Enrollment No./Seat No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering - SEMESTER - VII EXAMINATION - WINTER 2025

Subject Code: 3171917   **Date: 26-11-2025**

Subject Name: **Design of Machine Elements**

Time: 10:30 AM TO 01:30 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.
5. Use of PSG and V B Bhandari Design Data Book is permitted.

			Marks
Q.1	**(a)**	What is standardization? Enlist its advantages.	**03**
	(b)	A journal of nominal diameter 79 mm rotates in a bearing. The upper and lower deviations in hole diameter are + 0.05 mm and + 0.00 mm, respectively, while those for the shaft are – 0.03 mm and – 0.07 mm. Calculate: (i) Extreme diameters for hole and shaft, (ii) Tolerances for hole and shaft, and (iii) maximum and minimum clearance.	**04**
	(c)	Design a muff coupling to connect two steel shafts transmitting 40 kW at 350 rpm. The material for shafts and key is plain carbon steel for which allowable shear and crushing stresses are 40 MPa and 80 MPa, respectively. The material for the muff is cast iron, for which the allowable shear stress is 15 MPa.	**07**
Q.2	**(a)**	Compare a helical compression spring with a helical tension spring.	**03**
	(b)	What is pre-stressing? Why is it required in pressure vessels?	**04**
	(c)	Derive the Lame's equation for thick cylindrical shell.	**07**

<div align="center">OR</div>

	(c)	A helical spring is made from a wire of 6 mm diameter and has an outside diameter of 75 mm. If the permissible shear stress is 350 MPa and the modulus of rigidity is 84 kN/mm^2, find the axial load which the spring can carry and the deflection per active turn.	**07**
Q.3	**(a)**	Classify rolling contact bearings.	**03**
	(b)	Describe advantages and disadvantages of Gear Drives.	**04**
	(c)	Describe the design procedure of a spur gear.	**07**

<div align="center">OR</div>

	(a)	Define the following terms in the context of a sliding contact bearing: (i) Thick film lubrication, (ii) Thin film lubrication, (iii) Hydrostatic lubrication bearing	**03**
	(b)	Formulate the efficiency of worm gearing.	**04**

(c)	A pair of helical gears are to transmit 15 kW. The teeth are 20° stub in diametral plane and have a helix angle of 45°. The pinion runs at 10000 r.p.m. and has 80 mm pitch diameter. The gear has 320 mm pitch diameter. If the gears are made of cast steel having allowable static strength of 100 MPa; determine a suitable module and face width from static strength considerations and check the gears for wear, given σ_{es} = 618 MPa.	**07**

Q.4 **(a)** Enlist components of valve gear mechanism. **03**

(b) Explain the range ratio in gear box design. **04**

(c) A single-row deep groove ball bearing has a dynamic load capacity of 45000 N and operates on the following work cycle: **07**

(i) Radial load of 6000 N at 800 rpm for 35 % of the time.

(ii) Radial load of 11000 N at 600 rpm for 45 % of the time.

(iii) Radial load of 8000 N at 500 rpm for the remaining 20 % of the time.

Calculate the equivalent load for the complete work cycle and the expected life of the bearing in hours

OR

(a) What do you understand by 6 x 37 rope? Describe it with a sketch. **03**

(b) Define the following terms in the context of rolling contact bearing: **04**

(i) basic static load rating, (ii) static equivalent load, (iii) rating life, (iv) minimum life

(c) Describe a detailed design procedure of a sliding contact bearing. **07**

Q.5 **(a)** Explain the valve gear mechanism with a neat sketch. **03**

(b) Why dissimilar materials are used for worm and worm wheel? Explain the designation 4/29/10.6/2.5/50 used for the pair of worm and worm gear. **04**

(c) Explain the design procedure of an 8-speed gearbox for machine tool application with suitable assumptions. **07**

OR

(a) Give the classification of wire ropes and explain its construction with neat sketches. **03**

(b) Draw the structural diagrams and gear box layout of the structural formula: 2(1) 2(2) 2(4). **04**

(c) Write the detailed design procedure of the crane hook. **07**

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