1063139

A-HUF-P-OEA

MECHANICAL ENGINEERING

Paper I

(Conventional)

Time Allowed : Three Hours *Maximum Marks : 200*

INSTRUCTIONS

Please read each of the following instructions carefully before attempting the questions :

There are SEVEN questions in the paper.

Candidates are required to attempt FIVE questions in all.

*Question no. **1** is **compulsory**.*

Out of the remaining SIX questions, attempt any FOUR questions.

The number of marks carried by a question/part is indicated against it.

Unless otherwise mentioned, symbols and notations have their usual standard meanings.

Assume suitable data, if necessary and indicate the same clearly.

Neat sketches are to be drawn to illustrate answers, wherever required.

All parts and sub-parts of a question are to be attempted together in the answer book.

Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly.

Answers must be written in ENGLISH only.

Any page or portion of the page left blank in the answer book must be clearly struck off.

Values of constants which may be needed :

Universal gas constant $R = 8{\cdot}314$ kJ/kg mole-K.

For air $R = 0{\cdot}287$ kJ/kg-K, $C_p = 1{\cdot}005$ kJ/kg-K,

$\gamma = 1{\cdot}4$, $M = 28{\cdot}97$ kg/kg-mole

1. (a) A rigid tank whose volume is 0·75 m^3 developed a small hole on its wall. Air from the surroundings at 1 bar 25°C leaked in and finally the pressure in the tank reached 1 bar. The process occurred slowly so that heat transfer between the tank and the surroundings kept the temperature of the air inside the tank constant at 25°C. Determine the heat transfer involved in the process :

(i) if initially the tank was evacuated,

(ii) if it contained air at 0·7 bar and 25°C. *10*

(b) (i) Distinguish between skin friction drag and pressure drag. Does the total drag acting on a body necessarily decrease as a result of streamlining ? Explain. *5*

(ii) With a neat sketch explain the principle and working of a pitot tube. *5*

(c) (i) Two concentric spheres have diameters of 0·3 m and 0·8 m and are maintained at uniform temperatures of 700 K and 400 K respectively. The inner and outer spheres have emissivities of 0·5 and 0·7 respectively. The emissivity of the outer surface is 0·35. The surrounding medium and surrounding surfaces are at a temperature of 30°C. Determine the net radiation heat transfer between the two spheres. Also determine the convective heat transfer coefficient at the outer surface. *5*

(ii) Stainless steel ball bearings having diameter of 1·2 cm are to be quenched in water. The balls leave the oven at 900°C and are exposed to air at 30°C for a while before they are dropped in water. If the temperature of the balls is not to fall below 850°C prior to quenching and the heat transfer coefficient in the air is 125 W/m^2 K, determine how long they can stand in the air before being dropped into the water. Following properties of stainless steel may be used :

$\rho = 8085$ kg/m^3, $k = 15{\cdot}1 \frac{W}{mK}$,

$c_p = 0{\cdot}480 \frac{kJ}{kg\ K}$, $\alpha = 3{\cdot}91 \times 10^{-6}$ m^2/s 5

(d) A horizontal cylinder is separated into two compartments by an adiabatic frictionless piston. One side contains 0·2 m^3 of nitrogen and the other side contains 0·1 kg of helium both initially at 20°C and 95 kPa. The sides of the cylinder and the helium end are insulated. Now heat is added to the nitrogen side from a reservoir at 500°C until the pressure of the helium rises to 120 kPa. Determine (i) the final temperature of helium, (ii) the final volume of nitrogen, (iii) the heat transferred to nitrogen, and (iv) entropy generated during the process.

Following properties of nitrogen and helium are given :

Nitrogen : $R = 0{\cdot}2968 \ \frac{kJ}{kg\ K}$, $c_p = 1{\cdot}039 \ \frac{kJ}{kg\ K}$, $c_v = 0{\cdot}743 \ \frac{kJ}{kg\ K}$, $\gamma = 1{\cdot}4$

Helium : $R = 2{\cdot}0769 \ \frac{kJ}{kg\ K}$, $c_p = 5{\cdot}1926 \ \frac{kJ}{kg\ K}$, $c_v = 3{\cdot}1156 \ \frac{kJ}{kg\ K}$, $\gamma = 1{\cdot}667$ *10*

