Seat No.: ________ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– V (New) EXAMINATION – WINTER 2019

Subject Code: 2152508 **Date: 04/12/2019**

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.**

Q.1 **(a)** What is the difference between the Gerber Curve and Soderberg and Goodman line? **03**

(b) Determine the thickness of a 120 mm wide uniform plate for safe continuous operation if the plate is to be subjected to a tensile load that has a maximum value of 250 kN and a minimum value of 100 kN. The properties of the plate material are as follows: **04**
Endurance limit stress = 225 MPa, and Yield point stress = 300 MPa.
The factor of safety based on yield point may be taken as 1.5.

(c) A machine component is subjected to a flexural stress which fluctuates between + 300 MN/m^2 and – 150 MN/m^2. Determine the value of minimum ultimate strength according to 1. Gerber relation; 2. Modified Goodman relation; and 3. Soderberg relation. Take yield strength = 0.55 Ultimate strength; Endurance strength = 0.5 Ultimate strength; and factor of safety = 2. **07**

Q.2 **(a)** Define brake. Explain factors to be considered for brake design. **03**

(b) Name different types of clutches. Explain principle of centrifugal clutch with neat sketch. **04**

(c) A plate clutch having a single driving plate with contact surfaces on each side is required to transmit 110 kW at 1250 r.p.m. The outer diameter of the contact surfaces is to be 300 mm. The coefficient of friction is 0.4. **07**
1. Assuming a uniform pressure of 0.17 N/mm2; determine the inner diameter of the friction surfaces.
2. Assuming the same dimensions and the same total axial thrust, determine The maximum torque that can be transmitted and the maximum intensity of pressure when uniform wear conditions have been reached.

OR

(c) A rope drum of an elevator having 650 mm diameter is fitted with a brake drum of 1 m diameter. The brake drum is provided with four cast iron brake shoes each subtending an angle of 45°. The mass of the elevator when loaded is 2000 kg and moves with a speed of 2.5 m/s. The brake has a sufficient capacity to stop the elevator in 2.75 meters. Assuming the coefficient of friction between the brake drum and shoes as 0.2, find: **07**
1. Width of the shoe, if the allowable pressure on the brake shoe is limited to 0.3 N/mm^2.
2. Heat generated in stopping the elevator.

Q.3 **(a)** Discuss the design of flywheel arms. **03**

(b) Derive the relation $\Delta E = mR^2\omega^2C_S$ for energy stored in flywheel. **04**

(c) Explain design procedure of cast iron pulley. **07**

OR

Q.3 **(a)** Explain types of belt drive. Discuss factors to be considered for selection of belt drive. **03**

(b) Explain types of screw thread used for power screw. **04**

(c) What do you mean by overhauling and self-locking screws? Show that the efficiency of self-locking screw is less than 50% **07**

Q.4 **(a)** Explain different types of springs. **03**

(b) Explain terms used in compression spring. **04**

(c) A pair of helical gears is to transmit 15 kW. The teeth are 20° stub in diametral plane and have a helix angle of 45°. The pinion runs at 10 000 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**

OR

Q.4 **(a)** Give classification of bevel gear. **03**

(b) Explain Law of Gearing. **04**

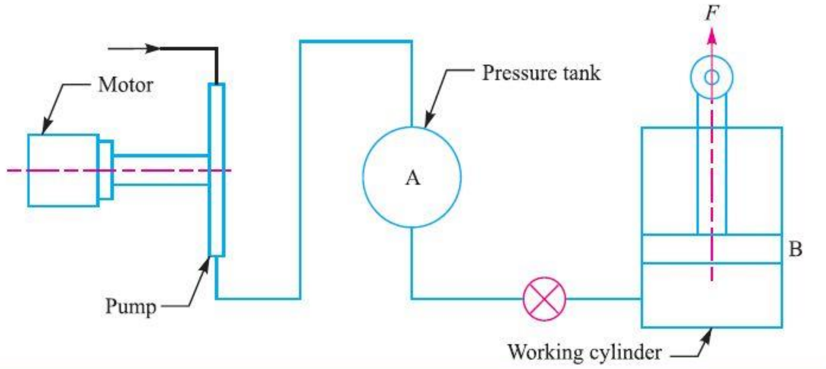
(c) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 MPa and modulus of rigidity 84 kN/mm2, find the axial load which the spring can carry and the deflection per active turn. **07**

Q.5 **(a)** Give classification of pressure vessel. **03**

(b) Design a leaf spring for the following specifications : **04**
Total load = 140 kN; Number of springs supporting the load = 4; Maximum number of leaves= 10; Span of the spring = 1000 mm; Permissible deflection = 80 mm. Take Young's modulus, E = 200 kN/mm2 and allowable stress in spring material as 600 MPa.

(c) An hydraulic control for a straight line motion, as shown in Fig., utilizes a spherical pressure tank 'A' connected to a working cylinder B. The pump maintains a pressure of 3 N/mm^2 in the tank. **07**

1. If the diameter of pressure tank is 800 mm, determine its thickness for 100% efficiency of the joint. Assume the allowable tensile stress as 50 MPa.
2. Determine the diameter of a cast iron cylinder and its thickness to produce an operating force F = 25 kN. Assume (i) an allowance of 10 per cent of operating force F for friction in the cylinder and packing, and (ii) a pressure drop of 0.2 N/mm2 between the tank and cylinder. Take safe stress for cast iron as 30 MPa.
3. Determine the power output of the cylinder, if the stroke of the piston is 450 mm and the time required for the working stroke is 5 seconds.
4. Find the power of the motor, if the working cycle repeats after every 30 seconds and the efficiency of the hydraulic control is 80 percent and that of pump 60 percent.



OR

Q.5 **(a)** Define the Surge in Springs. **03**

(b) A thin cylindrical pressure vessel of 500 mm diameter is subjected to an internal pressure of 2 N/mm^2. If the thickness of the vessel is 20 mm, find the hoop stress, longitudinal stress and the maximum shear stress. **04**

(c) Prove that the ratio of the driving tensions on the two sides of a pulley is **07**

$$\frac{T1}{T2} = e^{\mu\Theta}$$

where,

T_1 = Tension in the tight side of the belt,

T_2 = Tension in the slack side of the belt,

Θ = Angle of contact in radians,

μ= Coefficient of friction between the belt and the pulley.

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