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Roll No .....

ME-5003-CBGS

B.E. V Semester

Examination, December 2020

Choice Based Grading System (CBGS)

Design of Machine Elements

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt any five questions.

ii) All questions carry equal marks.

iii) Assume suitable data, if necessary. Use of design data book is permitted.

1. a) Explain: 7

   i) Conceptual design

   ii) Embodiment design

   b) Define engineering design. Explain a systematic design procedure by making use of a block diagram. 7

2. a) Discuss various guidelines used for "Design for safety". 7

   b) Determine factor of safety to be used in the design of connecting rod for: 7

   i) Double acting steam engine for ordinary general purpose

   ii) Airplane engine

3. a) A shaft supported at the ends in ball bearings carries a straight tooth spur gear at its mid span and is to transmit 7.5 kW at 300 rpm. The pitch circle diameter of the gear is 150 mm. The distances between the centre line of bearings and gear are 100 mm each. If the shaft is made of steel and the allowable shear stress is 45 MPa, determine the diameter of the shaft. The pressure angle of the gear may be taken as 20°. 7

b) A hollow shaft of 0.5 m outside diameter and 0.3 m inside diameter is used to drive a propeller of marine vessel. The shaft is mounted on bearings 6 meter apart and it transmits 5600 kW at 150 rpm. The maximum axial propeller thrust is 500 kN and the shaft weight 70 kN. Determine : 7

i) The maximum shear stress developed in shaft

ii) The angular twist between the bearings

4. a) Design a clamp coupling to transmit 30 kW at 100 rpm. Allowable shear stress for shaft and key is 40 MPa and number of bolts connecting two halves is six. Permissible tensile stress for bolt is 70 MPa. The coefficient of friction between muff and shaft may be taken as 0.307

b) A V-belt drive transmits 160 kW at 475 rpm. The angle of contact is 160° and the pulley groove angle is 38°. The mass of the belt is 0.6 kg/m, while the maximum permissible tension in the belt is 900 N. If the coefficient of friction between the belt and pulley is 0.2, find the minimum number of belts and pulley diameter. 7

5. a) State advantages, limitations and applications of chain drives. 4

   b) A rope drive transmits 600 kW from a pulley of effective diameter 4 m, which runs at a speed of 90 r.p.m. The angle of lap is 160°, angle of groove 45°, the coefficient of friction 0.28, the mass of rope 1.5 kg/m and allowable tension in each rope 2400 N. Find the number of ropes required. 10

6. a) A simple band brake operates on a drum of 600 mm in diameter that is running at 200 rpm. The coefficient of friction is 0.25. The band brake has a contact angle of 270°, one end is fastened to a fixed pin and other end to the brake arm 125 mm from the fixed pin. The straight brake arm is 750 mm long and placed perpendicular to the diameter that bisects the angle of contact. 7

      i) What is the pull necessary on the end of the brake arm to stop the wheel if 35 kW is being absorbed? What is the direction for this minimum pull?

      ii) What width of steel band of 2.5 mm thick is required for this brake if the maximum tensile stress is not to exceed 50 MPa?

   b) A plate clutch having a driving plate is required to transmit 100 kW at 1000 rpm. The outer diameter of contact surface is 300 mm. Determine the inner diameter of contact surfaces assuming uniform pressure of 0.17 N/mm^2. Assume $\mu = 0.4$. 7

7. Discuss following in brief: 14

   a) Lewis equation for gear design

   b) Causes of gear tooth failure

   c) Virtual Number of teeth

8. A pair of bevel gears connects two shafts at right angles and transmits 9 kW. Determine the required module and gear diameters for following specifications: 14

Particulars	Pinion	Gear
Number of Teeth	21	60
Material	Semi Steel (Ep=210 kN/mm^2)	Grey CI (Eg=84 kN/mm^2)
BHN	200	160
Allowable static stress	85 MPa	55 MPa
Speed	1200	420
Tooth profile	14½° composite	14½° composite

Check the gears for dynamic and wear loads.

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