

# GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-V (NEW) EXAMINATION – WINTER 2018

**Subject Code:2152508**

**Date:16/11/2018**

**Subject Name:Design of Machine Elements**

**Time: 10:30 AM TO 01:00 PM**

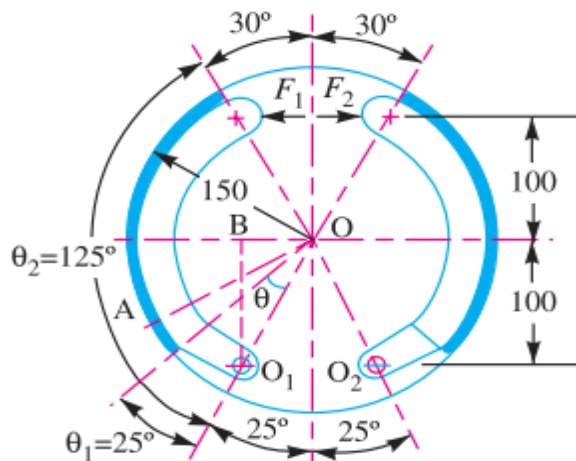
**Total Marks: 70**

**Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. PSG Design Data Book is permitted

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|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Q.1 | (a) Explain following terms: 1) Notch sensitivity 2) Endurance limit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 03    |
|     | (b) Explain the term stress concentration. In design how the effect of stress concentration is considered?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 04    |
|     | (c) A steel rod is to be subjected to reversed axial load of 150 KN. Find the diameter of the rod for the factor of safety of 2. Neglect column action. The material has an ultimate tensile strength as $1090 \text{ N/mm}^2$ , Yield stress as $920 \text{ N/mm}^2$ and Endurance limit as $540 \text{ N/mm}^2$ . Other correction factors are: Theoretical stress concentration factor: 2.5, Notch sensitivity: 0.8                                                                                                                                                                                                         | 07    |
| Q.2 | (a) Explain the term Wahl factor and its significance in helical spring design                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 03    |
|     | (b) Define the following terms:<br>(i) Spring Rate (ii) Free Length (iii) Solid Length (iv) Spring Index,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 04    |
|     | (c) Prove that “The bending stresses in full-length leaves are 50 % more than those in graduated-length leaves.”                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 07    |
|     | <b>OR</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |       |
|     | (c) It is required to design a helical compression spring subjected to a maximum force of 7.5 KN. The mean coil diameter should be 150 mm from space consideration. The spring rate is 75 N/mm. the spring is made of oil-hardened and tempered steel wire with ultimate tensile strength of $1250 \text{ N/mm}^2$ . The permissible shear stress for the spring wire is 30% of the ultimate tensile strength take modulus of rigidity as $81370 \text{ N/mm}^2$ . Calculate wire diameter and number of active coils.                                                                                                         | 07    |
| Q.3 | (a) Compare Involute and Cycloidal tooth profile of gear.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 03    |
|     | (b) Derive an expression for Lewis equation to calculate the beam strength of the Spur gear.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 04    |
|     | (c) Discuss causes of gear tooth failure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 07    |
|     | <b>OR</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |       |
| Q.3 | (a) Explain the terms used in bevel gear, i) formative number of teeth ii) cone radius.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 03    |
|     | (b) How worm gears are designated and explain the terms in it.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 04    |
|     | (c) A pair of spur gears with $20^\circ$ full depth involute teeth consists of a 20 teeth pinion meshing with a 41 teeth gear. The module is 3 mm while the face width is 40 mm. The material for pinion as well as gear is steel with an ultimate tensile strength of $600 \text{ N/mm}^2$ . The gears are heat treated to a surface hardness of 400 BHN. The pinion rotates at 1450 rpm and the service factor for the application is 1.75. Assume that velocity factor accounts for dynamic load and the factor of safety is 1.5<br>Determine the rated power that the gears can transmit.<br>Take Lewis Form factor = 0.32 | 07    |

- Q.4 (a) Explain with the help of neat sketch the working principal of centrifugal clutch. 03
- (b) In brake design explain self-energizing and self-locking condition 04
- (c) Figure below 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  $0.4 \sin \theta \text{ N/mm}^2$ , where  $\theta$  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  $F_2$ . All dimensions are in mm. 07



OR

- Q.4 (a) Why flywheel is needed in an Engine? 03
- (b) Explain coefficient of fluctuation of speed. 04
- (c) A multi-cylinder engine is to run at a constant load at a speed of 600 r.p.m. On drawing the crank effort diagram to a scale of 1 m = 250 N-m and 1 mm = 3°, the areas in sqmm above and below the mean torque line are as follows: +160, -172, +168, -191, +197, -162 sq mm. The speed is to be kept within ±1% of the mean speed of the engine. Calculate the necessary moment of inertia of the flywheel. 07
- Q.5 (a) Clutches are usually designed on the basis of Uniform wear. Justify the statement. 03
- (b) In pressure vessel design, what is Autofrettage and explain its need. 04
- (c) A shrink fit assembly, formed by shrinking one tube over another, is subjected to an internal pressure of 60 N/mm<sup>2</sup>. Before the fluid is admitted, the internal and the external diameters of the assembly are 120 mm and 200 mm and the diameter at the junction is 160 mm. If after shrinking on, the contact pressure at the junction is 8 N/mm<sup>2</sup>, determine using Lamé's equations, the stresses at the inner, mating and outer surfaces of the assembly after the fluid has been admitted. 07

OR

- Q.5 (a) Why is the efficiency of self-locking square threaded screw less than 50%? 03
- (b) Discuss types of pulleys for flat belts 04
- (c) Explain step by step design procedure of screw jack. 07

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