conditioning system; Servicing procedure.

**REFERENCE BOOKS:**

1. Refrigeration and Air Conditioning – Sadhu Singh, Khanna Book Publishing Co., New Delhi
2. Refrigeration and Air Conditioning – S. Domakundawar, Dhanpat Rai publications.
3. Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6<sup>th</sup> edition, Satya Prakashan publications, New Delhi, 2004.
4. Principles of Refrigeration – Roy J.Dossat, 5<sup>th</sup> edition, Pearson Publications, 2001.
5. Refrigeration and Air Conditioning – M.Zakria Baig, Premier/ Radiant Publishing House.
6. Refrigeration and Air Conditioning – C.P Arora, Tata McGraw Hill Education, 2000.

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(SEMESTER SCHEME-2020-21)

**AUTO ELECTRICAL ENGINEERING**

Course Code	MA 40052
Course Title	AUTO ELECTRICAL ENGINEERING
Number of Credits	3 (L:3, T:0,P:0)
Prerequisites	NIL
Course Category	PE

**COURSE OBJECTIVES:**

- To understand about Lead acid battery used in automobiles, its types ,charging processes, various tests, battery failure and rectification.
- To understand the principles of Alternator of automotive vehicles.
- To understand the principles of Self Starter of automotive vehicles.
- To understand the principles of Ignition System of automotive vehicles.
- To understand the principles of Lighting Systems of automotive vehicles.

**COURSE OUTCOMES:**

At the end of the course, the student will be able to:

CO1	Know about lead acid battery used in automobiles.
CO2	Understand the working of alternator.
CO3	Understand the principle and operation of starting motor.
CO4	Know about ignition system, ECM , Sensors and spark plug.
CO5	Understand the working of lighting system, wiring and Horn.

**COURSE CONTENT:****1. BATTERY :**

- 1.1 Function and types of battery
- 1.2 Lead acid battery- principle, chemical reaction and Construction detail
- 1.3 Battery rating
- 1.4 Battery Charging:
  - 1.4.1 Charging system - constant current and constant voltage
  - 1.4.2 Normal, booster and trickle charging
- 1.5 Battery test
  - 1.5.1 Specific gravity test
  - 1.5.2 Open and short circuit voltage test
  - 1.5.3 High discharge test
  - 1.5.4 Cadmium tip test
- 1.6 Battery failure and rectification
  - 1.6.1 Overcharging
  - 1.6.2 Cycling
  - 1.6.3 Sulfation
  - 1.6.4 Internal short circuit
  - 1.6.5 Buckling and cracking
- 1.7 Battery maintenance and storage (dry and wet type)

**2. ALTERNATOR AND REGULATOR**

- 2.1 Alternator
  - 2.1.1 Construction and working principle
  - 2.1.2 Advantage of alternator over dynamo
  - 2.1.3 Rectifier

- 2.1.3.1 Y- connected stator alternator with 6 diode rectifier
- 2.1.3.2 Delta-connected stator alternator with 6 diode rectifier
- 2.2 Regulator
  - 2.2.1 Single unit regulator
  - 2.2.2 Two-unit regulator
  - 2.2.3 Three-unit regulator
  - 2.2.4 Fully transistorized regulator
- 2.2 Alternator fault and rectification

### 3. STARTING SYSTEM

- 3.1 Starting Motor
  - 3.1.1 Motor types and specifications
  - 3.1.2 Construction of starting motor and working principle
- 3.2 Starter motor drive mechanism
  - 3.2.1 Need of drive mechanism
  - 3.2.2 Bendix drive
  - 3.2.3 Over running clutch drive
- 3.4 Starter motor control
  - 3.4.1 Manual switch
  - 3.4.2 Solenoid switch
- 3.5 Starting cable and specification

### 4. IGNITION SYSTEM :

- 4.1 Principle
- 4.2 Spark Advance Mechanism
- 4.3 Centrifugal spark advance mechanism
- 4.4 Vacuum spark advance mechanism
- 4.5 Magneto ignition system
- 4.6 Coil ignition system :
  - 4.6.1 Working principle
  - 4.6.2 Constructional detail of Ignition coil
  - 4.6.3 Constructional detail of Distributor
  - 4.6.4 Limitations of coil ignition system
- 4.7 Ignition timing
- 4.8 Comparison of coil and magneto ignition system
- 4.9 Electronic magneto ignition system
- 4.10 Electronic fuel injection
  - 4.10.1 E.C.M.
  - 4.10.2 Sensors and their supporting circuits
  - 4.10.3 M.P.F.I.
  - 4.10.4 C.R.D.I.
- 4.11 Spark Plug :
  - 4.11.1 Constructional details and classification
  - 4.11.2 Effect of leaded fuels
  - 4.11.3 Plug polarity

