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Question Paper Code : 40923

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Fifth/Sixth Semester

Mechanical Engineering

ME 8593 – DESIGN OF MACHINE ELEMENTS

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

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Approved Design data book may be permitted for the examination.

Any missing can be reasonably assumed

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

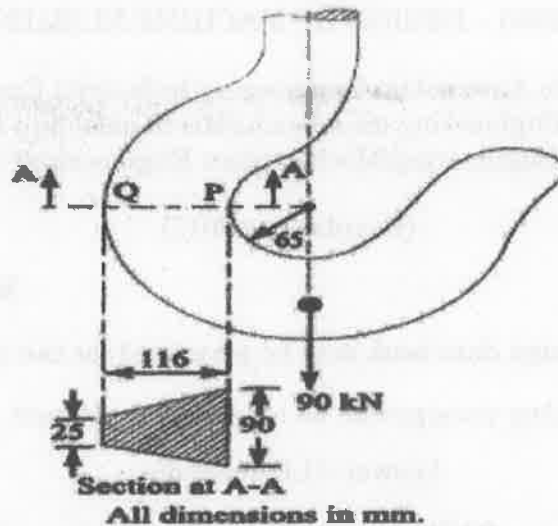
1. Show positive and negative fundamental deviation graphically.
2. Give the relationship between gradual loading stress induced and impact loading stress induced.
3. What do you understand by torsional rigidity and lateral rigidity?
4. State that effects critical speed of shaft.
5. State the selection criteria of a key.
6. Suggest a joint used to connect reciprocating pump rod and piston extension rod.
7. Write about the stresses induced in the flywheel arms.
8. Define spring index.
9. Make sketches to show the pressure distribution in a journal bearing.
10. What do mean by rated life of bearing?

PART B — ($5 \times 13 = 65$ marks)

11. (a) A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 N-m and a torque T . If the yield point of the steel in tension is 150 MPa, find the maximum value of this torque without causing yielding of the shaft according to (i) The maximum principal stress; (ii) The maximum shear stress; and (iii) The maximum distortion strain energy theory of yielding. (13)

Or

- (b) A crane hook has a trapezoidal section at A-A as shown in Fig. Find the maximum stress at points P and Q. (13)



12. (a) A steel solid shaft transmitting 10 kW at 250 r.p.m. is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 24 teeth of 5 mm module is located 100 mm 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 50 MPa in shear, determine the diameter of the shaft. (13)

Or

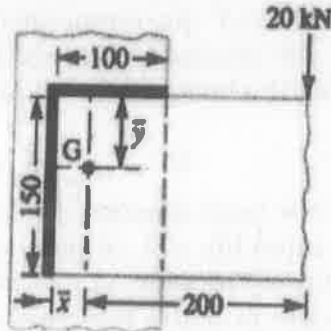
- (b) Design a cast iron protective flange coupling to connect two shafts in order to transmit 10 kW at 600 r.p.m. The following permissible stresses may be used :

Permissible shear stress for shaft, bolt and key material = 35 MPa

Permissible crushing stress for bolt and key material = 60 MPa

Permissible shear stress for the cast iron = 12 MPa (13)

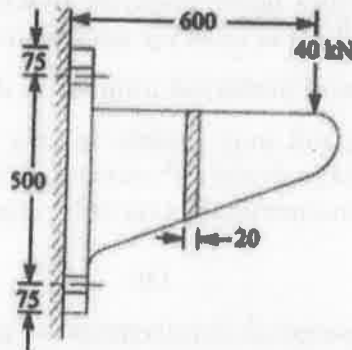
13. (a) A bracket, as shown in Fig, carries a load of 20 kN. Assume uniform size of the weld on the entire length of two legs. Find the size of the weld if the allowable shear stress is not to exceed 60 MPa. (13)



All dimensions in mm

Or

- (b) A wall bracket, as shown in Fig, is fixed to a wall by means of four bolts. Find the size of the bolts and the width of bracket. The safe stress in tension for the bolt and bracket may be assumed as 60 MPa. (13)



All dimensions in mm

14. (a) A punching press is required to punch 30 mm diameter holes in a plate of 10 mm thickness at the rate of 30 holes per minutes. It requires 6 N-m of energy per sqmm of sheared area. Determine the moment of inertia of the flywheel if the punching takes one-tenth of a second and the r.p.m. of the flywheel varies from 160 to 140. (13)

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 = 2 kg; Length of the connecting rod from centre to centre = 325 mm; Stroke length = 150 mm; R.P.M. = 1500 with possible over speed of 2500; Compression ratio = 4: 1; Maximum explosion pressure = 2.5 N/sq.mm. (13)

15. (a) A full journal bearing has a nominal diameter of 50.0 mm and a bearing length of 25.0 mm. The bearing supports a load of 3000 N and the journal design speed is 3000 rpm. The radial clearance has been specified as 0.04 mm. SAE10 oil has been chosen and the lubricant supply temperature is 50°C. Find the temperature rise of the lubricant, the lubricant flow rate, the minimum film thickness, the torque required to overcome friction, and the heat generated in the bearing. (13)

Or

- (b) (i) A catalog lists the basic dynamic load rating for a ball bearing to be 33,800N for a rated life of 1 million revolutions. What would be the expected L10 life of the bearing if it were subjected to 15,000 N and determine the life in hours that this corresponds to if the speed of rotation is 2000 rpm? Comment on the value obtained and its suitability for a machine. (8)
- (ii) What are essential conditions required to develop hydrodynamic action in the bearing? (5)

PART C — (1 × 15 = 15 marks)

16. (a) (i) For same input power, heavier flywheel is used with alternator and lighter flywheel is used for agriculture pump. Why? (5)
- (ii) Significance of preferred number in design. (5)
- (iii) Connecting rod may buckle in two principle axis xx and yy axis. Through shape design 'P' section, it is ensure that, if rod fails, it will fail about one principle axis only. How this is achieved. (5)

Or

- (b) (i) What are essential requirements of good bearing material? (5)
- (ii) Give a example in which both Hydrostatic and hydrodynamic bearings are used in one system. Why it is done so? (5)
- (iii) Write notes about the variation of coefficient of friction with bearing characteristic number. (5)