Total No. of Questions : 12]

SEAT No. :

P564

[Total No. of Pages : 7

[4457]-16

S.E. (Mechanical/Automobile) (Semester - II)

THEORY OF MACHINES - I

(2008 Course)

Time :4 Hours] *[Max. Marks :100*

Instructions to the candidates :

1) ***Answer three questions from Section I and three questions from Section II.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Your answers will be valued as a whole.***
6) ***Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
7) ***Assume suitable data, if necessary.***

SECTION - I

Unit - I

Q1) a) Define kinematic link, explain the types of rigid links. **[4]**

b) Explain the types of constrained motions with neat sketches. **[6]**

c) What is inversion of kinematic chain. Explain inversion of single slider crank chain, used as a Quick Return Mechanism. **[6]**

OR

Q2) a) State and explain 'Grashoff's Law'. State the conditions for, double crank mechanism, crank and rocker mechanism and double rocker mechanism.
Also explain about Deltoid four bar linkage. **[6]**

b) State and explain the condition for correct steering. Name the two main types of steering gear mechanisms used in automobiles. **[6]**

c) For the mechanism shown in fig.1, find,
i) No. of binary links.
ii) No. of binary joints.

P.T.O.

iii) No. of lower pairs.
iv) Degrees of freedom. **[4]**

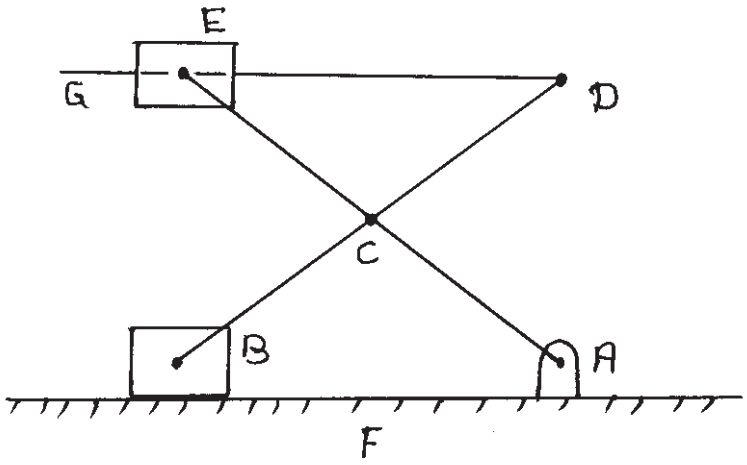

Fig. 1.

Unit - II

Q3) For the mechanism shown in Fig.2, the various dimensions are : OA = 50 mm, AB = 200 mm, QC = QB = 110 mm & CD = 100 mm. **[16]**
The crank OA rotates uniformly at 50 rad/sec. clockwise.
For the configuration shown in the figure, find :
a) Velocity and acceleration of slider D.
b) Angular Acceleration of link DC.
c) Angular velocity and angular acceleration of link BQC.
Use Relative velocity and Relative acceleration method.

