Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2022

Subject Code:3171917 Date:05-01-2023

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 design data book and V B Bhandari data book is permitted.**

			MARKS
Q.1	**(a)**	Explain different types of Standards used in Machine Design.	**03**
	(b)	Explain Contact Stress and Surface Durability for involute profile of spur gear tooth.	**04**
	(c)	A pair of spur gears consists of pinion 30 teeth, running at 1000 rpm transmitting power to a 75 teeth gear. Module of gear tooth is 5 mm and face width is 60 mm. Both the gears are made of steel with σ_{ut} = 450MPa. Gears are heat treated to a surface hardness of 350 BHN. Service factor is 1.5 and factor of safety is 2. Determine: (*a*) Beam strength (*b*) Wear strength of gear tooth (*c*) The amount of power that can be transmitted by gears.	**07**
Q.2	**(a)**	Explain the law of gearing and conjugate action?	**03**
	(b)	Explain the analysis of forces acting on a helical gear tooth with a neat sketch.	**04**
	(c)	Explain the design of Bush pin type flexible coupling.	**07**
		OR	
	(c)	A pair of bevel gears transmitting power of 8 kW with pinion shaft rotating at 400 rpm and gear shaft rotating at 200 rpm. Pitch circle radius of pinion =200 mm Face width b= 0.2 x cone distance. Determine components of resultant tooth force on the pinion.	**07**
Q.3	**(a)**	What is the curvature effect in a helical spring? How does it vary with spring index?	**03**
	(b)	Derive the expression for determining the stress and deflection in full length and graduated leaves.	**04**
	(c)	A helical compression spring is made of music wire. The spring has to support a load of 150 N. Due to space limitations, the outer diameter of the spring should not exceed 25 mm, the solid length should not to exceed 40 mm, and the free length of the spring is not to exceed 100 mm. Allowable shear stress for music wire is 800 MPa and G = 81000 N/mm^2.	**07**
		OR	
Q.3	**(a)**	Explain Maximum loss of economic cutting speed in gear box design.	**03**

(b) Explain the Laws of stepped regulation of speeds in multi-speed gearbox. **04**

(c) A three stage gear box with twelve speeds is to be designed based on R10 series with a minimum spindle speed of 125 rpm. The electric motor is connected to the gear box through a belt drive and runs at 1440 rpm and transmits power of 5 KW. Using standard spindle speed, **07**

a. Derive the standard speeds,
b. Draw structure and speed ray diagram
c. Determine the ratio of the belt pulley diameter.
d. Draw the gear box layout.

Q.4 **(a)** Explain Reliability of a Rolling Contact Bearing. **03**

(b) Derive the expression of Dynamic Load Rating for Rolling Contact Bearings under Variable Loads. **04**

(c) Design a self-aligning ball bearing for a radial load of 7000 N and a thrust load of 2100 N. The desired life of the bearing is 160 millions of revolutions at 300 r.p.m. Assume uniform and steady load, **07**

OR

Q.4 **(a)** Explain the parameters affecting the bearing performance in sliding contact bearing. **03**

(b) Derive the Petroff's equation and state how the coefficient of friction for lightly loaded bearing is obtained by using it. **04**

(c) In a journal bearing diameter of shaft 75 mm, L/D = 1, radial clearance 0.05 mm, minimum film thickness 0.02 mm, speed of journal 400 r.p.m, radial load 3.5 N, sp. gravity of oil 0.9 and specific heat 1.75 kJ/kg/°C. Calculate viscosity of suitable oil, power lost in friction and resultant temperature rise. **07**

Q.5 **(a)** What is the difference in the type of assembly generally used in running fits and interference fits? **03**

(b) The conical valve of an I.C. engine is 60 mm in diameter and is subjected to a maximum gas pressure of 4 N/mm^2. The safe stress in bending for the valve material is 46 MPa. The valve is made of steel for which k = 0.42. The angle at which the valve disc seat is tapered is 30°. **04**

Determine: 1. thickness of the valve head; 2. stem diameter; and 3. maximum lift of the valve.

(c) Derive the expression of principal stresses in thick cylinders. **07**

OR

Q.5 **(a)** Explain the selection of hook cross section based on stress optimization. **03**

(b) Explain different types of stresses observed in Hoisting Wire Ropes. **04**

(c) The worm and worm wheel set is designated by 2/54/10/8. The effective surface area of gear housing is 1.8 m^2 and heat transfer coefficient is 16 $W/m^2°C$. If the ambient temperature is 25°C, worm shaft runs at 1,000 rpm, with normal pressure angle of 20°, and power transmitted through worm is 4 kW, then what is the rise in temperature of lubricating oil? **07**

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