

# GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-IV (NEW) EXAMINATION – SUMMER 2024

**Subject Code:3144101**

**Date:20-07-2024**

**Subject Name:Design of Machine Elements and Transmission System**

**Time:10:30 AM TO 01:00 PM**

**Total Marks:70**

**Instructions:**

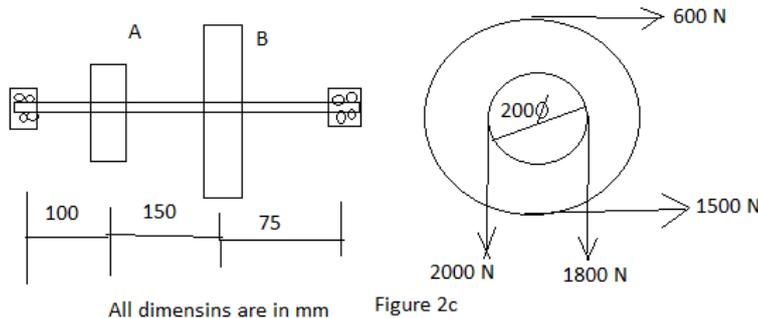
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

- Q.1** (a) What is Machine Design ? Explain its phases. **03**  
 (b) Define Endurance limit, notch sensitivity, stress concentration factor, fluctuating stresses. **04**  
 (c) Explain design consideration for casting. **07**

- Q.2** (a) Differentiate shaft axle and spindle in machine design. **03**  
 (b) Write a design steps for split muff coupling. **04**  
 (c) Design a protected type flange coupling to connect two shafts of 35 mm diameter transmitting a 16KW power at 720 rpm. The overload capacity is 25 % more than the average torque, bolts and keys are made of C20 steel and flanges are made from FG200 for C20 steel & with factor of safety 2,  $\tau = 50 \text{ N/mm}^2$  and for cast iron  $\tau = 10 \text{ N/mm}^2$ ,  $\sigma_{\text{crushing}}$  for bolt material is 25  $\text{N/mm}^2$  **07**

**OR**

- (c) Determine the diameter of shaft for Two pulleys are mounted on a shaft as shown in figure 2c. **07**  
 The power is transmitted from right pulley B to left pulley A The diameter of pulley A is 200 mm. The ultimate strength of shaft material is 600 MPa and yield strength is 345 MPa. Assume shock factor  $K_b = 1.5$  and  $K_t = 1.2$ , permissible value of stress =  $0.3 \sigma_{\text{yield}}$  Neglect the weight of shaft and pulleys.



- Q.3** (a) What is key ? Explain design of rectangular key **03**  
 (b) What is mean by preload in the bolt ? Explain condition for avoiding the joint separation of bolted joint. **04**  
 (c) Two plates of 6 mm thickness are to be joined by double riveted zig zag lap joint. Design the joint if allowable strength of mind steel permissible tensile stress  $100 \text{ N/mm}^2$ , permissible shear stress is  $70 \text{ N/mm}^2$ , permissible crushing stress is  $130 \text{ N/mm}^2$  for zig-zag rivet  $p \geq 2.5$  diameter of rivet. **07**  
 $P_{\text{transverse}} \geq 0.33p + 0.67D$

**OR**

- Q.3** (a) Discuss material of rivets and show atleast four different types of heads used in rivets. **03**  
 (b) Explain design procedure for eccentrically loaded welded joint. **04**
- (c) A plate 150 mm x 10 mm is welded to another plate as T joint by means of two fillet welds as shown in figure 3c. Determine the weld size to carry a torque of 8 KNm and an axial force of 5 KN. The permissible strength of weld material is 165 MPa. Polar moment of inertia  $J = \frac{tL^3}{12}$  **07**

