Roll No. ....

Total Pages : 3

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BT-5/DX
MACHINE DESIGN-I
Paper : ME-309(E)

Time : Three Hours]   [Maximum Marks : 100

Note : Attempt *five* questions in all, selecting at least *one* question from each unit. All questions carry equal marks. Any missing data may be assumed suitably.

UNIT-I

1. (a) Discuss the effect of silicon, manganese, sulphur and phosphorus on cast iron.   6

    (b) Select suitable material for the following parts stating the special property which makes it most suitable for use in manfacturing.

      Bush bearing, dies, cams, helical spring, turbine blade, ball bearing.   6

    (c) How is the factor of safety evaluated for different types of loading ?   8

2. (a) Write Soderberg's equation and state its application to different types of loading.   8

    (b) What is meant by Stress concentration ? How do you take it into consideration in case of a component subjected to dynamic loading ?   8

    (c) Write short note on the type of bearing metals.   4

UNIT-II

3. (a) What precautions should be observed while designing a weldment ?   6

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    (b) Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 75 kN. The ultimate strength of the material of the rod against tearing is 410 MPa. The ultimate tensile and shearing strength of the pin material are 510 MPa and 390 MPa respectively. Determine the tie rod section and pin section. Take factor of safety = 6.   14

4. A double riveted butt joint, in which the pitch of the rivets in the outer rows is twice that in the inner rows, connects two 16 mm thick plates with two cover plates each 12 mm thick. The diameter of rivets is 22 mm. Determine the pitches of the rivets in the two rows if the working stresses are not to exceed the following limits :
    Tensile stress in plates = 100 MPa;
    Shear stress in rivets = 75 MPa; and
    Bearing stress in rivets and plates = 150 MPa.   20

UNIT-III

5. A lever loaded safety value has diameter of 75 mm and the blow off pressure of the boiler is 1.45 N/mm^2. The weight on the lever is not to exceed 900 N. Design and prepare the drawing of the lever, fulcrum and pivot of the lever. The material of the lever and fulcrum is mild steel and the weights are of cast iron. Choose the suitable stresses of the material.
                                                              20

6. An overhang hollow shaft carries a 900 mm diameter pulley, whose centre is 250 mm from the centre of the nearest bearing. The weight of the pulley is 600 N and the angle of lap is 180°. The pulley is driven by a motor vertically below it. If permissible tension of the belt is 2650 N and if coefficient of friction between the belt and the pulley surface

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is 0.3, estimate diameters of the shaft, when the internal diameter is 0.6 of the external. Neglect centrifugal tension and assume permissible tensile and shear stresses in the shaft as 84 MPa and 68 MPa respectively. 20

UNIT–IV

7. A rigid coupling is used to connect a 45 kW, 1440 r.p.m. electric motor to a centrifugal pump. The starting torque of the motor is 225% of the rated torque. There are 8 bolts and their pitch circle diameter is 150 mm. The bolts are made of steel 45C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 2.5. Determine the diameter of the bolts. 20

8. A triple-threaded power screw, used in a screw jack has a nominal diameter of 50 mm and a pitch of 8 mm. The threads are square and the length of the nut is 48 mm. The screw jack is used to lift a load of 7.5 kN. The coefficient of friction at the threads is 0.12 and the collar friction is negligible. Calculate 20

   (i)   The principal shear stresses in the screw body,

   (iii) The transverse shear stresses in the screw and nut, and

   (iii) The unit bearing pressure.
   State whether the screw is self-locking.

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