

## Third Semester

### APPLIED MECHANICS (DME-301)

#### Discipline core (DC): Credit 4(4-0-0)

**Objective:** The subject Applied Mechanics deals with basic concepts of mechanics like laws of forces, moments, friction, center of gravity, laws of motion and simple machines which are required by the students for further understanding of other allied subjects. The subject enhances the analytical ability of the students.

#### **COURSE OUTLINE:**

##### **1. Introduction**

- 1.1 Concept of engineering mechanics definition of mechanics, statics, dynamics, application of engineering mechanics in practical fields. Definition of Applied Mechanics.
- 1.2 Definition, basic quantities and derived quantities of basic units and derived units
- 1.3 Different systems of units (FPS, CGS, MKS and SI) and their conversion from one to another density, force, pressure, work, power, velocity, acceleration
- 1.4 Concept of rigid body, scalar and vector quantities

##### **2. Laws of forces**

- 2.1 Definition of force, measurement of force in SI units, its representation, types of force: Point force/concentrated force & Uniformly distributed force, effects of force, characteristics of a force
- 2.2 Different force systems (coplanar and non-coplanar), principle of transmissibility of forces, law of super-position
- 2.3 Composition and resolution of coplanar concurrent forces, resultant force, method of composition of forces, laws of forces, triangle law of forces, polygon law of forces - graphically, analytically, resolution of forces, resolving a force into two rectangular components
- 2.4 Free body diagram
- 2.5 Equilibrant force and its determination
- 2.6 Lami's theorem (concept only)

*[Simple problems on above topics]*

##### **3. Moment**

- 3.1 Concept of moment
- 3.2 Moment of a force and units of moment
- 3.3 Varignon's theorem (definition only)
- 3.4 Principle of moment and its applications (Levers – simple and compound, steel yard, safety valve, reaction at support)
- 3.5 Parallel forces (like and unlike parallel force), calculating their resultant
- 3.6 Concept of couple, its properties and effects
- 3.7 General conditions of equilibrium of bodies under coplanar forces and beams, fixed support, roller, support, over hanging, Uniformly distributed load, point load, varying load
- 3.8 Position of resultant force by moment

*[Simple problems on the above topics]*

#### **4. Friction**

- 4.1 Definition and concept of friction, types of friction, force of friction
- 4.2 Laws of static friction, coefficient of friction, angle of friction, angle of repose, cone of friction
- 4.3 Equilibrium of a body lying on a horizontal plane, equilibrium of a body lying on a rough inclined plane, friction in simple screw jack
- 4.4 Calculation of least force required to maintain equilibrium of a body on a rough inclined plane subjected to a force:

- a) Acting along the inclined plane Horizontally
- b) At some angle with the inclined plane

*[Simple problems on the above topics]*

#### **5. Centre of Gravity**

- 5.1 Concept, definition of centroid of plain figures and centre of gravity of symmetrical solid bodies
- 5.2 Determination of centroid of plain and composite lamina using moment method only, centroid of bodies with removed portion
- 5.3 Determination of center of gravity of solid bodies - cone, cylinder, hemisphere and sphere; composite bodies and bodies with portion removed

*[Simple problems on the above topics]*

#### **6. Moment of Inertia**

Concept of moment of inertia and second moment of area and radius of gyration, theorems of parallel and perpendicular axis, second moment of area of common geometrical sections: rectangle, triangle, circle (*without derivations*). Second moment of area for L, T and I sections, section modulus.