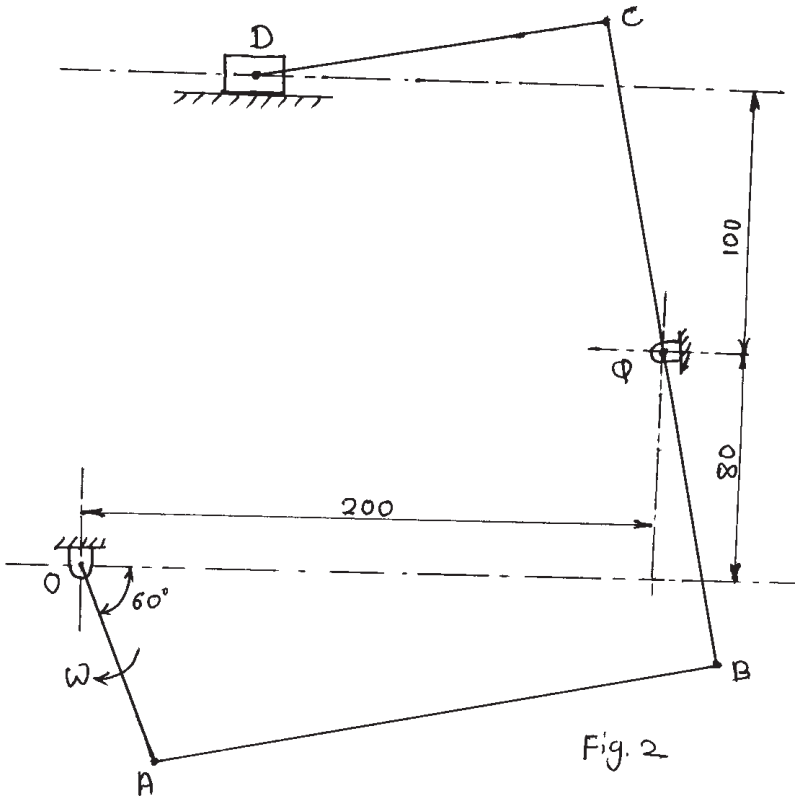

Fig. 2

OR

Q4) a) A horizontal link AB is 20 cm long. The direction of V_A is at 330° from positive X direction & that of V_B is at 60° from positive X direction. If V_B is 80 cm/sec, find V_A. **[4]**

b) The lengths of various links of mechanisms shown in fig.3 are OA = 0.3 m, AB = 1 m, CD = 0.8 m & AC = CB. Crank OA rotates at 60 rpm clockwise, Determine for the given configuration. **[12]**

i) Velocity of slider B.

ii) Velocity of slider D.

iii) Angular velocity of link CD.

iv) Angular velocity of link AB.

Use ICR method.

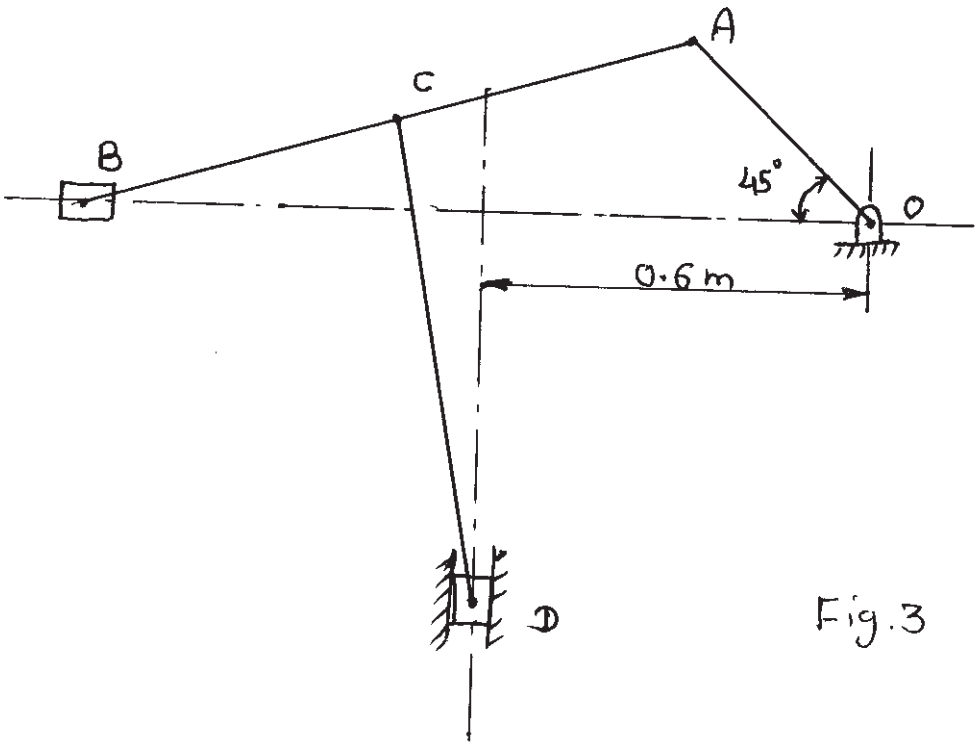

Fig.3

Unit - III

Q5) Fig.4 shows a quick return mechanism used in reciprocating machine tools.

