Total No. of Questions—**12**] [Total No. of Printed Pages—**8**

Seat No.	

[4957]-116

S.E. (Mech./Mech. Sand./Automobile) (II Sem.) EXAMINATION, 2016

THEORY OF MACHINES—I

(2008 PATTERN)

Time : Four Hours **Maximum Marks : 100**

N.B. **:—** (*i*) Answer any *three* questions from each Section.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of calculator is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

UNIT I

1. (*a*) Explain the following terms with neat sketches : [6]

(*i*) Kinematic chain

(*ii*) Structure

(*iii*) Machine

(*iv*) Degree of freedom in mechanisms

(*v*) Kutzbach criterion

(*vi*) Grubler's criterion.

P.T.O.

(*b*) Differentiate between : [4]

(*i*) Higher pair and Lower pair

(*ii*) Mechanism and Machine.

(*c*) State and prove the condition of correct steering for a four-wheeled vehicle. [6]

Or

2. (*a*) Write a short note on elliptical trammel. State and explain when it will trace a circle. [6]

(*b*) What is an inversion of a kinematic chain ? Explain any *two* inversions of single slider-crank chain with practical applications. [4]

(*c*) Explain with neat sketch "Geneva Mechanism". [6]

UNIT II

3. (*a*) What is velocity difference between two points on a rigid body ? Hence explain the concept of velocity image of a rigid body. [4]

(*b*) In a four bar mechanism ABCD, AD is fixed and crank AB rotates at 200 rpm in clockwise direction (Angle BAD is 50°). The dimensions of various links are as follows : BC = AD = 150 mm; CD = 80 mm; AB = 40 mm. Find angular velocity of link BC and link CD. Also find angular acceleration of link BC and link CD. [12]

Or

4. (*a*) Explain with neat sketch different types of ICRs. [4]

(*b*) An I.C. Engine Mechanism, in which crank AB rotates at 600 rpm in clockwise direction. The length of crank AB is 0.5 m and connecting rod is 2 m long. When the crank is turned 45° from Inner Dead Centre (I.D.C.). Find :

(*i*) Velocity of piston P;

(*ii*) Angular velocity of connecting rod BP;

(*iii*) Velocity of point D on the connecting rod which is at distance of 0.5 m from B;

(*iv*) Acceleration of point D and angular acceleration of connecting rod. [12]

UNIT III

5. (*a*) Explain the procedure to construct Klein's construction to determine the acceleration of a slider-crank mechanism. Also, find angular acceleration of connecting rod. [4]

(*b*) The Fig. 1 shows a crank and slotted lever quick return mechanism in which the distance between the fixed centres O and C is 210 mm. The driving crank CP is 105 mm long and it rotates clockwise at 90 rpm. The length of the

slotted link OD is 420 mm and the length of the link DE is 165 mm. The line of stroke of the arm E is horizontal and 210 mm above the fixed centre C. At the instant when the angle OCP is 110°. Find acceleration of ram E. [14]

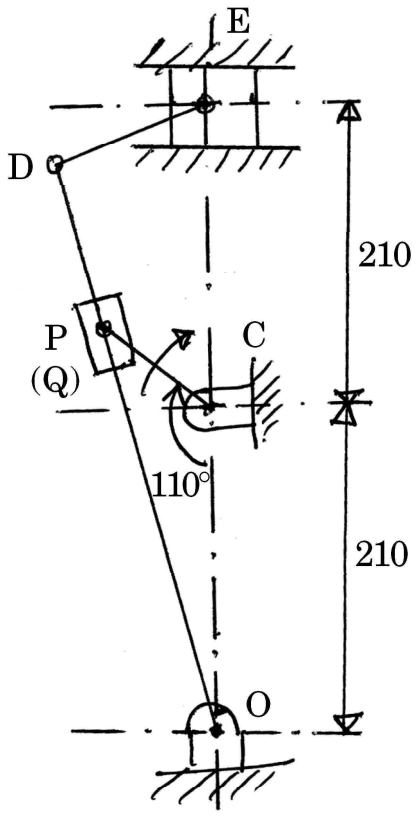

Fig. 1

Or

6. (*a*) What is meant by Coriolis component of acceleration ? In which mechanism it will exist ? Explain the method of finding the direction of Coriolis component of acceleration. [6]

