

## 7. MECHANICAL SCIENCE

### i) AUTOMOBILE ENGINEERING

#### Syllabus and Model Question Paper

##### Part - B

**Introduction:** 2 Stroke and 4 Stroke Engines, Engine Components, Carbonation, Petrol and Diesel Fuel Injection, Combustion in S. I & C. I Engines, Engine Cooling.

**Automotive Electrical & Electronics':** Storage Batteries, Ignition System, Starter Motor, Charging System

**Vehicle Dynamics:** Undamped and Damped vibrations, Forced Vibrations, Vehicle Vibrations on Human Comfort

**Automotive Component Design:** Power for Propulsion, Design of I. C Engine Parts and Gear Box.

**Metrology and Measurements:** Limits, Fits & tolerances, types of gauges, comparators, Surface finish equipment's, pressure, and flow and strain measurement

**CAD/ CAM:** Product Cycle, Elements of CAD/CAM system-Hardware and Software, modeling, Transformations, NC, CNC, Robots Configurations and Applications, Programming Language, Robotic Sensors.

SECTION – I OF PART (B)

Each question carries One marks

20 x 1 = 20 Marks

1. The probability of knocking in diesel engines is increased by  
(a) High self-ignition temperature      (b) Low volatility  
(c) Higher viscosity      (d) All of these
  
2. In a four stroke cycle diesel engine, the exhaust valve  
a) Opens at 30° before bottom dead centre and closes at 10° after top dead centre  
b) Opens at 30° after bottom dead centre and closes at 10° before top dead centre  
c) Opens at bottom dead centre and closes at top dead centre  
d) May open and close anywhere
  
3. In a single dry plate clutch, torsional vibrations are absorbed by  
a) Coil springs known as torsional springs  
b) Cushion springs  
c) Central hub  
d) Clutch pedal
  
4. The function of oil control rings is that it  
a) Lubricates the cylinder wall by releasing oil from its hole  
b) Keeps the cylinder wall lubricated by holding oil in its channel  
c) Prevents engine oil from going into the combustion chamber and returns excess lubricating oil off the cylinder wall through the return holes in the piston to the oil pan  
d) Maintains a seal and prevents escape of burned gases and oil leakage
  
5. Compression Ratio in diesel engine is lesser than that in Spark Ignition engine.  
a) True      b) No      c) They are equal      d) Doesn't matter
  
6. The degree of closeness of the measured value of a certain quantity with its true value is known as  
a) Accuracy    b) Precision      c) Standard      d) Sensitivity
  
7. The ability by which a measuring device can detect small differences in the quantity being measured by it, is called its  
a) Damping    b) Sensitivity      c) Accuracy      d) None of the above
  
8. The term that is used for geometric modelling like solid modelling, wire frame modelling and drafting is known as  
a) software package    b) operating system  
c) Application software    d) none of the mentioned

9. The system environment in a mainframe computer consists of  
 a) central processing                      b) storage devices  
 c) Printers and plotters                  d) both central processing and storage devices
10. A potentiometric device that contains sets of variable registers which feed signals that indicate the device position to the computer is known as  
 a) track ball                                  b) mouse  
 c) Joystick                                    d) all of the mentioned
11. The condition that causes vapour locking in a brake system is  
 a) overheating of the fluid due to frequent brake application  
 b) overcooling of the brakes during high speed driving  
 c) keeping the vehicle without use for an extended period  
 d) an excessively high engine speed on a downhill road
12. I - section of connecting rod is generally preferred for  
 a) Slow speed engine                      b) low horse power engine  
 c) High speed engine                        d) steam engine
13. The fuel injection timing in a distributor type pump is controlled by  
 a) Changing plunger stroke                  b) changing speed of rotor  
 c) Rotating the cam ring                    d) changing the number of cams on the ring
14. To check the diameter a twist drill with a micrometer, the measurement must be taken across the  
 a) margin of the drill                        b) lips of the drill  
 c) Flutes of the drill                         d) web of the drill
15. Which code represents canned cycle number for drilling?  
 a) G80    b) G82    c) G81    d) G83

SECTION - II OF PART (B)

