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06ME61

Sixth Semester B.E. Degree Examination, December 2012
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 handbook is permitted.
3. Missing data may be suitably assumed.

PART – A

1 a. Differentiate between a straight beam and a 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 upto 25 kN. The hook has trapezoidal cross section with parallel sides 60 mm and 30 mm, the distance between them being 90 mm. The inner radius of the hook is 100 mm. The load line is nearer to the inner surface of the hook by 25 mm 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 cast iron cylindrical pipe of outside diameter 300 mm and inside diameter 200 mm is subjected to an internal fluid pressure of 20 N/mm^2 and external fluid pressure of 5 N/mm^2. Determine the tangential and radial stresses at the inner, middle and outer surface. Sketch the tangential and radial stress distribution across its thickness. **(10 Marks)**

b. A cylinder is provided with a heat of flat circular steel plate of 500 mm diameter and is supported around the edge. It is subjected to a uniform pressure of 5 N/mm^2. The allowable working stress for the material is 70 N/mm^2 and Poisson's ratio is 0.3. Determine the i) Thickness of thick cylinder wall and ii) Thickness of the circular flat cylinder head. **(10 Marks)**

3 a. Derive an expression for strain energy stored in a body when the load is applied gradually. **(05 Marks)**

b. A railway wagon weighing 40 kN and moving with a speed of 10 km/hour has to be stopped by 4 buffer springs in which the maximum compression allowed is 200 mm. Find the number of turns in each spring of mean diameter 150 mm. The diameter of spring wire is 25 mm. Take G = 82.7 GPa. **(08 Marks)**

c. A truck spring has 12 leaves of which 2 are full length leaves. The spring supports are 1.05 m apart and the central band is 85 mm wide. The central load is to be 5400 N with a permissible stress of 0.28 GPa. The ratio of total depth to width of spring is 4. Assume E = 210 GPa. Determine the maximum deflection in the spring. **(07 Marks)**

4 a. Two spur gears are to be used for a rock crusher drive and are to be of minimum size. The gears are to be designed for the following requirements. Power to be transmitted is 20 kW; speed of pinion is 1200 rpm, velocity ratio is 3.5 : 1; tooth profile 20° stub involute. Determine module and face width for strength requirements only. **(10 Marks)**

b. A pair of mating helical gears have 20° pressure angle in the normal plane. The normal module is 5 mm and the module in the diametral plane is 5.7735 mm. The pitch diameter of the smaller gear is 115.47 mm. If the transmission ratio is 4:1, calculate i) Helix angle ii) Normal pitch iii) Transverse pitch iv) Number of teeth for each gear v) Addendum vi) Dedandum vii) Whole depth viii) Clearance ix) Tooth thickness x) Working depth xi) Outside diameters xii) Centre distance xiii) Root circle diameters xiv) Base circle diameters. **(10 Marks)**

PART – B

5 a. A pair of mitre gears have pitch diameter 280 mm and face width of 36 mm and run at 250 rpm. The teeth are of $14\frac{1}{2}^{\circ}$ involute and accurately cut and transmit 6 kW. Neglecting friction angle, find the following: i) Outside diameter of gears ii) Resultant tooth load tangent to pitch cone. iii) Radial load on the pinion iv) Thrust on the pinion. Assume low carbon cast steel 0.2%C heat treated as the material for both the gears. **(10 Marks)**

b. The following data refer to a worm and worm gear drive: i) centre distance = 200 mm ii) pitch circle diameter of the worm = 80 mm iii) Number of start = 4 iv) Axial module = 8 mm v) transmission ratio = 20 vi) the worm gear is made of phosphor bronze with an allowable bending stress = 55 MPa vii) the worm is made of hardened and ground steel viii) tooth form is 20° full depth involute. Determine i) Number of teeth on the worm gear ii) lead angle iii) face width of worm gear to 15 kW of power at 1750 rpm of the worm based on beam strength of the worm gear. **(10 Marks)**

6 a. In a multiple disc clutch, the radial width of the friction material is to be 0.2 of the maximum radius. The coefficient of friction is 0.250. The clutch is to transmit 60 kW at 3000 rpm. Its maximum diameter is 250 mm and the axial force is limited to 600 N. Determine i) Number of driving and driven discs ii) Mean unit pressure on each contact surface. Assume uniform wear. **(10 Marks)**

b. In a band and block brake $\theta = 15^{\circ}$ and effective diameter is 800 mm. P = 0.4, a = 100 mm, b = 25 mm. The power absorbed at 600 rpm is 450 kW when the force applied at the end of levels at a distance of 1.20 m from the fulcrum is 200 N. Find the number of blocks. **(10 Marks)**

7 a. Explain the meaning of, i) Oiliness ii) Flash point iii) Fire point iv) Pour point v) Cloud point. **(05 Marks)**

b. Write a note bearing modulus. **(05 Marks)**

c. A 75 mm journal bearing of diameters 75 mm supports a load of 15 kN. The ratio of $\frac{d}{c} = 1000$ and the viscosity of the oil is 25×10^{-3} PaS. The heat generated in the bearing is 442 watts. Determine the maximum speed of the journal using Mckee's equation. **(10 Marks)**

8 a. A nylon core flat belt 200 mm wide weighing 20 N/m, connected a 300 mm diameter pulley to a 900 mm diameter driven pulley at a shaft spacing of 6 m, transmits 55.2 kW at a belt speed of 25 m/s : i) Calculate the belt length and the angles of wrap ii) Compute the belt tensions based on a coefficient of friction 0.38. **(10 Marks)**

b. A compressor is driven by a motor of 2.5 kW running at 1200 rpm to a 400 rpm compressor. Select a suitable V-belt. **(10 Marks)**

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