

**GANPAT UNIVERSITY****B. Tech. Semester: V Mechatronics Engineering****CBCS Regular Examination December 2013****2MC503 - DESIGN OF MACHINE ELEMENTS****Time: 3 Hours****Total Marks: 70**

- Instruction:**
1. Attempt all questions,
  2. Assume suitable data if necessary,
  3. Figure to the right indicate full marks,
  4. Only scientific calculator is allowed.

**Section – I****Que. 1**

- (A) Compare single plate and multi-plate clutches and state their applications. (04)
- (B) A cone clutch is used to transmit 20 kW power at 1200 rpm. The coefficient of friction is 0.2, while the intensity of pressure is  $0.25 \text{ N/mm}^2$ . The semi-cone angle is  $12.5^\circ$ . The outer diameter of the friction surface is 240 mm. The overload factor is 1.25. Assuming the uniform wear theory, determine: (i) The inner diameter of the friction surface, (ii) The face width of the friction surface, and (iii) The axial force required to engage the clutch. (07)

**OR****Que. 1**

- (A) Derive the equation of torque transmitting capacity for dry clutch. (For both case) (04)
- (B) A single plate clutch, consisting of two pairs of contacting surface, is required to transmit 40 kW power at 1560 rpm. The co-efficient of friction between the contacting surfaces is 0.3 and the intensity of pressure is limited to  $0.4 \text{ N/mm}^2$ . The outer diameter is limited to 300 mm. If the service factor is 1.25, determine: - (i) The inner diameter of friction disk, and (ii) The axial force required to engage the clutch. (07)

**Que. 2**

- (A) Derive the equation  $h = 4.R.\sin\theta_1 / 2\theta_1 + \sin 2\theta_1$  for pivoted block brake. (05)
- (B) The pivoted block brake, as shown in Fig. (A) has a face width of 50 mm. The coefficient of friction and the permissible intensity of pressure between the lining and the brake drum are 0.25 and  $0.55 \text{ N/mm}^2$  respectively. If the pivot of the shoe is located such that the moment of friction force on shoe about the pivot is zero. Calculate: (i) The braking torque capacity, (ii) The actuating force, (iii) The heat generated, if the speed of the brake drum is 100 RPM and the brake is applied for 5 seconds to bring the drum to the rest. (07)

**OR****Que. 2**

- (A) Explain the disk brake with neat sketch. (05)
- (B) A cast-iron flywheel rotating at 600 rpm is brought to rest by a brake is 2 sec. The flywheel may be considered as solid circular disk, having a diameter of 400 mm and a thickness of 100 mm. The density of cast-iron is  $7200 \text{ Kg/m}^3$ . Determine: - (i) The energy absorbed by the brakes, (ii) Number of turns the drum rotates before coming to rest, (iii) The braking torque. (07)



Que. 3

Attempt Any Three.

- (A) What are rigid and resistant bodies? Elaborate.
- (B) Compare: - (i) Clutch, (ii) Brake, and (iii) Coupling.
- (C) What is the degree of freedom of a mechanism? How is it determined?
- (D) Explain the advantages and disadvantages of positive clutch and friction clutch.

Section - II

Que. 4

- (A) Derive the equation of belt tension ratio for flat belt drive? Also Explain belt creep. (06)
- (B) A V-belt drive is used to transmit 30 kW power from electric motor running at 1440 rpm to a machine running at 480 rpm. The centre distance between the input and output shaft is 1m. The pulley in groove angle is  $38^\circ$  and coefficient of friction between the belt and pulley is 0.2. The density of belt material is  $1000 \text{ kg/m}^3$  and the allowable tensile stress for the belt is  $1.53 \text{ N/mm}^2$ . The cross sectional dimension of the V-belt are: Width of the belt at top = 37 mm, Width of the belt at bottom = 19 mm, Depth of the belt = 25 mm. Find: (i) The minimum number of belt required, and (ii) The pulley diameter. (06)

OR

Que. 4

- (A) Explain the equation to find the length of open and cross belt drive? (06)
- (B) A flat belt is required to transmit 30 kW from a pulley of 1.5m effective diameter running at 300rpm. The angle of contact is spread over  $11/24$  of the circumference. The coefficient of friction between the belt and pulley surface is 0.3. Determine, taking centrifugal tension into account, width of the belt required. It is given that the belt thickness is 9.5 mm, density of its material is  $1100 \text{ kg/m}$  and the related permissible working stress is 2.5 Mpa. (06)

Que. 5

- (A) Explain with diagrams, methods for reduction stress concentration? (05)
- (B) A cantilever beam made of cold drawn carbon steel of circular cross section as shown in Fig. (B). Is subjected to a load which is varies from  $-55$  to  $165$ . Determine the diameter  $d$  of the beam withstand for an indefinite life using a factor of safety as 2. The theoretical stress concentration factor is 1.42, the notch sensitivity is 0.9 and the expected reliability is 90%. Assume the following values: Ultimate stress = 550 MPa, Yield stress = 470 MPa, Size factor = 0.85, Surface finish factor = 0.89. (06)

OR

Que. 5

- (A) Explain design procedure for finite life problems. Also explain cumulative damage in fatigue. (05)
- (B) A plate made of steel 20C8 (Ultimate tensile strength =  $440 \text{ N/mm}^2$ ) in got rolled and normalized condition is shown in Fig. (C). It is subjected to a completely reversed axial load 30 kN. The notch sensitivity factor can be taken as 0.8 and expected reliability is 90%. The factor of safety is 2. Determine the plate thickness for infinity life. (06)

Que. 6

Attempt Any Three.

