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10ME62

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting at least TWO full questions from each part.*
2. Use of design data hand book is permitted.
3. Any missing data can be assumed suitably and stated.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. A crane hook of trapezoidal cross section whose inner and outer sides are 60mm and 30mm has a depth of 64mm. The centre of curvature is at a distance of 90mm from the inside of the beam. Determine the maximum tensile and compressive stresses induced in the crane hook when its lifting capacity is 60kN. **(12 Marks)**

b. A compound cylinder is made by shrinking a cylinder of external diameter 300mm and internal diameter of 250mm over another cylinder of external diameter 250mm and internal diameter 200mm. If the radial pressure at the junction is $8N/mm^2$, determine using Lame's equations, the stresses at outer and inner surfaces of the outer cylinder. **(08 Marks)**

2 a. Select a V-belt drive to transmit a load of 6kW from a shaft rotating at 1000rpm to a parallel shaft to be rotated at 350rpm. The space limits the centre distance between shafts to 500mm. The pitch diameter of the smaller pulley could be assumed to be 150mm. **(10 Marks)**

b. A 6 × 19 wire rope is used to lift a load of 10kN of iron ore from a mine of 600 metre deep. The weight of the bucket is 2kN. The maximum speed of 50m/min is attained in 1 second. Find diameter of the wire rope, assuming factor of safety as 6. **(10 Marks)**

3 a. Derive an expression for stress induced in a helical coil spring. **(05 Marks)**

b. What is surging in springs and how it can be overcome? **(03 Marks)**

c. A semi elliptical laminated leaf spring with two full length leaves, ten graduated leaves are to be designed to support a central load of 6kN over two points 1 metre apart. The central band width is 100mm. The ratio of total depth of spring to its width is 2.5. Maximum normal stress in the material of leaves is 400MPa and modulus of elasticity is 208GPa. Determine:
i) Width and thickness of leaves.
ii) The initial gap between full length and graduated leaves.
iii) Central bolt load. **(12 Marks)**

4 a. Write a note on applications of gear drives. **(04 Marks)**

b. Design a pair of spur gears to transmit 20kW of power while operating for 8 to 10 hrs. per day sustaining medium shock from a shaft rotating at 1000rpm to a parallel shaft which is to rotate at 310rpm. Assume the number of teeth on pinion to be 31 and 20° full depth involute tooth profile. The material for pinion is C40 steel whose $\sigma_b = 206.8MPa$ and for gear is cast steel whose $\sigma_b = 137.3MPa$. Check the design for wear and dynamic load. Assume load factor, C = 522.46 N/mm and load stress factor, $K = 0.279\ N/mm^2$. **(16 Marks)**

PART – B

5 a. Mention the advantages and disadvantages of worm gear drive. **(04 Marks)**

b. Design a pair of right angle bevel gears to transmit 8.5kW at 1500 rpm of pinion. The velocity ratio is 5:1. Pinion is made of cast steel and gear of high grade cast Iron with allowable static stresses as 120MPa and 93MPa respectively. The teeth are 20° stub involute, pinion has a pitch diameter of 90mm. **(16 Marks)**

6 a. Design a cone clutch to transmit a power of 40kW at a rated speed of 750rpm. Also determine:

i) Axial force necessary to transmit torque

ii) Axial force necessary to engage the cone clutch. Assume coefficient of friction = 0.3, cone angle = 20°. **(10 Marks)**

b. A single band brake operates on a drum 600mm in diameter that is running at 200rpm while absorbing 15kW 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. Straight arm is 750mm long and is placed perpendicular to the diameter that bisects the angle of contact. Determine maximum effort required to stop the rotation of drum. **(06 Marks)**

c. Classify the brakes and name different types of mechanical brakes. **(04 Marks)**

7 a. Derive Pettroff's equation, with usual notations. **(08 Marks)**

b. It is required to design a main bearing of a 4-stroke engine to sustain a load of 6kN over a shaft of diameter 50mm. The operating speed of the shaft is 1000rpm and operating temperature is 50°C. Assuming absolute viscosity as 33 CP, determine:

i) Length of bearing

ii) Coefficient of friction

iii) Heat generated

iv) Heat dissipated

v) State whether artificial coding is necessary

vi) Sommerfield number. **(12 Marks)**

8 a. Explain the considerations given in the design of crank shaft of an IC Engine. **(04 Marks)**

b. Design a connecting rod for a I.C. engine with the following data:
Diameter of piston = 110mm
Stroke = 160mm
Explosion pressure = 3.5MPa
Engine speed = 2000 rpm
Weight of reciprocating parts = 20N
Material C50 steel,
Length of connecting rod = 320mm
(Assume bolt material as C50 steel and factor of safety as 3). **(16 Marks)**

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