(3 Hours) [Total Marks : 100

N.B.: (1) Question No. **1** is **compulsory**.
(2) Answer any **four** out of remaining **six** questions.
(3) Assume any **suitable data** wherever **required**.

1. Answer any **four** of the following questions :— **20**
   (i) State and prove with the help of a neat sketch Kennedy's theorem of three centres.
   (ii) With the help of a neat sketch explain any one of the exact straight line mechanism.
   (iii) With the help of a neat sketch explain law of gearing.
   (iv) State and explain D' Alembert's principle with respect to kinetics of a rigid body.
   (v) State Grubler's criteria. Using the same, Deduce minimum number of links required to form a mechanism.

2. (a) **Fig. 1** shows the mechanism of a radial valve gear. Crank OA rotates uniformly at 150 rpm and is pinned at A to rod AB. Point C is guided in the circular path with D as centre and DC as radius. Dimensions of the various links are :— **14**
   OA =150 mm ; AB = 550 mm; AC = 450 mm ; DC = 500 mm ; BE = 350 mm.
   Determine the velocity of the slider at E by :—
   (i) Relative velocity method (ii) Instantaneous Centre method.

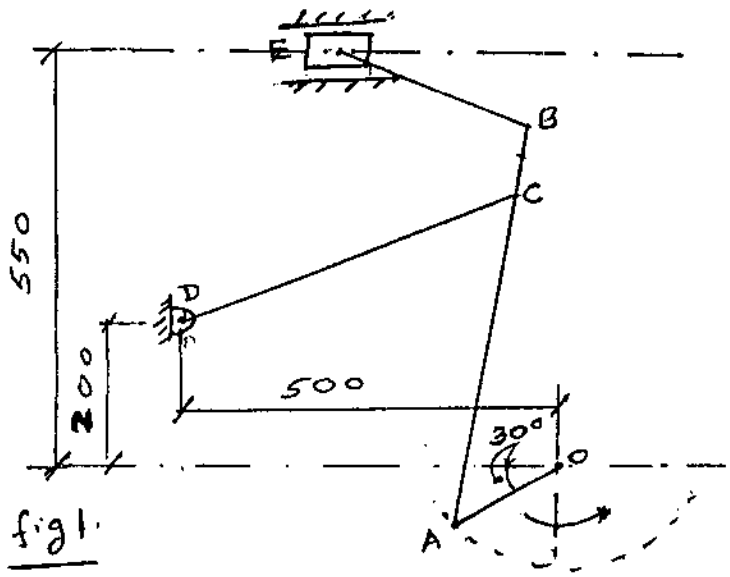


fig 1.

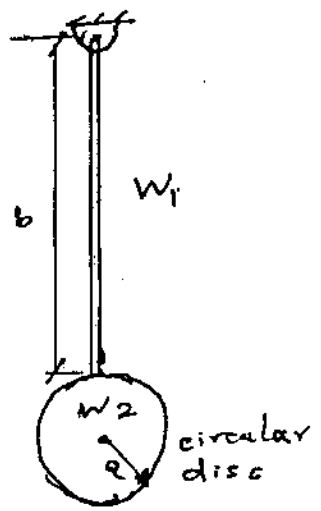


fig 2.

   (b) Determine moment of Inertia of a compound pendulum as shown in **fig 2**. The pendulum consists of a disc suspended by a slender rod. Numerical data regarding the pendulum is given below :— **6**
   b = 250 mm ; a = 125 mm ; W_1 = 0.225 kg ; W_2 = 1.4 kg.

3. (a) A rope drive transmits 100 kW at 225 rpm by ropes, each 25 mm diameter and density 6800 kg/m^3. **10**
   Maximum rope tension to be limited to 1500 N and is designed for maximum power conditions. The angle of contact is 160° and coefficient of friction between the rope and the pulley is 0.2. Groove angle is 45°.
   Determine the diameter of pulley and number of ropes.
   (b) The turning moment diagram of an engine consists of two isosceles triangles. Maximum height of each triangle represents turning moment equal to 1000 Nm, while the base of the triangle is from θ = 0° to 180° and θ =180° to 360°. If the engine runs at 200 rpm and if the total fluctuation of speed is not to exceed 3%, find— **10**
   (i) Indicated horse power of the engine and
   (ii) Moment of inertia of the flywheel.