Each question carries Two marks

10 x 2 = 20 Marks

- The bore and stroke of a 4-cylinder petrol Fiat car engine are 6.85cm and 7.5cm respectively. The compression ratio is 8.2. Find clearance volume.  
a)  $38.4\text{cm}^3$                       c)  $28.4\text{cm}^3$   
b)  $30.4\text{cm}^3$                       d)  $48.4\text{cm}^3$
- The road resistance for a car is 23 Kg/tones, and air resistance is given by the expression  $0.00843v^2$ . What is the BHP required for a top speed of 144Km/hr if the car weighs 2.032 tones and transmission efficiency in top gear is 88%  
a) 130.5 HP                      b) 134.5 HP  
c) 131.5 HP                      d) 132.5HP
- In a gear box the clutch shaft pinion has 14 teeth and low gear main shaft pinion 32 teeth. The corresponding lay shaft pinions have 36 and 18 teeth. The rear axle ratio is 37: 1 and the effective radius of the tyre is 0.355 m. what is the car speed in the above arrangement at an engine speed of 2500 rpm.  
a) 19.8km/hr                      c) 18.8kmlhr  
b) 20.8 km/hr                      d) 17.8 km/hr
- An instrument vibrates with frequency of 1 Hz when there is no damping. When the Damping is provided the frequency of damped vibration was observed to be 0.9Hz. The damping factor is  
a) 0.236                              c) 0.636  
b) 0.936                              d) 0.434
- If no re-boring allowance is to be given, then thickness of cylinder wall is max pressure is  $3.5\text{N/mm}^2$ , bore diameter=200mm and permissible tensile stress is  $40\text{N/mm}^2$ .  
a) 7mm                      b) 8mm                      c) 9mm                      d) 10mm
- If diameter of cylinder of bore is 120mm, then thickness of the cylinder will be  
a) Information not sufficient                      b) 7mm                      c) 12mm                      d) 6mm
- If nominal diameter of bolt used is 20mm, then find the radial distance between outer diameter of flange and pitch circle diameter of studs.  
a) 24mm                      b) 28mm                      c) 32mm                      d) 36mm
- In a differential with a gear ratio of 4 :1 the drive pinion would revolve four times to cause the ring gear to rotate  
(a) 1 time                      (b) 2 times                      (c) 4 times                      (d) 6 times

## MECHANICAL SCIENCE

### ii) Industrial Engineering and Management Syllabus & Model Question Paper

#### PART - B

**Work Study and Ergonomics**- Productivity, Work Study, Method Study, Ergonomics.

**Quality Management** - Statistical Process Control, Control Charts, Inspection and Test -Sampling Plans

**Industrial Management** - Introduction, Management Function, Motivation and Behavior

**MIS**- Fundamentals, Business Application, Issues in Management Information Technology

**DBMS**- Introduction, Concepts and Architecture and Data Modeling

**OR** - LPP, Transportation, Assignment Problems, Inventory Control, PERT - CPM

**Materials Management**- Introduction, Purchasing, Stores: Inventory: Supply Chain management

**CAD/ CAM**: Product Cycle, Elements of CAD/CAM system - Hardware and Software, modeling. Transformations, NC, CNC, Robots Configurations and Applications, Programming Language, Robotic Sensors.

**Metrology**: Limits, fits, Tolerances, Gauges, Comparators, Surface Finish Measurements

SECTION – I OF PART (B)

Each question carries One marks

20 x 1 = 20 Marks

1. The number of Therblig symbols are:  
(a) 20            (b) 15    (c) 18            (d) 16
  
2. A Database holds  
a)    Processed and organized data  
b)    Conceptual, mathematical and logical order models  
c)    Knowledge in variety of forms  
d)    none of the above
  
3. In PERT, the distribution of activity time is assumed to be  
a) Normal distribution            b) Beta distribution  
c) Binomial distribution            d) Gamma distribution
  
4. The M-system and E-system in metrology are related with measurement of  
(a) Gears (b) Screw threads (c) Flatness (d) Surface finish
  
5. The Optimality of a transportation problem is determined by the application of  
(a) North West corner rule method            (b) Vogel's approximation method  
(c) Modi method            (d) none of the above

SECTION - II OF PART (B)

