

III B. Tech I Semester Regular Examinations, February-2022
DESIGN OF MACHINE MEMBERS-II

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**

All Questions Carry Equal Marks

Design data book is permitted for examination

UNIT-I

1. a) List the basic assumptions used in the theory of hydrodynamic lubrication. [5M]
- b) Design a journal bearing for a centrifugal pump running 1440 r.p.m. [10M]
The diameter of the journal is 100 mm and load on each bearing is 20 kN. The factor ZN/P may be taken as 28 for centrifugal pump bearings. The bearing is running at 75°C temperature and the atmosphere temperature is 30°C. The energy dissipation coefficient is 87.5W/m² °C. Take diametric clearance as 0.1 mm.

(OR)

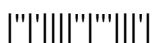
2. a) Define the term static equivalent load as applied in rolling contact bearing. [2M]
- b) Select a single row deep groove ball bearing for a radial load of 4500 N [13M]
and an axial load of 6000 N, operating at a speed of 1440 r.p.m. for an average life of 5 years at 8 hours per day. Assume uniform and steady load.

UNIT-II

3. Design a centre crankshaft for a single cylinder vertical engine using [15M]
the following data: Cylinder bore = 125 mm, (L/r) ratio = 4.5, maximum gas pressure = 2.5 MPa, length of the stroke = 150 mm, weight of flywheel cum belt pulley = 1 kN, total belt pull = 2 kN, width of the hub for flywheel cum belt pulley = 200 mm. The torque on the crankshaft is maximum when the crank turns through 250 from the top dead centre and at this position the gas pressure inside the cylinder is 2 MPa. The belts are in the horizontal direction. Assume suitable data and state the assumptions you make.

(OR)

4. a) List the various types of cylinder liners. [2M]



- b) The following data is given for a four-stroke diesel engine: Cylinder bore = 250 mm, Length of stroke = 300 mm, Speed = 600 r.p.m, Indicated mean effective pressure = 0.6 MPa, Mechanical efficiency = 80%, Maximum gas pressure = 4 MPa, Fuel consumption = 0.25 kg per BP per h, Higher calorific value of fuel = 44000 kJ/kg. Assume that 5% of the total heat developed in the cylinder is transmitted by the piston. The piston is made of grey cast iron FG 200 ($S_{ut} = 200 \text{ N/mm}^2$ and $k = 46.6 \text{ W/m/}^\circ\text{C}$) and the factor of safety is 5. The temperature difference between the centre and the edge of the piston head is 220°C . [13M]
- Calculate the thickness of piston head by strength consideration.
 - Calculate the thickness of piston head by thermal consideration.
 - Which criterion decides the thickness of piston head?
 - State whether the ribs are required or not.
 - If so, calculate the number and thickness of piston ribs.
 - State whether a cup is required in the top of the piston head.
 - If so, calculate the radius of the cup.

UNIT-III

5. a) A cast iron flat pulley transmits 25 kW at a speed of 580 r.p.m. The pulley overhangs the nearest bearing by 200 mm. Assuming the ratio of belt tensions as 2.6; determine: i) shaft diameter, ii) pulley diameter, and iii) cross-section of eight arms. [7M]
- b) It is required to select a V-belt drive to connect a 20 kW, 1440 r.p.m motor to a compressor running at 480 r.p.m for 15 hours per day. Space is available for a centre distance of approximately 1.2 m. Determine [8M]
- the specifications of the belt;
 - diameters of motor and compressor pulleys;
 - the correct centre distance; and
 - the number of belts.

(OR)

6. a) Discuss the various types of threads. Give at least two practical applications for each type. Discuss their relative advantages and disadvantages. [6M]
- b) A triple-threaded power screw, used in a screw jack, has a nominal diameter of 50 mm and a pitch of 8 mm. The threads are square and the length of the nut is 48 mm. The screw jack is used to lift a load of 7.5 kN. The coefficient of friction at the threads is 0.12 and the collar friction is negligible. Calculate: [9M]
- the principal shear stress in the screw body;
 - the transverse shear stresses in the screw and the nut; and
 - the unit bearing pressure. State whether the screw is self-locking.

UNIT-IV

7. a) How the gears classified and what are are the various terms used in spur gear terminology? Explain with a neat sketch. [6M]



- b) A pair of spur gears has pinion made of material with 80 MPa safe static bending stresses, gear made of material with safe static bending stresses of 55 MPa. The module and face width of the teeth are 5 mm and 60 mm respectively. The pinion rotates at 60 r.p.m. The number of teeth on pinions and gear are 20 and 80 respectively. Find the capacity in kW of the gear drive. The error is limited to $e = 16 + 1.25(m + 0.25 d)$ microns. The B.H.N of the pinion material is 250. [9M]

(OR)

8. a) What is the difference between double and herringbone helical gears? [2M]
- b) A pair of parallel helical gears consists of 24 teeth pinion rotating at 5000 r.p.m and supplying 2.5 kW power to a gear. The speed reduction is 4:1. The normal pressure angle and helix angle are 20° and 23° respectively. Both gears are made of hardened steel ($S_{ut} = 750 \text{ N/mm}^2$). The service factor and the factor of safety are 1.5 and 2 respectively. The gears are finished to meet the accuracy of grade 4. In initial stages of gear design, assume that the velocity factor accounts for the dynamic load and that the face width is ten times the normal module. Assuming the pitch line velocity to be 10 m/s, estimate the normal module. Select the first preference module and calculate the main dimensions. [13M]

UNIT-V

9. a) Draw the hanger wall boxes and identify different elements in it. [5M]
- b) Let 6×19 wire ropes with fibre core and nominal diameter of 10 mm are used for a hoist. The tensile designation of wires is 1770. The mass of the wire rope is 34.6 kg per 100 m length, while the breaking load is 54 kN. The weight of the hoist along with the material is 10 kN, which is raised through a distance of 3 m. The maximum acceleration during the operation is limited to 1 m/s^2 . Neglecting bending stresses and assuming a preliminary factor of safety of 10, determine the required number of wire ropes. [10M]

(OR)

10. A punch press, used for stamping sheet metal, has a punching capacity of 50 kN. The section of the frame is as shown in below Figure 1. Find the resultant stress at the inner and outer fibre of the section. [15M]

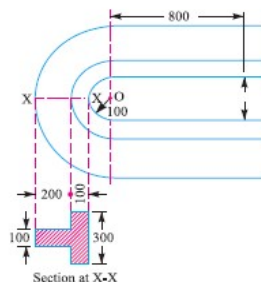


Figure 1