### 5. LIGHTING SYSTEM :

- 5.1 Introduction
- 5.2 Head lamps- Sealed beam type
- 5.3 Focusing and alignment of head lamp
- 5.4 Fog lamp, brake warning light, side light, direction indicator, hazard warning light (functions only)
- 5.5 Switches : (function only)- Door switch, Head light, Parking light, Combination switch, Horn switch
- 5.6 Wiring
  - 5.6.1 Wiring circuit for two wheeler and four wheeler vehicle.
  - 5.6.2 H.T.L.T. cable and specification

- 5.6.3 Fuse and fuse rating
- 5.6.4 Cable colour code
- 5.7 Horn :Electric ,Windtone type ,Diaphragm type

## REFERENCE BOOKS:

- |   |  |
|---|--|
| 1. Automotive Electrical Equipment            | William H Crouse (TMH)                           |
| 2. Basic Automobile Engineering               | C.P.Nakra (DhanpatRai publishing)                |
| 3. Automobile Engineering                     | Kirpal Singh( Standard Publishers Distributors ) |
| 4. Automobile Engineering                     | R.B. Gupta( SatyaPrakashan)                      |
| 5. Automotive Electrical Equipment            | P.L. Kohli (TMH)                                 |
| 6. Automotive Electrical Systems & Equipments | N.R.Khatawate( S.Chand& Company Ltd.)            |

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(SEMESTER SCHEME-2020-21)

**MATERIAL TESTING LAB**

Course Code	*MA 4006 (Same in ME 4006)
Course Title	MATERIAL TESTING LAB
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Material Science & Engineering (ME 3002) Strength of Materials (ME 4002)
Course Category	PC

**COURSE OBJECTIVES:**

- To identify the type of material based on its grain structure
- To learn the procedure for identifying the cracks in the material
- To understand various material testing methods to determine mechanical properties such as yield stress, Ultimate stress, percentage elongation, Young's Modulus etc.

**COURSE OUTCOMES**

At the end of the course, the student will be able to:

CO1	Identify the given specimen by viewing the micro structure using metallurgical microscope
CO2	Identify the cracks in the specimen using different techniques
CO3	Determine the various types of stress and plot the stress strain diagram for mild steel.
CO4	Determine the torsion, bending, impact and shear values of given materials
CO5	Determine the modulus of rigidity, strain energy, shear stress and stiffness of coil spring

**PRACTICALS:**

1. Prepare a specimen and examine the microstructure of the Ferrous and Non-ferrous metals using the Metallurgical Microscope.
2. Detect the cracks in the specimen using  
(i) Visual inspection and ring test (ii) Die penetration test (iii) Magnetic particle test.
3. Determination of Rockwell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminium.
4. Finding the resistance of materials to impact loads by Izod test and Charpy test.
5. Torsion test on mild steel – relation between torque and angle of twist determination of shear modulus and shear stress.
6. Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel.
7. Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open & Closed coil spring)
8. Single or double Shear test on M.S. bar to finding the resistance of material to shear load.

**REFERENCE BOOKS:**

1. Measurement system (Application and Design) – Ernest O Doebelin.
2. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi
3. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi

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**MEASUREMENTS & METEOROLOGY LAB**

Course Code	:	*MA 4007 (Same in ME 4007)
Course Title	:	MEASUREMENTS & METROLOGY LAB
Number of Credits	:	1 ( L:0, T:0 , P:2)
Prerequisites	:	Measurements & Meteorology (ME 4001)
Course Category	:	PC

**COURSE OBJECTIVES:**

- To understand techniques for precise measurement of the dimensions of various objects and shapes.

