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**Question Paper Code: U5704**

B.E./B.Tech. DEGREE EXAMINATION, NOV 2023

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 difference between the upper limit and lower limit of a dimension is known as CO1- U  
(a) basic size                      (b) nominal size                      (c) tolerance                      (d) actual size
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. Explain about factor of safety? List the factors to be considered while deciding the factor of safety. CO1 -U
12. Why is maximum shear stress theory used for shaft? CO1 -U
13. Why are welded joints preferred over riveted joints? CO1 -U
14. State any two functions of springs. CO1 -U
15. Classify the types of bearing? CO1- U

PART – C (5 x 16= 80Marks)

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 simply supported beam has a concentrated load at the centre which fluctuates from  $P$  to  $4P$ . Span of beam is 500mm and diameter 60 mm. Let the stress concentration factor be 1.8. Endurance limit 330 MPa and tensile ultimate strength is 700MPa. The shaft is machined for a factor of safety 1.3, size factor 0.85 and a surface finish factor 0.9. Determine the required Load of the shaft. CO2 -App (16)

17. (a) Design a muff coupling to connect two shafts transmitting 40 kW at 120 rpm. The shear and crushing stress for the shaft and key material are 30 MPa and 80 MPa respectively. The material of muff is cast iron with permissible shear stress of 15 MPa. Assume that the maximum torque transmitted is 25% greater than the mean torque. CO3- App (16)

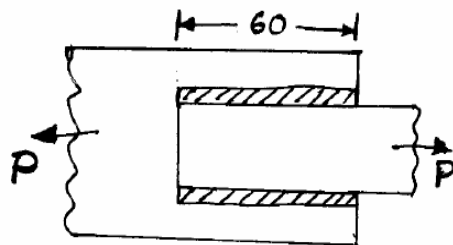
Or

- (b) 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 percent more than mean torque. The material properties are as follows: CO3- App (16)

follows:

- (i) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively
- (ii) The allowable shear stress for cast iron is 15 MPa,
- (iii) The allowable bearing pressure for rubber bush is  $0.8 \text{ N/mm}^2$
- (iv) The material of the pin is same as that of shaft and key.

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) A full journal bearing of 50mm diameter and 100mm long has a bearing pressure of  $1.4\text{N/mm}^2$ . The speed of the journal is 900rpm and the ratio of journal diameter to the diametric clearance is 1000. The bearing is lubricated with oil, whose absolute viscosity at the operating temperature of  $75^\circ\text{C}$  may be taken as  $0.011\text{ kg/m}\cdot\text{s}$ . The room temperature is  $35^\circ\text{C}$ . Find, (1) The amount of artificial cooling required. (2) The mass of lubricating oil required, if the difference between the outlet and inlet temperature of the oil is  $10^\circ\text{C}$ . Take specific heat of oil as  $1850\text{J/Kg}/^\circ\text{C}$ . CO3- App (16)
- Or
- (b) Design a mild steel connecting rod with an I-Section for a single cylinder IC Engine from the following data: Diameter of the piston = 0.104m, Weight of reciprocating parts = 18.2N, Length of connecting rod-center to center = 0.314m, Stroke length = 0.4m, Speed of the engine = 500rpm, Maximum explosion pressure = 2.28MPa (gauge), Assume that the maximum thrust takes place at TDC during the explosion stroke. Assume also any missing data sketch the connecting rod. CO3- App (16)