Each question carries Two marks

10 x 2 = 20 Marks

- 1 If the selected time for an element is 2 min per piece and the performance rating of the operator is 120 and 10 % personal allowances is provided, the standard time per piece is  
a) 2.6 min      b) 2 min      c) 2.64 min      d) 2.66min
- 2 In PERT activity has an optimistic time of 8 days, pessimistic time of 12 days and the most likely time is 10 days, the expected time of the activity would be:  
(a) 12 days (b) 10 days (c) 14 days (d) 8 days
- 3 A Process is to be controlled with standard values of mean=15 and standard deviation=3.5. The sample size is 9, the control limits for x-bar chart are  
a)  $15 \pm 10.8$     b)  $15 \pm 3.5$       c)  $0.4 \pm 10.8$     d)  $0.4 \pm 3.6$
- 4 If the primal problem gives an unbounded solution in LPP, the dual of the same will give  
(a) Optimal solution                      (b) unbounded solution  
(c) Infeasible solution                    (d) basic feasible solution
- 5 In transportation problems, there are 4 supply centers and 5 demand centers the total quantity of supply available is greater than the total demand. The number of allocations without degeneracy, during an iteration is  
a) 6    b) 3    c) 9    d) 10

**MECHANICAL SCIENCE**

**iii) INDUSTRIAL & PRODUCTION ENGINEERING**

**Syllabus and Model Question Paper**

**Part - B**

**Metrology:** Limits, Fits & tolerances. Gauges, Comparators, Surface Finish

**Operations Research:** LPP, Transportation, Assignment, Game Theory

**Quality Management:** Statistical Process Control, Control charts, Inspection and Test, Sampling plans.

**Work Study - Method Study, Work Measurement, Ergonomics.**

**CAD/CAM System - Hardware and Software, Modeling, Transformations, NC, CNC, Robot Configurations and Applications**

**Metal Forming - Rolling, Forging, Extrusion, Sheet Metal Forming.**

**Engineering Economy:** Depreciation, Cost Estimation.

**Non Destructive Testing:** Liquid Penetrant, Ultrasonic, Radiography, Magnetic Particle inspection & Leak Test.

**Welding Metallurgy & Heat Treatment.**

**Metal Cutting:** Basic Theory - Tool Life, Tool Wear, Cutting Tools, Geometry & Materials.

SECTION - I OF PART (B)

Each question carries One marks

20 x 1 = 20 Marks

1. Gauges are designed on the Principle of  
(a) GANTT (b) TAYLOR (c) Gilbreth (d) Maslows
2. Spherical co-ordinate is also known as  
(a) Polar co-ordinate (b) Cylindrical (c) Joint arm (d) Cartesian co-ordinate
3. Curved surface can be measured in a NC machine by  
(a) Point to point method (b) Straight line (c) Contour method (d) Bend axis method.
4. Following is not a metal forming process  
(a) Drawing (b) Cupping (c) Milling (d) None of the above
5. Following is a single point cutting tool  
(a) Grinding wheel (b) Milling cutter (c) Lathe tool (d) Hob.
6. Etching of specimen is done to achieve  
a) Visible grain boundary b) Invisible grain boundary c) Toughness d) Hardness
7. Find grain diameter in 'mm' for ASTM 12?  
a) .0066 b) .0078 c) .0021 d) .0056
8. Which of the following penetrating liquid is used in liquid penetration test?  
a) Water b) Chlorine based solvent  
c) Petroleum based carrier fluid d) Fluorine based solvent

SECTION – II OF PART (B)

Each question carries Two marks

10 x 2 = 20 Marks

1. Surface roughness on a drawing is represented by  
(a) Circles (b) Squares (c) Triangles (d) Curves
2. Travel chart helps to decide  
(a) Production Schedule (b) Material Handling (c) Inventory Control (d) Cost of product
3. A machine is purchased for Rs.22, 000/- and has a life of 10 years. The salvage value is Rs.4,000/-. Calculate the book value at the end of 8 years by straight line method.  
(a) Rs.7, 600/- (b) Rs.8, 400/- (c) Rs. 10, 000/- (d) Rs.9,200/-
4. Residual stresses in weld causes  
(a) Stress Concentration (b) Distortion (c) Martensitic Structure (d) None of above
5. Find the cutting speed for a job 20mm in diameter and rotating at 1000 Rpm.  
(a) 62.8m/min (b) 82m/min. (c) 31.4m/min (d) None of above
6. The tool life equation for HSS tool is  $VT^{0.14} f^{0.7} d^{0.4} = \text{Constant}$ . The tool life ( $T$ ) of 30 min is obtained using the following cutting conditions:  $V=45\text{ m/min}$ ,  $f=0.35\text{ mm}$ ,  $d=2.0\text{ mm}$ . If speed ( $V$ ), feed ( $f$ ) and depth of cut ( $d$ ) are increased individually by 25%, the tool life (in min) is  
(a) 0.15 (b) 1.06 (c) 22.5 (d) 30.0

