

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Design of Machine Elements - II

Time: 3 hrs.

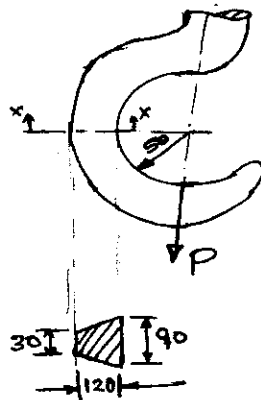
Max. Marks:100

- Note: 1. Answer FIVE full questions, selecting at least TWO questions from each part.**
2. Use of design data hand book is permitted.

PART - A

- 1 a. List the differences between a straight beam and a curved beam. (04 Marks)
 b. A crane hook having trapezoidal cross section is shown in Fig. Q1(b). It is made of plain carbon steel ($\sigma_y = 380\text{MPa}$). Assuming a factor of safety of 3.5, determine the load carrying capacity of hook. (16 Marks)

Fig. Q1 (b)

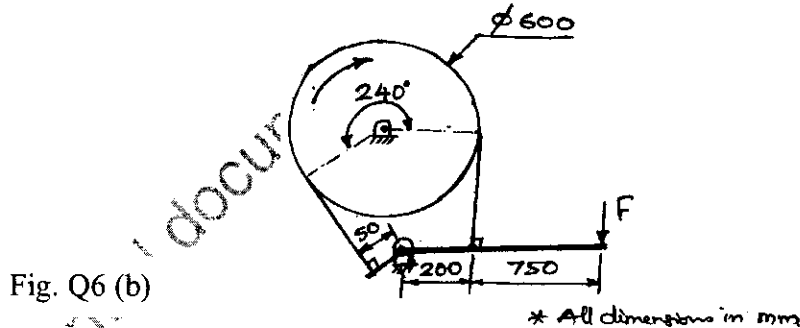


- 2 a. What is autofrettage? What are the methods adopted? (06 Marks)
 b. A high pressure cylinder consists of an inner cylinder of inner and outer diameter 200mm and 300mm respectively. It is jacketed by an outer cylinder of outside diameter 400mm. The difference between the outer diameter of the inner cylinder and the inner diameter of the jacket before assembly is 0.25mm. Take $E = 207\text{ GPa}$, calculate the shrinkage pressure and the maximum tensile stress induced in any of the cylinders. (08 Marks)
 c. In a hydraulic cylinder made of cast iron, the total force is 20kN. The pressure in cylinder is 15MPa. Taking ultimate strength of CI as 210 MPa and factor of safety as 5, determine the diameter and the thickness of the cylinder. (06 Marks)
- 3 a. A helical tension spring is used in the spring balance to measure the weights. One end is fixed and the other end carries a maximum weight of 1500N. The elongation is 100mm. The spring index can be taken as 6. The spring is made of material having ultimate tensile strength of 1300 MPa and modulus of rigidity 81GPa. The permissible shear stress in the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring. (10 Marks)
 b. A semi elliptical has an effective length of 900mm and consists of 3 full length leaves and 12 graduated length leaves, including the master leaf. It supports a load of 50kN. The leaves are pre-stressed such that the stresses in all leaves is same and equal to 400MPa. Ratio of total depth to width of plates is 3. Taking $E = 210\text{ GPa}$. Calculate i) Dimensions of the leaves ii) the initial nip, and iii) the initial pre-load required to close the gap. (10 Marks)

- 4 Design a pair of spur gears to transmit 20kW at 900rpm of the pinion. The pinion is made of cast steel having allowable stress of 190MPa. The gear is made of cast steel having allowable stress of 100MPa and rotates at 144rpm. The number of teeth on pinion is 16. The teeth are of 20° involute profile and ratio of face width to module is 10. Take $C = 550\text{N/mm}$ for dynamic load and check for wear to determine the hardness of gears. (20 Marks)

PART – B

- 5 a. A pair of straight bevel gears has velocity ratio of 2:1. The pitch circle diameter of the pinion is 80mm at the larger end of the tooth. Power transmitted is 5kW at 800rpm of the pinion. The face width is 40mm and the pressure angle is 20° . If the angle between shafts is 90° , calculate the tangential, radial and axial components of the resultant tooth force acting on pinion. (10 Marks)
- b. One kW power at 720rpm is supplied to the worm shaft. The number of starts for worm is four with 50mm pitch circle diameter. The worm wheel has 30 teeth with a 5mm module. The normal pressure angle is 20° . Calculate the efficiency of the worm gear and the power loss in friction. (10 Marks)
- 6 a. A single plate clutch having both sides effective transmits 25kW at 900rpm. The maximum pressure intensity between the plates is 85 kN/m^2 . The outer diameter of the plate is 360mm. If the coefficient of friction between contact surfaces is 0.25, determine i) The inner diameter of the plate ii) Axial force required to engage the clutch, and iii) Average pressure between contact surfaces. (10 Marks)
- b. A differential band brake is as shown in Fig Q6 (b). The width and thickness of the steel band are 100mm and 3mm respectively. The maximum tensile stress in the band is 50MPa. The coefficient of friction is 0.25. Calculate i) Tensions in the band, ii) Actuating force, iii) Torque capacity of the brake. Find out whether the brake is self – locking. (10 Marks)



- 7 a. With neat sketch explain hydrodynamic lubrication. (08 Marks)
- b. A journal bearing 100mm in diameter and 100mm long supports a load of 50kN at 1440rpm. The radial clearance is 0.12mm and the absolute viscosity of the oil is 16CP. Calculate :
i) Minimum film thickness ii) Coefficient of friction iii) Power lost in friction. (12 Marks)
- 8 a. List any four advantages and disadvantages of chain drive. (08 Marks)
- b. A 6×19 wire rope is used to lift a load of 10kN from a well 60m deep. The weight of bucket is 5kN. The load is lifted up at a speed of 2.5 m/s which is attained in 1 second. The weight of the rope is 18.5N/m. The average tensile strength of the rope may be taken as $590d^2\text{ N}$, where d is the rope diameter in mm ; diameter of the wire = $0.063d$ and area of the rope = $0.38d^2$. Determine the diameter of wire rope. Take factor of safety of 6, Young's modulus for wire rope $0.8 \times 10^5\text{ MPa}$, rope drum diameter as 45 times the diameter of the rope. (12 Marks)

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