

Code No: 56019

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, November/December - 2015

DESIGN OF MACHINE MEMBERS-II

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 75

Answer any five questions

All questions carry equal marks

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- 1.a) 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 r.p.m. and the ratio of journal diameter to the diametral 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 $1850 \text{ J/kg/}^\circ\text{C}$.
- b) Explain with reference to a neat plot the importance of the bearing characteristic curve. [10+5]
- 2.a) A ball bearing subjected to a radial load of 4000 N is expected to have a satisfactory life of 12,000 hours at 720 r.p.m. with a reliability of 95%. Calculate the dynamic load carrying capacity of the bearing, so that it can be selected from manufacturer's catalogue based on 90% reliability. If there are four such bearings each with a reliability of 95% in a system, what is the reliability of the complete system?
- b) The rolling contact ball bearing are to be selected to support the overhung countershaft. The shaft speed is 720 r.p.m. The bearings are to have 99% reliability corresponding to a life of 24,000 hours. The bearing is subjected to an equivalent radial load of 1 kN. Consider life adjustment factors for operating condition and material as 0.9 and 0.85 respectively. Find the basic dynamic load rating of the bearing from manufacturer's catalogue, specified at 90% reliability. [7+8]
3. Design a cast iron piston for a single acting four stroke 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 = $42 \times 10^3 \text{ kJ/kg}$; Speed = 2000 r.p.m. Any other data required for the design may be assumed. [15]
- 4.a) A pulley of 0.9 m diameter revolving at 200 r.p.m. is to transmit 7.5 kW. Find the width of a leather belt if the maximum tension is not to exceed 145 N in 10 mm width. The tension in the tight side is twice that in the slack side. Determine the diameter of the shaft and the dimensions of the various parts of the pulley, assuming it to have six arms. Maximum shear stress is not to exceed 63 MPa.
- b) Design a chain drive to actuate a compressor from 15 kW electric motor running at 1000 r.p.m., the compressor speed being 350 r.p.m. The minimum centre distance is 500 mm. The compressor operates 16 hours per day. The chain tension may be adjusted by shifting the motor on slides. [8+7]

5. A gear drive is required to transmit a maximum power of 22.5 kW. The velocity ratio is 1:2 and r.p.m. of the pinion is 200. The approximate centre distance between the shafts may be taken as 600 mm. The teeth has 20° stub involute profiles. The static stress for the gear material (which is cast iron) may be taken as 60 MPa and face width as 10 times the module. Find the module, face width and number of teeth on each gear. Check the design for dynamic and wear loads. The deformation or dynamic factor in the Buckingham equation may be taken as 80 and the material combination factor for the wear as 1.4. [15]
- 6.a) A pair of straight bevel gears is required to transmit 10 kW at 500 r.p.m. from the motor shaft to another shaft at 250 r.p.m. The pinion has 24 teeth. The pressure angle is 20° . If the shaft axes are at right angles to each other, find the module, face width, addendum, outside diameter and slant height. The gears are capable of withstanding a static stress of 60 MPa. The tooth form factor may be taken as $0.154 - 0.912/T_E$, where T_E is the equivalent number of teeth. Assume velocity factor as $\frac{4.5}{4.5 + v}$ where v the pitch line speed in m/s. The face width may be taken as 1/4 of the slant height of the pitch cone.
- b) A pair of helical gears with 30° helix angle is used to transmit 15 kW at 10,000 r.p.m. of the pinion. The velocity ratio is 4:1. Both the gears are to be made of hardened steel of static strength 100 N/mm^2 . The gears are 20° stub and the pinion is to have 24 teeth. The face width may be taken as 14 times the module. Find the module and face width from the standpoint of strength and check the gears for wear. [7+8]
7. The mean diameter of the square threaded screw having pitch of 10 mm is 50 mm. A load of 20 kN is lifted through a distance of 170 mm. Find the work done in lifting the load and the efficiency of the screw, when a) The load rotates with the screw, and b) The load rests on the loose head which does not rotate with the screw. The external and internal diameter of the bearing surface of the loose head are 60 mm and 10 mm respectively. The coefficient of friction for the screw and the bearing surface may be taken as 0.08. [15]
8. A speed reducer unit is to be designed for an input of 1.1 kW with a transmission ratio 27. The speed of the hardened steel worm is 1440 r.p.m. The worm wheel is to be made of phosphor bronze. The tooth form is to be 20° involute. Design the gears. [15]

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