**COURSE OUTCOMES:**

At the end of the course, the student will be able to:

CO1	Measure various component of linear measurement using Vernier calipers and Micrometre.
CO2	Measure various component of angle measurement using sine bar and bevel Protractor
CO3	Measure the geometrical dimensions of V-thread and spur gear

**PRACTICALS:**

- Measure the diameter of a wire using micrometre and compare the result with digital Micrometer.
- Measure the angle of the machined surface using sine bar with slip gauges.
- Measure the angle of a V-block / Taper Shank of Drill / Dovetail using universal bevel protractor.
- Measure the dimensions of ground MS flat/cylindrical bush using Vernier Calliper compare with Digital/Dial Vernier Calliper.
- Measure the geometrical dimensions of V-Thread using thread Vernier gauge.
- Measure the thickness of ground MS plates using slip gauges.

**REFERENCE BOOKS:**

- Engineering Metrology – R. K. Jain
- Engineering precision metrology – R. C. Gupta
- A Hand book of Industrial Metrology – ASME

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**AUTO THERMODYNAMICS – II LAB**

Course Code	MA 4008
Course Title	AUTO THERMODYNAMICS – II LAB
Number of Credits	1 (L:0, T:0, P:2)
Prerequisites	Auto Thermodynamics – I (MA 3005)
Course Category	PC

**COURSE OBJECTIVES:**

- \* To understand features of I.C.engine combustion chambers
- \* To understand the exhaust gas analysis of I.C.engine
- \* To understand the refrigeration and air-conditioning processes and tools.
- \* To understand the automobile air-conditioning system components and their working.
- \* To understand the air compressor construction and working

**COURSE OUTCOMES:**

At the end of the course, the student will be able to:

CO1	Explain the features of I.C.engine combustion chambers
CO2	Explain the exhaust gas analysis of I.C.engine
CO3	Explain the refrigeration and air-conditioning processes and tools.
CO4	Explain the working of automobile air conditioning system
CO5	Explain the construction and working of air compressor.

**PRACTICALS**

1. Study of different type of S. I. combustion chambers.
2. Study of different type of C. I. combustion chambers
3. Emission measurement by exhaust gas analyzer.
4. To acquaint with the use of refrigeration tools, charging board, special refrigeration tube fittings.
5. Copper tube jointing practice, flaring and brazing.
6. Study of following components:-
  - 6.1 Auto air-conditioning Compressor
  - 6.2 Expansion valves
  - 6.3 Starting and over load relay
  - 6.4 Thermostats
  - 6.5 Strainer and receiver drier
  - 6.6 Magnetic clutch
7. Charging practice including making vacuum, pressure testing, charging and final testing for performance
8. Determination of psychometric properties of air at different places with the help of sling- psychrometer and hygrometer.
9. Using refrigeration trainer test rig / Air-conditioning test rig to find out its refrigerating capacity, power input and C.O.P.
10. Study of Air compressor components and working.

**REFERENCE BOOKS:**

1. Internal Combustion Engines ML.Mathur&R.P.Sharma
2. Automobile Engines Dr. Kirpal Singh
3. Automobile Engg. R.B. Gupta
4. Refrigeration & Air Conditioning Manohar Prasad
5. Refrigeration & Air Conditioning C.P.Arora
6. Refrigeration & Air Conditioning R.K. Rajput
7. Refrigeration & Air Conditioning R.S. Khurmi

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**VEHICLE TECHNOLOGY LAB**

Course Code	MA 4009
Course Title	VEHICLE TECHNOLOGY LAB
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Basic Vehicle Technology (MA 40041)
Course Category	PC

**COURSE OBJECTIVES:**

- \* To impart practical knowledge of various tools used in auto workshop.
- \* To impart practical knowledge of the basic structure of conventional vehicle.
- \* To understand the constructional and working features of different systems of vehicle such as suspension, brakes, steering, transmission.

**COURSE OUTCOMES:**

At the end of the semester, student will acquire practical knowledge of

CO1	Various tools used in auto workshop
CO2	Basic structure of a conventional vehicle
CO3	Constructional and working features of different systems of vehicle such as suspension, brakes, steering, transmission.

**PRACTICALS:**

1. Study of various tools used in Auto workshop.
2. Study of conventional layout of 4×2 vehicle.
3. Study and inspection of suspension system of light and heavy vehicles(with helper spring)
4. Study of mechanical and hydraulic braking system (Drum and Disc) and bleeding of hydraulic braking system.
5. Study of Steering system of conventional vehicle.
6. Study of clutch - Single plate & multi plate, Coil and Diaphragm spring type
7. Study of sliding mesh, constant mesh and synchronous mesh gear boxes.
8. Study of Propeller shafts, Universal joints, Sliding joint, differential and rear axle.
9. Study of wheel and tyre construction, Tyre repair, Wheel balancing, Tyre retreading study
10. Visit to nearby auto workshop and service station.

