Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2017

Subject Code: 2151907 Date: 13/11/2017

Subject Name: Design of Machine Elements

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.**

			MARKS
Q.1	**(a)**	What are the effects of following alloying elements on the properties of the materials. (i) Chromium, (ii) Molybdenum, (ii) Manganese	**03**
	(b)	Explain the different factors affecting the fatigue behavior.	**04**
	(c)	What is helical torsion spring? How does it differ from helical compression spring?	**07**
Q.2	**(a)**	Compare the belt and chain drives.	**03**
	(b)	What are the types of end closures used for cylindrical pressure vessels? Explain any one with neat sketch.	**04**
	(c)	A closed vessel is to be designed to withstand an internal pressure of 5 MPa having inside diameter of 450 mm. The properties of the vessel material are yield strength is 300 MPa, ultimate tensile strength is 500 MPa, Poisson's ratio = 0.3. Determine the required wall thickness of the vessel using a factor of safety of 1.5 based on yield strength on the basis of i) maximum principal stress theory, ii) maximum shear stress theory.	**07**
		OR	
	(c)	The cover of a cylindrical pressure vessel made of cast iron. The inner diameter of the cylinder is 500 mm and the internal pressure is limited to 2 MPa. The cover is fixed to the cylinder by means of 16 bolts with a nominal diameter of 20 mm. Each bolt is initially tightened with a preload of 20 kN. The bolts are made of steel FeE 250 having yield stress = 250 N/mm^2. The Youngs module of elasticity for steel, cast iron and zinc is 207 kN/mm^2, 100 kN/mm^2 and 90 kN/mm^2 respectively. Determine the factor of safety for bolts considering the effect of the gasket. Assume thickness of cylinder cover, cylinder flange and zinc gasket is 25 mm, 25 mm and 5 mm respectively.	**07**
Q.3	**(a)**	What are the objectives of providing openings in pressure vessels?	**03**
	(b)	What do you mean by crowning of the pulleys? State the objectives of providing crowning.	**04**
	(c)	A pressure vessel consists of a cylindrical shell with an inside diameter of 1650 mm, which is closed by torispherical heads with a crown radius of 1300 mm. The operating pressure inside the vessel is 1.5 MPa. The yield strength of the material used for the shell and head is 255 N/mm^2 and the weld joint efficiency may be assumed to be 0.8. The corrosion allowance is 2 mm. Determine the thickness of the cylindrical shell and the torispherical head.	**07**
		OR	
Q.3	**(a)**	Explain the step by step procedure used for selection of chain drive.	**03**
	(b)	Explain different types of supports used for pressure vessels.	**04**
	(c)	A centrifugal blower driven by horizontal belt drive running at 600 r.p.m. by a 15 kW, 1750 r.p.m. electric motor. The center distance is twice the	**07**

diameter of the larger pulley. The density of the belt material = 1500 kg/m^3; maximum allowable stress = 4 MPa; Coefficient of friction at motor pulley and blower pulley is 0.5 and 0.4 respectively; peripheral velocity of the belt = 20 m/s. Determine the following: 1. Pulley diameters; 2. belt length; 3. cross-sectional area of the belt; 4. minimum initial tension for operation without slip.

Q.4 **(a)** Classify and explain springs according to their shapes with neat sketches. **03**

(b) A bar of steel having corrected endurance strength of 275 MPa, tensile yield strength of 415 MPa and ultimate tensile strength of 550 MPa. If it is subjected to an alternating torsional stress of ± 250 MPa, find the factor of safety against fatigue failure and the expected life of the component. **04**

(c) Design a close coiled helical compression spring for a service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 N/mm^2 and modulus of rigidity, G = 84 kN/mm^2. **07**

OR

Q.4 **(a)** What is cumulative damage in fatigue? Explain in brief. **03**

(b) Prove that equal strength nested springs having the same solid length and deflection would have the same spring index. **04**

(c) A transmission shaft carries a pulley midway between the two bearings. The bending moment at the pulley varies from 200 N-m to 600 N-m, as the torsional moment in the shaft varies from 70 N-m to 200 N-m. The frequencies of variation of bending and torsional moments 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 diameter of the shaft using a factor of safety of 2. **07**

Q.5 **(a)** What is stress concentration? **03**

(b) A 15 KW power transmitting leather belt drive running at 1440 rpm to 480 rpm. The center distance between the pulleys is twice the diameter of the bigger pulley. The belt should operate at 20 m/s approximately. Calculate the diameters pulleys and the length of the belt for open belt drive. **04**

(c) What are the principles of design for manufacture and assemblies? **07**

OR

Q.5 **(a)** What are preferred numbers? **03**

(b) A semi-elliptic leaf spring used for automobile suspension consists of three extra full-length leaves and 15 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 75 kN. For each leaf, the ratio of width to thickness is 9:1. The modulus of elasticity of the leaf material is 207000 N/mm^2. The leaves are pre-stressed in such a way that when the force is maximum, the stresses induced in all leaves are same and equal to 450 N/mm^2. Determine (i) the width and thickness of the leaves; (ii) the initial nip. **04**

(c) What are the principles for design of welded assemblies? Explain with neat sketch. **07**

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