Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2021

Subject Code:3141907 Date:03/01/2022

Subject Name:Fundamentals of Machine Design

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.**

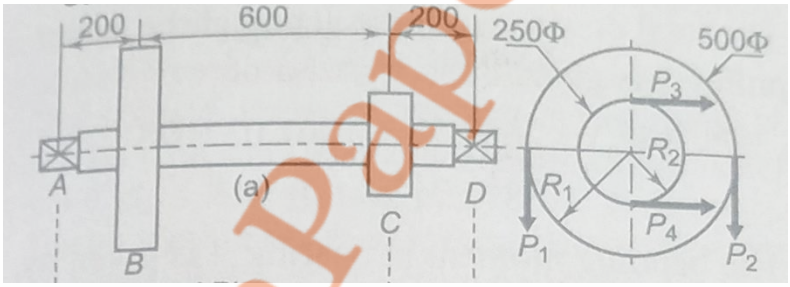
Q.1	**(a)**	Explain the Hooke's law with a neat sketch for ductile materials.	**03**
	(b)	Derive the equation for simple bending. Also state the assumptions in this derivation.	**04**
	(c)	Define and explain the following: a) Modulus of elasticity b) Modulus of rigidity c) Lateral Strain d) Thermal Strain e) Poisson's ratio	**07**
Q.2	**(a)**	Discuss the different types of supports / end conditions related to beams with neat sketches.	**03**
	(b)	Explain the Euler's Formula and Rankin's Formula used for columns design.	**04**
	(c)	Explain the following: 1. Aesthetic and Ergonomic considerations in Design 2. Materials Selection in Machine Design	**07**
		OR	
	(c)	Explain the following: 1. Manufacturing considerations in design 2. Standardization in design	**07**
Q.3	**(a)**	Write a detailed note on: Contact stresses and its examples	**03**
	(b)	Define the factor of safety. State and explain the factors affecting its selection.	**04**
	(c)	Design a knuckle joint to transmit 70 kN. The design stresses may be taken as 70 MPa in tension, compression and crushing for rod. The design stresses may be taken as 120 MPa in tension, 66 MPa in shear and 120 MPa in crushing in shear for pin.	**07**
		OR	
Q.3	**(a)**	Explain the use of bush and boss in lever design with neat sketches.	**03**
	(b)	State and explain the different theories of failures and its importance. Explain Distortion energy (von Mises) theory.	**04**
	(c)	A bell crank lever is to be designed to lift the load of 75 kN acting at the end of short arm of the lever. The length of short arm and long arm is 100 mm and 500	**07**

mm respectively. Allowable shear stress and tensile stress for lever and pin materials is 60 N/mm^2 and 60 N/mm^2 respectively. Allowable bearing pressure for pin material is 10 N/mm^2. For pin L/D=1. 5 and for the rectangular cross section of the lever, ratio of height to width is 4. Assume that the arm of bending moment on the lever extends up to the axis of the fulcrum. Determine: (1) dimension of the fulcrum pin (2) dimensions of lever.

Q.4 **(a)** Explain the design of shaft based on rigidity and stiffness. **03**

(b) State the different types of keys and explain the design of key – rectangular cross section with neat sketches stating equations. **04**

(c) The layout of transmission shaft is shown in fig below carrying two pulleys B and C and supported on two bearings A and D. Power is supplied to the shaft by means of a vertical belt on pulley B ,which is then transmitted to pulley C carrying horizontal belt. The maximum tension in belt on pulley B is 2.5 kN. The angle of warp on both the pulleys is 180^0 and coefficient of friction 0.24. The shaft is made of plain carbon steel 30C8 having σ_{yt} = 400MPa and factor of safety is 3.find the shaft diameter on strength basis. **07**



OR

Q.4 **(a)** State the advantages and disadvantages of hollow shaft over solid shaft. **03**

(b) Explain the design of splines with neat sketch. **04**

(c) Explain the terms: Moment of inertia and Polar moment of inertia. **02**

Explain the design of eccentric loaded bolted joints. **05**

Q.5 **(a)** Explain the Soderberg and Goodman diagram with neat sketches. **03**

(b) State the different types of screw threads used in power screw and explain any three of them. **04**

(c) A solid circular shaft 15 mm in diameter is subjected to torsional shear stress which varies from 0 to 35 N/mm^2 and at the same time subjected to an axial stress that varies from - 15 to + 30 N/mm^2.The frequencies of variation of these stresses are equal to the shaft speed. The shaft is made of steel FeE 400 having Ultimate tensile stress 540 N/mm^2 and yield stress 400 N/mm^2. The corrected endurance limit of the shaft is 200 N/mm^2. Determine the factor of safety. **07**

OR

Q.5 **(a)** What is self-locking of power screw? Explain the condition for self-locking. **03**

(b) What do you mean by stress concentration? State the reasons for stress concentration and explain any two of the methods used for reducing it. **04**

(c) A double threaded power screw is to lift a load of 5 kN. The nominal diameter is 60 mm and the pitch is 9 mm. The threads are Acme type ($2\Theta = 29^0$) and the coefficient of friction at the screw thread is 0.15.Neglecting the collar friction, calculate **07**

1. Torque required to raise the load
2. Torque required to lower the load
3. Efficiency of the screw for lifting the load

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