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Question Paper Code: U5704S

B.E./B.Tech. DEGREE EXAMINATION, NOV 2024

Fifth Semester

Mechanical Engineering

21UME504-DESIGN OF MACHINE ELEMENTS

(Regulations 2021)

(Design data book may be permitted)

Duration: Three hours

Maximum: 100 Marks

Answer All Questions

PART A - (10 x 1 = 10 Marks)

1. The material commonly used for crane hooks is CO1-U
(a) cast iron (b) wrought iron (c) mild steel (d) aluminium
2. The ratio of the ultimate stress to the design stress is known as CO1-U
(a) Elastic limit (b) Strain (c) Factor of safety (d) Bulk modulus
3. A key capable of fitting in a recess milled out in a shaft is known as CO1-U
(a) Feather key (b) Gib head key (c) Woodruff key (d) Flat saddle key
4. Two shafts, one solid and the other hollow, of the same material will CO1-U
have the same strength if they are having
(a) same length and same weight (b) same length and same polar modulus
(c) same weight and same polar modulus (d) same length weight and same polar modulus
5. The transverse fillet welded joints are designed for CO1-U
(a) tensile strength (b) compressive strength (c) bending strength (d) shear strength
6. The square threads are usually found on CO1-U
(a) spindles of bench vices (b) railway carriage couplings
(c) feed mechanism of machine tools (d) screw cutting lathes
7. Which of the following spring is used in a mechanical wrist watch? CO1-U
(a) Helical compression spring (b) Spiral spring
(c) Torsion spring (d) Belleville spring

8. Due to the centrifugal force acting on the rim, the flywheel arms will be subjected to CO1-U
(a) tensile stress (b) compressive stress (c) shear stress (d) none of these
9. In thrust bearings, the load acts CO1-U
(a) along the axis of rotation (b) parallel to the axis of rotation
(c) perpendicular to the axis of rotation (d) in any direction
10. A connecting rod should be CO1-U
(a) strong in buckling about X-axis (b) strong in buckling about Y-axis
(c) equally strong in buckling about X-axis and Y-axis (d) any one of the above

PART – B (5 x 2= 10Marks)

11. Classify the various types of stresses. CO1-U
12. A line shaft rotating at 200rpm is to transmit 20kW. It may be assumed to be made of mild steel with an allowable shear stress of 42MPa. Determine the diameter of the shaft, neglecting the bending moment on the shaft. CO2-App
13. Enumerate the different types of riveted joints and rivets. CO1-U
14. Discuss the various types of stresses induced in a flywheel rim. CO1-U
15. List out the important physical characteristics of a good bearing material. CO1-U

PART – C (5 x 16= 80Marks)

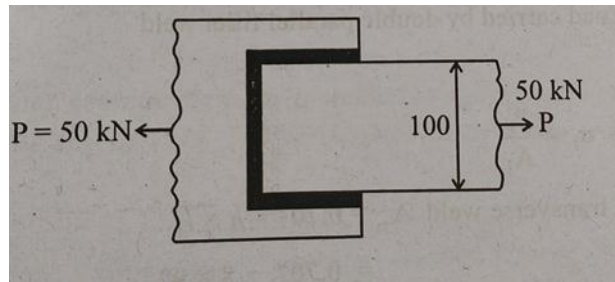
16. (a) A bolt which connects two flat plates together is subjected to an axial pull of 12000 N and transverse shear force of 8000 N simultaneously. The permissible tensile stress of the bolt is 100 N/mm² and the poission’s ratio is 0.3. determine the diameter of bolt by: CO2-App (4)
(4)
(4)
(4)
- a) Maximum principle stress theory
b) Maximum shear stress theory
c) Maximum strain theory
d) Maximum strain energy theory
- Or
- (b) A 50 mm diameter shaft is made from carbon steel having ultimate tensile strength of 600 Mpa. It subjected to a torque which fluctuates between 2000 N-m to 900 N-m. Using soderberg method, calculate the factor of safety. CO2-App (16)

17. (a) Design a muff coupling for a shaft which transmits 55 kW at 120 rpm. The permissible shear stress value are, for shaft is 60 N/mm^2 , for sleeve is 10 N/mm^2 and for key 40 N/mm^2 respectively. The permissible crushing stress for key is 120 N/mm^2 CO3-App (16)

Or

- (b) Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression. CO3-App (16)

18. (a) A plate of 100 mm wide and 8 mm thickness is to be welded to another plates by means of single transverse and double parallel fillet weld. Determine the length of weld in both case. The maximum tensile and shear stress is not to exceed 80 N/mm^2 and 50 N/mm^2 . CO3-App (16)



Or

- (b) A steam engine cylinder has an effective diameter of 350 mm and the maximum steam pressure acting on the cylinder cover is 1.25 N/mm^2 . Calculate the number and size of studs required to fix the cylinder cover, assuming the permissible stress in the studs as 33 Mpa. CO3-App (16)

19. (a) Design a helical spring for the following specification. The mean coil diameter of 40 mm, maximum deflection of 20 mm under the action of load of 400N. Assume the mean permissible shear stress of 500 MPa. CO3-App (16)

Or

- (b) A semi elliptical laminated spring is to carry a load of 5000 N and consists of 8 leaves, 46 mm wide, two of leaves being of full length. The spring is to be made 1000 mm between the eyes and is held at the center by a 60 mm wide band. Assume that the spring is initially stressed so as to induce an equal stress of 500 N/mm^2 , when full loaded. Design the spring by finding

CO3-App (4)
(4)
(4)
(4)

1. Thickness
2. Eye diameter
3. Length of leaves
4. Maximum deflection

Assume $E = 2.1 \times 10^5 \text{ N/mm}^2$.

20. (a) Design a journal bearing for a centrifugal pump with the following data:

CO3-App (16)

Diameter of the journal = 140mm

Load on bearing = 50KN

Speed of journal = 900 rpm

Or

- (b) Select a suitable roller bearing for a 50mm diameter shaft. The bearing should be capable of withstanding 3kN radial and 2kN axial load at 700 rpm. The bearing is to have a desired rated life of 2000 hrs at a reliability of 95 %. There is a light shock load and inner ring rotates.

CO3-App (16)