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

Question Paper Code : 53310

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fourth/Fifth/Sixth Semester

Mechanical Engineering

ME 6503 – DESIGN OF MACHINE ELEMENTS

(Common to Mechanical Engineering (Sandwich), Automobile Engineering, Industrial Engineering, Mechatronics and Automobile Engineering, Mechanical Engineering)

(Regulation 2013)

(Also common to PTME 6503 – Design of Machine Elements for B.E Part Time – Fourth Semester – Mechanical Engineering – Regulation 2014)

Time : Three hours Maximum : 100 marks

Use of Approved Design Data book is permitted.

Any required design data can be suitably assumed.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List any two factors that influence the process of machine design.
2. Brief Saint venant's theory of failure.
3. Compare rigid coupling and Flexible coupling.
4. What is meant by critical speed?
5. Under what circumstances riveted joints are preferred over welded joints.
6. List out the advantages of threaded joints.
7. Determine the combined stiffness of two springs connected in parallel and series.
8. What are the various forces acting on a connecting rod?
9. Differentiate sliding contact bearing and rolling contact bearing.
10. Define life of a bearing.

PART B — (5 × 13 = 65 marks)

11. (a) A hollow shaft is required to transmit 500 KW at 100 rpm. The maximum torque being 20% greater than the mean. The shear stress is not to exceed 65 MPa and twist in a length of 2 metres not to exceed 1.2 degrees. Find the external and internal diameter of the shaft, if the ratio of internal to external diameter is 3/8. Take modulus of rigidity as 84 GPa. (13)

Or

(b) A 40 mm diameter shaft is made from carbon steel having ultimate tensile strength of 600 MPa. It is subjected to a torque which fluctuates between 1500 Nm to –900 Nm. Using Soderberg method, calculate the factor of safety. Assume suitable values for any other data needed. (13)

12. (a) Design a clamp coupling to transmit 40kW at 150 rpm. The allowable shear stress for the shaft and key is 50 MPa and the number of bolts connecting the two halves are six. The permissible tensile stress for the bolts is 70 MPa. The coefficient of friction between the muff and the shaft surface may be taken as 0.3. (13)

Or

(b) A Steel solid shaft transmitting 15 KW at 200 rpm is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5 mm module is located 100mm to the left of the right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5 mm module is located 150 mm to the right of the left hand bearing and receives power in a vertical direction from below. Using an allowable stress of 54 MPa in shear, determine the diameter of the shaft. (13)

13. (a) Design a knuckle joint to transmit 100 KN. The design stresses may be taken as 70 MPa in tension, 65 MPa in shear and 120 MPa in compression. (13)

Or

(b) Find the efficiency of a double riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 55 mm. Assume Permissible tensile stress in plate is 120 MPa, Permissible shearing stress is 90 MPa and Permissible crushing stress is 180 MPa. (13)

14. (a) Determine the dimensions of cross section of the connecting rod for a diesel engine with the following data

Cylinder bore = 100 mm, Length of connecting rod = 350 mm

Maximum gas pressure = 4 MPa and factor of safety= 2 (13)

Or

(b) A mechanism used in printing machinery consists of a tension spring assembled with a preload of 30 N. The wire diameter of spring is 2 mm with a spring index of 6. The spring has 18 active coils. The spring wire is hard drawn and oil tempered having a design shear stress of 680 MPa and modulus of rigidity of 80 KN/mm^2. Determine the spring rate and initial shear stress in the wire. (13)

15. (a) A ball bearing is operating on a work cycle consisting of three parts- a radial load of 3000 N at 1440 rpm for one quarter cycle, a radial load of 5000 N at 720 rpm for one half cycle and radial load of 2500 N at 1440 rpm for the remaining cycle. The expected life of the bearing is 10,000 hr. calculate the dynamic load carrying capacity of the bearing.

Or

(b) Following data is given for a 360° hydrodynamic bearing.

Radial load = 3.2 KN

Journal speed = 1490 rpm

l/d ratio = 1

Unit bearing pressure = 1.3 MPa

Radial clearance = 0.05 mm

viscosity of oil = 25 centipoise

Assume that the total heat generated in the bearing is carried by the total oil flow in the bearing, calculate the journal diameter, power lost in friction and the temperature rise. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A Single row deep groove ball bearing is subjected to a radial force of 8 KN and a thrust force of 3 KN. The values of X and Y factors are 0.56 and 1.5 respectively. The shaft rotates at 1200 rpm. The diameter of the shaft is 75 mm and Bearing No. 6315 (C = 112000 N) is selected for this application. Estimate

(i) Life of the bearing with 90% reliability

(ii) Reliability for 20000 hr. life. (15)

Or

(b) Design a cotter joint to support a load varying from 30 KN in compression to 30 KN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically.

Tensile and compressive stresses = 50 MPa

Shear stress = 35 Mpa

Crushing stress = 90 MPa. (15)