Seat No./Enrollment No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 4 – EXAMINATION – SUMMER 2026

Subject Code: 3144101 **Date: 25/05/2026**

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 fatigue failure? State different modes of failure in machine elements.	**03**
	(b)	Discuss importance of codes and standards in design.	**04**
	(c)	Explain stress concentration in detail and discuss various methods to reduce it.	**07**
Q.2	**(a)**	Explain crushing and shearing failure in keys.	**03**
	(b)	Discuss failure modes of bolts under static loading.	**04**
	(c)	A triple riveted lap joint is to be made between two plates of 10 mm thickness. The permissible tensile stress for the plate is 100 N/mm^2. The permissible shear and crushing stress for rivet are 75 N/mm^2 and 150 N/mm^2 respectively. If the number of the rivets per row is 4, determine: the diameter of rivet, pitch of rivets, the load carrying capacity of joint, the efficiency of the joint, the width of plate and the distance between the row of rivets.	**07**
		OR	
Q.2	**(c)**	The Kennedy keys are used to transmit 30 KW power at 500 rpm from 40 mm diameter shaft to the hub. The keys are made of steel 55C8 with yield strength of 400 N/mm^2 and ultimate tensile strength of 700 N/mm^2. If the factor of safety required is 3 and overload factor is 1.5, design the keys.	**07**
Q.3	**(a)**	Explain difference between spindle, shaft and axle.	**03**
	(b)	Discuss the function of a coupling. Give at least three practical applications	**04**
	(c)	Explain design of sleeve or muff-coupling with neat sketch.	**07**
		OR	
Q.3	**(a)**	A hollow shaft has greater strength and stiffness than solid shaft of equal weight. Explain.	**03**
	(b)	Write short note on universal coupling.	**04**
	(c)	Compare the weight, strength and stiffness of a hollow shaft of the same external diameter as that of solid shaft. The inside diameter of the hollow shaft being half the external diameter. Both the shafts have the same material and length.	**07**
Q.4	**(a)**	What are the factors upon which the coefficient of friction between the belt and the pulley depends?	**03**

(b) It is stated that the speed at which a belt should be run to transmit maximum power is that at which the maximum allowable tension is three times the centrifugal tension in the belt at that speed. Prove the statement. **04**

(c) Design a belt drive to transmit 110 KW for a system consisting of two pulleys of diameters 0.9 m and 1.2 m, Centre distance of 3.6 m, a belts speed 20 m/s, coefficient of friction 0.3, a slip of 1.2 % at each pulley and 5 % friction loss at each shaft, 20% overload. Assume. thickness of belt 15mm and safe stress for the belt 2.5 MPa. **07**

OR

Q.4 **(a)** What condition must be satisfied in order that a pair of spur gears may have a constant velocity ratio? **03**

(b) Explain the following terms used in helical gears: (a) Helix angle; (b) normal pitch; and (c) axial pitch. **04**

(c) Discuss the design procedure of spur gears. **07**

Q.5 **(a)** What is pulsating shear stress? Why are springs subjected to pulsating shear stress? **03**

(b) Explain the following term of the spring: Free Length, Solid Height, Spring rate and spring index. **04**

(c) A helical compression spring made of coil tempered carbon steel, is subjected to a load which varies from 400 N to 1000N. the spring index is 6 and the design factor of safety is 1.25. if the yield stress in shear is 770 MPa and endurance stress in shear is 350 MPa; find: 1. Size of the spring wire, 2. Diameter of spring, 3. Number of turns of the spring, and 4. Free length of the spring. The compression of the spring at the maximum load is 30m. the modulus of rigidity for the spring material may be taken as $80KN/mm^2$. **07**

OR

Q.5 **(a)** What is the criterion for dynamic load carrying capacity of ball bearing? What is L10 life? **03**

(b) State two advantages and disadvantages of hydrodynamics bearings over hydrostatic bearings. **04**

(c) Explain the design procedure for journal bearing. **07**

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