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

Question Paper Code : 51856

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fifth Semester

Mechanical Engineering

ME 2303/ME 53/10122 ME 504 – DESIGN OF MACHINE ELEMENTS / MACHINE DESIGN

(Common to Fifth Semester, Automobile Engineering and Mechanical and Automation Engineering, Fourth Semester – Manufacturing Engineering, Industrial Engineering and Management and Industrial Engineering)

(Regulations 2008/2010)

(Common to PTME 2303 – Design of Machine Elements for B.E. (Part-Time) Fourth Semester – Mechanical Engineering – Regulations – 2009)

Time : Three Hours **Maximum : 100 Marks**

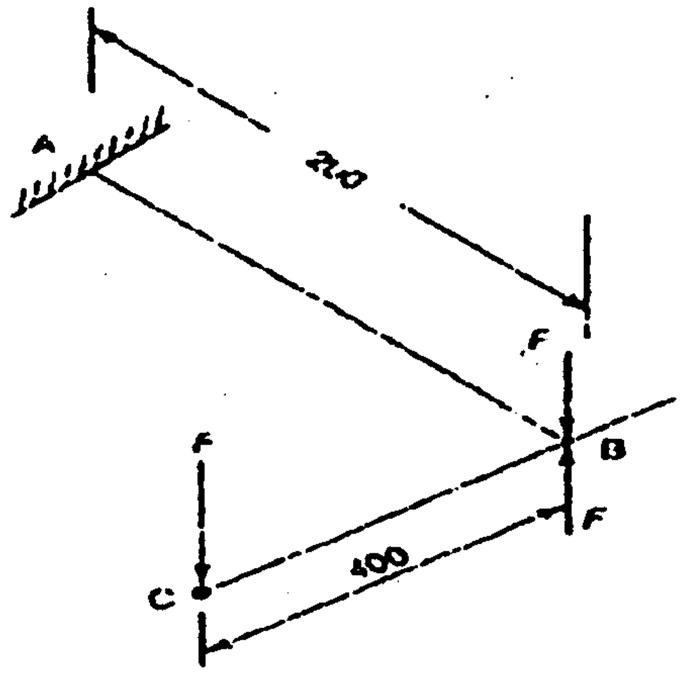
Use of approved data book permitted
Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Define limits and fits.
2. What is an adaptive design ?
3. Why a hollow shaft has greater strength and stiffness than solid shaft of equal weight ?
4. Under what circumstances flexible couplings are used ?
5. State the two types of eccentric welded connections.
6. What is a gib ? Why is it provided in a cotter joint ?
7. What is stiffness of spring ?
8. What is nipping of leaf spring ?
9. What is meant by journal bearing ?
10. What do you mean by life of an individual bearing ?

PART – B (5 × 16 = 80 Marks)

11. (a) The shaft of an overhang crank is subjected to a force F of 2 kN as shown in fig. below. The shaft is made of 30 Mn^2 steel having a allowable shear strength equal to 100 N/mm^2. Determine the diameter of the shaft. **(16)**



OR

(b) Design a muff coupling to connect two steel shafts transmitting 25 kW power at 360 rpm. The shafts and key are made of plain carbon steel 30 C8 ($S_{yt} = S_{yc} = 400$ N/mm^2). The sleeve is made of grey cast iron FG 200 ($S_{ut} = 200$ N/mm^2). The factor of safety for the shafts and key is 4. For the sleeve, the factor of safety is 6 based on ultimate strength. **(16)**

12. (a) A horizontal nickel steel shaft rests on two bearings, A at the left and B at the right end and carries two gears C and D located at distances of 250 mm and 400 mm respectively from the centre line of the left and right bearings. The pitch diameter of the gear C is 600 mm and that of gear D is 200 mm. The distance between the centre line of the bearings is 2400 mm. The shaft transmits 20 kW at 120 rpm. The power is delivered to the shaft at gear C and is taken out at gear D in such a manner that the tooth pressure F_{tc} of the gear C and F_{tD} of the gear D act vertically downwards.

Find the diameter of the shaft, if the working stress is 100 MPa in tension and 56 MPa in shear. The gear C and D weighs 950 N and 350 N respectively. The combined shock and fatigue factors for bending and torsion may be taken as 1.5 and 1.2 respectively. **(16)**

OR

(b) Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 r.p.m. The overall torque is 20 percent more than mean torque. The material properties are as follows :

(i) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively

(ii) The allowable shear stress for cast iron is 15 MPa;

(iii) The allowable bearing pressure for rubber bush is 0.8 N/mm^2

(iv) The material of the pin is same as that of shaft and key.

Draw neat sketch of the coupling. **(16)**

13. (a) A rectangular steel plate 100 mm wide is welded to a vertical plate to form a cantilever with an overlap of 50 mm and an overhang of 150 mm. It carries a vertical downward load of 60 kN at free end. Fillet weld is done three sides of the plate for a permissible stress of 140 N/mm^2. Determine the size of the weld. **(16)**

OR

(b) A knuckle joint is to transmit a force of 140 kN. Allowable stresses in tension, shear and compression are 75 N/mm^2, 65 N/mm^2 and 140 N/mm^2 respectively. Design the joint. **(16)**

14. (a) 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 safely is 1.25. If the yield stress in shear is 770 MPa and endurance stress in shear is 350 MPa, find: (i) Size of the spring wire, (ii) Diameter of the spring, (iii) Number of turns of the spring, and (iv) 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. **(16)**

OR

(b) A single cylinder double acting steam engine delivers 185 kW at 100 r.p.m. The maximum fluctuation of energy per revolution is 15 percent of the energy developed per revolution. The speed variation is limited to 1 percent either way from the mean. The mean diameters of the rim are 2.4 m. Design and draw two views of the flywheel. **(16)**

15. (a) Design a journal bearing for 12 MW, 1000 rpm steam turbine, which is supported by two bearings. Take the atmospheric temperature as 16 °C and operating temperature of oil as 60 °C assume viscosity of oil as 23 Ns/m^2. **(16)**

OR

(b) Select a suitable deep groove ball bearing for supporting a radial load of 10 kN and an axial load of 3 kN for a life of 4000 hours at 800 rpm. Select from series 63. Calculate the expected life of the selected bearing. **(16)**
