Question Paper

Exam Date & Time: 16-Nov-2018 (02:00 PM - 05:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
THIRD SEMESTER B.SC. Applied Sciences in Engg.
END - SEMESTER THEORY EXAMINATIONS NOVEMBER - 2018
DESIGN OF MACHINE ELEMENTS [ME 232]

Marks: 100 **Duration: 180 mins.**

Answer 5 out of 8 questions.

Answer ANY FIVE FULL questions.
Any missing data if any, may be suitable assumed.
Use of machine design data hand book is permitted.

1) A) Define the following (5)
i) Strain energy
ii) Resilience
iii) Toughness
iv) Hardness
v) Hertz contact stresses

B) Define stress concentration and explain the methods of reducing stress concentration with neat sketch. (5)

C) A bolt is subjected to a tensile load of 18 kN and a shear load of 12 kN. The material has yield strength of 326.8 MPa. Taking factor of safety as 2.5, determine the core diameter according to the following theories of failure. (10)
i) Rankine's theory ii) Maximum Shear stress theory iii) Shear energy theory iv) St. Venant's theory. Take Poissons ratio equal to 0.298.

2) A) A shaft of diameter 65 mm transmits power at maximum shear stress of 67 MPa. Shear stress in key should not exceed 75% of shear stress developed in shaft. Take maximum crushing stress in key as 2.5 times the maximum shear stress in key. Dimesions of key are 18 mm x 11 mm. Find the length of key. (5)

B) A shaft 600 mm between the bearings supports a 400 mm diameter pulley, 200 mm to the right of the left hand bearing and it receives power from a motor placed vertically below it Another pulley 350 mm diameter is located 150 mm to the right of the right hand bearing and delivers power to a pulley to the right horizontally. The coefficient of friction is 0.3. The maximum tension in any belt is 5000 N. The angle of wrap of the belt on each pulley is 180Âº. Determine the maximum resultant bending moment acting on the shaft. Draw the horizontal, vertical and resultant bending moment diagram (15)

3) A) A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 kN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction wear condition may be assumed to be 0.2 and 0.15 respectively. The screw rotates at 12 rpm. Assuming uniform friction wear conditions at the collar and allowable thread bearing pressure of 5.77 MPa. Find the power required to rotate the Screw, stresses in the screw and number of threads of nut in engagement with the screw. (12)

B) A bracket shown in Fig.Q3B supports a load of 10 kN. It is fixed to the horizontal channel by means of four identical bolts, two at A and two at B. The bolts are made of 30C8 steel and the factor of safety is 6. Determine the size of the bolt on the basis of principal stress theory. (8)

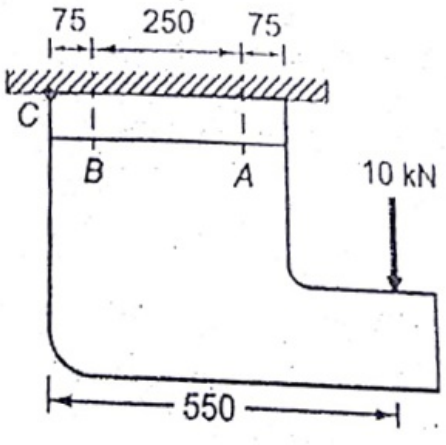

Fig.Q3B

All dimensions are in mm

4) A) Derive an expressions for shearing stress induced and deflection in a helical compression spring subjected to a compressive load with a neat sketch. (8)

B) A spur gear transmits 20 kW of power at 1200 rpm of pinion. The gear ratio is 3:1. The pinion is to have 18 number of teeth. The pressure angle is 20Âº. The material of pinion is C30 and that of gear is C45. The gear is subjected to medium shock with 8-10 hrs / day of service. Design the gears based on strength. Calculate the dynamic load. (12)

5) A) Stating the assumptions made, derive Lewis equation for beam strength of tooth with neat sketch. (8)

B) A diesel engine weighing 800 kN is mounted on 16 springs in order to protect building from vibrations. The section of the spring wire is rectangular with side ratio of 1.8. Each spring has four effective (active) coils. The spring index is 6. Determine (12)
a) Cross section of the spring so that longer side is parallel to axis.
b) Maximum coil diameter.
c) Deflection of spring.
d) Shear stress induced if shorter side is parallel to axis.
Take Maximum allowable shear stress, T_{max} = 300 MPa and Modulus of rigidity, G= 84 GPa.

6) A) A pair of continuously lubricated helical gears transmits 10 kW at 9000 rpm of the pinion. The teeth are of 20Âº full depth involute profile. The velocity ratio is 3:1. The pinion is made of C45 steel and gear is made of untreated forged steel. The number of teeth on the pinion is 20. The face width is 15 times the module. The helix angle is 20Âº. Assume starting torque as 50 % more than the rated torque. Design the gears based on strength and suggest suitable hardness for the gears. (15)

B) Define the following with respect to gears. (5)
i) Helix angle
ii) Formative number of teeth
iii) Circular Pitch
iv) Module
v) Pressure angle

7) A) The main bearing of a steam turbine runs at 1500 rpm and diameter of the journal is 40 mm. The load on the bearing is estimated to be 3 kN. Take the temperature of the oil to be 60Âº C. Determine whether fluid film lubrication can be expected; Is artificial cooling necessary? Also find the amount of oil flow required, minimum oil film thickness. (15)

B) With neat sketch explain the theory of hydrodynamic lubrication. (5)

8) A) Define the following (5)

i) Static load carrying capacity
ii) Dynamic load carrying capacity
iii) Bearing life
iv) Equivalent bearing load
v) Bearing characteristic number

B) Select suitable ball bearing for the shaft of axial flow compressor for the following details (15)

Radial load = 2500 N
Thrust load = 1500 N
Speed = 1000 rpm
Bore diameter = 50 mm
Bearing life = 50 hours per week for 5 years.

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