#### **7. Simple Machines**

- 7.1 Definition of effort, velocity ratio, mechanical advantage and efficiency of a machine and their relationship, law of machines
- 7.2 Simple and compound machine (Examples)
- 7.3 Definition of ideal machine, reversible and self locking machine
- 7.4 Effort lost in friction, Load lost in friction, determination of maximum mechanical advantage and maximum efficiency
- 7.5 System of pulleys (first, second, third system of pulleys), determination of velocity ratio, mechanical advantage and efficiency

#### **LIST OF PRACTICALS**

1. Verification of the following laws: a) Parallelogram law of forces b) Triangle law of forces c) Polygon law of forces
2. To verify the forces in different members of jib crane.
3. To verify the reaction at the supports of a simply supported beam.
4. To find the Mechanical Advantage, Velocity Ratio and efficiency in case of an inclined plane.
5. To find the Mechanical Advantage, Velocity Ratio and efficiency of a screw jack.
6. To find the Mechanical Advantage, Velocity Ratio and efficiency of worm and worm wheel.
7. To find Mechanical Advantage, Velocity Ratio and efficiency of single purchase crab.
8. To find out center of gravity of regular lamina.
9. To find out center of gravity of irregular lamina.
10. To determine coefficient of friction between three pairs of given surface.

#### **RECOMMENDED BOOKS**

1. A Text Book of Applied Mechanics by S Ramamurtham, Dhanpat Rai Publishing Co. Ltd.
2. A Text Book of Engineering Mechanics (Applied Mechanics) by RK Khurmi; S Chand and Co. Ltd., New Delhi.

## **FLUID MECHANICS (DME-302)**

### **Discipline core (DC): Credit 4(3-0-2)**

**Objective:** Materials play an important role in the construction and manufacturing of equipment/tools. Right selection of materials add to the economy, working and life of machinery. A diploma holder must be conversant with the properties, uses, availability and costs of materials used for construction/fabrication to enable him to perform his functions confidently

#### **COURSE OUTLINE:**

1. Introduction:
  - 1.1 Fluids: Real and ideal fluids
  - 1.2 Fluid Mechanics, Hydrostatics, Hydrodynamics, Hydraulics
2. Properties of Fluids (definition only)
  - 2.1 Mass density, specific weight, specific gravity, viscosity, surface tension - cohesion, adhesion and, capillarity, vapour pressure and compressibility.
  - 2.2 Units of measurement and their conversion
3. Hydrostatic Pressure:
  - 3.1 Pressure, intensity of pressure, pressure head, Pascal's law and its applications.
  - 3.2 Total pressure, resultant pressure, and centre of pressure.
  - 3.3 Total pressure and centre of pressure on horizontal, vertical and inclined plane surfaces of rectangular, triangular, trapezoidal shapes and circular. (No derivation)
4. Measurement of Pressure:
  1. Atmospheric pressure, gauge pressure, vacuum pressure and absolute pressure.
  - 4.2 Piezometer, simple manometer and differential manometer, Bourdon gauge and dead weight pressure gauge.
5. Fundamentals of Fluid Flow:
  - 5.1 Types of Flow: Steady and unsteady flow, laminar and turbulent flow, uniform and non-uniform flow
  - 5.2 Discharge and continuity equation (flow equation) {No derivation}
  - 5.3 Types of hydraulic energy: Potential energy, kinetic energy, pressure energy. Hydraulic gradient line and total energy line.
  - 5.4 Bernoulli's theorem; statement and description (without proof of theorem) and simple numerical problems.
6. Flow Measurements (brief description with simple numerical problems)
  - 6.1 Venturimeter and mouthpiece
  - 6.2 Pitot tube
  - 6.3 Orifice and Orificemeter
  - 6.4 Current meters

6.5 Notches and weirs (simple numerical problems)

7. Flow through Pipes:

7.1 Definition of pipe flow; Reynolds number, laminar and turbulent flow - explained through Reynold's experiment

7.2 Critical velocity and velocity distributions in a pipe for laminar flow

7.3 Head loss in pipe lines due to friction, sudden expansion and sudden contraction, entrance, exit, obstruction and change of direction (No derivation of formula)

