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**Question Paper Code: U5704**

B.E./B.Tech. DEGREE EXAMINATION, APRIL 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 ability of material to resist scratching and indentation is CO1- U  
(a) Hardness                      (b) Stiffness                      (c) Resilience                      (d) Surface finish
2. Yield point in fatigue loading as compared to static loading is CO1- U  
(a) higher                      (b) lower                      (c) same                      (d) none of these
3. Two shafts, one solid and the other hollow, of the same material will have the same strength if they are having CO1- U  
(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
4. Stress concentration factor is a function of CO1- U  
(a) geometry of the machine component  
(b) material of the machine component  
(c) geometry and material of the machine component  
(d) none of the above

5. The crest diameter of a screw thread is same as CO1- U  
 (a) Major diameter (b) Minor diameter  
 (c) Pitch diameter (d) None of the above
6. For riveted joints, the type of joint preferred is CO1- U  
 (a) Lap joint (b) Butt joint  
 (c) Over lapping joint (d) Any of the above
7. An elastic member which deflects under the action of load and regains its original shape after the removal of load is CO1- U  
 (a) shaft (b) bolt (c) spring (d) coupling
8. The longest leaf in Semi-elliptic leaf spring is known as CO1- U  
 (a) Chief leaf (b) Master leaf (c) Major leaf (d) Higher leaf
9. Antifriction bearings are CO1- U  
 (a) Sleeve bearings (b) Hydrodynamic bearings  
 (c) Ball and Roller bearings (d) none of these
10. The ball bearings are provided with a cage CO1- U  
 (a) To reduce friction (b) To facilitate slipping of balls  
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PART – B (5 x 2= 10Marks)

11. Differentiate between static and variable stresses CO1 -U
12. Which material used for flange or flange coupling? CO1 -U
13. State the advantages of threaded joints. CO1 -U
14. When two concentric springs of stiffness 200 N/mm respectively are subjected to an axial load of 1500 N, what will be the deflection of each spring? CO1 -U
15. Explain any points to be considered for selection of bearings. CO1- U

16. (a) A bolts is subjected to an axial force of 25KN, with a transverse shear force of 10KN. find the diameter at the bolt required according to: (i) Maximum Principal stress theory (ii) Maximum Principal strain theory (iii) Maximum shear stress theory. Assume permissible tensile stress at elastic limit is  $300 \text{ N/mm}^2$  and poisson ratio = 0.25, FOS =2. CO2- App (16)

Or

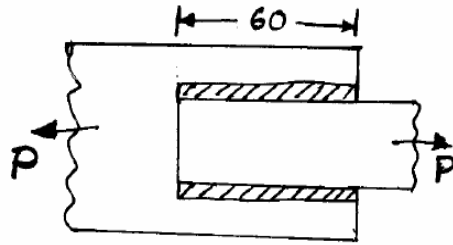
- (b) A shaft of 200mm length is cantilever rod of circular section. It is subjected to a cyclic transverse load that varies from -50 to 150 KN. Determine the diameter of the shaft assuming a factor of safety of 2, size correction factor of 0.85 and surface correction factor of 0.9. The material properties are ultimate strength = 550MPa; yield strength = 320MPa and endurance limit = 275MPa. Theoretical stress factor = 1.4, Notch sensitivity factor = 0.9. CO2 -App (16)

17. (a) Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32kW at 960 rpm. The overall torque is 20% more than mean torque. The material properties are as follows. The allowable shear and crushing stress for the shaft and key material is 40 MPa and 80 MPa. The allowable shear stress for cast iron is 15 MPa. The allowable bearing pressure for rubber bush is  $0.8\text{N/mm}^2$ .The material of the pin is same as that of shaft and key. CO3- App (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:  
 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 bolt = 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. CO3- App (16)

18. (a) A plate 60mm and 10mm thick is weld to another plate by two parallel fillet welds as shown in fig. Determine the shaft load that the weld joint can carry. The allowable working stress in shear for the weld material is  $75\text{N/mm}^2$ . CO2- App (16)



Or

- (b) Design and draw a cotter joint to support a load varying from 30kN in compressing to 30kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically. Tensile stress and compressive stress = 50MPa. Shear stress = 35MPa and crushing stress = 90MPa. CO2- App (16)
19. (a) A safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm. It is held on its seat by a close coiled helical spring. The maximum lift of the valve is 10 mm. Design a suitable compression spring of spring index 5 and providing an initial compression of 35 mm. The maximum shear stress in the materials of the wire is limited to 500 MPa. The modulus of rigidity for the spring material is  $80\text{kN/mm}^2$ . Calculate: (i) Diameter of the spring wire, (ii) Mean coil diameter, (iii) Number of active turns, (iv) Pitch of the coil. CO3- App (16)

Or

- (b) Design a CI flywheel for a four stroke engine developing 150kW at 200rpm. Calculate the mean diameter of the flywheel if hoop stress is not to exceed 4MPa. Total fluctuation of speed is to be 4% mean speed. Work done during power stroke is 1.5times average work done during the cycle. Density of CI is  $7200\text{kg/m}^3$ . CO3- App (16)

20. (a) Design a journal bearing for a centrifugal pump from the following data: Load on the journal=20000N, Speed of the journal=900rpm, Type of oil is SAE10, for which the absolute viscosity at 55°C=0.017kg/m-s, Ambient temperature of oil = 15.5°C, Maximum bearing pressure for the pump=1.5N/mm<sup>2</sup>. Calculate also mass of the lubricating oil required for artificial cooling, If the rise of temperature, if the rise of temperature of oil be limited to 10°C heat dissipation coefficient=1232W/m<sup>2</sup>/°C CO3- App (16)

Or

- (b) Select a suitable Conrad-type deep-groove ball bearing for the following data, the radial load is 7500N and axial load is 4500N, the shaft speed is 2000rpm, the  $L_{10}$  life required is  $4.9 \times 10^8$  revolutions; the inner ring of the bearing rotates. CO3- App (16)