## MECHANICAL SCIENCE

### iv) MANUFACTURING ENGINEERING

#### Syllabus and Model Question Paper

#### Part - B

**OR :** LPP, Transportation, Assignment Problems, Inventory Control, PERT – CPM

**Theory of Metal Cutting:** Cutting Tools, Geometry, Materials, Measurement of Cutting Forces, Tool Wear and Life

**Plasticity and Metal Forming:** Yield Criteria, 2-D Plastic flow, Fundamentals of Metal Working, Drawing, Extrusion, Forging & Rolling.

**Welding Technology:** Introduction, Metal Joining Process, Welding Processes: - Pressure, gas and electric, Testing and Inspection.

**Industrial Robotics:** Robot components, Classification, Configuration, Direct and Inverse Kinematics, Robot Programming and Sensors.

**Automation in Manufacturing:** Automation: Definitions, reasons, high Volume Production Systems, Computerized Manufacturing Systems and Networks

**CAD/CAM:** Product Cycle, Elements of CAD/CAM system - Hardware and Software, modeling, Transformations, NC, CNC machines.

**Metrology and Measurements:** Limits, Fits & tolerances, types of gauges, comparators, Surface finish equipment's, pressure, and flow and strain measurement

SECTION – I OF PART (B)

Each question carries One marks

20 x 1 = 20 Marks

1. In an arc welding process, the voltage and current are 25 V and 300 A respectively. The arc heat transfer efficiency is 0.85 and welding speed is 8 mm/sec. The net heat input (in J/mm) is  
a) 64            b) 797            c) 1103            d) 79700
2. Which of the following arc welding processes does not use consumable electrodes?  
a) GMAW    b) GTAW    c) Submerged Arc Welding    d) None of these
3. In a fillet welded joint, the weakest area of the weld is  
a) Toe    b) Root    c) Throat    d) Face
4. Four basic elements are required for an automated machine tool or production process. They are: input interface, memory, output interface, and  
a) Logic    b) NC tape programming    c) Software    d) Computer graphics work station
5. To obtain solution of material problem so that the cost of handling will be minimum is  
a) Simplex method    b) Queuing theory    c) Transport method    d) Value engineering
6. The following is true for a Robot and NC Machine  
(A) Similar power drive technology is used in both  
(B) Different feedback systems are used in both  
(C) Programming is same for both  
(D) All of the above
7. Radial movement (in & out) to the manipulator arm is provided by  
(A) Elbow extension  
(B) Wrist bend  
(C) Wrist swivel  
(D) Wrist yaw
8. The Robot designed with Cartesian coordinate systems has  
(A) Three linear movements  
(B) Three rotational movements  
(C) Two linear and one rotational movement  
(D) Two rotational and one linear movement

9. The strength of a brazed joint
- (A) Decrease with increase in gap between the two joining surfaces
  - (B) Increase with increase in gap between the two joining surfaces
  - (C) Decrease up to certain gap between the two joining surfaces beyond which it increases
  - (D) Increases up to certain gap between the two joining surfaces beyond which it decreases
10. Which one of the following is a solid state joining process?
- (A) Gas tungsten arc welding
  - (B) Resistance spot welding
  - (C) Friction welding
  - (D) Submerged arc welding

SECTION - II OF PART (B)

Each question carries Two marks

10 x 2 = 20 Marks

1. During orthogonal cutting of mild steel with a  $10^\circ$  rake angle tool, the chip thickness ratio was obtained as 0.4. The shear angle (in degrees) evaluated from this data is  
(a) 6.53      (b) 20.22      (c) 22.94      (d) 50.00
2. Forging of plain carbon steel is carried out at  
(a)  $750^\circ\text{C}$       (b)  $900^\circ\text{C}$       (c)  $1100^\circ\text{C}$       (d)  $1300^\circ\text{C}$
3. Software package used for computer simulation is known as  
a) GPSS      (b) HTPM      (c) CRAFT      (d) COMSAL
4. The Poisson's ratio of a material which has Young's modulus of 120 GPa and shear modulus 50 GPa is  
(a) 0.1      (b) 0.2      (c) 0.3      (d) 0.4
5. What key hardware item ties a CAD/CAM system together?  
(a) Keyboard      (b) Graphics work station      (c) Digitizer      (d) Plotter
6. In an arc welding process, the voltage and current are 25 V and 300 A respectively. The arc heat transfer efficiency is 0.85 and welding speed is 8 mm/sec. The net heat input (in J/mm) is:  
(A) 64      (B) 797      (C) 1103      (D) 79700