(e) (i) What is 'dry bulb' temperature and 'wet bulb' temperature ? Explain the principle of a sling psychrometer. *5*

(ii) How does a natural draft wet cooling tower work ? What is a spray pond ? How does its performance compare to that of a wet cooling tower ? *5*

(f) (i) A long water trough of triangular cross-section is formed from two rectangular planks. A gap of 3 mm is maintained at the junction of the two planks. If the water depth initially was 0·6 m, how long does it take for the water depth to reduce to 0·3 m ? *5*

(ii) Obtain an expression for the reversible work transfer associated with an internally reversible process in a steady flow device in terms of thermodynamic properties of the system. Deduce Bernoulli's equation from it. *5*

(g) (i) A two-dimensional incompressible flow of a Newtonian fluid has the following velocity field :

$$u = -2xy,\ v = y^2 - x^2,\ w = 0.$$

Show that it represents a possible flow field. Find the pressure field p(x, y), if the pressure at point (x = 0, y = 0) is equal to p_a. *5*

(ii) A 5 cm diameter horizontal jet of water, with a velocity of 30 m/s, strikes the tip of a horizontal cone which deflects the water by 45° from its original direction. How much force is required to hold the cone against the water stream ? *5*

(h) (i) A centrifugal pump having an impeller diameter of 1 m is to be constructed so that it will supply a head rise of 200 m at a flow rate of water when operating at a speed of 1200 rpm. To study the characteristics of this pump, a geometrically similar model operated at the same speed is to be tested in the laboratory. Determine the required model discharge and head rise. Assume that both model and prototype operate with the same efficiency. *5*

(ii) What is cavitation in hydraulic machines ? Explain the significance of Thoma cavitation factor. *5*

2. (a) A simple steam power cycle uses solar energy for heat input. Water in the cycle enters the pump as saturated liquid at 40°C and is pumped to 2 bar. The water at this pressure evaporates in the steam generator and enters the turbine as saturated vapour. At the exit of the turbine, the condition of steam is 40°C with dryness fraction of 0·9. The flow rate is 150 $\frac{kg}{h}$. The instantaneous solar input is 0·58 $\frac{kW}{m^2}$ at a specified time. Obtain the isentropic efficiency of the turbine, network output, cycle efficiency and the area of the solar collector needed based on the given solar input.

Following properties of steam are given : *10*

p (bar)	T (°C)	h_f	h_{fg} (kJ/kg)	h_g	s_f	s_{fg}	s_g
					(kJ/kg K)		
0·07375	40	167·53	2405·97	2573·5	0·572	7·686	8·258
2	120·2	504·7	2201·6	2706·3	1·530	5·597	7·127

(b) Liquid nitrogen is stored in a spherical thin walled metallic container at 77 K temperature. The container is of 1·0 metre diameter and is covered with evacuated silica powder. The insulation is 20 mm thick and the outer surface is exposed to the surrounding air at 300 K. The convective heat transfer coefficient of the exposed surface is 25 W/m^2 K. The density and latent heat of vaporization of the liquid nitrogen are 804 kg/m^3 and 2×10^5 J/kg respectively. Determine the rate of heat transfer to the liquid nitrogen and the rate of liquid boil-off. The thermal conductivity (k) of evacuated silica powder is 0·0017 W/m.K. Neglect the thermal resistance of the metallic container. *10*

(c) (i) Explain how draft tubes are advantageous when installed at the exit of Francis and Kaplan turbines. *3*

(ii) A sphere of diameter D and density ρ_s falls at a steady rate through a liquid of density ρ and viscosity μ. If the Reynolds number is less than 1, show that the viscosity can be determined from $\mu = \frac{g D^2 (\rho_s - \rho)}{18U}$ where the Reynolds number is evaluated as $\frac{\rho DU}{\mu}$. *7*

3. (a) (i) Compare the governing mechanism of a Pelton turbine with that of a Francis turbine. *4*

(ii) Water to run a Pelton wheel is supplied by a penstock of length l and diameter D with a friction factor f. If the only losses associated with the flow in the penstock are due to pipe friction, show that the maximum power output of the turbine occurs when the nozzle diameter D_1 is given by $D_1 = \frac{D}{\left(\frac{2fl}{D}\right)^{1/4}}$. *6*