**REFERENCE BOOKS:**

1. Automobile Engineering(Hindi and English) Dr.Kirpal Singh
2. Basic Automobile Engineering C.P.Nakra
3. Automobile Engineering R.B.Gupta
4. AutomobileEngineering H.S. Reyat
5. AutomobileEngineering T.R.Banga, Nathu Singh
6. ऑटोमोबाइल अभियांत्रिकी एस. एम. पाण्डेय (दीपक प्रकाशन, म.प्र.)
7. Vehicle and Engine Technology Vol 1&2 Heinz Heisler

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**AUTO ELECTRICAL LAB**

Course Code	MA 4010
Course Title	AUTO ELECTRICAL Lab
Number of Credits	1 (L:0, T: 0,P :2)
Prerequisites	NIL
Course Category	PC

**COURSE OBJECTIVES:**

- To study about Lead acid battery used in automobiles, its constructional details, various tests, battery failure and rectification.
- To understand the working of Alternator of automotive vehicles.
- To understand the working of Self Starter of automotive vehicles and their testing procedures.
- To understand the working of Ignition System of automotive vehicles .
- To understand the working of Lighting Systems of automotive vehicles and their testing procedures.

**COURSE OUTCOMES:**

At the end of the course, the student will be able to:

CO1	Know about construction, testing and failure of lead acid battery used in automobiles.
CO2	Explain the construction and working of alternator.
CO3	Explain the working principle of operation of starting motor.
CO4	Know about ignition system, spark plug cleaning ,setting and testing ,MPFI system, Sensors and their locations.
CO5	Explain the working of lighting system , wiring and Horn.

**PRACTICALS**

1. To study the constructional details of lead acid battery
2. To study various causes of failures and various tests to determine the condition of lead acid battery.
3. To study and testing the various components of charging system.
4. To study and testing the regulator system.
5. Study of starting system.
6. Study of Ignition system.
7. Study of Light and sound system
8. Spark plug cleaning, setting and testing.
9. Practice to read, the wiring diagram of different vehicles and to trace fault in electrical circuit and different electrical components.
10. Study of MPFI system and sensors

**REFERENCE BOOKS:**

- |   |   |
|---|---|
| 1. Automotive Electrical Equipment            | William H Crouse (TMH)                            |
| 2. Automobile Engineering                     | Kirpal Singh ( Standard Publishers Distributors ) |
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**ESSENCE OF INDIAN KNOWLEDGE AND TRADITION**

Course Code	MA 4222 (Same in All Branches of Engg.)
Course Title	Essence of Indian Knowledge and Tradition
Number of Credits	0(L-2,T-0, P-0)
Prerequisites	None
Course Category	AU

**COURSE CONTENTS:**

Basic Structure of Indian Knowledge System:

- (i) वेद,
- (ii) उन्नवेद (आयुर्वेद, धनुर्वेद, गन्धर्वेद, स्थानत्यआदद)
- (iii) वेदशाखांग (शिक्षा, कलत्र, ननरुत, व्याकरण, ज्योनतषद्धथांद),
- (iv) उन्नथाइग (धर्मशास्त्र, र्ीर्थाथांसथा, नुरथाण, तकशरथास्त्र)
  - Modern Science and Indian Knowledge System
  - Yoga and Holistic Health care
  - Case Studies.

**REFERENCES /SUGGESTED LEARNING RESOURCES:**

1. V. Sivarama Krishna, " Cultural Heritage of India- Course Material", Bhartiya Vidya Bhavan, Mumbai, fifth Edition, 2014.
2. Swami Jitatmanand, " Modern Physics and Vedant", Bhartiya Vidya Bhavan.
3. Fritz of Capra, " The wave of Life".
4. Fritz of Capra, " Tao of Physics".
5. V N Jha, " Tarka sangraha of Annam Bhatta, International" Cinmay Foundation, Velliarnad, Amakuum.
6. R N Jha, " Science of Consciousness Psychotherapy and Yoga Practices" Vidya nidhi Prakasham, Delhi, 2016.

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