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Question Paper Code	12441
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B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2023

Fifth Semester

**Mechanical and Automation Engineering
20MUPC501 - MACHINE DESIGN**

(Use of Approved Design Databook is permitted
Any required design data can be suitably assumed)
(Regulations 2020)

Duration: 3 Hours

Max. Marks: 100

PART-A (10 × 2 = 20 Marks)
Answer ALL Questions

- | | |
|---|-------------------------------|
| | <i>Marks,
K-Level, CO</i> |
| 1. List the various phases of the design process. | 2,K1,CO1 |
| 2. Define stress concentration and stress concentration factor. | 2,K1,CO1 |
| 3. What are the various types of stresses induced in a shaft? | 2,K1,CO2 |
| 4. Compare rigid coupling and flexible coupling. | 2,K2,CO2 |
| 5. List the two types of eccentric welding connections. | 2,K1,CO3 |
| 6. Classify the types of bearings. | 2,K2,CO3 |
| 7. List the materials by which belts are made. | 2,K1,CO4 |
| 8. Define the term “module”. | 2,K1,CO4 |
| 9. For what purpose do we use a gearbox? | 2,K1,CO5 |
| 10. Define step ratio. | 2,K1,CO5 |

PART - B (5 × 13 = 65 Marks)
Answer ALL Questions

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|--------|--|-----------|
| 11. a) | A simply supported shaft with a 30 mm diameter and 200 mm length is acted upon by a sudden load of 1000 N at its mid-span. This load falls freely from a height of 2 mm. Determine the impact stress produced in the shaft. Assume Young’s modulus of the shaft material is 2×10^5 MPa. | 13,K3,CO1 |
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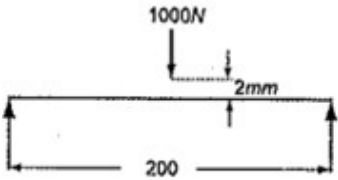


Fig.11.a

OR

- b) A steel member is subjected to a 3-dimensional stress system, and the resulting principal stresses are 120 N/mm^2 tension, 80 N/mm^2 , and 40 N/mm^2 compression. If the proportional limit of the material in simple tension is 280 N/mm^2 and its poisson's ratio is 0.3, determine the factor of safety according to a) Maximum principal stress theory b) Maximum principal strain theory, and c) Maximum shear stress theory. 13,K3,CO1

12. a) A solid shaft is to transmit 1000 kW at 120 r.p.m. Determine the shaft diameter if the design shear stress is 80 N/mm^2 . If the shaft is made hollow with an internal diameter is 0.6 times the outside diameter, estimate the % of saving in material. 13,K3,CO2

OR

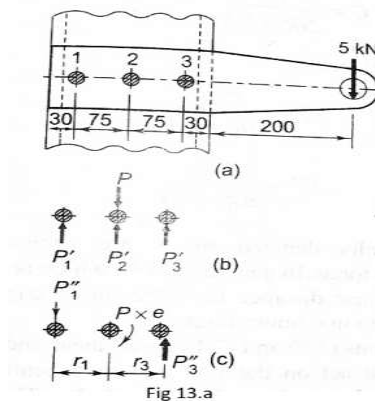
- b) Design a protected type of flange coupling for the following requirements: 13,K3,CO2

Power to be transmitted = 10 kW

Speed of the shaft = 960 r.p.m.

Select suitable materials.

13. a) A steel plate subjected to a force of 5 kN and fixed to a channel using three identical bolts is shown in Fig.13.a. The bolts are made from plain carbon steel 45C8 ($S_{yt} = 380 \text{ N/mm}^2$) and the factor of safety is 3. Determine the size of the bolts. 13,K3,CO3



OR

- b) A brake band attached to the hinge through a riveted joint is shown in Fig. 13. b. Determine the size of the rivets needed for the load of 10 kN . Also, determine the width of the band. The permissible stresses for the band and rivets in tension, shear, and compression are 80 , 60 , and 120 N/mm^2 respectively Assume margin (m) = $1.5d$ and Transverse pitch (p_t) = p . Determine the pitch of the rivets. 13,K3,CO3

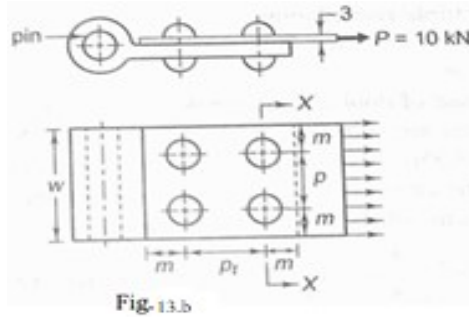


Fig-13.3.b

14. a) A stone crushing machine receives power from a motor rated at 50 kW at 1800 r.p.m. using flat belts. The pulley diameters are 200 mm and 700 mm. The center distance between the two pulleys is 4000 mm. Design the belt drives if the directions of rotation of two pulleys are opposite to each other. 13,K3,CO4

OR

- b) In a spur gear drive for a rock crusher, the gears are made of case-hardened steel. The pinion is transmitting 18 kW at 1200 r.p.m. The gear ratio is 3.5. The gear is to work 8 hours per day for 3 years. Design the drive. 13,K3,CO4
15. a) Design a nine-speed gearbox, used as a turret lathe's headstock gearbox, provides a speed range of 180 r.p.m. to 1800 r.p.m. Using standard step ratio, construct the speed diagram and the kinematic layout. Also, determine and fix the number of teeth on all gears. 13,K3,CO5

OR

- b) A gearbox is to be designed to provide 12 output speeds ranging from 160 to 2000 r.p.m. The input speed of the motor is 1600 r.p.m. Choose a standard speed ratio. Also, construct the speed diagram and the kinematic arrangement. 13,K3,CO5

PART - C (1 × 15 = 15 Marks)

16. a) Design a V-belt drive to the following specifications: 15,K3,CO4
 Power to be transmitted = 7.5 kW
 Speed of driving wheel = 1440 r.p.m.
 Speed of driven wheel = 400 r.p.m.
 The diameter of the driving wheel = 300 mm
 Centre distance = 1000 mm
 Service = 16 hours/day.

OR

- b) Design a journal bearing for a centrifugal pump with the following data: Diameter of the journal = 150 mm, Load on bearing = 40 kN, Speed of journal = 900 r.p.m. 15,K3,CO3