Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 90370

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Fifth Semester

Automobile Engineering

ME 8593 : DESIGN OF MACHINE ELEMENTS

(Common to Industrial Engineering/Mechanical Engineering/ Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering)

(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

Usage of approved design data book is permitted.

PART – A **(10×2=20 Marks)**

1. List the factors influencing machine design.
2. Why distortion energy theory is preferred over other theories of failure in ductile materials ?
3. Distinguish rigid and flexible couplings.
4. Why generally, hollow shafts are preferred over solid shafts ?
5. Why preloading of bolted joints is done ?
6. State the advantages of welded joints over riveted joints.
7. Write the purpose of flywheel in reciprocating engines and punching machines.
8. How the crank shafts are manufactured ?
9. What is the significance of Somerfield number in bearing design ?
10. Differentiate sliding and rolling contact bearings based on the applications.

PART – B (5×13=65 Marks)

11. a) A shaft which has a diameter of 30 mm is subjected to an axial tension load of 15 kN and a torque of 400 Nm. In addition to these, there is a bending moment of 300 Nm on the shaft. The shaft is made of steel having the properties of Su = 780 MPa and Sy = 600 MPa. (Refer Fig. 11(a).

Neglecting the column action, determine the factor of safety.

a) by using distortion energy theory of failure.

b) by using maximum shear stress theory of failure.

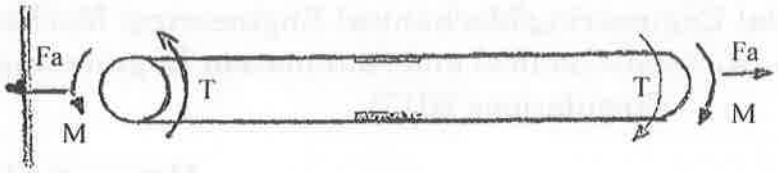

Fig. 11 (a)

(OR)

b) Considering fits and tolerances, give the dimensions for the hole and shaft for the following : a) a 12 mm electric motor sleeve bearing, b) a medium force fit on a 200 mm shaft, c) a 50 mm sleeve bearing on the elevating mechanism of a road grader.

12. a) For the shaft shown in Fig. 12 (a) the ratio of belt tension for either belt is 3 : 1. The maximum tension in the belt is 3000 N. S_{ut} = 650 MPa, Sy = 400 MPa for the shaft material K_m = 1.5, K_1 = 1.2. Determine the shaft diameter and angle of twist when the pulleys are keyed to the shaft.

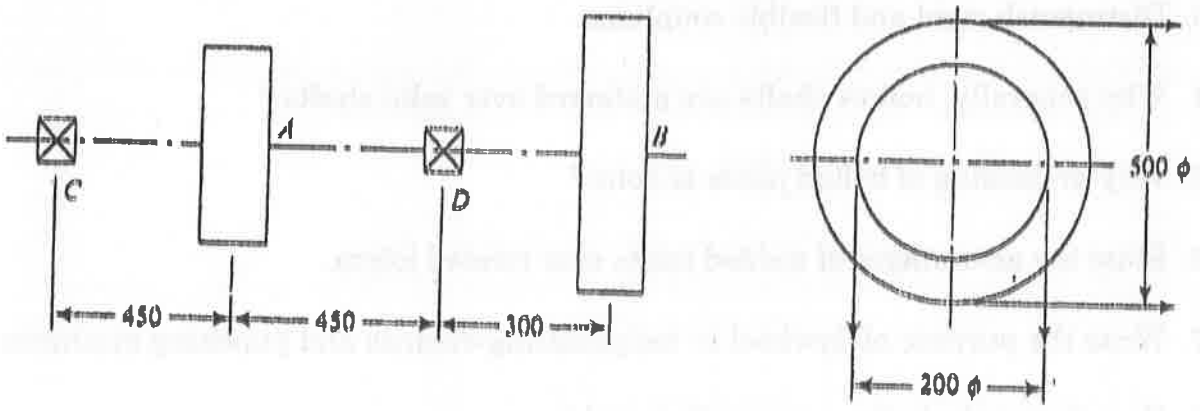

Fig. 12 (a)

(OR)

b) Design a bushed pin type of flexible coupling to connect the motor shaft and pump shaft of 50 mm and 40 mm diameter respectively when 15 kW power is to be transmitted at 1200 r.p.m. the permissible bearing pressure for pin is 0.3 MPa.

