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Sixth Semester B.E. Degree Examination, June/July 2015
Design of Machines Elements – II

Time: 3 hrs.

Max. Marks:100

- Note: 1. Answer any FIVE full questions, selecting atleast TWO questions from each part.**
2. Use of design data handbook is permitted.
3. Assume suitable data if missing.

PART – A

- 1
 - a. Write the difference between straight beam and curved beam. (04 Marks)
 - b. Compute the combined stresses at the inner and outer fibres in the critical cross section of a crane hook which is required to lift loads up to 25kN. The hook has trapezoidal cross-section with parallel sides 60mm and 30mm, the distance between them being 90mm. The inner radius of the hook is 100mm. The load line is nearer to the inner surface of the hook by 25mm than the centre of curvature at the critical section. What will be the stresses at the inner and outer fibre, if the beam is treated as straight beam for the given load? (16 Marks)

- 2
 - a. A 400mm outside diameter × 200mm inside diameter steel hub is to have a shrink fit on a shaft of diameter 200mm. The tangential stress is to be limited to 90MPa. The hub length is 270mm. Modulus of elasticity is 206 GPa. Poisson ratio is 0.3.
 - i) Find and sketch the resulting stress distribution.
 - ii) The original diameter before shrink fit.
 - iii) The axial force necessary to assemble the hub taking coefficient of friction as 0.1.
 - iv) The power that can be transmitted by this joint at 1200rpm. (14 Marks)
 - b. The cylinder of a hydraulic press is 100mm inside diameter with wall thickness of 16mm. If the allowable stress in the steel used is 150MPa, find the safe force that can be withstood by this cylinder. (06 Marks)

- 3
 - a. Design a valve spring for an automobile engine, when the valve is closed, the spring produces a force of 45N and when it opens, produces a force of 55N. The spring must fit over the valve bush which has an outside diameter of 20mm and must go inside a space of 35mm. The lift of the valve is 6mm. The spring index is 12. The allowable stress may be taken as 0.33 GPa. Modulus of rigidity 80 GPa. (10 Marks)
 - b. Design a leaf spring for the following specifications for a truck. Total load = 120kN. Number of springs = 4. Material for the spring is chrome-vanadium steel, permissible stress is 0.55 GPa. Span of spring = 1100mm. Width of central band = 100mm and allowable deflection = 80mm. Number of full length leaves are 2 and graduated leaves 6. (10 Marks)

- 4
 - a. A cone clutch has a semi-cone angle of 12° to transmit 10 kW at 750 rpm. The width of the face is one fourth of the mean diameter of friction lining. If the normal intensity of pressure between the contacting surface is not to exceed 0.85 bar, assuming uniform wear criterion and taking $\mu = 0.2$. Calculate dimensions of clutch. Also find the axial force while running i.e. at the beginning of engagement. (10 Marks)

- b. A single band brake operates on a drum 600mm in diameter that is running at 200 rpm while absorbing 15 kW of power. The coefficient of friction is 0.25. The brake band has a contact of 270° and one end is fastened to a fixed pin and the other end to the brake arm 125mm from the fixed pin. The straight brake arm is 750mm long and is placed perpendicular to the diameter that bisects the angle of contact. Determine:
- The maximum effort required to stop the rotation of drum.
 - Width of 2.5mm thick steel band, if the maximum tensile stress in it is not to exceed 56 MPa. (10 Marks)

PART – B

- 5 A pair of carefully cut spur gears transmit 20 kW from a shaft rotating at 1000 rpm to a parallel shaft which is to rotate at 310 rpm. Assume number of teeth on pinion 31 and 20° full depth tooth form. The material for pinion is C40 steel untreated and for gear cast steel 0.20% C untreated. Take service factor 1.5. Design the gear against dynamic load and wear load. (20 Marks)
- 6 A pair of bevel gear wheels with 20° pressure angle consist of 20 teeth pinion meshing with 30 teeth gear. The module is 4mm while the face width is 20mm. The surface hardness of both pinion and gear is 40 BHN. The pinion rotates at 500rpm and receives power from an electric motor. The starting torque of the motor is 150% of the rated torque. Determine the safe power that can be transmitted considering the dynamic load, wear strength. The allowable bending stress may be taken as 240 MPa. (20 Marks)
- 7 a. A 75mm long full journal bearing of diameter 75mm supports a radial load of 12kN at the shaft speed of 1800 rpm. Assume ratio of diameter to the diametral clearance as 1000. The viscosity of oil is 0.01 Pas at the operating temperature. Determine the following:
- Sommerfeld number
 - The coefficient of friction based on Mckee equation
 - Amount of heat generated. (10 Marks)
- b. List the advantages and disadvantages of rolling bearings compared to journal bearings. (05 Marks)
- c. A single row deep groove ball bearing has a specific dynamic capacity of 46.3 kN. The actual radial load = 9kN. The speed of rotation is 1800 rpm. What is the life in
- Cycles of operation
 - in hours
 - What is average life? (05 Marks)
- 8 a. A nylon core flat belt 200mm wide weighing 20 N/m, connecting a 300mm diameter pulley to a 900mm diameter driven pulley at a shaft. Spacing of 6m transmits 55.2 kW at a belt speed of 25m/s.
- Calculate the belt length and the angle of wrap.
 - Calculate belt tensions based on a coefficient of friction 0.38. (08 Marks)
- b. Select a V-belt drive to transmit 10 kW of power from a pulley of 200mm diameter mounted on an electric motor running at 720 rpm to another pulley mounted on compressor running at 200 rpm. The service is heavy duty varying from 10 hrs. to 14 hours per day and centre distance between centre of pulleys is 600mm. (12 Marks)

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