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BT-6/M-19 36044

MACHINE DESING-II

ME-310-E(i)

Time : Four Hours] [Maximum Marks : 100

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks. Use of Machine Design data book is allowed.

Unit I

1. A reciprocating compressor is to be connected to an electric motor with the help of spur gears. The distance between the shaft is to be 500 mm. The speed of the electric motor is 900 r.p.m. and the speed of the compressor shaft is desired to be 200 r.p.m. The torque, to be transmitted is 5000 N-m. Taking starting torque as 25% more than the normal torque, determine : (i) Module and face width of the gears using 20 degrees stub teeth, and (ii) Number of teeth and pitch circle diameter of each gear. Assume suitable values of velocity factor and Lewis factor.

2. A pair of 20° full depth involute teeth bevel gears connect two shafts at right angles having velocity ratio 3 : 1. The gear is made of cast steel having allowable static stress as 70 MPa and the pinion is of steel with allowable static stress as 100 MPa. The pinion transmits 37.5 kW at 750 r.p.m. Determine : (i) Module and face width; (ii) Pitch diameters; and (iii) Pinion shaft diameter. Assume tooth form factor $y = 0.154 - \frac{0.912}{TE}$,

where TE is the formative number of teeth, width = 1/3rd the length of pitch cone, and pinion shaft overhangs by 150 mm.

Unit II

3. Power of 60 kW at 750 r.p.m. is to be transmitted from an electric motor to compressor shaft at 300 r.p.m. by V-belts. The approximate larger pulley diameter is 1500 mm. The approximate centre distance is 1650 mm, and overload factor is to be taken as 1.5. Give a complete design of th belt drive. A belt with cross-sectional area of 350 mm^2 and density 1000 kg/m^3 and having an allowable tensile strength 2 MPa is available for use. The coefficient of friction between the belt and the pulley may be taken as 0.28. The driven pulley is overhung to the extent of

300 mm from the nearest bearing and is mounted on a shaft having a permissible shear stress of 40 MPa with the help of a key. The shaft, the pulley and the key are also to be designed.

4. Determine the principal dimensions of a cone clutch faced with leather to transmit 30 kW at 750 r.p.m. from an electric motor to an air compressor. Sketch a sectional front view of the clutch and provide the main dimensions on the sketch. Assume : semi-angle of the cone = 12.5°; μ = 0.2; mean diameter of cone = 6 to 10 d where d is the diameter of shaft; allowable normal pressure for leather and cast iron = 0.075 to 0.1 N/mm^2; load factor = 1.75 and mean diameter to face width ratio = 6.

Unit III

5. Design a close coiled helical compression spring for a service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity, G = 84 kN/mm^2. Neglect the effect of stress concentration. Draw a fully dimensioned sketch of the spring, showing details of the finish of the end coils.

2. 6. A full journal bearing of 50 mm diameter and 100 mm long has a bearing pressure of 1.4 N/mm^2. The speed of the journal is 900 rpm and the ratio of journal diameter to the dimetral clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75°C may be taken as 0.011 kg/m-s. The room temperature is 35°C. Find : (i) The amount of artificial cooling required, and (ii) The mass of the lubricating oil required, if the difference between the outlet and inlet temperature of the oil is 10°C. Take specific heat of the oil as 1850 J/kg/°C.

Unit IV

7. Design a cast iron piston for a single acting four strok engine for the following data :

Cylinder bore = 100 mm; Stroke = 125 mm; Maximum gas pressure = 5 N/mm^2; Indicated mean effective pressure = 0.75 N/mm^2; Mechanical efficiency = 80%; Fuel consumption = 0.15 kg per brake power per hour; Higher calorific value of fuel = 42×10^3 kJ/kg; speed = 2000 r.p.m. Any other data required for the design may be assumed.

8. A single cylinder, single acting, four stroke oil engine develops 20 kW at 300 r.p.m. The workdone by the gases during the expansion stroke is 2.3 times the workdone on the gases during the compression and the workdone during the suction and exhaust strokes is negligible. The speed is to be maintained within ±1%. Determine the mass moment of inertia of the flywheel.