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**020403**

**May 2024**

**B. Tech. (RAI) (Fourth Semester)**

**Design of Machine Elements (PCC-RAI-403-21)**

*Time : 3 Hours]*

*[Maximum Marks : 75*

**Note :** It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other.

**Part A**

1. (a) What is the need for factor of safety ? 1.5
- (b) What is static loading ? 1.5
- (c) What is the use of a knuckle joint ? 1.5
- (d) What is the main difference between riveted joint and a welded joint ? 1.5
- (e) What are the key factors influencing the selection of material ? 1.5
- (f) What are types of keys ? 1.5
- (g) What are applications of cotter joints ? 1.5
- (h) What are various material properties ? 1.5

- (i) What is fatigue failure in design ? 1.5  
 (j) Name different types of gears. 1.5

**Part B**

2. (a) A knuckle joint is required to withstand a tensile load of 25 KN. Design the joint if permissible stresses are Tensile = 56 MPa, Shear = 40 MPa and Crushing 70 MPa. 10  
 (b) What are the various design considerations for a mechanical design ? 5
3. (a) What are different types of keys ? 5  
 (b) The load on the journal bearing is 150 kN due to turbine shaft of 300 mm diameter at 1800 rpm. Determine the following :
- (i) Length of the bearing if the allowable bearing pressure is  $1.6 \text{ N/mm}^2$   
 (ii) Amount of heat to be removed by the lubricant per minute if the bearing temperature is  $600 \text{ C}$  and viscosity of oil is  $0.02 \text{ kg/m-s}$  and the bearing clearance is  $0.25 \text{ mm}$ . 10

4. A solid circular shaft is subjected to a bending moment of 3000 N-m and a torque of 10000 N-m. The shaft is made of 45 C 8 steel having ultimate tensile stress of 700 MPa and a ultimate shear stress of 500 MPa. Assuming a factor of safety as 6, determine the diameter of the shaft. 15
5. (a) Differentiate between a shaft and an Axle with examples. 5  
 (b) Explain the design procedure for an eccentrically loaded riveted joint having six rivets symmetrically. 10
6. (a) Explain Goodmans and Soderberg's criterion with suitable diagrams. 5  
 (b) Explain in detail about various joints installed in mechanical structures with their design and applications. 10
7. Design a muff coupling to connect two shafts for 25 kW at 360 rpm. The shaft and key are made of plain carbon steel ( $S_y = 400 \text{ N/mm}^2$ ). The sleeve is made of grey cast iron ( $S_{ut} = 200 \text{ N/mm}^2$ ). The F.O.S for shaft and key is 4 while for sleeve is 6. 15