Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– V EXAMINATION – SUMMER 2020

Subject Code: 2151907 **Date:29/10/2020**

Subject Name: DESIGN OF MACHINE ELEMENTS

Time: 02:30 PM TO 05:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Discuss the various alloying elements used in 'alloy' steels and their effect on properties of Alloy steels.	**03**
	(b)	A manufacturer is interested in starting a business with seven different models of tractors ranging from 40 to 360 kW capacities. Specify power capacities of the models.	**04**
	(c)	Explain the Aesthetic and Ergonomic considerations in Design in detail.	**07**
Q.2	**(a)**	Explain the Wahl's factor used in spring design in detail.	**03**
	(b)	Explain the buckling of helical compression spring. How will you prevent it?	**04**
	(c)	Design a helical compression spring made of cold drawn steel is subjected to a fluctuating load from 500 N to 1000 N and during this, it deflects through 25 mm. The spring index is 8. The spring has square and grounded ends. There should be a gap of 2 mm between adjacent coil when the spring is subjected to maximum load of 1000 N. If the ultimate tensile stress for the spring material is 1000 MPa and the permissible stress in shear is 50 % of the ultimate tensile stress. For spring material, the modulus of rigidity is 81730 N/mm^2. Find: 1. Size of the spring wire, 2. Diameters of the spring, 3. Number of turns of the spring, and 4. Free length of the spring.	**07**
		OR	
	(c)	A semi-elliptic leaf spring used for automobile suspension consists of two extra full-length leaves and 8 graduated-length leaves, including the master leaf. The centre-to-centre distance between two eyes of the spring is 1 m. The maximum force that can act on the spring is 30 kN. For each leaf, the ratio of width to thickness is 2.3. The modulus of elasticity of the leaf material is 207000 MPa. The leaves are pre-stressed so as to equalize the stresses in all leaves under maximum load. The ultimate tensile stress for the spring material is 1500 MPa and the factor of safety is 2. Determine (i) the width and thickness of the leaves; (ii) the deflection at the end of the spring.	**07**
Q.3	**(a)**	Distinguish between flat and V- belt drives.	**03**
	(b)	Explain the step by step procedure used for selection of chain drive.	**04**
	(c)	Two pulleys, one 450 mm diameter and the other 200 mm diameter, on parallel shafts 1.95 m apart are connected by a crossed flat belt. Find the length of the belt required and the angle of contact between the belt and each pulley. What power can be transmitted by the belt when the larger pulley rotates at 200 rev/min, if the maximum permissible tension in the belt is 1000 N, and the coefficient of friction between the belt and pulley is 0.25?	**07**
		OR	
Q.3	**(a)**	State the advantage and disadvantage of the chain drive over belt and rope drives.	**03**
	(b)	Explain the different types of stresses induced in a belt with neat sketch.	**04**

	(c)	V-belt drive is used to transmit 90 kW power from an electric motor running at 750 rpm to compressor running at 250 rpm. The diameter of the pulley on the compressor shaft must not be greater than 1 metre while the centre distance between the pulleys is limited to 1.75 metre. The belt speed should not exceed 1600 m/min. Determine the number of V-belts required to transmit the power if each belt has a cross-sectional area of 375 mm^2, density 1000 kg/m^3 and an allowable tensile stress of 2.5 MPa. The groove angle of the pulleys is 35°. The coefficient of friction between the belt and the pulley is 0.25.Calculate also the length required of each belt.	**07**
Q.4	**(a)**	Explain the wire wounding in pressure vessels.	**03**
	(b)	An air receiver consisting of 500 mm diameter cylinder closed by hemispherical ends. The gas pressure is limited to 15 MPa. It is made of steel FeE 200 (S_{yt} = 200 N/mm^2 and μ = 0.27) and the factor of safety is 2.5. Calculate the cylinder wall thickness and the hemispherical ends. Neglect the effects of welded joints. Consider the receiver as thin cylinder.	**04**
	(c)	Explain the different types of end closure for cylindrical pressure vessel with neat sketch.	**07**
		OR	
Q.4	**(a)**	Explain the pre-stressing in pressure vessels.	**03**
	(b)	Explain the different pressure vessels materials in detail.	**04**
	(c)	A high-pressure cylinder consists of an inner cylinder of inner and outer diameters of 200 mm and 300 mm respectively. It is jacketed by an outer steel tube, having an outer diameter of 400 mm. The difference between the outer diameter and the inner diameter of the jacket before assembly is 0.25 mm. Calculate the shrinkage pressure and maximum tensile stress induced in any of the cylinders. (Take E = 207 kN/mm^2).	**07**
Q.5	**(a)**	Explain the thick cylinders design in brief.	**03**
	(b)	Explain the different parameters affecting endurance strength of the components.	**04**
	(c)	A solid circular shaft mad of steel Fe 620 (Sut = 630 N/mm^2 and Syt = 380 N/mm^2) is subjected to a alternating torsional moment that varies from - 200 Nm to + 400 Nm. The factor of safety is 2 and the expected reliability is 90%. The shaft is grounded. Neglecting the effect of stress concentration; determine the diameter of the shaft for infinite life. Assume the distortion energy theory of failure.	**07**
		OR	
Q.5	**(a)**	Explain Stress Concentration in brief with neat sketches.	**03**
	(b)	Explain the design consideration of castings process with sketches.	**04**
	(c)	Explain the Soderberg, Gerber and Goodman criteria used in fatigue design with the help of neat sketches (diagrams).	**07**

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