(*b*) An I.C. engine mechanism has crank 10 cm long and connecting rod 40 cm long. The crank rotates clockwise at 10 rad/sec.

and at a particular instant it is inclined to I.D.C. position at 30°. Using Klein's construction method determine :

(*i*) Velocity of piston

(*ii*) Acceleration of piston

(*iii*) Angular velocity of connecting rod (C.R.)

(*iv*) Angular acceleration of connecting rod. [12]

SECTION II

UNIT IV

7. (*a*) Explain the method of chase solution, when magnitudes of two different vectors are unknown. [6]

(*b*) In an I.C. engine mechanism, crank is 40 mm long and length of connecting rod is 160 mm. The crank angle is 40° with T.D.C. position. Find the angle made by connecting rod with the line of stroke and the distance between the crank and piston using chase solution. [10]

Or

8. (*a*) Find the ratio of the input and output speed for an Universal coupling for a shaft angle [illegible] [4]

(*b*) In I.C. engine the speed of rotation is 2000 rpm. The connecting rod is 270 mm long and crank radius is 60 mm. Determine at 30% out stroke :

(*i*) Linear velocity of piston;

(*ii*) Angular position of the crank;

(*iii*) Linear acceleration of the piston;

(*iv*) Angular acceleration of the connecting rod;

(*v*) Angular velocity of the connecting rod;

(*vi*) Crank angle for maximum piston velocity. [12]

UNIT V

9. (*a*) Explain with the help of neat sketches, what is meant by 'Path Generation', function generation and motion generation ? [6]

(*b*) Design a four bar mechanism to co-ordinate **3** (*three*) positions of the input and output links as follows :

$\theta_1 = 20°$; $\theta_2 = 35°$; $\theta_3 = 50°$;

$\theta_1 = 35°$; $\theta_2 = 45°$; $\theta_3 = 60°$. [12]

Or

10. (*a*) Explain *three* (**3**) position synthesis for single slider crank mechanism. [6]

(*b*) A four bar mechanism is used to generate the function $y = 1/x$ for the range $1 \leq x \leq 3$. Find the three precision from Chebyshev spacing if the initial values of the crank angle and follower angle is 30° and 200° respectively. Take $\theta = \theta = 90°$. Find the corresponding values of and .[12]

UNIT VI

11. (*a*) With the help of neat schematic diagram derive frequency equation of compound pendulum. [4]

(*b*) A rectangular cross-section bar is suspended horizontally with the help of two equal length strings which are equidistance from centre of gravity of bar. The length of each string is 275 mm and the distance between each string and the centre of gravity of bar is 150 mm. The cross-section of bar is 25 mm × 20 mm. The length of the bar is 750 mm. The density of bar is 7.8 gm/cc. Two identical cylindrical components each with mass 450 gm are kept on the bar on either side of the centre of gravity of bar. The distance between the C.G. of the bar and the C.G. of cylindrical components is 200 mm. The system makes 100 oscillations in 150 sec. Find the radius of gyration of the bar and the cylindrical components. [12]

Or

12. (*a*) Explain the following terms : [4]

(*i*) Dynamically equivalent system

(*ii*) Correction couple.

(*b*) In slider crank mechanism, the crank is 300 mm long and connecting rod 850 mm long. The piston is of 90 mm in diameter and has pressure acting on the piston is 5 MPa. When the crank has moved through 45° from I.D.C. Find :

(*i*) Thrust in connecting rod;

(*ii*) Reaction from guide (piston side thrust);

(*iii*) Torque acting on the crankshaft and

(*iv*) Load on Main Bearing (Radial load). [12]