KUMARAGURU
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Register Number: ……

B.E DEGREE EXAMINATIONS: NOV/DEC 2014

(Regulation 2009)

Fifth Semester

MECHANICAL ENGINEERING

MEC114: Design Of Machine Elements

(Use of approved Design Data Book is permitted)

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Resistance to fatigue of a material is measured by
   a) Young's modulus b) Co efficient of elasticity
   c) Elastic limit d) Endurance limit
2. For steel the ultimate strength in shear as compared to ultimate strength in tension is
   a) 1/3 b) 1/2
   c) 2/3 d) 1/4
3. If d is the diameter of bolt hole then for a flanged pipe joint to be leak proof, the circumferential pitch of the bolt should be
   a) $10\sqrt{d}$ b) $10\sqrt{d}$ to $15\sqrt{d}$
   c) $15\sqrt{d}$ to $20\sqrt{d}$ d) $20\sqrt{d}$ to $30\sqrt{d}$
4. The include angle in unified of American national thread is
   a) 60° b) 55°
   c) 47° d) 29°
5. Ball bearing type screws are found in the following application
   a) Screw jack b) Aeroplane engines
   c) Cranes d) Steering mechanism
6. A self-locking screw has
   a) Fine threads b) Coarse threads
   c) Coefficient of friction ≥tangent of load angle d) Two nuts for locking
7. The rated life of bearing varies
   a) Directly as a load b) Inversely as a square of load
   c) Inversely as a cube of load d) Directly as a square of load
8. The usual clearance provided in hydrodynamic bearing per mm of diameter of shaft is
   a) 0.01micron b) 0.1micron
   c) 1micron d) 10 micron
9. Spring index is the
   a) Ratio of coil diameter to wire diameter b) Load required to produce unit deflection
   c) Its capability of storing energy d) indication of quality of spring

10. For the same diameter ,the radius of gyration of disc type flywheel as compared to rim type flywheel is

a) √2 times
b) 1/√2 times
c) 2 times
d) 1/2 times

PART B (10 x 2 = 20 Marks)

11. Distinguish between repeated stress and reversed stress.
12. State Rankine's theory.
13. Hollow shaft has greater strength and stiffness than solid shaft of equal weight-Justify.
14. What is the significant of slenderness ratio in shaft design?
15. Explain wedge film journal bearings.
16. Why I section is chosen for the connecting rod?
17. List the stresses to be considered while designing a screw fastening?
18. Compare single start and double start threads.
19. Why Whal's factor is to be considered in the design of helical compression springs?
20. List out the functions of flywheel.

PART C (5 x 14 = 70 Marks)

21. a) The frame of a punch press is shown in Fig1. Find the stresses at the inner and outer surface at section X-X of the frame, if W = 5000 N.

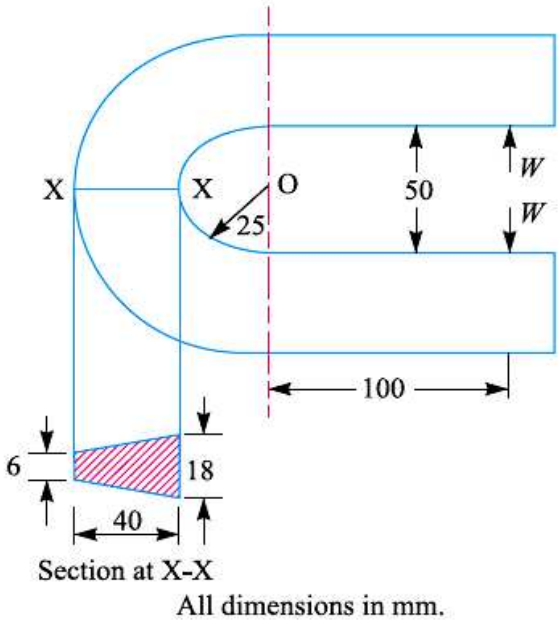

Fig 1

(OR)

b) A steel cantilever is 200 mm long. It is subjected to an axial load which varies from 150 N (compression) to 450 N (tension) and also a transverse load at its free end which varies from 80 N up to 120 N down. The cantilever is of circular cross-section. It is of diameter 2d for the first 50 mm and of diameter d for the remaining length. Determine its diameter taking a factor of safety of 2. Assume the following values :
Yield stress = 330 MPa,
Endurance limit in reversed loading = 300 MPa

Correction factors = 0.7 in reversed axial loading
= 1.0 in reversed bending
Stress concentration factor = 1.44 for bending
= 1.64 for axial loading
Size effect factor = 0.85,
Surface effect factor = 0.90
Notch sensitivity index =0.90

22. a) A shaft is supported on bearing A and B 800mm between centers. A 20° spur gear having 600mm pitch diameter is located 200mm to the right of the left hand bearing A and 700 mm diameter pulley is mounted 250mm towards left of the bearing B. The gear is driven by a pinion with a downward tangential force while the pulley drives a horizontal belt having 180° wrap angle. The pulley also serves as a flywheel and weighs 2000N.the maximum belt tension is 3000N and the tension ratio is 3:1.Selecting suitable material for the shaft ,determine the shaft diameter for a factor of safety 1.5.

b) Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15 kW at 200 r.p.m. and having an allowable shear stress of 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14 MPa.