(b) A runner of a Francis turbine having 1·5 m outer diameter and 0·75 m inner diameter operates under a head of 150 m with a specific speed of 120 and generates 14 MW power. If the water enters the wheel at an angle of 11°20′ and leaves the blade radially with no velocity of whirl, what will be the value of inlet and outlet blade angles ? Assume the hydraulic efficiency of the turbine as 92 percent. *10*

(c) A room is provided with a sliding glass door (patio door) with a height of 1·8 m and width of 1 m. On a cold winter day, the window glass on the patio door has a uniform temperature of 0°C and the room wall and air temperatures are 15°C. The emissivity of the glass surface is 0·94. A frost line was observed at the base of the window glass. (i) Explain why the window developed a frost layer at the base and not at the top. (ii) Estimate the heat loss through the window due to free convection and radiation. (iii) If the room is provided with an electric heater, estimate the corresponding daily cost of the window heat loss for an electricity cost of ₹ 5/kWh. Assume the following properties of air at 280 K : $\nu = 14{\cdot}11 \times 10^{-6} \frac{m^2}{s}$,

$k = 0{\cdot}0247 \frac{W}{mK}$, $\alpha = 1{\cdot}986 \times 10^{-5} \frac{m^2}{s}$,

$Pr = 0{\cdot}710$

The following empirical correlation may be useful :

$$Nu_L = \frac{h_L L}{k} = \left\{ 0{\cdot}825 + \frac{0{\cdot}387\, Ra_L^{1/6}}{\left[1 + (0{\cdot}492/Pr)^{9/16}\right]^{8/27}} \right\}^2$$

where, Ra_L is the Rayleigh number. *10*

4. (a) (i) A ship with a hull length of 140 metres has to travel with 7·6 m/s velocity. Compute the Froude number. For dynamic similarity, at what velocity should a 1 : 30 scale down model flow through water ? *5*

(ii) Illustrate the head vs discharge curves for three dissimilar pumps in series and three such pumps in parallel. *5*

(b) Carbon dioxide enters an adiabatic nozzle at 1200 K with a velocity of 50 $\frac{m}{s}$ and leaves at 400 K. Determine the Mach number (i) at the inlet of the nozzle, and (ii) at the exit of the nozzle. For CO_2, R = 0·1889 $\frac{kJ}{kg\ K}$,

c_p = 0·8439 $\frac{kJ}{kg\ K}$, γ = 1·288. *10*

(c) On the basis of a cold-air-standard analysis, show that the thermal efficiency of an ideal regenerative gas turbine can be expressed as

$$\eta = 1 - \left(\frac{T_1}{T_3}\right)(\gamma)^{\left(\frac{k-1}{k}\right)},$$

where, γ is the compressor pressure ratio and T_1, T_3 denote the temperatures at the compressor and turbine inlets respectively. *10*

5. (a) The impeller of a centrifugal pump has a diameter of 0·2 m and axial width at outlet of 20 mm. There are 18 blades swept backwards and inclined at 25° to the tangent to the periphery. The flow rate through the impeller is 8·5 $\frac{m^3}{h}$ when it rotates at 750 rpm. Calculate the head developed by the pump when handling water and assuming one-dimensional ideal flow theory. How can a more realistic estimation of the head developed be carried out ? *10*

(b) Hot oil is to be cooled in a multi-pass shell and tube heat exchanger by water. The oil flows through the shell with a heat transfer coefficient of h = 35 $\frac{W}{m^2K}$ and the water flows through the tube with an average velocity of 3 m/s. The tube is made of brass $\left(k = 110 \frac{W}{mK}\right)$ with internal and external diameters of 1·3 cm and 1·5 cm respectively. Determine the overall heat transfer coefficient of this heat exchanger based on the inner surface. Properties of water at 25°C : k = 0·607 $\frac{W}{mK}$,

$\nu = 0{\cdot}894 \times 10^{-6} \frac{m^2}{s}$, Pr = 6·14.