7.4 Flow from one reservoir to another through a long pipe of uniform cross section (simple problems)

7.5 Pipes in series and parallel

7.6 Water hammer phenomenon and its effects (only definition and description)

8. Flow through open channels:

8.1 Definition of an open channel, uniform flow and non-uniform flow

8.2 Discharge through channels using i) Chezy's formula (no derivation)

ii) Manning's formula (no derivation)

iii) Simple Numerical Problem

## **PRACTICAL EXERCISES**

i)To verify Bernoullis Theorem

ii)To find out venturimeter coefficient

iii)To determine coefficient of velocity (C<sub>v</sub>), Coefficient of discharge (C<sub>d</sub>) Coefficient of contraction (C<sub>c</sub>) of an orifice and verify the relation between them

iv)To perform Reynold's experiment

v)To verify loss of head in pipe flow due to a)Sudden enlargement b)Sudden contraction c)Sudden bend

vi)Demonstration of use of current meter and pitot tube

vii)To determine coefficient of discharge of a rectangular notch/triangular notch.

## **RECOMMENDED BOOKS**

1. Jagdish Lal, "Fluid Mechanics and Hydraulics" Delhi Metropolitan Book Co. Pvt Ltd.

2. Modi, PN, and Seth, SM; "Hydraulics and Fluid Mechanics", Standard Publishers Distributors, Delhi

## **WORKSHOP TECHNOLOGY (DME-304)**

### **Discipline core (DC) : Credit 4(3-0-2)**

**Objective:** This subject provides knowledge about various welding processes and foundry work and machine work. Welding is very useful for fabrication work and foundry for production of castings used for manufacturing of machines and machine work is also used for manufacturing which is included in this subject and it is very essential for diploma holders.

#### **COURSE OUTLINE:**

##### **1. Welding**

Principle of welding, Classification of welding processes, Advantages and limitations, Industrial applications of welding, Welding positions and techniques, symbols.

Gas Welding , Principle of gas welding, Types of gas welding flames and their applications, Gas welding equipments, Gas welding torch, Oxy acetylene cutting torch, Blow pipe, Pressure regulators, Filler rods and fluxes.

Arc Welding, Principle of operation, Arc welding machines and equipment, A.C. and D.C. arc welding, Effect of polarity, current regulation and voltage regulation, Electrodes, Flux for arc welding.

Other Welding processes, Resistance welding: Principle, advantages, limitations, working and applications of spot welding, seam welding, projection welding and percussion welding. Shielded metal arc welding, submerged arc welding, welding defects, methods of controlling welding defects and inspection of welded joints.

Modern Welding Methods, Principle of operation, advantages, disadvantages and applications of: Tungsten inert gas (TIG) welding, Metal inert gas (MIG) welding, Thermit welding, Electro slag welding.

##### **2. Pattern making**

Pattern Making, Types of pattern, Pattern material, Pattern allowances, Pattern codes as per B.I.S. Introduction to cores, core boxes and core materials, Core making procedure , Core prints, positioning of cores.

Moulding Sand , Properties of moulding sand, permeability, refractoriness, adhesiveness, cohesiveness, strength, flow ability, collapsibility etc. Various types of moulding sand and testing of moulding sand.

Mould Making, Types of moulds, Molding boxes, hand tools used for mould making, Molding processes: Bench molding, floormolding, pit molding and machine molding.

Special Casting Processes Principle, working and applications of Die casting: hot chamber and cold chamber, Investment and lost wax process, Centrifugal casting, Continuous casting process

Gating and Risering system , Elements of gating system, Pouring basin, sprue, runner, gates Types of risers, location of risers.

Melting Furnaces Construction and working of: Pit furnace, Cupola furnace, Crucible furnace –tilting type.

Casting Defects, Different types of casting defects and their reasons, testing of defects: radiography, magnetic particle inspection, and ultrasonic inspection.

### **3. Chips**

Elementary theory of metal cutting, chip formation, continuous chip, continuous chip with BUE, discontinuous chips. Mechanism of chip formation, Geometry of chip formation, forces of chip, Merchant circle diagram. Tool life, Economics of tool life.