23. a) Design a full journal bearing for the following specifications: diameter of journal 75mm,load on the journal 3500N,length of journal 75mm,speed 400rpm,minimum film thickness 0.02mm

b) The following data is given for a hydrostatic thrust bearing.
Thrust load = 500 kN; Shaft speed = 720 rpm; shaft diameter = 500 mm; recess diameter = 300 mm; film thickness = 0.15 mm; viscosity of lubricant = 160 SUS; specific gravity = 0.86. Calculate (1) supply pressure (2) flow requirement (3) power loss in pumping (4) Frictional power loss

24. a) A plate 75 mm wide and 12.5 mm thick is joined with another plate by a single transverse weld and a double parallel fillet weld as shown in Fig.2 The maximum tensile and shear stresses are 70 MPa and 56 MPa respectively. Find the length of each parallel fillet weld, if the joint is subjected to both static and fatigue loading.

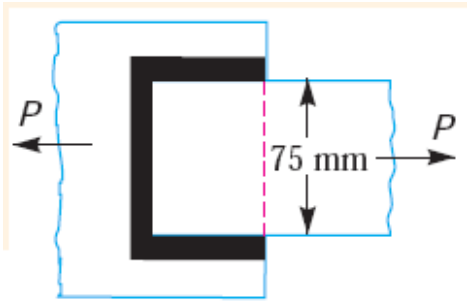

Fig 2

b) Determine the size of the bolts and the thickness of the arm for the bracket as shown in Fig 3, if it carries a load of 40 kN at an angle of 60° to the vertical. The material of the bracket and the bolts is same for which the safe stresses can be assumed as 70, 50 and 105 MPa in tension, shear and compression respectively.

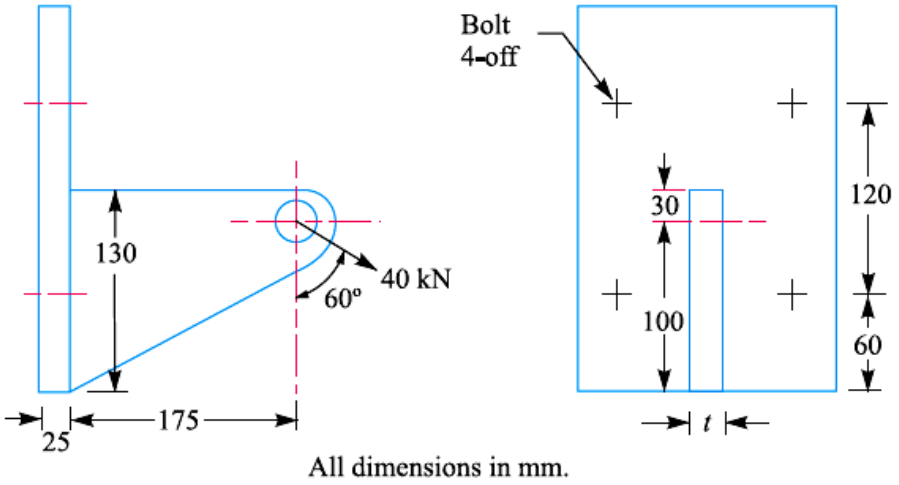

Fig 3

25. a) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 N/mm^2 and modulus of rigidity 84 kN/mm^2, find the axial load which the spring can carry and the deflection per active turn.
1.Neglecting the effect of curvature
2.Considerng the effect of curvature

b) The intercepted areas between the output torque curve and the mean resistance line of a turning moment diagram for a multi cylinder engine, taken in order from one end are as follows:
– 35, + 410, – 285, + 325, – 335, + 260, – 365, + 285, – 260 mm^2.
The diagram has been drawn to a scale of 1 mm = 70 N-m and 1 mm = 4.5°. The engine speed is 900 r.p.m. and the fluctuation in speed is not to exceed 2% of the mean speed.

Find the mass and cross-section of the flywheel rim having 650 mm mean diameter. The density of the material of the flywheel may be taken as 7200 kg/m^3. The rim is rectangular with the width 2 times the thickness. Neglect effect of arms, etc.

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