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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 N/mm^2

(ii) Amount of heat to be removed by the lubricant per minute if the bearing temperature is 600 C and viscosity of oil is 0.02 kg/m-s and the bearing clearance is 0.25 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 N/mm^2). The sleeve is made of grey cast iron (S_{ut} = 200 N/mm^2). The F.O.S for shaft and key is 4 while for sleeve is 6. **15**