

Total No. of Questions—8]

[Total No. of Printed Pages—6

Seat No.	
-------------	--

**[5252]-517**

**S.E. (Mechanical/Auto.) (Second Semester) EXAMINATION, 2017**

**THEORY OF MACHINES I**

**(2015 COURSE)**

**Time : Three Hours**

**Maximum Marks : 70**

**N.B. :—** (i) Neat diagrams must be drawn wherever necessary.

(ii) Figures to the right indicate full marks.

(iii) Use of electronic pocket calculator is allowed.

(iv) Assume suitable data, if necessary.

1. (a) Define 'inversion' and explain with neat sketches any two inversions of single slider kinematic chain, giving their practical applications. [5]
- (b) Describe with neat sketches 'Dynamically Equivalent System'. [5]

*Or*

2. (a) Define Grashoff's law. State how it is helpful in classifying the four link mechanism into different types. [4]
- (b) The obliquity ratio of a vertical reciprocating engine is 4.5. The engine bore and stroke is 75 mm and 90 mm respectively. The engine rotates at 2200 rpm. The mass of the reciprocating parts is 1.2 kg. The gas pressure intensity is 5.5 bar. When it has moved 50° from the IDC on its power stroke, determine the piston effort. At what engine speed will be load on the gudgeon pin at crank pin be zero? [6]

P.T.O.

3. (a) Describe with neat sketch the construction and working of Belt Transmission Dynamometer. [5]
- (b) Two shafts P and Q are connected by Hookes coupling and have their axes included at  $15^\circ$ . If the shaft P rotates at a uniform speed of 1200 rpm, find the maximum acceleration of shaft Q and the angular positions of the shaft P at these instants. [5]

Or

4. (a) Explain loop closure equation for four bar mechanism. [4]
- (b) A single plate clutch, effective on both sides, is required to transmit 25 kW at 3000 rpm. Determine the outer and inner radii of friction surface if the coefficient of friction is 0.255, the ratio of radii is 1.25 and the maximum pressure is not to exceed  $0.1 \text{ N/mm}^2$ . Also determine the axial thrust to be provided by springs. Assume the theory of uniform wear. [6]
5. (a) Explain with the help of neat sketch the concept of 'Velocity Image Principle'. [4]
- (b) The configuration of wrapping machine is shown in Fig. 1. Determine by using ICR method, the velocity of point P on bell crank lever PQR, if the crank rotates at 80 rad/s. The dimensions of various links are  $OA = 150 \text{ mm}$ ,  $AB = 950 \text{ mm}$ ,

CB = 250 mm, BD = 400 mm, CR = 350 mm, QR = 250 mm and PQ = 600 mm. [11]

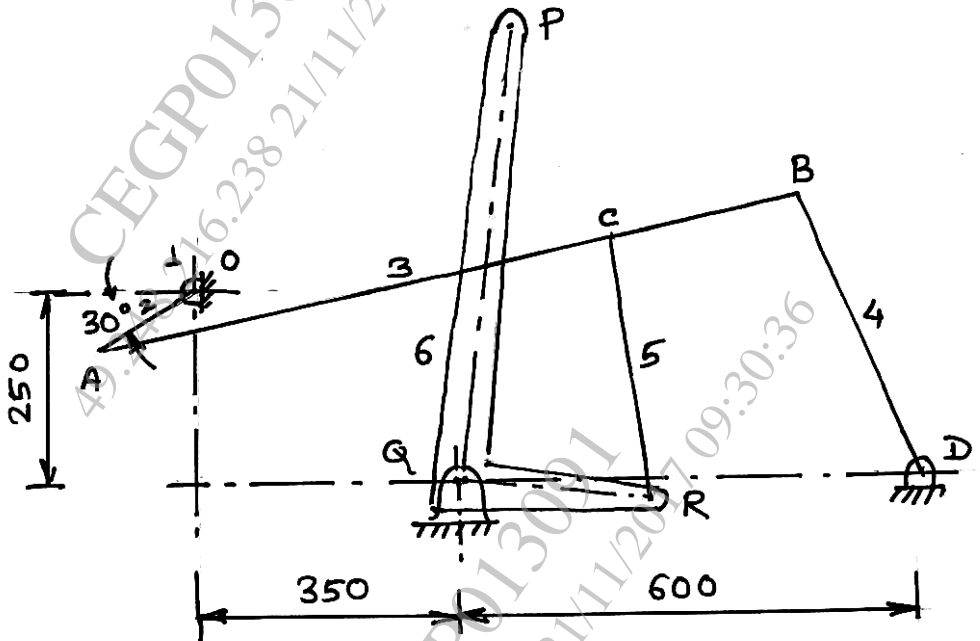
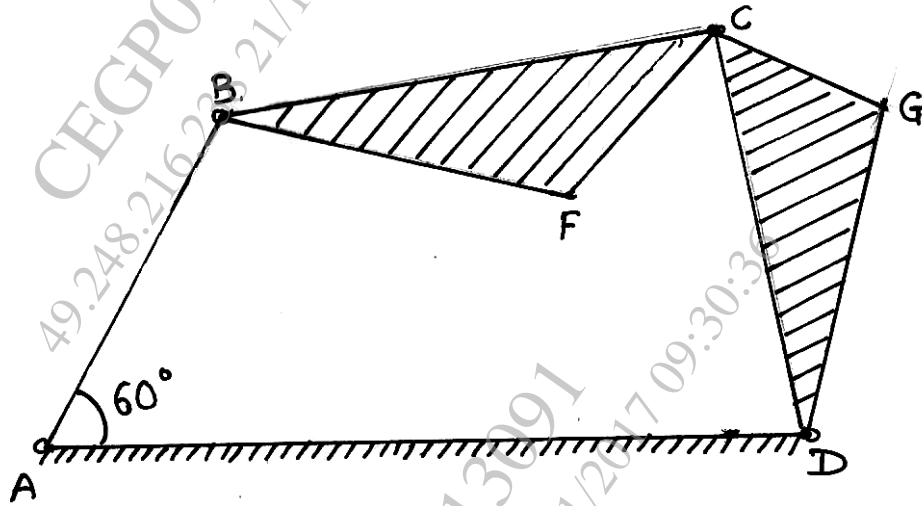