## MECHANICAL SCIENCE

### v) MECHANICAL ENGINEERING

#### Syllabus and Model Question Paper

#### Part - B

**Heat Transfer:** Modes of Heat transfer, one dimensional heat conduction. Fins Dimensionless parameters in convective heat transfer. Forced convection heat transfer over flat plates and through tubes. Free convection heat transfer over flat plates and cylinders, radiation, heat transfer, Heat exchangers, LMTD and NTU methods.

**Industrial Management** - Introduction, Management Function, Motivation and Behavior Fluid Machines: Introduction, Principles of Hydraulic Machines, Impulse and Reaction Turbines, Steam Turbines.

**Mechatronics:** Introduction, Transducers, Mechatronic Elements, Pneumatic, Hydraulic, Electrical and Mechanical Actuation Systems, Signal Conditioning.

**POM:** Plant Layout, Plant Location, Forecasting, Scheduling, Inventory Control.

**OR - LPP,** Transportation, Assignment Problems, Inventory Control, PERT - CPM

**CAD/ CAM:** Product Cycle, Elements of CAD/CAM system - Hardware and Software, modeling, Transformations, NC, CNC, Robots Configurations and Applications, Programming Language, Robotic Sensors.

**Metrology and Measurements:** Limits, Fits & tolerances, types of gauges, comparators, Surface finish equipment's, pressure, and flow and strain measurement

SECTION - I OF PART (B)

Each question carries One marks

20 x 1 = 20 Marks

1. If 20 percent managers are technocrats the probability that a random committee of managers Consists of exactly 2 technocrats is  
a) 0.2048      b) 0.4000      c) 0.4096      d) 0.9421
  
2. In the Gauss elimination method for solving a system of linear algebraic equations triangularisation leads to  
a) Diagonal matrix      b) Lower triangular matrix  
c) Upper triangular matrix      d) Singular matrix
  
3. In a fibre reinforced composite  
a) Matrix is stronger than fibre      b) Matrix is weaker than fibre  
c) Matrix and fibres are of equal strength      d) none of the above
  
4. Which is the most effective alloying element is increasing the hardness of steel for the same percentage of composition  
a) Mo      b) Ni      c) Cu      d) Cr
  
5. A fatigue fracture is characterized by  
a) Ductile fracture      b) Brittle Fracture  
c) Cup & cone formation      d) None of the above

SECTION – II OF PART (B)

Each question carries Two marks

10 x 2 = 20 Marks

1. Helium is flowing in a pipe line at a velocity of 350 m/s and pressure and temperature of 100 kPa and 25°C. The stagnation temperature is  
a) 298.8 K    b) 305.5 K    c) 358.95 K    d) 368.8 K
2. Two parallel opposed, infinite black planes are maintained at 300°C and 400°C respectively. If the temperature difference is doubled by increasing the temperature from 400°C to 500°C, the heat exchange rate will increase by a factor of about  
a) 2.5    b) 4.5    c) 5.5    d) 6.25
3. When the temperature of a solid surface changes from 227°C to 1227°C, its total emissive power changes from  $E_1$  to  $E_2$  the ratio ( $E_2/E_1$ ) will be  
a) 3    b) 6    c) 9    d) 81
4. In a forecasting model, at the end of period 13, the forecasted value for period 14 is 75. Actual value in the period 14 to 16 are constant at 100. If the assumed simple exponential smoothing parameter is 0.5, then the MSE at the end of period 16 is  
a) 820.31    b) 273.44    c) 43.75    d) 14.58
5. At a production machine, parts arrive according to a Poisson process at the rate of 0.35 parts per minute. Processing time for parts have exponential distribution with mean of 2 minutes. What is the probability that a random part arrival finds that there are already 8 parts in the system (in machine + in queue)?  
a) 0.0247    b) 0.0576    c) 0.0173    d) 0.082