

Code No: 156AQ

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD****B. Tech III Year II Semester Examinations, February/March - 2022****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 journal bearing for a steam turbine is required to support a radial load of 2650 N. The shaft diameter at the bearing is 60 mm. The speed of rotation is 1800 rpm. Design the bearing. Design should clearly indicate requirement of artificial cooling.
- b) Discuss the significance of bearing modulus in the design of journal bearing. [8+7]
- 2.a) Design a suitable journal bearing for a centrifugal pump from the following available data: Load on the bearing = 13.5 kN; Diameter of the journal = 75 mm; Speed = 1440 rpm; Bearing characteristic number at the working temperature of  $75^{\circ}\text{C} = 30$ ; Permissible bearing pressure intensity =  $0.7\text{ N/mm}^2$  to  $1.4\text{ N/mm}^2$ ; Average atmospheric temperature =  $30^{\circ}\text{C}$ . Calculate the cooling requirements, if any.
- b) Explain the various types of lubrication methods for journal bearings. [8+7]
- 3.a) A single row deep groove ball bearing has a dynamic load capacity of 40210 N and operates on the work cycle consisting of radial load of 2000 N at 1000 rpm for 25 % of the time, radial load of 5000 N at 1500 rpm for 50 % of time, and radial load of 3000 N at 700 rpm for the remaining 25 % of time. Calculate the expected life of the bearing in hours.
- b) Enumerate any two advantages and disadvantages of rolling-contact bearings over sliding contact bearings. What is the reliability of rolling-contact bearing selected from the manufacturer's catalogue? [8+7]
- 4.a) A roller bearing is selected to withstand a radial load of 40 kN and life of 1200 hrs at 600 rpm. What load rating would you look for in searching from manufacturers catalogue if it specifies load at speed 500 rpm and life 3000 hrs.
- b) Select a suitable rolling bearing for a 55 mm diameter shaft. The bearing should be capable of withstanding 3 kN radial and 1.5 kN axial load at 750 rpm. The bearing is to have a desired rated life of 2000 hrs at a reliability of 94%. There is a light shock load and inner ring rotates. [7+8]
- 5.a) Explain the stresses developed in the connecting rod. What do you mean by whipping stress?
- b) The following data is given for the cap and bolts of the big end of a connecting rod: Engine speed = 1500 rpm, Length of connecting rod = 320 mm, Length of stroke = 140 mm, Mass of reciprocating parts = 1.75 kg, Length of crank pin = 54 mm, Diameter of crank pin = 38 mm, Permissible tensile stress for bolts =  $120\text{ N/mm}^2$ , Permissible bending stress for cap =  $120\text{ N/mm}^2$ . Calculate the nominal diameter of bolts and thickness of cap for the big end. [7+8]

6. Design a connecting rod of a diesel engine for the following data:  
Cylinder bore = 85 mm, Length of connecting rod = 350 mm, Maximum gas pressure = 3 MPa, Factor of safety against buckling failure = 5,  $(l/d)$  ratio for piston pin bearing = 1.5,  $(l/d)$  ratio for crank pin bearing = 1.25, Allowable bearing pressure for piston pin bearing = 13 MPa, Allowable bearing pressure for crank pin bearing = 11 MPa, Length of stroke = 140 mm, Mass of reciprocating parts = 1.5 kg, Engine speed = 2000 rpm, Thickness of bearing bush = 3 mm, Material of cap = 40 C8 ( $S_{yt} = 380 \text{ N/mm}^2$ ), Material of bolts = Alloy steel ( $S_{yt} = 450 \text{ N/mm}^2$ ), Factor of safety for cap and bolts = 4 and 5 respectively, Density of connecting rod material =  $7800 \text{ kg/m}^3$ . [15]
- 7.a) “The springs subjected to fluctuating stresses are designed on the basis of two criteria” – what are they? Explain.
- b) Design the cross section of a flat belt drive to run a compressor having a reduction ratio of 3, 15. The input speed is 960 rpm, and power to be transmitted is 15 kW. The compressor runs for 10 to 12 hours per day, and expected life of the belt is 1.5 years. [8+7]
- 8.a) Derive the Buckingham’s equation for wear of gear teeth.
- b) A pair of helical gears consists of a 25 teeth pinion meshing with a 50 teeth gear. The normal module is 4 mm. Find the required value of the helix angle, if the center distance is exactly 165 mm. [7+8]

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