Given $Nu = 0{\cdot}023\ Re^{0{\cdot}8}\ Pr^{0{\cdot}4}$. *10*

(c) A gas turbine engine with regeneration operates with two stages of compression and two stages of expansion. The pressure ratio across each stage of the compressor and turbine is 3·5. The air enters each stage of the compressor at 300 K and each stage of the turbine at 1200 K. The compressor and turbine efficiencies are 78% and 86% respectively and the effectiveness of the regenerator is 72%. Determine the back work ratio and the thermal efficiency of the cycle, assuming constant specific heats for air at room temperature. *10*

6. (a) (i) Consider a conical enclosure of height h and base diameter D. Determine the view factor from the conical side surface to a hole of diameter d located at the centre of the base. *5*

(ii) Sketch the typical boiling curve for water at 1 atm clearly indicating the salient regimes of boiling. *5*

(b) Air at 27°C with a free stream velocity of 10 m/s is used to cool electronic devices mounted on a printed circuit board. Each device, 4 mm × 4 mm dissipates 40 mW which is removed from the top surface. A turbulator is located at the leading edge of the board. Estimate the surface temperature of the fourth device located at 15 mm from the leading edge of the board. The following relation may be used :

$Nu_x = 0{\cdot}0296 \ Re_x^{4/5} \ Pr^{1/3}$.

For air at 315 K and 1 atm, $k = 0{\cdot}0274 \ \frac{W}{mK}$,

$\nu = 17{\cdot}4 \times 10^{-6} \ \frac{m^2}{s}$, $\alpha = 24{\cdot}7 \times 10^{-6} \ \frac{m^2}{s}$,

$Pr = 0{\cdot}705$. *10*

(c) An air-conditioner with refrigerant R134a as the working fluid is used to keep a room at 26°C by rejecting the waste heat to the outside air at 34°C. The room is gaining heat through the walls and the windows at a rate of $250\ \frac{kJ}{min}$ while the heat generated by the appliances in the room amounts to 900 W. An unknown amount of heat is also generated by the people in the room. The condenser and evaporator pressures are 1200 kPa and 500 kPa respectively. The refrigerant is saturated liquid at the condenser exit and saturated vapour at the compressor inlet. If the refrigerant enters the compressor at a rate of $100\ \frac{L}{min}$ and the isentropic efficiency of the compressor is 75%, determine the (i) temperature of the refrigerant at the compressor exit, (ii) rate of heat generation by the people in the room, (iii) COP of the air-conditioner, and (iv) minimum volume flow rate of the refrigerant at the compressor inlet for the same compressor inlet and exit conditions.

Properties of R134a :

At 500 kPa : $h_g = 259{\cdot}3\ \frac{kJ}{kg}$, $v_g = 0{\cdot}4112\ \frac{m^3}{kg}$

$$s_g = 0{\cdot}924\ \frac{kJ}{kg}$$

At 1200 kPa : $h_f = 117{\cdot}77\ \frac{kJ}{kg}$ *10*

7. (a) Show that the enthalpy of an ideal gas is a function of temperature only and that for an incompressible substance it also depends on pressure, using thermodynamic property relations. *10*

(b) A house built on a riverside is to be cooled in summer by utilizing the cool water of the river which flows at an average temperature of 15°C. A 15 m long section of a circular duct of 20 cm diameter passes through the water. Air enters the underwater section of the duct at 25°C at a velocity of 3 m/s. Assuming the surface of the duct is at the temperature of water, determine the outlet temperature of air as it leaves the underwater portion of the duct. Also, for an overall fan efficiency of 55%, determine the fan power input needed to overcome the flow resistance in this section of the duct. The properties of air at 20°C and 1 atm :

$\rho = 1{\cdot}204\ kg/m^3$, $k = 0{\cdot}02514\ \frac{W}{mK}$,

$\nu = 1{\cdot}516 \times 10^{-5}\ \frac{m^2}{s}$, $c_p = 1{\cdot}007\ \frac{kJ}{kg\ K}$,

$Pr = 0{\cdot}7309$.

For fully developed turbulent flow in smooth pipes : $f = (0{\cdot}790\ ln\ Re - 1{\cdot}64)^{-2}$, where f is the friction factor. *10*

(c) A two-cylinder single-acting air compressor is to deliver 20 kg/minute of free air from atmospheric conditions (100 kPa, 20°C). The delivery pressure is 7 bar, clearance is 4% of the stroke and the index for both compression and expansion is 1·3. The compressor is directly coupled to a four-cylinder, four-stroke petrol engine running at 2000 rpm. The BMEP of the engine is 5 bar. Assuming stroke-to-bore ratio of 1·1 for both engine and compressor and mechanical efficiency of 80% for the compressor, calculate the cylinder dimensions for the compressor. *10*

ENGINEERING SERVICES
EXAMINATION-2016

0063468

Sl. No.