Cutting Tools and Materials, Various types of single point cutting tools and their uses, Single point cutting tool geometry, tool signature and its effect, Heat produced during cutting and its effect, Cutting speed, feed and depth of cut and their effect, Properties of cutting tool material, Study of various cutting tool materials viz. High speed steel, tungsten carbide, cobalt steel, cemented carbides and diamond.

### **4. Lathe**

Lathe, Principle, Description and function of various parts of a lathe, Classification and specification of various types of lathe, Drives and transmission, Work holding devices, Lathe tools: Parameters/Nomenclature and applications, Lathe operations :- Plain and step turning, facing, parting off, taper turning, eccentric turning, drilling, reaming, boring, threading and knurling. Cutting parameters –Speed, feed and depth of cut for various materials and for various operations, machining time. Speed ratio, preferred numbers of speed selection. Lathe accessories:- Centers, dogs, chucks, collets, face plate, angle plate, mandrel, steady rest, taper turning attachment, tool post grinder.

### **5. Drilling**

Drilling, Principle of drilling. Classification of drilling machines and their description. Various operations performed on drilling machine –drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping. Speeds and feed during drilling, machining time. Types of drills and their features.

Boring Principle of boring, Classification of boring machines and their brief description. Specification of boring machines. Shaping, Planing and Slotting ,Working principle of shaper, planer and slotter. Quick return mechanism applied to shaper, slotter and planer machine. Types of tools used and their geometry. Specification of shaper, planer and slotting machine. Speeds and feeds in above processes.

Cutting fluids and Lubricants, Function of cutting fluid ,Types of cutting fluids, Difference between cutting fluid and lubricant, Selection of cutting fluids for different materials and operations, Common methods of lubrication of machine tools.

## **PRACTICAL EXERCISES**

1. Single point cutting tool grinding.
2. A composite job involving turning, taper turning, thread cutting and knurling.
3. Marking and drilling practice using column and knee type drilling machine and radial drilling machine.
4. A job on drilling, reaming, counter boring and counter sinking.
5. Prepare a V- block on shaper machine.
6. Exercise on key way cutting.
7. Planning of C.I. block

8. Preliminary joining practice by gas welding.
9. Exercises of gas welding on the following Aluminum, Brass, Copper, C.I.
10. Gas cutting of the following types
  - (a) Preliminary gas cutting practice
  - (b) Stock cutting by oxy acetylene
11. Making following types of joints by arc welding:
  - (a) Preliminary joining practice by arc welding
  - (b) Butt and lap joint (in vertical position, travel up and down)
  - (c) Welding of outside corner joint
12. Exercise on spot welding
13. Exercise on brazing
14. Exercise on TIG/MIG welding
15. Testing & Inspection of welding defects visually
16. Pattern making: Preparation of solid pattern (single piece), Preparation of split pattern
17. Preparation of the following types of moulds. Floor molding.
18. Testing moisture content of moulding sand
19. Moulding and casting of ( a ) a solid pattern b) a split pattern
20. Testing and inspection of casting defects visually

#### **RECOMMENDED BOOKS**

1. Welding Technology by R.L. Agarwal and Tahil Maghanani; Khanna Publishers, Delhi.
2. Principles of Foundry Technology by Jain; Tata Mc Graw Hill Publishers, New Delhi.

## **MACHINE DRAWING (DME-305)**

### **Discipline core (DC): Credit 3(2-0-2)**

**Objective:** Diploma holders are required to read and interpret drawings .Therefore, it is essential that they have competency in preparing drawings and in sketching various machine parts and this will also improve their imagination skill.

