BT-5/D–19
MACHINE DESIGN-I
Paper–ME-309-E

Time allowed : 3 hours]   [Maximum marks : 100

Note : *Attempt any five questions, selecting at least one question*
from each unit. All questions carry equal marks.

Unit–I

1. (a) Discuss the effect of silicon, manganese, sulphur and
   phosphorus on cast iron.   10

   (b) What are the common materials used in Mechanical
   Engineering Design ? How can the properties of steel
   be improved ?   10

2. Determine the thickness of a 125 mm wide unifrom plate for
   safe continuous operation if the plate is to be subjected to a
   tensile load that has a maximum value of 250 kN and a minimum
   value of 100 kN.

   The properties of the plate material are as follows :

   Endurance limit stress = 225 MPa, and Yield point stress =
   300 MPa.

   The factor of safety based on yield point may be taken
   as 1.5.   20

Unit–II

3. Two plate of 10 mm thickness each are to be joined by means
   of a single riveted double strap butt joint. Determine the
   rivet diameter; rivet pitch, strap thickness and efficiency of the
   joint. Take the working stresses in tension and shearing as
   80 MPa and 60 Mpa respectively.   20

4. Design a knuckle joint for a tie rod of a circular section to
   sustain a maximum pull of 70 kN. The ultimate strength of the
   material of the rod against tearing is 420 MPa. The ultimate
   tensile and shearing strength of the pin material are 510 MPa
   and 396 MPa respectively. Determine the tie rod section and
   pin section. Take factor of safety = 6.   20

Unit–III

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

   Determine the maximum bending moment and the necessary
   shaft diameter if the allowable shear stress of the material
   is 40 MPa.   20

6. Design a right angled bell crank lever. The horizontal arm is
   500 mm long and a load of 4.5 kN acts vertically downward
   through a pin in the forked end of this arm. At the end of the
   150 mm long arm which is perpendicular to the 500 mm long
   arm, a force P act at right angles to the axis of 150 mm arm
   through a pin into a forked end. The lever consists of forged
   steel material and a pin at the fulcrum. Take the following data
   for both the pins and lever material : Safe stress in tension = 75
   MPa, Safe stress in shear = 60 MPa. Safe bearing pressure on
   pins = 10 N/mm².   20

Unit–IV

7. 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. 20

8. Design a square flanged pipe joint for pipes of internal diameter 50 mm subjected to an internal fluid pressure of 7 N/mm². The maximum tensile stress in the pipe material is not to exceed 21 MPa and in the bolts 28 MPa. 20

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