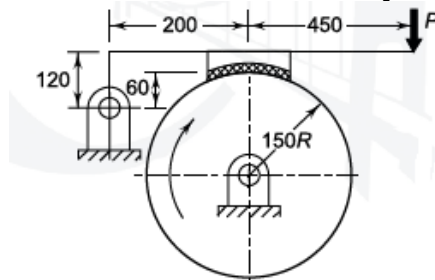


**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-V (NEW) EXAMINATION – SUMMER 2019****Subject Code: 2152508****Date: 31/05/2019****Subject Name: Design of Machine Elements****Time: 02:30 PM TO 05:00 PM****Total Marks: 70****Instructions:**

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

|     |                                                                                                                                                                                                                                                                                                                                                                                              | MARKS |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Q.1 | (a) Explain the term: Fatigue failure, Fatigue life                                                                                                                                                                                                                                                                                                                                          | 03    |
|     | (b) What is the difference between the Gerber curve and Soderberg and Goodman lines?                                                                                                                                                                                                                                                                                                         | 04    |
|     | (c) What are the methods of reducing Stress concentration? Explain details.                                                                                                                                                                                                                                                                                                                  | 07    |
| Q.2 | (a) What is the difference between clutch and flange coupling?                                                                                                                                                                                                                                                                                                                               | 03    |
|     | (b) A car engine develops maximum power of 15 kW at 1000 rpm. The clutch used is single plate clutch both side effective having external diameter 1.25 times internal diameter $\mu = 0.3$ . Mean axial pressure is not to exceed 0.085 N/mm <sup>2</sup> . Determine the dimension of the friction surface and the force necessary to engage the plates. Assume uniform pressure condition. | 04    |
|     | (c) A single block brake with a torque capacity of 15 N-m is shown in Fig. The coefficient of friction is 0.3 and the maximum pressure on the brake lining is 1 N/mm <sup>2</sup> . The width of the block is equal to its length.                                                                                                                                                           | 07    |



Calculate

- (i) the actuating force;
- (ii) the dimensions of the block;
- (iii) the resultant hinge-pin reaction; and
- (iv) the rate of heat generated, if the brake drum rotates at 50 rpm.

**OR**

- (c) A machine component is subjected to Fluctuating stress that varies from 40 to 100 N/mm<sup>2</sup>. The corrected endurance limit stress for the machine component is 270 N/mm<sup>2</sup>. The ultimate tensile strength and yield strength of material are 600 and 450 N/mm<sup>2</sup> respectively.

Find factor of safety using

- I Gerber Theory
- II Soderberg Theory
- III Goodman Theory

Also find the factor of safety against static failure.

|     |                                                                                                                                                     |    |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Q.3 | (a) What is cooling stress in case of Flywheel?                                                                                                     | 03 |
|     | (b) What is the coefficient of fluctuation of energy?                                                                                               | 04 |
|     | (c) It is required to design a V-belt drive to connect a 7.5 kW, 1440 rpm induction motor to a fan, running at approximately 480 rpm, for a service | 07 |

of 24 h per day. Space is available for a centre distance of about 1 m. Take  $F_a = 1.3$ , PCD of Smaller pulley = 200 mm, pitch length  $L = 3200$  mm, Correction factor  $F_c = 1.08$ , Power rating  $P_r = 6.36$  kW.

**OR**

- Q.3** (a) Explain the Law of Belting. **03**  
 (b) What is creep in belts? **04**  
 (c) A pair of spur gears with  $20^\circ$  pressure angle consists of a 25 teeth pinion meshing with a 60 teeth gear. The module is 5 mm, while the face width is 45 mm. The pinion rotates at 500 rpm and the gears are made up on steel with surface hardness of 220 BHN and ultimate tensile strength of 600 MPa. Take service factor 1.75 and factor of safety 2. Assume that the dynamic load is accounted by means of velocity factor method. Determine rated power that can be transmitted by gears. Take  $Y = 0.32$  **07**

- Q.4** (a) What is the minimum number of teeth on the spur gear? why? **03**  
 (b) Explain the concept of Interference and Undercutting. **04**  
 (c) A pair of helical gears consists of a 25 teeth pinion meshing with a 50 teeth gear. The normal module is 4 mm. Find the required value of the helix angle, if the centre distance is exactly 165 mm. **07**

**OR**

- Q.4** (a) What are the drawbacks of worm gear drives? **03**  
 (b) Derive the Lame's equation to determine wall thickness. **04**  
 (c) The piston rod of hydraulic cylinder exerts an operating force of 10 kN. The friction due to piston packing and stuffing box is equivalent to 10% of operating force. The pressure in the cylinder is 10 MPa. The cylinder is made of cast iron FG200 and factor of safety is 5. Determine the diameter and thickness of the cylinder. **07**
- Q.5** (a) What is the criterion to distinguish between thick and thin cylinder? **03**  
 (b) Explain the terminology of power screw. **04**  
 (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 N/mm<sup>2</sup>. The permissible shear stress for the spring wire is 30% of the ultimate tensile strength ( $G = 81\,370$  N/mm<sup>2</sup>). Calculate  
 (i) wire diameter; and  
 (ii) number of active coils. **07**

**OR**

- Q.5** (a) What is concentric spring? **03**  
 (b) What is the nip of leaf spring? What is the objective of nipping? **04**  
 (c) In a machine tool application, the tool holder is pulled by means of an operating nut mounted on a screw. The tool holder travels at a speed of 5 m/min. The screw has single-start square threads of 48 mm nominal diameter and 8 mm pitch. The operating nut exerts a force of 500 N to drive the tool holder. The mean radius of the friction collar is 40 mm. The coefficient of friction at thread and collar surfaces is 0.15. Calculate power required to drive the screw and the efficiency of the mechanism. **07**

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