#### **COURSE OUTLINE:**

##### **1. Introduction to Machine Drawing**

- 1.1 Graphic language, classification of machine drawing, conventional representation.
- 1.2 System of orthographic projections. Third angle projection, first angle Projection No. of views required. One view, Two views, Three views drawing
- 1.3 Sectioning- Material convention, important types of section- full section, half Section ,revolved section and aligned section
- 1.4 Temporary and permanent fasteners

##### **2. Bearings (3 sheets)**

- 2.1 Bush bearing 2.2 Foot Step bearing 2.3 Simple wall bracket

##### **3. Pulleys (2 sheets)**

- 3.1 Flat belt pulley 3.2 V belt pulley 3.3 Cone or stepped pulley 3.4 Fast and loose pulley

##### **4. Pipe Joints (4 sheets)**

- 4.1 Flange joint 4.2 Spigot and socket joint 4.3 Threaded pipe joint 4.4 Expansion joint 4.5 piping joint

##### **6. Gears and Gearing (2 sheets)**

- 6.1 Spur gear- Nomenclature, gear formula, method to draw base circle, involute curve, tooth profile of internal and external gears. 6.2 Bevel gear- Nomenclature, gear formula, method to draw Bevel gear

##### **7. Free hand sketches (2 sheets)**

- 7.1 Cutting tool of lathe, shaper, milling cutter, drilling tools, broaching tools. 7.2 Gear puller, C clamp 7.3 Square and hexagonal nut bolt assembly 7.4 Cotter joint 7.5 Knuckle joint 7.6 Pipe joints

##### **8. Jig, fixture and Gauges (2 sheets)**

- 8.1 Concept of jig and fixture, types of jig and fixture and applications 8.2 Simple plate drill jig, drill jig for batch production 8.3 Indexing fixture 8.4 Introduction to gauges, use of Go-No Go gauge and ring gauge

#### **RECOMMENDED BOOKS**

1. Machine Drawing by P.S. Gill; Kataria and Sons, Ludhiana.
2. A Text book of Machine Drawing by R.K. Dhawan , S.Chand and Company Ltd.,New Delhi.
3. Machine Drawing by GR Nagpal; Khanna Publishers, New Delhi.

## **THERMODYNAMICS (DME-306)**

### **Discipline core (DC): Credit 4(3-0-2)**

Objective: Looking at the needs of various industries and departments, the following topics lay a firm foundation for the advanced knowledge of topics like thermal power plants, internal combustion engines etc.

#### **COURSE OUTLINE:**

**FUNDAMENTAL OF THERMODYNAMICS:** Introduction of thermodynamics, Basic properties, classification of system, Various system and its boundaries Energy, Zeroth law of thermodynamics & equilibrium, Processes & cycle, Quasi-static process.

**FIRST LAW OF THERMODYNAMIC:** Joule's experiment, First law of thermodynamics, Control mass & control volume concept, Energy equation, Equation of work for open system, Application of SFEE, Numerical.

**SECOND LAW OF THERMODYNAMIC:** Second law of thermodynamic, Kelvin-Plank & clausius statements and equivalence, Reversible and irreversible processes, Carnot cycle and theorem, corollary, Entropy, Numerical.

**IDEAL GASES AND PROCESSES:** Ideal gas laws, Characteristic equation of gas & universal gas constant, Specific heat, thermodynamic processes and their relationship, Adiabatic and polytropic process, Numerical.

**THERMODYNAMIC CYCLE:** Classification of thermodynamic cycle, Concept of power cycle, Power producing cycles, Carnot cycle, Otto cycle, Diesel cycle, Dual combustion cycle, Brayton cycle.

#### **LIST OF PRACTICES**

- 1 Demonstration of steam turbines through models and visit
- 2 Demonstration of steam condensers through models and visits
3. Study of modern high pressure steam boilers (at least one)
- 4 Demonstration of boiler Accessories and mountings
- 5 Demonstration/ study of an impulse turbines
- 6 Demonstration/ study of a reaction turbine
- 7 Demonstration of air compressor

## **RECOMMENDED BOOKS**

1. Engineering Thermodynamics by PK Nag; Tata McGraw Hill, Delhi.
2. Basic Engineering Thermodynamics by Roy Chaudhary; Tata McGraw Hill, Delhi.