13. a) A deep groove ball bearing has dynamic capacity of 20200 N and is to operate on the following work cycle.
Radial load of 5800 N at 200 r.p.m. for 25% of the time
Radial load of 8900 N at 500 r.p.m. for 20% of the time
Radial load of 3500 N at 400 r. p.m. for remaining time
Assuming the loads are steady and the inner race rotates, find the expected average life of the bearing in hours.

(OR)

b) A 360° journal bearing of length 45 mm and L/D = 1 has been scored due to dirty oil. The surface roughness of the bearing increases due to dirty oil and causes to increase the viscosity of the oil by 10% due to the working environment. Decide whether the bearing is to be replaced based on the criterion that 5% increase in power loss justifies the replacement. Consider the radial load 900 N. Speed = 3000 rpm, radial clearance = 0.02 mm. SAE 10 oil is to be used and the inlet temperature is limited to 60°C.

14. a) Design a spring for a balance to measure 0 to 1000 N over a scale of length 80 mm. The spring is to be enclosed in a casing of 25 mm diameter. The approximate number of turns is 30. The modulus of rigidity is 85 kN/mm^2. Also calculate the maximum shear stress induced. Assume d = 4 mm, initially.

(OR)

b) A helical compression spring made of oil tempered carbon steel, is subjected to a load which varies from 400 N to 1000 N. The spring index is 6 and the design factor of safety is 1.25. If the yield stress in shear is 770 MPa and endurance stress in shear is 350 MPa, find 1) Size of the spring wire, 2) Diameters of the spring, 3) Number of turns of the spring, and 4) Free length of the spring.
The compression of the spring at the maximum load is 30 mm. The modulus of rigidity for the spring material may be taken as 80 kN/mm^2.

15. a) Determine the length of the weld run for a plate of size 120 mm wide and 15 mm thick to be welded to another plate by means of
1. A single transverse weld ; and
2. Double parallel fillet welds when the joint is subjected to variable loads
Refer Fig. 15 (a).

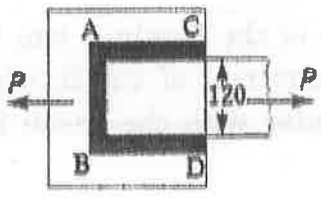

Fig. 15 (a)

(OR)

b) A bracket is riveted to a column by 6 rivets of equal size as shown in fig 15 (b). It carries a load of 60 kN at a distance of 200 mm from the centre of the column. If the maximum shear stress in the rivet is limited to 150 MPa, determine the diameter of the rivet.

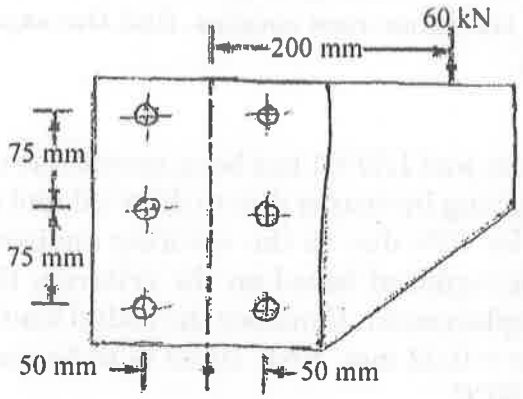

Fig.15 (b)

PART – C (1×15=15 Marks)

16. a) 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.

(OR)

b) The intercepted areas between the output torque curve and the mean resistance line of a turning moment diagram for a multicylinder 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.