Code No: 136BA **R16**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, July - 2023

DESIGN OF MACHINE MEMBERS - II

(Mechanical Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a)	What is the advantages of hydrodynamic bearings over roller bearings	[2]
b)	What are the parameters influences the radius of the friction circle in a journal bearing? Explain.	[3]
c)	What is the criterion for dynamic load carrying capacity of ball bearing?	[2]
d)	How do you express the life of a bearing? What is an average or median life?	[3]
e)	Name two criteria for calculating the thickness of piston head.	[2]
f)	What are the methods and materials used in the manufacture of connecting rod?	[3]
g)	What is the spring index and spring stiffness?	[2]
h)	The difference between tensions on the tight and slack sides of a belt drive is 3000 N. If the belt speed is 15 m/s, what is the transmitted power in KW?	[3]
i)	What is the minimum number of teeth on spur gear? Why?	[2]
j)	The velocity ratio between pinion and gear in a gear drive is 2.3, the module of teeth is 2.0 mm and sum of number of teeth on pinion and gear is 99.What is the centre distance between pinion and the gear?	[3]

PART – B

(50 Marks)

2.a) Explain about bearing modulus and Clearance ratio.

b) The load on the journal bearing is 150 kN due to turbine shaft of 300 mm diameter running at 1800 rpm. Determine i) Length of the bearing if the allowable bearing pressure is 1.6 N/mm^2 ii) Amount of heat to be removed by the lubricant per minute if the bearing temperature is 60^0C and viscosity of the oil at 60^0C is 0.02 kg/m-s and the bearing clearance is 0.25 mm. [3+7]

OR

3.a) What are journal bearings? Give classifications.

b) A tentative design of a journal bearing results in a diameter of 75 mm and a length of 125 mm for supporting a load of 20 kN. The shaft runs at 1000 rpm. The bearing surface temperature is not to exceed 75^0C in a room temperature of 35^0C. The oil used has an absolute viscosity of 0.01 kg/m-s at the operating temperature. Determine the amount of artificial cooling required in watts. Assume d/c = 1000. [3+7]

4.a) What is the criterion for static load carrying capacity of ball bearing?

b) A ball bearing subjected to a radial load of 4000 N is expected to have a satisfactory life of 12 000 hours at 720 rpm 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? [3+7]

OR

5.a) State any two advantages and two disadvantages of taper roller bearings.

b) A system involves four identical ball bearings, each subjected to a radial load of 2500 N. The reliability of the system, i.e., one out of four bearings failing during the lifetime of five million revolutions, is 82%. Determine the dynamic load carrying capacity of the bearing, so as to select it from the manufacturer's catalogue based on 90% reliability. [3+7]

6.a) What are the forces acting on the piston? Explain.

b) Determine the dimensions of cross-section of the connecting rod for a diesel engine with the following data: Cylinder bore = 100 mm, Length of connecting rod = 350 mm, Maximum gas pressure = 4 MPa, Factor of safety = 6. [5+5]

OR

7. A connecting rod is required to be designed for a high speed, four stroke I.C. engine. The following data are available. Diameter of piston = 88 mm; Mass of reciprocating parts=1.6kg; Length of connecting rod (centre to centre)=300mm; Stroke=125mm; R.P.M.=2200 (when developing 50 kW); Possible over speed=3000rpm.; Compression ratio = 6.8 : 1 (approximately); Probale maximum explosion pressure (assumed shortly after dead centre, say at about 3^{0}) = 3.5 N/mm^2. Draw fully dimensioned drawings of the connecting rod showing the provision for the lubrication. [10]

8.a) Derive the formula for the natural frequency of helical springs.

b) Design a leaf spring for the following specifications: Total load = 140 kN; Number of springs supporting the load = 4 ; Maximum number of leaves = 10; Span of the spring = 1000 mm; Permissible deflection = 80 mm. Take Young's modulus, E = 200 kN/mm^2 and allowable stress in spring material as 600 MPa. [4+6]

OR

9. Design the elliptical cross-section of a belt pulley arm near the hub for the following specifications: The mean pulley diameter is 300 mm and the number of pulley arms is 4. The elliptical section has major axis twice the minor axis length. The tight and slack sides tension in the belt are 600 N and 200 N respectively. Assume half number of arms transmit torque at any time and the load factor of 1.75 to account for dynamic effects on the pulley while transmitting torque. The permissible tensile stress for cast iron pulley material is 15 MPa. The pulley hub diameter is 60 mm. [10]

10. A motor shaft rotating at 1500 r.p.m. has to transmit 15 kW to a low speed shaft with a speed reduction of 3:1. The teeth are $14\frac{1}{2}^0$ involute with 25 teeth on the pinion. Both the pinion and gear are made of steel with a maximum safe stress of 200 MPa. A safe stress of 40 MPa may be taken for the shaft on which the gear is mounted and for the key. Design a spur gear drive to suit the above conditions. Also sketch the spur gear drive. Assume starting torque to be 25% higher than the running torque. [10]

OR

11. A pair of helical gears consists of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 rpm. The normal pressure angle is 20^0 while the helix angle is 25^0. The face width is 40 mm and the normal module is 4 mm. The pinion as well as gear is made of steel having ultimate strength of 600 MPa and heat treated to a surface hardness of 300 BHN. 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. [10]

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