## **BASIC ELECTRICAL AND ELECTRONICS TECHNOLOGY (DME-303)**

### **Basic Engineering and Science (BES) Core: Credit 4(3-0-2)**

**Objective:** The objective of the course is to impart basic knowledge and skills regarding electrical and electronics engineering, which diploma holders will come across in their professional life

### **COURSE OUTLINE:**

#### **1. Overview of Electricity:**

General use and applications of electricity; Use and applications of electricity to agriculture, Mechanical & Automobile sector; Advantages of electrical energy over other forms of energy.

#### **2. DC Circuits:**

Introduction to basic terms: charge, current, voltage, power, and energy; Ohm's law; Power dissipation in resistors; Series and parallel combination of resistors; Kirchhoff's laws; Star-delta conversions; Thevenin's theorem, Norton's theorem, and Maximum-power-transfer theorem.

#### **3. AC Circuits:**

Concept of alternating voltage and current; Introduction to basic terms: cycle, frequency, time period, amplitude, instantaneous value, rms value, peak value, phase difference, form factor, and peak factor; Concept of phasor; Phasor diagrams; Concepts of reactance, impedance, admittance, susceptance, and conductance; Concepts of instantaneous power, real power, reactive power, apparent power, complex power, and power factor; Analysis of simple AC circuits; Overview of three-phase AC circuits.

#### **4. Batteries and Solar Cells:**

Primary and secondary cells; Construction, working, and applications of Lead-Acid; Charging methods for Lead-Acid batteries; Maintenance of Lead-Acid batteries; Series and parallel connection of batteries; Maintenance free batteries; General idea of solar cells, solar panels and their applications.

#### **5. Electrical Machines:**

Electromagnetic induction; Introduction to magnetic circuits; Principles of electromechanical energy conversion; Construction and operation of single phase transformers; Tests of transformers; Efficiency and regulation; Operation of autotransformers & welding transformer;. Types of three-phase induction motors; principle of operation; Methods of starting and speed-control of three-phase induction motors; Overview of single-phase induction motors.; Construction and operation of synchronous machines; Construction and operation of stepper motors. Applications of single and three phase induction motors.

#### **6. Semiconductors:**

Classification of materials as conductors, insulators, and semiconductors; Intrinsic and extrinsic semiconductors; p-type and n-type semiconductors; pn-junction diode; Half wave and full wave

rectification using diodes; Basic construction and operation of BJT, UJT, JFET, MOSFET, and thyristor.

### **7. Measuring Instruments:**

Construction and working principles of PMMC and MI type voltmeters and ammeters; Dynamometer wattmeter; Induction-type energy meters; Measurement of power and energy in three-phase circuits.

### **8. Electrical Installation and Safety:**

Various accessories and parts of electrical installation; Overview of industrial and domestic wiring systems; Common electrical safety measures; Protection and precaution against electrical shock; Treatment of electrical shock; Basic protective devices like fuse, MCB, thermal overload relay, ELCB, and RCCB; Concepts and types of earthing; Protection against lightning.

## **LIST OF PRACTICALS**

1. Verification of Ohm's Law
2. Verification of KCL and KVL
3. Test of charging and discharging of lead-acid battery using hydrometer
4. Connection of a three-phase motor and starter with fuses and reversing of direction
5. Connection of analog and digital single phase energy meter
6. Study of a distribution board for domestic and industrial installation
7. Open-circuit and short-circuit test on a single-phase transformer
8. Star-delta starting of induction motors
9. To draw V-I characteristics of pn-junction diode
10. To draw input and output characteristics of a transistor in CB and CE configurations

## **RECOMMENDED BOOKS**

- 1 Basic Electrical Engineering by PS Dhongal; Tata McGraw Hill Publishers
- 2 Basic Electricity by BR Sharma; Satya Prakashan, New Delhi
- 3 Electrical Machines by SK Bhattacharya; Tata McGraw Hill, New Delhi