- (A) What is stress concentration? What are the causes of stress concentration?
- (B) What is ergonomics? What is its importance in machine design?
- (C) Which are the basic requirements of machine design?
- (D) Give advantage and disadvantage of open belt drive over cross belt drive?

(12)



Figures

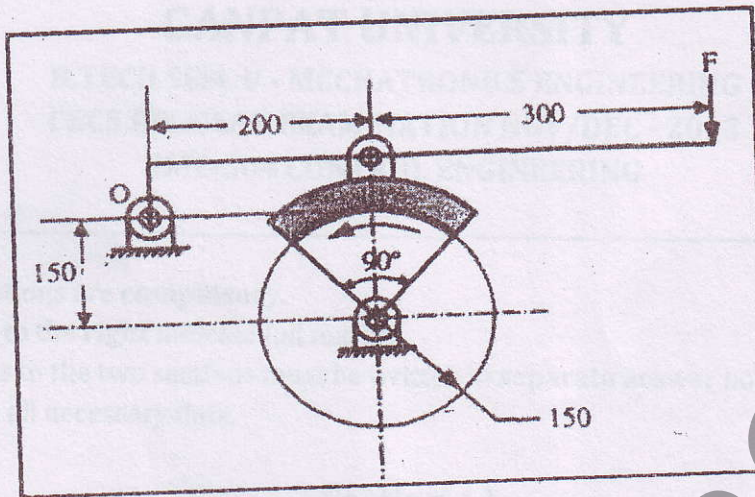


Fig. (A)

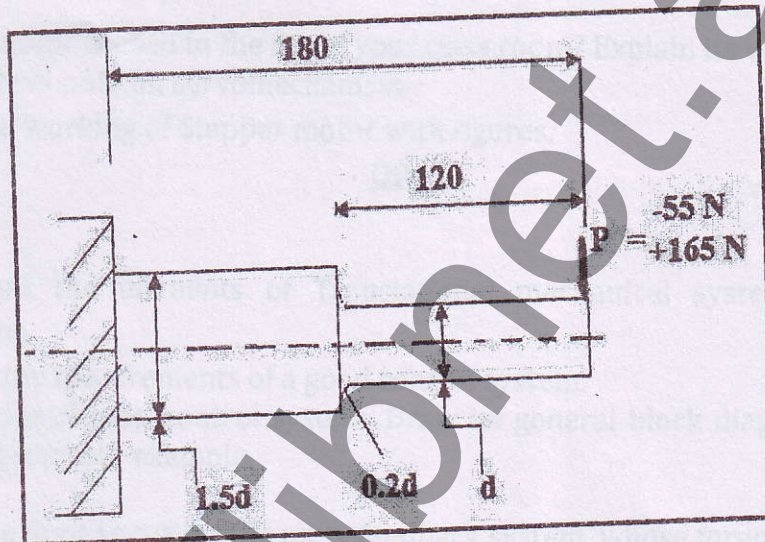


Fig. (B)

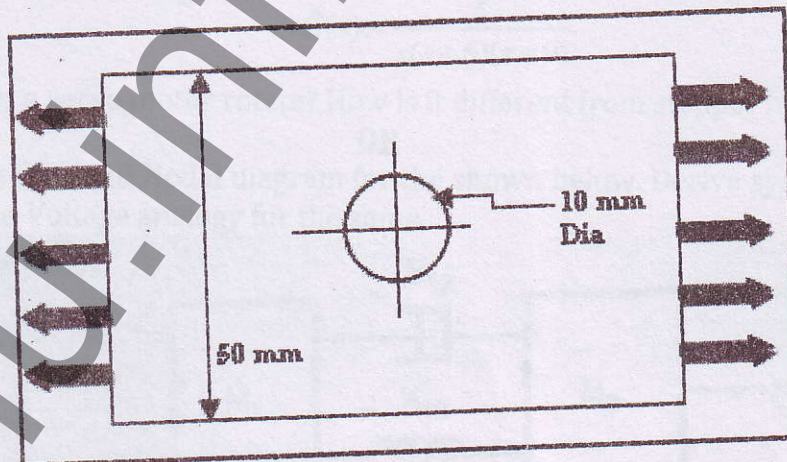


Fig. (C)

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