

(3 hours)

Total Marks: 80

- NB
- 1) Question No. 1 is compulsory
  - 2) Attempt any three questions out of the remaining five questions.
  - 3) Figures to the right indicate full marks.
  - 4) Assume suitable data wherever required but justify the same.

**Q1. Attempt any four** (20)

- A. What are rigid and resistant bodies? Elaborate.
- B. What is fundamental equation of steering gears? Which steering gear fulfil this condition?
- C. Two points located along the radius of a wheel have velocities of 8 m/s and 14 m/s respectively. The distance between the points is 300 mm. What is radial distance of outer point from the centre.
- D. Define base circle, pitch circle, trace point, pitch curve and pressure angle.
- E. State and derive law of gearing.

**Q2 A.** A pinion of 120 mm pitch circle diameter and having 20 involute teeth drives a rack. The addendum of both the pinion and rack is 6 mm. Determine the least value of the pressure angle to avoid interference. With this value of pressure angle, find the length of arc of contact and the minimum number of teeth in contact at a time. (10)

**B.** What is the effect of centrifugal tension on the power transmitted? (5)

**C** State and explain Kennedy's theorem. (5)

**Q3 A.** In an open-belt drive, the diameters of the larger and smaller pulley are 1.2 m and 0.8 m respectively. The smaller pulley rotates at 320 rpm. The center distance between the shaft is 4 m. When stationary, the initial tension on the belt is 2.8 kN. The mass of belt is 1.8 kg/m and the coefficient of friction between the belt and pulley is 0.25. Determine the power transmitted. (10)

**B.** Use following data of a cam in which a knife-edge follower is raised with uniform acceleration and deceleration and is lowered with simple harmonic motion: least radius of cam=60 mm, Lift of follower=45 mm, Angle of ascent= 60°, dwell between ascent and descent= 40°, Angle of descent= 70°  
 If cam rotates at 180 rpm, determine the maximum velocity and acceleration during ascent and descent. (10)

**Q4 A.** In a reduction gear shown in fig. 1, the input S has 24 teeth. P and C constitute a compound planet having 30 and 18 teeth respectively. If all gears are of the same pitch, find ratio of reduction gear. Assume A to be fixed. (10)

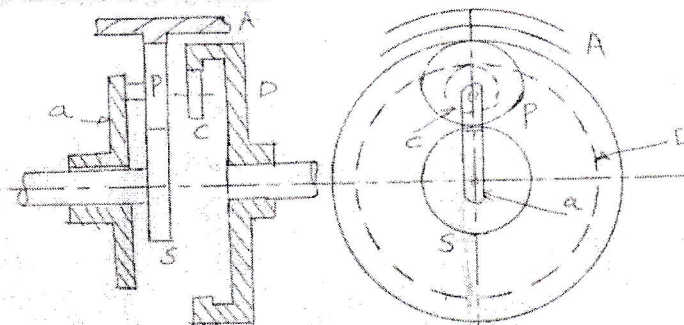


Fig. 1 Reduction Gear Mechanism

- B. A uniform 50-kg crate rest on a horizontal surface for which coefficient of kinetic friction is 0.2. Determine the crate acceleration if a force of  $P=600\text{ N}$  is applied to the crate as shown in fig 2. (10)

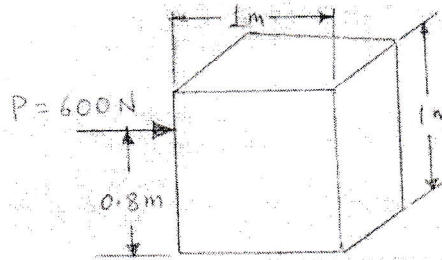


Fig. 2 Crate subjected to force

- Q5 A. A toggle mechanism shown in fig 3. Find the velocities of the slider by  
 i) relative velocity method  
 ii) Instantaneous center method (14)

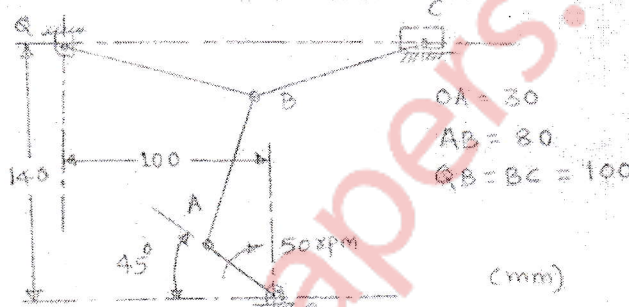


Fig. 3 Toggle Mechanism

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- B. Explain self locking and self energising brakes. (06)

- Q6 A. In the toggle mechanism as shown Fig. 3, the crank OA rotates at 210 rpm counterclockwise increasing at the rate of  $60\text{ rad/s}^2$ . For the given configuration, determine i) velocity of slider D and angular velocity of lin BD ii) acceleration of slider D and angular acceleration of link BD. (14)

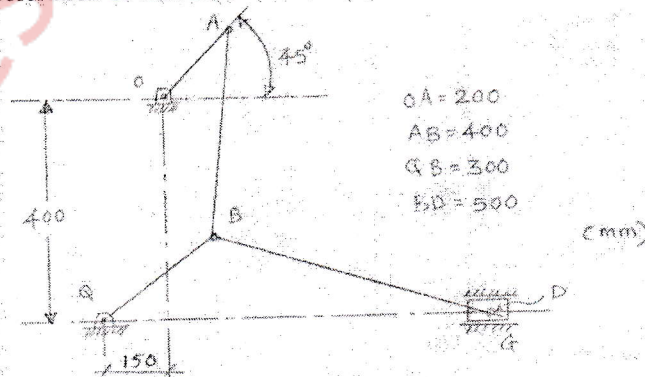


Fig. 4 Toggle Mechanism

- B. A fixed gear having 200 teeth meshes with a pinion having 50 teeth. The two are connected by an arm. What is the number of turns made by the pinion for one complete revolution of the arm about center of the gear?  
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