A-HUF-P-OEB

MECHANICAL ENGINEERING

Paper II

(Conventional)

Time Allowed : Three Hours	*Maximum Marks : 200*

INSTRUCTIONS

Please read each of the following instructions carefully before attempting questions.
There are SEVEN questions divided under THREE sections.
Candidates are required to attempt FIVE questions in all.
In Section A, Question No.1 is compulsory.
In Section B, TWO out of THREE questions are to be attempted.
In Section C, TWO out of THREE questions are to be attempted.
The number of marks carried by a question/part is indicated against it.
Unless otherwise mentioned, symbols and notations have their usual standard meanings.
Assume suitable data, if necessary and indicate the same clearly.
Neat sketches are to be drawn to illustrate answers, wherever required.
All parts and sub-parts of a question are to be attempted together in the answer book.
Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly.
Answers must be written in ENGLISH only.
Any page or portion of the page left blank in the answer book must be clearly struck off.

Section – A

(Answer *all* of the following parts)

(Each part carries 4 marks) $4 \times 10 = 40$

1. (a) The crank of a crank and slotted lever quick return mechanism is driven at 120 rpm clockwise. The vertical distance between the centres of rotation of the crank and slotted lever is 50 cm. What should be the length of the crank if the quick return ratio is 1 : 2 ? Determine the angular velocity of the slotted lever, when the tool-post attains maximum velocity during cutting stroke.

(b) Square key of side $d/4$ and length l is used to transmit torque T from the shaft of diameter d to the hub of a pulley. Assuming the length of the key to be equal to the thickness of the pulley, find the average shear stress and crushing stress developed in the key.

(c) A tapering bar having d_1 and d_2 as diameters of end sections and another bar of uniform cross-section d are of same length l. Both are subjected to the same axial pull P. What should be the value of d in terms of d_1 and d_2 so that both the bars of same material will have same extension ? Evaluate maximum stresses in both the bars.

(d) In a cam-follower mechanism the follower needs to rise through 20 mm during 60° of cam rotation, the first 30° with a constant acceleration and then retardation of equal magnitude for next 30°. The cam rotates at uniform speed of 300 rpm. Find out the maximum velocity and acceleration of the follower during the rise period.

(e) Through the temperature vrs carbon percentage diagram of steel, show the microstructures of various phases of steel.

(f) In reference to primary processes of Powder Metallurgy, explain the following :

(i) Blending

(ii) Compacting

(iii) Pre-sintering

(iv) Sintering

(g) What is centreless grinding ? Explain with sketch. What is the difference w.r.t. cylindrical grinding ?

(h) Illustrate the difference between

(i) open die forging and

(ii) closed die forging with appropriate sketches.

(i) Show in a figure location of the surface texture details when used with machining symbols.

(j) With sketches describe any four types of point defects in metallic materials.

Section – B

(Answer any two questions)

2. (a) A machine is driven by a motor, which delivers a constant torque. The resisting torque of the machine increases uniformly from 500 Nm to 1500 Nm through one revolution of the driving shaft and drops suddenly to 500 Nm again at the beginning of the next revolution. The mean speed of the machine shaft is 300 rpm. In order to maintain coefficient fluctuation of speed of the machine as 0·2, a solid circular steel disc of 25 mm thick is used as a flywheel. The mass density of steel is 7800 kg/m^3. Evaluate the diameter of the flywheel disc. 10

(b) A solid shaft of diameter d is used for power transmission. Due to modification of the existing transmission system, it is required to replace the solid shaft by a hollow shaft of the same material and equally strong in torsion. Further the weight of the hollow shaft per metre length should be half that of the solid shaft. Determine the outer and inner diameters of the hollow shaft if diameter of solid shaft, d = 40 mm. 20

