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BT-6/M-20 **36130**

MACHINE DESIGN-II

Paper–ME-310 N

Time : Three Hours] [Maximum Marks : 75

Note : Attempt *five* questions in all. Assume any missing data suitably.

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1. A 15 kW and 1200 r.p.m. motor drives a compressor at 300 r.p.m. through a pair of spur gears having 20° stub teeth. The centre to centre distance between the shafts is 400 mm. The motor pinion is made of forged steel having an allowable static stress as 210 MPa, while the gear is made of cast steel having allowable static stress as 140 MPa. Assuming that the drive operates 8 to 10 hours per day under light shock conditions, find from the standpoint of strength,

1. Module; 2. Face width and 3. Number of teeth and pitch circle diameter of each gear.

Check the gears thus designed from the consideration of wear. The surface endurance limit may be taken as 700 MPa. 15

2. A pair of helical gears consist of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 r.p.m. The normal pressure angle is 20° while the helix angle is 25°. The face width is 40 mm and the normal module is 4 mm. The pinion as well as gear are made of steel "having ultimate

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strength of 600 MPa and heat treated to a surface hardness of 300 B.H.N. The service factor and factor of safety are 1.5 and 2 respectively. Assume that the velocity factor accounts for the dynamic load and calculate the power transmitting capacity of the gears. 15

3. A V-belt drive system transmits 100 kW at 475 r.p.m. The belt has a mass of 0.6 kg/m. The maximum permissible tension in the belt is 900 N. The groove angle is 38° and the angle of contact is 160°. Find minimum number of belts and pulley diameter. The coefficient of friction between belt and pulley is 0.2. 15

4. A cone clutch is mounted on a shaft which transmits power at 225 r.p.m. The small diameter of the cone is 230 mm, the cone face is 50 mm and the cone face makes an angle of 15° with the horizontal. Determine the axial force necessary to engage the clutch to transmit 4.5 kW if the coefficient of friction of the contact surfaces is 0.25. What is the maximum pressure on the contact surfaces assuming uniform wear? 15

5. A vertical spring loaded valve is required for a compressed air receiver. The valve is to start opening at a pressure of 1 N/mm^2 gauge and must be fully open with a lift of 4 mm at a pressure of 1.2 N/mm ^{2} gauge. The diameter of the port is 25 mm. Assume the allowable shear stress in steel as 480 MPa and shear modulus as 80 kN/mm ^{2}.
Design a suitable close coiled round section helical spring having squared ground ends. Also specify initial compression and free length of the spring. 15

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6. Design a journal bearing for a centrifugal pump running at 1440 r.p.m. The diameter of the journal is 100 mm and load on each bearing is 20 kN. The factor ZN/p may be taken as 28 for centrifugal pump bearings. The bearing is running at 75°C temperature and the atmosphere temperature is 30°C. The energy dissipation coefficient is 875 W/m^2/°C. Take diametral clearance as 0.1 mm. 15

7. Design a piston for a four stroke diesel engine consuming 0.3 kg of fuel per kW of power per hour and produces a brake mean effective pressure of the 0.7 N/mm^2. The maximum gas pressure inside the cylinder is 5 N/mm^2 at a speed of 3500 r.p.m. The cylinder diameter is required to be 300 mm with stroke 1.5 times the diameter. The piston may have 4 compression rings and an oil ring. The following data can be used for design:

Higher calorific value of fuel = 46×10^3 kJ/kg;
Temperature at the piston centre = 700 K;
Temperature at the piston edge = 475 K;
Heat conductivity factor = 46.6 W/m/K;
Heat conducted through top = 5% of heat produced:
Permissible tensile strength for the material of piston = 27 N/mm^2;
Pressure between rings and piston = 0.04 N/mm^2;
Permissible tensile stress in rings = 80 N/mm^2;
Permissible Pressure on piston barrel = 0.4 N/mm^2;
Permissible pressure on piston pin = 15 N/mm^2;
Permissible stress in piston pin = 85 N/mm^2.
Any other data required for the design may be assumed. 15

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8. A single cylinder internal combustion engine working on the four stroke cycle develops 75 kW at 360 r.p.m. The fluctuation of energy can be assumed to be 0.9 times the energy developed per cycle. If the fluctuation of speed is not to exceed 1 per cent and the maximum centrifugal stress in the fly wheel is to be 5.5 MPa. Estimate the mean diameter and the cross-sectional area of the rim. The material of the rim has a density of 7200 kg / m^3.

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