Reg. No. : ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Question Paper Code : 31569

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Fifth Semester

Mechanical Engineering

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

(Regulation 2008 / 2010)

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

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

Time : Three hours   Maximum : 100 marks

Note : Approved Design Data Book is permitted to use in the examination.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1.   Describe the material properties of hardness, stiffness and resilience.

2.   What are the methods used to improve fatigue strength?

3.   A shaft of 70mm long is subjected to shear stress of 40 MPa and has an angle of twist equal to 0.017 radian. Determine the diameter of the shaft. Take $G = 80\ GPa$.

4.   What is the main use of woodruff keys?

5.   State the two types of eccentric welded connections.

6.   What is a gib? Why is it provided in a cotter joint?

7.   A helical spring of rate 12 N/mm is mounted on the top of another spring of rate 8 N/mm. Find the force required to give a deflection of 50mm.

8.   What is the purpose of flywheel that is used in an IC engine?

9. What is meant by life of anti- friction bearings?

10. What are the essential requirements in an end face seal?

PART B — (5 × 16 = 80 marks)

11. (a) A cast-iron link, as shown in figure, is to carry a load of 20 kN. If the tensile and compressive stresses in the link are not to exceed 25 MPa and 80 MPa respectively, obtain the dimensions of the cross- section of the link at the middle of its length. (16)
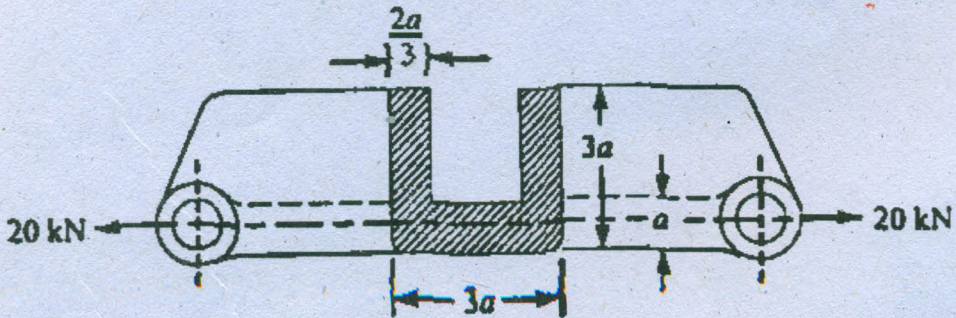
Or

(b) A hot rolled steel shaft is subjected to a torsional moment that varies from 330 Nm clockwise to 110 Nm counter clockwise and an applied bending moment at a critical section varies from 440 Nm to -220 Nm. The shaft is of uniform cross- section and no keyway is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MPa and yield strength of 410 MPa. Take the endurance limit as half the ultimate strength, factor of safety of 2, size factor of 0.85 and a surface finish factor of 0.62. (16)

12. (a) A hoisting drum 0.5 m in diameter is keyed to a shaft which is supported in two bearings and driven through a 12:1 reduction ratio by an electric motor. Determine the power of the driving motor, if the maximum load of 8 kN is hoisted at a speed of 50 m/min and the efficiency of the drive is 80%. Also determine the torque on the drum shaft and the speed of the motor in r.p.m. Determine also the diameter of the shaft made of machinery steel, the working stresses of which are 115 MPa in tension and 50 MPa in shear. The drive gear whose diameter is 450 mm is mounted at the end of the shaft such that it overhangs the nearest bearing by 150mm. The combined shock and fatigue factors for bending and torsion may be taken as 2 and 1.5 respectively. (16)

Or

(b) Design a rigid flange coupling to transmit a torque of 250 Nm between two co-axial shafts. The shaft is made of alloy steel, flanges out of cast iron and bolts out of steel. Four bolts are used to couple the flanges. The shafts are keyed to the flange hub. The permissible stresses are given below :

Shear stress on shaft = 100 MPa

Bearing or crushing stress on shaft = 250 MPa

Shear stress on keys = 100 MPa

Bearing stress on keys = 250 MPa

Shearing stress on cast iron = 200 MPa

Shearing stress on bolts = 100 MPa.

After designing the various elements, make a neat sketch of the assembly indicating the important dimensions. The stresses developed in the various members may be checked if thumb rules are using for fixing the dimensions. (16)

13. (a) For supporting the travelling crane in a workshop, the brackets are fixed on steel columns as shown in figure. The maximum load that comes on the bracket is 12 kN acting vertically at a distance of 400 mm from the face of the column. The vertical face of the bracket is secured to a column by four bolts, in two rows (two in each row) at a distance of 50 mm from the lower edge of the bracket. Determine the size of the bolts if the permissible value of the tensile stress for the bolt material is 84 MPa. Also find the cross- section of the arm of the bracket which is rectangular.

(16)

Or

3   31569
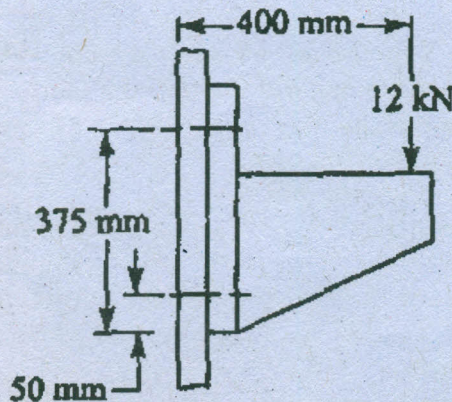
(b) Find the maximum shear stress induced in the weld of 6 mm size when a channel, as shown in figure, is welded to a plate and loaded with 20 kN force at a distance of 200 mm. (16)
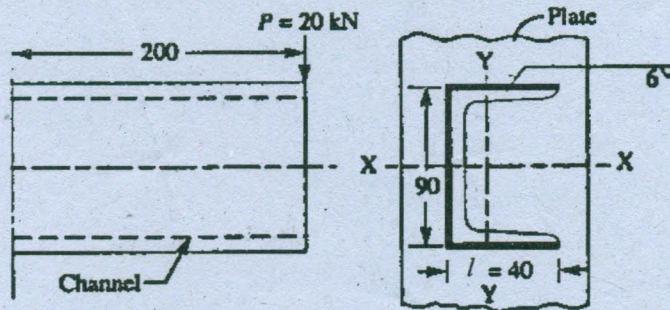
All dimensions in mm.

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 a centrifugal pump for the following data: Load on the journal = 20000 N; Speed of the journal= 900 r.p.m.; Type of oil is SAE 10, for which the absolute viscosity at 55°C = 0.17 N/m-s; Ambient temperature of oil = 15.5°C; Maximum bearing pressure for the pump = 1.5 N/mm^2. Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. Heat dissipation coefficient = 1232 W/m^2/°C. (16)

Or

(b) Determine the dimensions of an I- section connecting rod for a petrol engine from the following data:

Diameter of the piston	=	110 mm
Mass of the reciprocating parts	=	2kg
Length of the connecting rod from centre to centre	=	325 mm
Stroke length	=	150mm
R.P.M.	=	1500 with possible over speed of 2500
Compression ratio	=	4 :1
Maximum explosion pressure	=	2.5 N/mm^2. (16)

4