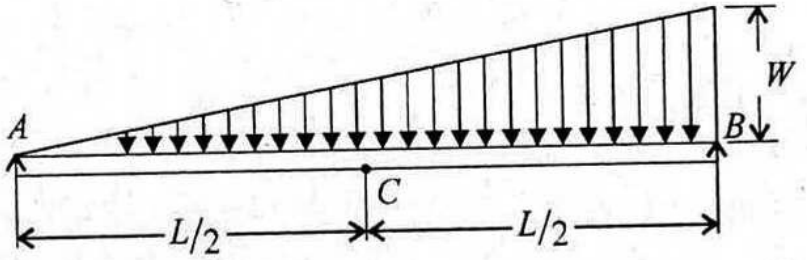
(c) A thin cylinder with closed ends has an internal pressure of 6 MN/m^2. The cylinder is of 50 mm internal diameter and 2·5 mm thick. It is also subjected to an axial pull of 10 kN and a torque of 500 Nm.

Determine the principal stresses in the cylinder and maximum shear stress. 10

3. (a) The cylinder axes of a V-engine are at 90° to each other. The mass of each piston is 2 kg and that of each connecting rod is 2·8 kg. The mass of rotating parts like crank webs and the crank pin is 1·8 kg. The connecting rod is 400 mm long and its centre of mass is 100 mm from crank pin centre. The stroke of the piston is 160 mm. Find the magnitude of the balancing mass for balancing primary unbalance force and its position, if its centre is placed at 100 mm from crank shaft centre. Whether secondary unbalance force is balanced or not ? If not, what is the magnitude of resultant secondary unbalance force for the engine speed of 840 rpm ? 10

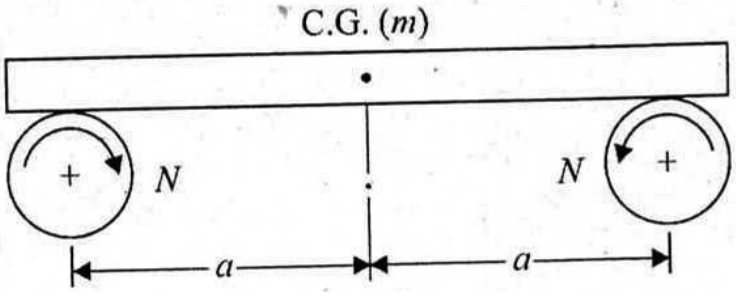
(b) Design a muff coupling to connect two steel shafts of same diameter in order to transmit 25 kW of power at 360 rpm. The shafts and keys are made of plain carbon steel 30C8 ($S_{yt} = S_{yc} = 400$ N/mm^2). The sleeve is made of grey cast iron FG 200 ($S_{ut} = 200$ N/mm^2). The factor of safety for the shafts and key is 4 and for the sleeve the same is 6 based on yield strengths and ultimate strengths respectively. The standard proportion for the sleeve of muff coupling is usually taken as external diameter = (2 × shaft diameter + 13) mm. Axial length of sleeve = (3·5 × shaft diameter). Sketch the coupling showing all the dimensions of the shafts, sleeve and keys. Ensure safety of all components. 20

(c) A simply supported beam AB of span L carries a distributed load of varying intensity as shown in figure below. Establish the equation for deflection curve for the beam at a distance x from the origin A of the beam. Determine the deflection of the beam at the mid-section C in terms of W, L, E and I, where EI is the flexural rigidity of the beam.



10

4. (a) A uniform plank of mass m is resting over two identical rollers rotating in the opposite directions as shown in figure below. The distance between the roller axes is 20 and the rollers are spinning at same speed. The coefficient of friction between the plank and the rollers is μ. Show that the plank will oscillate when its C.G. is displaced from the mid-point between the rollers. Develop the equation of motion of the plank in the direction of oscillation.



(i) Determine the frequency of this oscillation.

(ii) Investigate the motion of the plank, when the direction of rotation of both the rollers are reversed. 10

(b) A pair of spur gears with 20° full-depth involute teeth consists of a 20 teeth pinion meshing with a 41 teeth gear. The module is 3 mm while the face width is 40 mm. The material for pinion as well as for gear is steel with an ultimate tensile strength of 600 N/mm^2. The gears are heat treated for a surface hardness of 400 BHN. The pinion rotates at 1450 rpm and the service factor for the application is 1·75. Assume that the velocity factor accounts for the dynamic load and the factor of safety is 1·5. Determine the rated power that the gears can transmit, taking Lewis form factor as 0·32. 10

(c) A steel rod of 10 cm diameter is forced into a steel ring of 15 cm external diameter and 6 cm wide. Measured strain in the circumferential direction on the external surface of the ring is found to be $1·55 \times 10^{-4}$. Assuming coefficient of friction for the mating surfaces to be 0·25, estimate the force required to push the rod out of the ring. Use E = 200 GPa. 10

(d) Describe the properties of the following aluminium alloys :

Duralumin, Y-alloy, Magnalium and Hindalium. 10

Section – C

(Answer any two questions)

5. (a) Classify gating designs for pouring of metals into the mould cavity in a casting operation. Show them by sketches.

