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B. TECH.
(SEM -VI) THEORY EXAMINATION 2018-19
MACHINE DESIGN-II

Time: 3 Hours ***Total Marks: 100***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.
2. Use of design data book is allowed.

SECTION A

1. Attempt *all* questions in brief. 2 x10 = 20

a. Mention four important types of gears and discuss their applications, the materials used for them and their construction.
b. Define the virtual no. of teeth for a helical gear.
c. Discuss the effect of helical angle on the performance of helical gears.
d. What is the procedure followed in designing a journal bearing?
e. Explain with sketches the working of different types of thrust bearing
f. How do you express the life of a bearing? What is an average or median life?
g. Why the area of the inlet valve port is made larger than the area of exhaust valve port?
h. Sketch a valve gear mechanism of an internal combustion engine and label its various parts.
i. Explain the various types of crankshafts.
j. What are the limits of helix angle and pressure angle drive in warm gear drive.

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. A 20° full-depth steel spur pinion has 17 teeth and a module of 1.5 mm and is to transmit 0.25 kWat a speed of 400 rev/min. Find an appropriate face width if the bending stress is not to exceed75 MPa.
b. A worm drive transmits 15 kW at 2000 r.p.m. to a machine carriage at 75 r.p.m.The worm is triple threaded and has 65 mm pitch diameter. The worm gear has 90 teeth of 6 mm module. The tooth form is to be 20° full depth involute. The coefficient of friction between the mating teeth may be taken as 0.10. Calculate: 1. tangential force acting on the worm; 2. axial thrust and separating force on worm; and 3. efficiency of the worm drive.
c. Construct the distributional properties of a 02-30 mm deep-groove ball bearing if theWeibull parameters are $x_0 = 0.02$, $(\theta - x_0) = 4.439$, and $b = 1.483$. Find the mean,median, 10th percentile life, standard deviation, and coefficient of variation.
d. Design a journal bearing for a centrifugal pump running at 1440 r.p.m. The diameter of the journal is100 mm and load on each bearing is 20 kN. The factor ZN/p may be taken as 28 for centrifugal pumpbearings. The bearing is running at 75°C temperature and the atmosphere temperature is 30°C. Theenergy dissipation coefficient is 875 $W/m^2/°C$. Take diametral clearance as 0.1 mm.
e. Design a side or overhung crankshaft for a 250 mm × 300 mm gas engine. The weight of the flywheel is 30 kN and the explosion pressure is 2.1 N/mm^2. The gas pressure at themaximum torque is 0.9 N/mm^2, when the crank angle is 35° from I. D. C. The connecting rod is 4.5times the crank radius.

SECTION C

3. Attempt any *one* part of the following: 10 x 1= 10

(a) A micarta pinion rotating at 1200 r.p.m. is to transmit 1 kW to a cast iron gear at a speed of 192 r.p.m.Assuming a starting overload of 20% and using 20° full depth involute teeth, determine the module,number of teeth on the pinion and gear and face width. Take allowable static strength for micarta as 40MPa and for cast iron as 53 MPa. Check the pair in wear.

(b) A pair of helical gears are to transmit 15 kW. The teeth are 20° stub in diametralplane and have a helix angle of 45°. The pinion runs at 10 000 r.p.m. and has 80 mm pitch diameter.The gear has 320 mm pitch diameter. If the gears are made of cast steel having allowable staticstrength of 100 MPa; determine a suitable module and face width from static strength considerations
and check the gears for wear, given σ_{es} = 618 MPa.

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) A pair of worm gears is designated as, 1/30/10/8
Calculate
- (i) The center distance;
- (ii) The speed reduction;
- (iii) The dimension of the worm; and
- (iv) The dimensions of the worm wheel

(b) A pair of worm and worm wheel is designated as3/60/10/6. The worm is transmitting 5Kw power at 1440 rpm to the worm wheel. The coefficient of friction is 0.1 and the normal pressure angle is 20º. The components of the gear tooth force acting on the worm and the worm wheel.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) In bearings tested at 2000 rev/min with a steady radial load of 18 kN, a set of bearings showedan L10 life of 115 h and an L80 life of 600 h. The basic load rating of this bearing is 39.6 kN.Estimate the Weibull shape factor b and the characteristic life θ for a two-parameter model.This manufacturer rates ball bearings at 1 million revolutions

(b) A full journal bearing has a shaft diameter of 80.00 mm with a unilateral tolerance of −0.01 mm.The l/d ratio is unity. The bushing has a bore diameter of 80.08 mm with a unilateral toleranceof 0.03 mm. The SAE 30 oil supply is in an axial-groove sump with a steady-state temperatureof 60°C. The radial load is 3000 N. Estimate the average film temperature, the minimum filmthickness, the heat loss rate, and the lubricant side-flow rate for the minimum clearance assembly, if the journal speed is 8 rev/s.

6. Attempt any *one* part of the following: 10 x 1 = 10

(a) A ball bearing subjected to a radial load of 5 kN is expected to have a life of 8000 hours at 1450 r.p.m. with a reliability of 99%. Calculate the dynamic load capacity of the bearing so that it can be selectedfrom the manufacturer's catalogue based on a reliability of 90%.

(b) A single row deep groove ball bearing operating at 2000 r.p.m. is acted by a 10 kN radial load and8 kN thrust load. The bearing is subjected to a light shock load and the outer ring is rotating. Determine the rating life of the bearing.

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) The conical valve of an I.C. engine is 60 mm in diameter and is subjected to amaximum gas pressure of 4 N/mm^2. The safe stress in bending for the valve material is 46 MPa. Thevalve is made of steel for which k = 0.42. The angle at which the valve disc seat is tapered is 30°.Determine : 1. thickness of the valve head ; 2. stem diameter ; and 3. maximum lift of the valve.

(b) Design a side crankshaft for a 500 mm × 600 mm gas engine. The weight of the flywheel is 80 kN and the explosion pressure is 2.5 N/mm^2. The gas pressure at maximum torque is 0.9 N/mm^2 when thecrank angle. is 30º. The connecting rod is 4.5 times the crank radius.Any other data required for the design may be assumed.