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10ME62

Sixth Semester B.E. Degree Examination, July/August 2022
Design of Machine 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 machine design data handbook is permitted.

PART – A

1. a. The section of a crane hook is trapezoidal, whose inner and outer sides are 90mm and 25mm respectively and has a depth of 116mm. The center of curvature of the section is at a distance of 65mm from. The inner side of the section and load line passes through the center of curvature. Find the maximum load the hook can carry, if the maximum stress is not to exceed 70 MPa. (12 Marks)
b. A cast iron cylindrical pipe of outside diameter 300mm and inside diameter 200mm is subjected to an internal fluid pressure of 20N/mm² and external fluid pressure of 5N/mm². Determine the tangential and radial stresses at the inner, middle and outer surface. (08 Marks)
2. a. Select a v-belt drive to connect 15KW, 2880 rpm motor to a centrifugal pump running at 2400 rpm, for a service of 18 hrs/day. The center distance should be approximately 400mm. Assume the pitch diameter of driving pulley as 125mm. (10 Marks)
b. Select a wire rope to lift 10kN of debris from a mine shaft 600m deep. The weight of bucket is 2.5kN. The maximum velocity of 20m/sec is attained in 5 seconds. (10 Marks)
3. a. Derive an expression for the stress induced in helical coil spring. (04 Marks)
b. Design a helical compression spring for a maximum load of 1000N and for a deflection of 25mm. The maximum permissible shear stress for a spring wire is 420N/mm², modulus of rigidity is 0.84×10^5 N/mm² and value of spring index is 6. (10 Marks)
c. A one meter long cantilever spring is composed of 8 graduated leaves and one full length leaf. The leaves are 45mm wide. A load of 2000N at the end of the spring causes a deflection of 75mm. Determine the thickness of the leaves and maximum bending stress in the full length leaf assuming that leaves are not pre-stressed and the value of Young's modulus $E = 2 \times 10^5$ N/mm². (06 Marks)
4. A pair of spur gears has to transmit 20 KW from a shaft rotating at 1000 rpm to a parallel shaft which is to rotate at 310 rpm. Number of teeth on pinion is 31 with 20 full depth involutes tooth form. The material for pinion is steel SAE1040 untreated with allowable static stress 206.81MPa and the material for gear is cast steel 0.20%C untreated with allowable static stress 137.34MPa. Determine the module and face width of the gear pair. Also find dynamic tooth load on the gears. Take the service factor as 1.5. (20 Marks)

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 – B

- 5 Design a worm gear drive to transmit 12 kW at 1200rpm. Speed reduction ratio is 30 : 1. The worm is made of hardened steel ($\sigma_0 = 210$ MPa) and gear of phosphor Bronze ($\sigma_0 = 90$ MPa). The teeth are $14\frac{1}{2}^\circ$. Check the heating capacity of the gears for a gear temperature of 60°C and an ambient temperature of 30°C . Also determine the efficiency of the drive. Take service factor $s = 1.5$. (20 Marks)
- 6 a. A multiple plate clutch with steel on bronze is to transmit 8kN at 1440 rpm. The inner diameter of the contact is 80mm and the outer diameter of contact is 140mm. The clutch operates in oil with expected coefficient of friction of 0.1 and allowable pressure of 0.35MPa. Assume uniform wear theory and determine the number of steel and bronze plates. (10 Marks)
- b. A differential band brake shown in Fig.Q6(b) operates on a drum diameter of 600mm. The band is $3.2\text{mm} \times 100\text{mm}$ and coefficient of friction is 0.22. Determine :
- Least force required at the end of operating lever when the band is subjected to a stress of 55N/mm^2
 - Torque applied to the brake drum shaft
 - Is this brake self locking? Prove your answer.

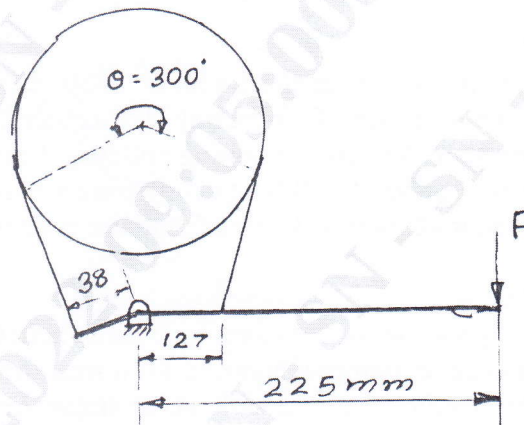


Fig.Q6(b)

(10 Marks)

- 7 a. With usual notations, derive Petroff's equations for frictional force and coefficient of friction. (10 Marks)
- b. A lightly loaded full journal bearing has the following specifications.
- | | |
|---------------------|-------------|
| Journal diameter | = 80 mm |
| Bearing length | = 60 mm |
| Diametral clearance | = 0.12mm |
| Journal speed | = 24000 rpm |
| Viscosity of oil | = 4 cp |
| Radial load | = 900N |
- Determine :
- Frictional force
 - Power loss
 - Coefficient of friction.

(10 Marks)

8 Design a connecting rod for a petrol engine from the following data :

Cylinder bore	= 100mm
Length of connecting rod	= 350mm
Maximum explosion pressure	= 3 N/mm ²
Length of stroke	= 150mm
Engine speed	= 1500rpm
Weight of reciprocating parts	= 25N
Compression ratio	= 4 : 1
Factor of safety against buckling failure	= 5
Compressive yield stress of connecting rod	= 330 N/mm ²
Rankine's constant	= $\frac{1}{7500}$

Section of connecting rod is standard I. Section with width of section B = 4t

Depth of section H	= 5t
Thickness of flange	= t
thickness of web	= t
L/d ratio for piston pin	= 2.0.
Allowable bearing pressure at big end	= 7.5N/mm ²
Allowable bearing pressure at small end	= 12N/mm ²
L/d ration for crank pin (big end)	= 1.25
Permissible tensile stress for bolt material	= 100 N/mm ²
Permissible tensile stress for cap material	= 100 N/mm ²
Weight density of connecting rod	= 76.6 kn/m ³
Moment of inertia of section K _{xx}	= 1.78t.

(20 Marks)

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