A mould of 50 cm × 25 cm × 10 cm has the provision of a top gating system with pouring height of 15 cm and cross-sectional area of the gate as 5 cm^2. Determine the filling time. 10

(b) Name four types of resistance welding processes. Describe with sketch "Spot welding". 10

(c) Describe with sketches Ultrasonic Machining Process (USM) and the principle of metal removal by this. 15

(d) Write the generalized Taylor's tool life equation. Also write the simplified Taylor's tool life equation.

During machining of low carbon steel with HSS tool, the following observations have been made :

Cutting speed, m/min	40	50
Tool life, min	40	10

Derive the V-T relationship. 5

6. (a) (i) Distinguish between "Simple Moving Average" and "Weighted Moving Average" methods of forecasting.

(ii) Demand for an item of a particular size and specification in the past six months, in a firm had been as follows :

January	*February*	*March*	*April*	*May*	*June*
600	700	800	800	900	1000

Compute a weighted 4 months moving average for July. 10

(b) (i) Explain what is "Break Even Analysis" ? Demonstrate by a graphical representation.

(ii) The Fixed costs of a company are ₹700,000. The net sales amount is ₹1,200,000 annually. The direct costs are 35% of sales in rupees. Determine the following :

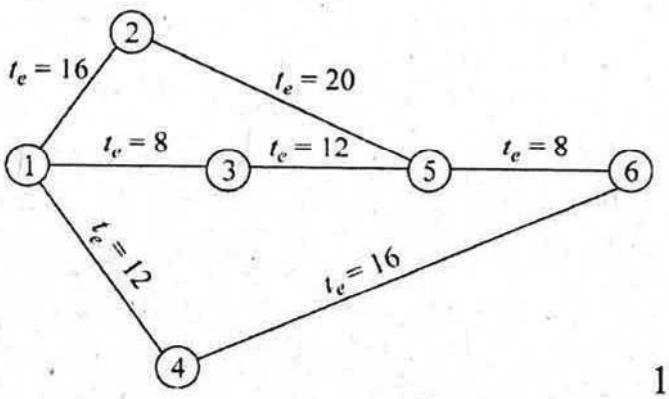
(I) "The Break Even Point" in terms of sales Rupees.

(II) The sales required to earn a profit of ₹1,60,000·00. 15

(c) (i) With respect to PERT Analysis define the following :

Earliest Starting Time (T_E)
Latest Finish Time (T_L)
Slack, and
critical path

(ii) Indicate the Earliest Starting and Latest Finish times on the following network and also indicate the critical path on it. The t_e values indicated are as per standard deviation.



15

7. (a) The sales of cars for an automobile manufacturing company for last five years are given below :

Year	*Sales (Y) (No. of cars)*	*Demand index (X) (No. of cars)*
2015	1800	2000
2014	1600	1500
2013	1500	1400
2012	1300	1100
2011	1100	1000

Find the relation between the demand index (X) and sale of cars (Y). Make a forecast for the year 2016; supposing the demand index rise to 2100. Use Least square method. 10

(b) Describe Laser Beam Machining (LBM). Give a detailed schematic diagram. Also discuss the Mechanics of LBM. 10

(c) Explain in detail "Wire Drawing" process. Give a detailed drawing of the set-up. What is the function of "Dog-Gripping tool" for this process ? 10

(d) (i) For calculation of simple interest 3 sets of p = principal, n = no. of years and r = rate are given. Simple interest has to be calculated by using C-program. Draw a Flow chart using "Loop Control Structure".

(ii) Write a C-code to compute the volume and Area of a sphere using the formulas.

$$V = 4\frac{\pi r^3}{3}$$

$$A = 4\pi r^2$$ 10