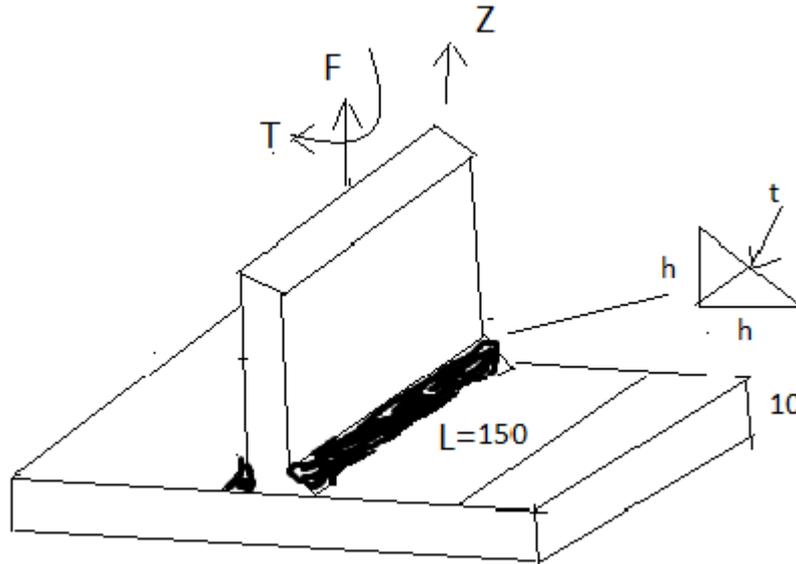


Fig 3c OR All Dimensions are in mm

- Q.4** (a) Sketch the cross section of V belt and explain each completely. **03**  
 (b) Derive the relation for ratio of driving tension in V belt drive. **04**  
 (c) Pulley with 450 mm diameter and 200 mm diameter connected through a parallel shaft with distance 1.95 m by a cross belt drive. Find the length of belt and angle of contact on each pulley. Find power transmitted by belt when big pulley rotates at 200 rev/min if the maximum big pulley rotates at 200 rev/min, if the maximum permissible tension in belt is 1 KN, and the coefficient of friction between belt and pulley is 0.25 **07**

OR

- Q.4** (a) Explain following terms helix angle, normal pitch, normal pressure angle **03**  
 (b) Explain types of gear tooth failure. **04**
- (c) Pinion and gear with 30 and 60 teeth having speed of pinion at 1440 rpm, pressure angle  $20^\circ$ , involute with module of gear 3 mm, face width is 32mm. Gears and pinion is having same material with ultimate strength 560 MPa. Find the power on basis of bending failure if factor of safety based( using lewis equation) on dynamic factor( using buckinghams equation)  
 Buckingham's equation is  $F_d = F_t + \left[ \frac{21v(bc+F_t)}{21v + \sqrt{bc + F_t}} \right]$   
 Where value of  $C = 285 \text{ KN/m}$ , b is width of gear,  $F_t$  is tangential force  
 Velocity Factor,  $C_v = \frac{3}{3+v}$  **07**

- Q.5** (a) List the important considerations for selection of bearing. **03**  
 (b) Define following terms with respect to journal bearing **04**  
 Eccentricity ratio, clearance, Bearing Characteristic Number, Sommerfeld Number

- (c) Drilling machine spindle runs at 1000 rpm it is mounted on single row ball bearings, having 2250 N radial load and 1900 N thrust load. The machine runs at 8 hour/day. Assume life for four year and spindle diameter equals to 30 mm, select suitable bearing ( for Fax/Frad >0.7, 7306 bearing with  $c = 34500$  N,  $C_o=19000$  N, for  $iF_{ax}/C_0 > e$  ( $i=1$ ),  $X = 0.56$ ,  $Y = 1.5$ ,  $V=1$  for inner race rotating where  $e = 0.292$  Assume 300 day/year **07**

**OR**

- Q.5** (a) What types of stresses are produced in wire of closed coil helical spring? Draw the distribution of stresses. **03**
- (b) Explain nipping in laminated leaf spring. **04**
- (c) Design a helical spring for a maximum load of 1000 N for a deflection of 25 mm having a spring index 5, Maximum permissible shear stress for spring wire is 410 MPa, Modulus of rigidity 84 KN/mm<sup>2</sup>, Whals factor  $K = (4C - 1)/(4C - 4) + 0.615/C$ , Where C is a spring index Standard diameter **07**

	Wire dia
SWG2	7.010
SWG3	6.41
SW4	5.893

\*\*\*\*\*