

Please check that this question paper contains 9 questions and 2 printed pages within first ten minutes.

[Total No. of Questions: 09]

[Total No. of Pages:2]

Uni. Roll No.

Program: BTech

Semester: 5th

Name of Subject: Design of Machine Element

Subject Code: PCME 111

Paper ID: 16377

Time Allowed: 02 Hours

Max. Marks: 60

NOTE:

- 1) Each question is of 10 marks.
- 2) Attempt any six questions out of nine.
- 3) Any missing data may be assumed appropriately.
- 4) Suitable data can be taken from Design Data Book.

11-01-2022(E)

Q1 An open belt 100 mm wide connects two pulleys mounted on parallel shafts with their centres 2.4 m apart. The diameter of the larger pulley is 450 mm and that of the smaller pulley 300 mm. The coefficient of friction between the belt and the pulley is 0.3 and the maximum stress in the belt is limited to 14 N/mm width. If the larger pulley rotates at 120 r.p.m., find the maximum power that can be transmitted.

Q2 Find the diameter of a shaft made of 37 Mn 2 steel having the ultimate tensile strength as 600 MPa and yield stress as 440 MPa. The shaft is subjected to completely reversed axial load of 200 kN. Neglect stress concentration factor and assume surface finish factor as 0.8. The factor of safety may be taken as 1.5.

Q3 a) An universal coupling is used to connect two mild steel shafts transmitting a torque of 6000 N-m. Assuming that the shafts are subjected to torsion only, find the diameter of the shaft and the pin. The allowable shear stresses for the shaft and pin may be taken as 55 MPa and 30 MPa respectively.

b) A shaft 80 mm diameter transmits power at maximum shear stress of 63 MPa. Find the length of a 20 mm wide key required to mount a pulley on the shaft so that the stress in the key does not exceed 42 MPa.

Q4 How does the working of a clamp coupling differ from that of a muff coupling ? Explain..

Q5 Design a foot brake lever from the following data :

Length of lever from the centre of gravity of the spindle to the point of application of load = 1 metre

Maximum load on the foot plate = 800 N

Overhang from the nearest bearing = 100 mm

Permissible tensile and shear stress = 70 MPa

Q6 Two 400 mm diameter pulleys are keyed to a simply supported shaft 500 mm apart. Each pulley is 100 mm from its support and has horizontal belts, tension ratio being 2.5. If the shear stress is to be limited to 80 MPa while transmitting σ kW at 900 r.p.m., find the shaft diameter if it is to be used for the input-output belts being on the same or opposite sides.

Q7 a) A shaft running at 400 r.p.m. transmits 10 kW. Assuming allowable shear stress in shaft as 40 MPa, find the diameter of the shaft.

b) A hollow steel shaft transmits 600 kW at 500 r.p.m. The maximum shear stress is 62.4 MPa. Find the outside and inside diameter of the shaft, if the outer diameter is twice of inside diameter, assuming that the maximum torque is 20% greater than the mean torque.

Q8 Design a cotter joint to connect a piston rod to the crosshead. The maximum steam pressure on the piston rod is 35 kN. Assuming that all the parts are made of the same material having the following permissible stresses :

$\sigma_t = 50$ MPa ; $\tau = 60$ MPa and $\sigma_c = 90$ MPa.

Q9 A knuckle joint is required to withstand a tensile load of 25 kN. Design the joint if the permissible stresses are :

$\sigma_t = 56$ MPa ; $\tau = 40$ MPa and $\sigma_c = 70$ MPa.
