B.E DEGREE EXAMINATIONS: APRIL/MAY 2014

(Regulation 2009)

Fifth Semester

MECHATRONICS ENGINEERING

MCT112**:** Design of Machine Elements

Time: Three Hours   Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The process which improves the machinability of steels, but lower the hardness and tensile strength is
    (a) normalising   (b) full annealing
    (c) process annealing   (d) spheroidising

2. The maximum energy that can be stored in a body due to external loading upto the elastic limit is called
    (a) resilience   (b) proof resilience
    (c) strain energy   (d) modulus of resilience

3. Mild steel shaft is designed using
    (a) Bending moment only   (b) Twisting moment only
    (c) Combined bending moment and torsion   (d) Combined action of bending moment, twisting moment and axial thrust

4. The shock absorbing capacity of a bolt may be increased by
    (a) Increasing its shank diameter   (b) Decreasing its shank diameter
    (c) Tightening the bolt properly   (d) Making the shank diameter equal to the core diameter of the thread

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6. In transverse fillet welded joint, the size of weld is equal to
    (a) $0.5 \times$ Throat of weld   (b) Throat of weld
    (c) $2^{1/2} \times$ Throat of weld (d) $2 \times$ Throat of weld

7. The property of a bearing material which has the ability to accommodate small particles of dust, grit etc., without scoring the material of the journal, is called
    (a) bondability   (b) embeddability
    (c) comformability   (d) fatigue strength

8. In thrust bearing the load acts
    (a) along the axis of rotation   (b) parallel axis of rotation
   (c) perpendicular to the axis of rotation   (d) in any direction

9. When helical compression spring is cut into halves, the stiffness of the resulting spring will be
    (a) same   (b) double
    (c) one-half   (d) one-fourth

10. Due to the centrifugal force acting on the rim, the flywheel arms will be subjected to
    (a) tensile stress   (b) compressive stress
    (c) shear stress   (d) All the above

PART B (10 x 2 = 20 Marks)

11. What are the advantages of malleable cast iron over white or grey cast iron?

12. Write short notes on theories of failures and its application

13. Differentiate between keys and splines.

14. In what situation flexible couplings are used?

15. Give the two examples of bolted joints subjected to a fatigue load.

16. When will the weld deposit be weaker?

17. State the type of stresses induced in a rim flywheel?

18. What is nipping of laminated leaf spring? Discuss its role in spring design.

19. What are the required properties of bearing materials?

20. Discuss advantages of rolling contact bearing over sliding contact bearing

PART C (5 x 14 = 70 Marks)

21. a) The crane hook carries a load of 20 kN as shown in Fig. The section at X-X is rectangular whose horizontal side is 100 mm. Find the stresses in the inner and outer fibers at the given section.

Section at X-X

All dimensions in mm.

All dimensions in mm.
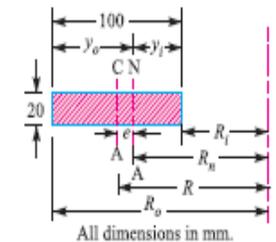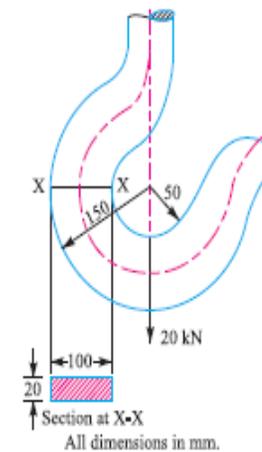
(OR)

b) A hot rolled bar of steel is subjected to a torsional load varying from-150N-m to 450N-m. Determine the required diameter of the bar using a factor of safety of 1.7. Properties of the material may be assumed as follow.

Ultimate tensile stress = 450MPa

Yield stress = 300MPa

22. a) A shaft is supported by two bearings placed 200 mm apart. A gear of 125 mm diameter is mounted at a distance of 100 mm to the right of left hand bearing and this transmits 3.7 kW at 120 rpm. Determine the suitable diameter for the solid shaft, allowing working stress is 42 N/mm^2 in shear for the material of the shaft.

(OR)

b) Design and sketch protective type C.I flange coupling to transmit 10KW at 250rpm. The permissible shear stress for key, shaft, and bolt as 50N/mm^2.Take crushing stress of key as 90N/mm^2 and shear stress for C.I as 14N/mm^2.Assume maximum torque is 30% higher than mean torque.

23 a) A cast iron bracket to carry a shaft and a belt pulley is shown in Fig.2. The bracket is fixed to the main body by means of four standard bolts. The tensions in the slack and tight sides of the belt are 2.2 kN and 4.25 kN respectively. Find the size of the bolts, if the safe tensile stress for bolts is 50 MPa.

OR

b) A plate 100 mm wide and 12.5 mm thick is to be welded to another plate by means of two parallel fillet welds. The plates are subjected to a load of 50KN. Find the length of the weld so that the maximum stress does not exceed 56N/mm^2.

24. a) A gas engine valve spring is to have a mean diameter 37.5mm.The maximum load will have to sustain is 450N with a corresponding deflection of 12.5mm.The spring is to be subjected to repeated loading and fatigue must be considered a low working stress of 300N/mm^2 will be used. Find the size for the wire and number of coil used. Take rigidity of modulus as 0.8 X I0^5 N/mm^2.

(OR)

b) A semi-elliptical laminated spring 900 mm long and 55 mm wide is held together at the centre by a band 50 mm wide. If the thickness of each leaf is 5 mm, find the number of leaves required to carry a load of 4500 N. Assume a maximum working stress of 490 MPa. If the two of these leaves extend the full length of the spring, find the deflection of the spring. The Young's modulus for the spring material may be taken as 210 kN/mm2.

25. a) Design a journal bearing for a centrifugal pump from the following data:

Load on the journal=20000N, Speed of the journal=900rpm, Type of oil is SAEl0, for which the absolute viscosity at 55°C=0.017kg/m-s, Ambient temperature of oil = 15.5^{0}C, Maximum bearing pressure for the pump=1.5N/mm^2.Calculate also mass of the lubricating oil required for artificial cooling, If the rise of temperature, of oil be limited to l0^{o}C heat dissipation coefficient=1232W/m^2/^{o}C.

(OR)

b) The turning moment diagram of a multi-cylinder engine is drawn with a scale of (1 mm = 1°) on the abscissa and (1 mm =250 Nm) on the ordinate. The intercepted between the torque developed by the engine and the mean resisting torque of the machine, taken in order from one are -350,+800,-600,+900, -550,+450,-650 mm^2.The engine is running at a mean speed fluctuations is limited to 0.02. A rimmed flywheel made of grey cast iron FG 200 (Density=7100Kg/m^3) is provided. The spokes, shaft and hub are assumed to contribute 10% of the required moment of inertia. The rim has rectangular cross section and the ratio of width to thickness is 1.5. Determine the dimensions of the rim.

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