

B.TECH
(SEM VI) THEORY EXAMINATION 2022-23
MACHINE DESIGN-II

Time: 3 Hours

Total Marks: 70

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt all questions in brief.

2 x 7 = 14

- a. What are different standard proportion of gear systems?
- b. Define Sommerfeld Number.
- c. What are properties required in lubricant used in hydrodynamic bearing?
- d. What are different stresses generated in cylinder of I.C. engine?
- e. Compare squeeze and wedge film bearing
- f. Compare spur gear and helical gear.
- g. Describe about the various material used for piston.

SECTION B

2. Attempt any three of the following:

7 x 3 = 21

- a. The pitch circle diameters of the pinion and gear are 100 and 300 mm respectively. The pinion is made of plain carbon steel 40C₈ ($S_{ut} = 600 \text{ N/mm}^2$) while the gear is made of grey cast iron FG 300 ($S_{ut} = 300 \text{ N/mm}^2$). The pinion receives 5 KW power at 500 r.p.m through its shaft. The service factor and factor of safety can be taken as 1.5 each. The face width of the gear can be taken as ten times that of module. Assume that velocity factor accounts for the dynamic load. Calculate:
 - (i) Module (ii) The number of teeth on pinion and gear
- b. Explain force analysis in bevel gear system.
- c. Design a bearing and journal to support a load of 5.5 kN at 650 r.p.m using a hardened steel journal and bronze backed babbit bearing. The bearing is lubricated by oil rings. Take room temperature as 22⁰ C and oil temperature as 85⁰ C. The permissible bearing pressure is taken as 2 N/mm².
- d. Derive the expression of dynamic load rating for rolling contact bearing under variable loads
- e. A four stroke internal combustion engine has the following specifications : Brake power= 7.5 KW ; speed= 1000 r.p.m ; Indicated mean effective pressure = 0.35 N/mm² ; Maximum gas pressure = 3.5 N/mm² ; Mechanical Efficiency= 80 % . Determine (i) The dimensions of the cylinder, if the length of stroke is 1.4 times the bore of the cylinder (ii) Wall thickness of the cylinder, if the hoop stress is 35 MPa (iii) Thickness of the cylinder head and size of studs when the permissible stresses for the cylinder head and stud materials are 45 MPa and 65 MPa respectively.

SECTION C

3. Attempt any one part of the following:

7 x 1 = 7

- a. A helical pinion having 20 teeth transmits 30 KW power at 30 rev/sec. The speed ratio is 4. The normal module is 4 mm, while face width is 36 mm. The normal pressure angle is 20⁰ and helix angle is 30⁰. If the gear pair is made of steel, Calculate the maximum contact stress in the tooth.

- b. A pair of helical gears consists of 21 teeth pinion meshing with 63 teeth gear. The normal module is 5 mm, while normal pressure angle is 20° . If the centre distance is 225 mm. Calculate (i) helix angle (ii) The gear ratio (iii) The transverse module (iv) The transverse pressure angle

4. Attempt any one part of the following:

7 x 1 = 7

- a. A 50 HP motor running at 750 r.p.m. drives another shaft at right angle through 90° bevel gearing. The velocity ratio is 3:1. The teeth are 20° full depth involute. If the number of teeth on pinion are 20. The material for pinion is alloy steel ($S_{ut} = 800$ MPa) and for gear is plain carbon steel ($S_{ut} = 720$ MPa).
- b. A worm gear pair is designated as 4/30/10/5 Calculate
- (i) Dimensions of the worm and worm gear
 - (ii) The centre distance
 - (iii) The reduction ratio

5. Attempt any one part of the following:

7 x 1 = 7

- a. For a given journal bearing with fixed clearance and radius, plot the variation of coefficient of friction with the sommerfeld number and explain the stable and unstable regimes of operation
- b. A 150 mm diameter shaft supporting a load of 10 KN has a speed of 1500 r.p.m. The shaft runs in a bearing whose length is 1.5 times the shaft diameter. If the diametral clearance of the bearing is 0.15 mm and the absolute viscosity of the oil at the operating temperature is 0.011 Kg/m-sec. Find the power wasted in friction

6. Attempt any one part of the following:

7 x 1 = 7

- a. Design a self-aligning ball bearing for a radial load of 7000 N and a thrust load of 2100 N. The desired life of bearing is 160 millions of revolutions at 300 r.p.m. Assume uniform and steady load
- b. A ball bearing subjected to radial load of 5 KN is expected to have a life of 8000 hours at 1450 r.p.m while the reliability of 90 %. Calculate the dynamic load capacity of the bearing so that it can be selected from the manufacturer's catalogue based on a reliability of 90 %.

7. Attempt any one part of the following:

7 x 1 = 7

- a. Design a side or overhung crankshaft for a 250 mm x 300 mm gas engine, The weight of the flywheel is 30 KN and explosion pressure is 2.1 N/mm^2 . The gas pressure at the maximum torque is 0.9 N/mm^2 when the crank angle is 35° from the I.D.C. The connecting rod is 4.5 times the crank radius.
- b. Write a short note on following
- (i) Virtual teeth in helical Gear
 - (ii) Comparison between sliding contact and roller contact bearing