4. (a) The following data relate to a pair of involute spur gears in mesh :— **12**

Teeth on pinion	= 24
Gear ratio	= 2
Pressure angle	= 20°
Module	= 5 mm.
Pitch velocity of pinion	= 1.2 m/sec.

Determine the path of approach, path of recess and contact ratio, if the addendum is equal to one module.

(b) The driving shaft of a Hooke's joint has a uniform angular speed of 280 rpm. Determine the permissible angle between the axes of the shafts to permit a maximum variation of 8% of the mean speed. **8**

5. (a) The following data relate to the connecting rod of a reciprocating engine :— **10**

Mass	= 50 kg.
Distance between bearing centres	= 900 mm.
Diameter of big end bearing	= 100 mm.
Diameter of small end bearing	= 80 mm.
Time of oscillation when the connecting rod is suspended from big end	= 1.7 sec.
Time of oscillation when the connecting rod is suspended from small end	= 1.85 sec.

Determine :—

(i) The radius of gyration of the rod about an axis passing the centre of mass perpendicular to the plane of oscillation.

(ii) The moment of inertia of the rod about the same axis and

(iii) The dynamically equivalent system of the connecting rod comprising two masses one at the small end bearing centre.

(b) A machine which is to rotate at approximately 400 rpm, is run by an engine, turning at 1500 rpm, through a roller chain having a pitch of 15 mm. The number of teeth on sprockets should be between 18 and 105. **10**

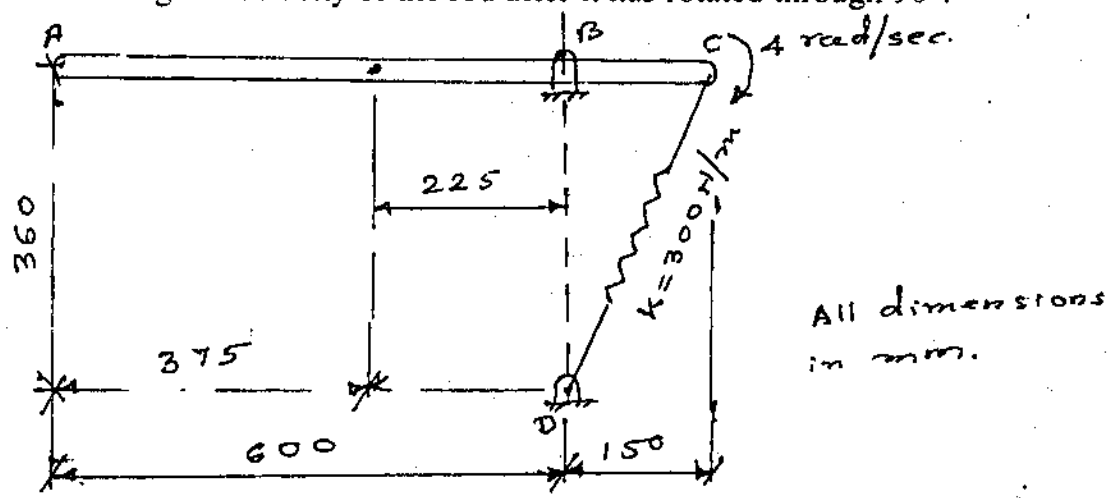
The linear velocity of chain drive is not to exceed 600m/min. Find the suitable tooth numbers for both the sprockets.

6. (a) Draw a neat sketch of Tchebicheff's mechanism and show that its links are in ratio of 1: 2.5 : 2. **8**

(b) Draw any mechanism wherein we have to consider the Corioli's component of acceleration while drawing an acceleration diagram. State its magnitude and direction with proof. **12**

7. (a) A 3kg uniform rod rotates in a vertical plane about B. The spring of constant k = 300 N/m and unstretched length of 120 mm is attached to the rod. In position shown, angular speed of the rod is 4 rad/sec. clockwise. **12**

Determine angular velocity of the rod after it has rotated through 90°.



(b) With help of neat sketches explain major differences between Davis steering gear and Ackerman steering gear. **8**

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