GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2018

Subject Code:2152508   **Date:30/04/2018**
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.**
4. **Use of PSG Design Data Book is permitted.**

			MARKS
Q.1	**(a)**	Explain the following terms in connection with design of machine members subjected to variable loads: (a) Size factor, (b) Surface finish factor, and (c) Notch sensitivity	**03**
	(b)	What is meant by endurance strength of a material? How do the size and surface condition of a component and type of load affect such strength?	**04**
	(c)	A 50 mm diameter shaft is made from carbon steel having ultimate tensile strength of 630 MPa. It is subjected to a torque which fluctuates between 2020 N-m to – 850 N-m. Using Soderberg method, calculate the factor of safety. Assume suitable values for any other data needed.	**07**
Q.2	**(a)**	What are the advantages and disadvantages of V-belt drive over flat belt drive?	**03**
	(b)	Explain the utility of the centre bolt, U-clamp, rebound clip and camber in a leaf spring.	**04**
	(c)	An exhaust fan fitted with 900 mm diameter pulley is driven by a flat belt from a 30 kW, 950 r.p.m. squirrel cage motor. The pulley on the motor shaft is 250 mm in diameter and the centre distance between the fan and motor is 2.25 m. The belt is 100 mm wide with a coefficient of friction of 0.25. If the allowable stress in the belt material is not to exceed 2 MPa, determine the necessary thickness of the belt and its total length. Take centrifugal force effect into consideration for density of belt being 950 kg/m^3.	**07**

OR

	(c)	A single cylinder double acting steam engine delivers 180 kW at 110 r.p.m. The maximum fluctuation of energy per revolution is 15 per cent of the energy developed per revolution. The speed variation is limited to 1 per cent either way from the mean. The mean diameter of the rim is 2.4 m. Design the flywheel.	**07**
Q.3	**(a)**	What is a clutch? Discuss the various types of clutches giving at least one practical application for each.	**03**
	(b)	What are the important points to be considered while designing a pressure vessel?	**04**
	(c)	A single plate clutch, effective on both sides, is required to transmit 22 kW at 2500 r.p.m. Determine the outer and inner diameters of frictional surface if the coefficient of friction is 0.255, ratio of diameters is 1.25 and the maximum pressure is not to exceed 0.1 N/mm^2 . Also, determine the axial thrust to be provided by springs. Assume the theory of uniform wear.	**07**

OR

Q.3 **(a)** Discuss the different types of brakes giving at least one practical application for each. **03**

(b) Discuss the various types of power threads. Give at least two practical applications for each type. **04**

(c) Fig. shows the arrangement of two brake shoes which act on the internal surface of a cylindrical brake drum. The braking force F_1 and F_2 are applied as shown and each shoe pivots on its fulcrum O_1 and O_2. The width of the brake lining is 30 mm. The intensity of pressure at any point A is $0.4 \sin\theta$ N/mm^2, where θ is measured as shown from either pivot. The coefficient of friction is 0.4. Determine the braking torque and the magnitude of the forces F_1 and F_2. **07**
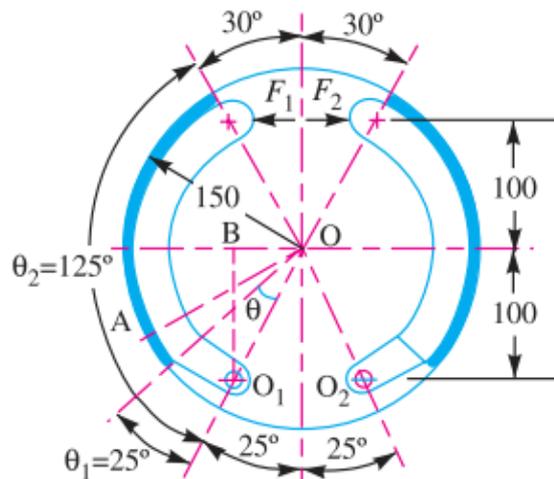
All dimensions in mm.

Q.4 **(a)** A safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm^2. It is held by a close coiled helical spring. The maximum lift of the valve is 12 mm. Spring having spring index of 5 and providing an initial compression of 35 mm. The maximum shear stress in the material of the wire is limited to 500 MPa. The modulus of rigidity for the spring material is 80 kN/mm^2. Calculate: 1. Diameter of the spring wire, 2. Mean coil diameter, 3. Number of active turns, and 4. Pitch of the coil. **07**

(b) A single stage helical gear reducer is to receive power from a 1440 r.p.m., 25 kW induction motor. The gear tooth profile is involute full depth with 20° normal pressure angle. The helix angle is 23°, the gear ratio is 3. Assume gear materials & other data and design the gears. **07**

OR

Q.4 **(a)** A semi-elliptical laminated vehicle spring to carry a load of 6600 N is to consist of seven leaves 60 mm wide, two of the leaves extending the full length of the spring. The spring is to be 1.15 m in length and attached to the axle by two U-bolts 80 mm apart. The bolts hold the central portion of the spring so rigidly that they may be considered equivalent to a band having a width equal to the distance between the bolts. Assume a design stress for spring material as 350 MPa.
Determine: 1. Thickness of leaves, 2. Deflection of spring, 3. Length of leaves, and 4. Radius to which leaves should be initially bent. **07**

(b) Design a speed reducer unit of worm and worm wheel for an input of 1 kW. The speed of the worm is 1600 r.p.m. The worm is made of hardened steel and wheel of phosphor bronze. The worm is made of double start. Check the design for heat dissipation. Assume additional data if required. **07**

Q.5 **(a)** Explain the different causes of gear tooth failures and suggest possible remedies to avoid such failures. **07**

(b) The hydraulic cylinder 450 mm bore operates at a maximum pressure of 5 N/mm^2. The piston rod is connected to the load and the cylinder to the frame through hinged joints. **07**
Design: 1. cylinder, 2. piston rod, 3. hinge pin, and 4. flat end cover. The allowable tensile stress for cast steel cylinder and end cover is 80 MPa and for piston rod is 60 MPa.

OR

Q.5 **(a)** A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 12 kN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 15 r.p.m. Assuming uniform wear condition at the collar and allowable thread bearing pressure of 5.8 N/mm^2, **07**
Find: 1. the torque required to rotate the screw; 2. the stress in the screw; and 3. the number of threads of nut in engagement with screw.

(b) A pulley of 0.9 m diameter revolving at 230 r.p.m. is to transmit 8.5 kW. Find the width of a leather belt if the maximum tension is not to exceed 145 N in 12 mm width. The tension in the tight side is twice that in the slack side. **07**
Determine the diameter of the shaft and the dimensions of the various parts of the pulley, assuming it to have six arms. Maximum shear stress as 63 MPa.

****