

MFS.

2007

MECHANICAL ENGINEERING (Optional)

यंत्र अभियांत्रिकी (वैकल्पिक)

000184

Time : 3 hours

Maximum Marks : 200

- Note :
- In all attempt Five Questions.
 - Question No. 1 is Compulsory.
 - Of the remaining Questions, Attempt Any four by selecting one Question from each section
 - Numbers of optional questions upto the prescribed number in the order in which questions have been solved, will only be assessed and excess answers of the question/s will not be assessed.

Question 1. Answer any four (Ten marks each).

- Cantilever beam of rectangular section, having 2m span, carries vertical load at free end of 10kN. If depth to width ratio is 2, allowable bending stress is 200 N/mm^2 and factor of safety 2.5. Find cross section of beam.
Draw nature of S.F. and B.M. diagram. Explain why depth is always more than width for the beams. 10
- What is purpose of servo system in EDM? Explain with sketch EDM process, it's advantages, limitations and applications. 10
- Describe with sketch how load and speed regulation and hydraulic braking is done in pelton wheel. 10
- Air expands from 3 bar to 1 bar in nozzle. Initial velocity is 90 m/sec and temperature is 150°C . Find final velocity assuming adiabatic condition with $C_p = 1.005 \text{ kJ/kgK}$. 10
- Power required to mill is 30,000 kN.m/min. If heat source is at 400°C and surrounding at 27°C . If actual engine is 30% efficient as Carnot engine, working between same temperature limits. Find energy supplied. 10

P.T.O.

Section A

Question. 2

- (a) Describe how antifriction bearings are selected for particular application from manufacturer's catalogue. 15
- (b) Shaft transmitting 20 kW power at 500 RPM and bending moment of 1000 N.m. If permissible shear strength of shaft material is 100 N/mm^2 . Find diameter of shaft. 15
- (c) Define robot. Discuss its applications in CAM with justification. 10

Question. 3

- (a) Belt is transmitting power of 15kW with speed reduction from 1440 RPM to 480 RPM. If belt speed is approx. 20m/sec and centre distance between pulleys is twice the bigger diameter of pulley. Find pulley diameters, length of belt, wrap angle and correct belt velocity. 15
- (b) Helical spring is made from wire of 6mm diameter and outside diameter of spring is 75mm. If permissible shear stress is 350 MPa and modulus of rigidity 84 kN/mm^2 . Find axial load which spring can carry and deflection per active number of turns. (Neglect Curvature effect) 15
- (c) Explain term 'Productivity'. Discuss how productivity is enhanced by using machining centre. 10

Section B

Question. 4

- (a) Describe with sketch, how liners of I.C. engines are manufactured. Explain advantages of the process. 20
- (b) With help of block diagram, explain various inputs and outputs of MRP processor. 20

Question. 5

- (a) Which basic process is used to manufacture connecting rod of I.C. engine ? Why ? Explain advantages limitations of process. Which defects are likely to occur during suggested process. 20
- (b) As manager of plant you have to determine whether you should purchase component part or make in the plant at individual station or at assembly line. You can purchase the item at Rs. 10 per piece. With investment to an annual fixed cost of Rs. 20,000 and variable cost of Rs. 2.50 per piece a assembly line can be set up to manufacture the part third option open to you is to make part at individual station with annual fixed cost of Rs. 10,000 and variable cost of Rs. 5 per piece. Assuming that the annual demand is expected to be around 3500 units, which alternative would you suggest. 20
(Also comment if quantity varies)

Section C**Question. 6**

- (a) Rectangular barge is 20m long 7 m wide and 3m deep. It has draft of 2 m when fully loaded. C.G. of barge is on axis of symmetry at water surface. Determine stability condition of barge and metacentre height. 15
- (b) Venturimeter has entrance of 0.2 m dia and throat of 0.1 m dia., whose centre is 0.5m above centre of entrance. Find water velocity at throat when pressure difference is 30 kN/mm². Coefficient of discharge is 0.97. 15
- (c) Apply dimensional analysis if dynamic force (F) is function of length (L), velocity (V) and density (ρ). 10

Question. 7

- (a) Dam is having parabolic section. Vertical distance (half major axis) is 250 from bottom level of water to top and horizontal distance (half minor axis) is 50 m. If width of Dam is 10 m. Find magnitude, direction of water pressure acting on dam. 15
(Equation of Parabola $10Z = x^2$)
- (b) Calculate force exerted by jet of water 10mm in diameter which strikes a flat plate at an angle of 30° to the normal of plate with velocity of 10 m/sec. If (i) plate is stationary (ii) If plate is moving in direction of jet with velocity of 2 m/sec. 15
- (c) Explain Buckingham Pi theorem and it's use in model analysis 10

P.T.O.

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Section D

Question. 8

- (a) Explain function, operation advantages and limitations of super charger. 15
- (b) Three stage compressor delivers air at 70 bar from atmospheric pressure at 1 bar and 30°C. Assuming complete intercooling and maximum efficiency condition find for 1 kg of air per second. 10
- (i) Intermediate pressures.
- (ii) Power required
- (iii) Compare power, if compressor is single stage
- (c) If 500 kg of H_2SO_4 is cooled per hour from 70°C to 30°C, in counterflow heat exchanger, by using 400 kg of fluid at 20°C, find area of heat exchanger from following data.
- specific heat of $H_2SO_4 = 3.36 \text{ kJ/kg } ^\circ\text{C}$
- specific heat of fluid = 4.2 kJ/kg °C
- Convective H.T. coefficient of H_2SO_4 side = 400 W/m² °C
- Convective H.T. coefficient of fluid side = 500 W/m² °C
- Neglect tube resistance and assume no loss of heat. 15

Question. 9

- (a) Define 'Octane number'. Explain how octane number and compression ratio, affects performance of I.C. engine. 15
- (b) Classify various compressors. Compare rotary and reciprocating compressors. 10
- (c) Capacity of refrigerator is 600 tons when working between -5 °C to 20 °C. Find weight of ice produced within 24 hours when water is supplied at 10 °C. Also find minimum I.P. required. Assume cycle of operation is carnot cycle. Latent heat of ice is 334.5 kJ/kg and C_p of water 4.2 kJ/kg -k. 15

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