Fig. 1

Or

6. (a) State and explain Kennedy's theorem. [4]
- (b) The Fig. 2 shows four link mechanism. The link AB has angular velocity of 10.5 rad/s in counterclockwise direction. Find velocity of midpoint of link DGC and angular acceleration of link BCF. The dimensions of links are AD = 100 mm, AB = 50 mm,

BC = 66 mm, CD = 56 mm, BF = 45 mm, CF = 30 mm,  
CG = 24 mm and GD = 44 mm. [11]



**Fig. 2**

7. (a) Explain with neat drawing the procedure of Kleins construction to determine acceleration of piston of slider crank mechanism, when crank rotates with angular velocity  $\omega$  and angular acceleration  $\alpha$ . [5]
- (b) The Fig. 3 shows Scotch Yoke Mechanism. The length of the crank OP is 200 mm. At the instant shown in fig. the crank OP has angular velocity of 10 rad/s and angular acceleration

of  $30 \text{ rad/s}^2$ . Determine the acceleration of slider P in the guide and the horizontal acceleration of guide. [10]

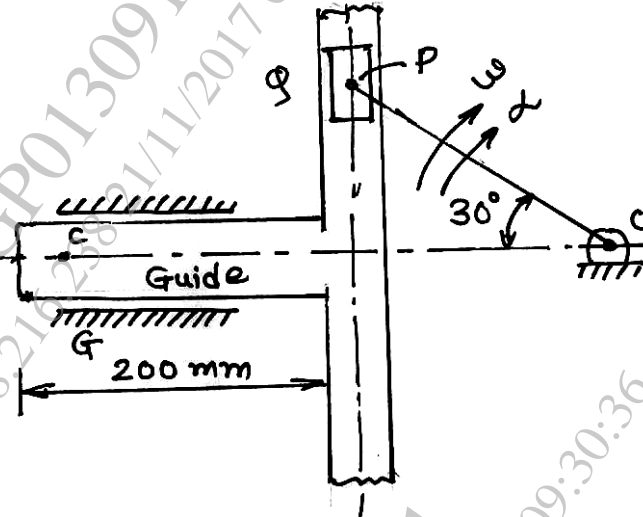


Fig. 3

Or

8. (a) In the Fig. 4, show the Coriolis component of acceleration of link with direction for the following *two* cases :
- Crank OA rotates in clockwise direction.
  - Slider A moving towards fixed point Q.
- [4]

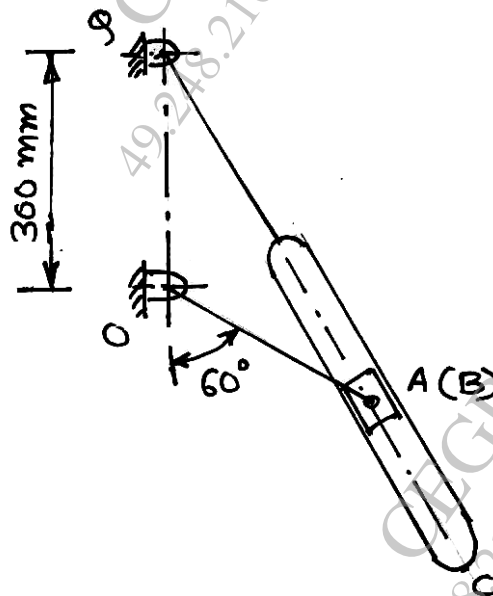


Fig. 4

- (b) In the IC engine mechanism the crank radius is 300 mm and length of connecting rod is 1050 mm. The crank is rotating with uniform angular velocity of 60 rad/s clockwise. Determine when crank at  $120^\circ$  from IDC by using Kliens construction.
- (i) Acceleration of piston;
  - (ii) Angular acceleration of connecting rod.
- The line of stroke of slider passes through fixed point. [11]