Dimensions of various links are, OP = 85 mm, CR = 75 mm, RS = 405mm, OC = 150 mm.

The crank OP rotates at 18 rad/sec counter clockwise uniformly. **[18]**

For the given configuration, determine

a) Velocity and acceleration of slider S.

b) Angular acceleration of link RS.

[Find the required quantities in magnitude and directions]

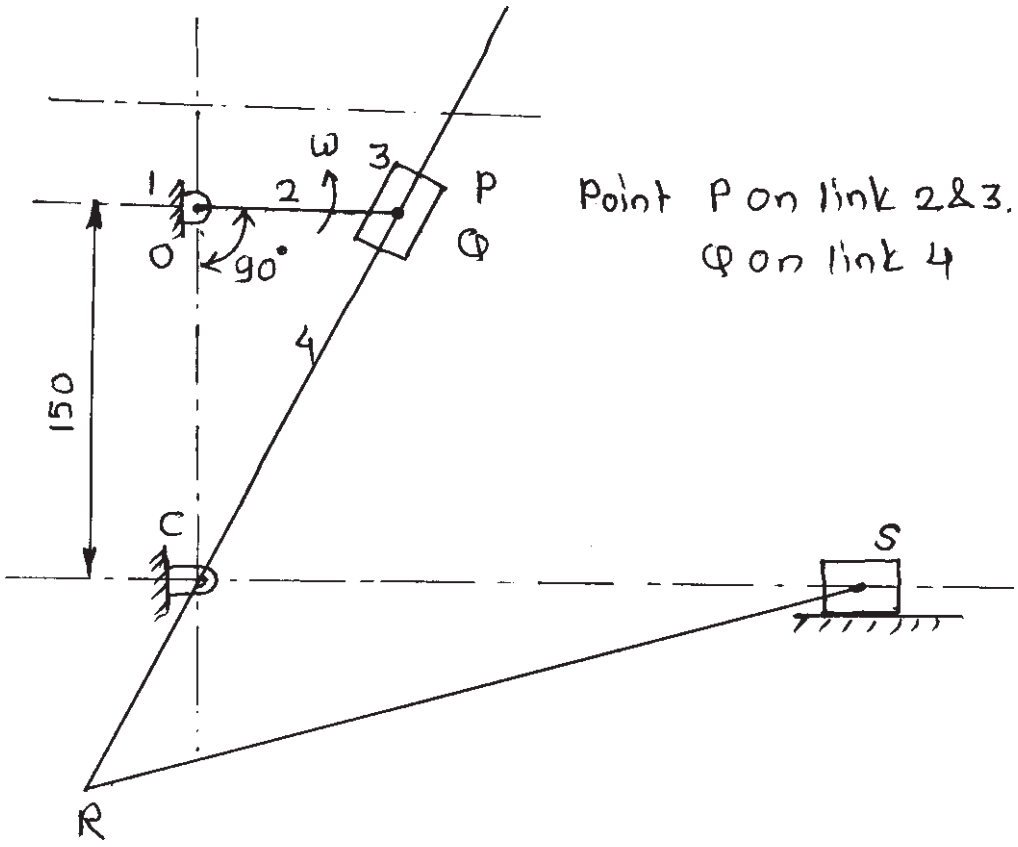

Fig. 4

OR

Q6) a) End A of a bar AB moves along a vertical path AD. The bar passes through a swivel bearing pivoted at point E. Which is 40 cm from the vertical AD. At the instant when the bar is 30° from horizontal, the end A is moving vertically at 3 m/sec. Such that the inclination of AB with horizontal decreases. This velocity of the end A decreases at the rate 1500 m/s per minute uniformly.

Draw the velocity and acceleration diagrams and find : **[12]**

i) Relative velocity between the bar and swivel.

ii) Sliding acceleration of the bar w.r.t. swivel.

iii) Angular velocity of the bar.

iv) Angular acceleration of the bar.

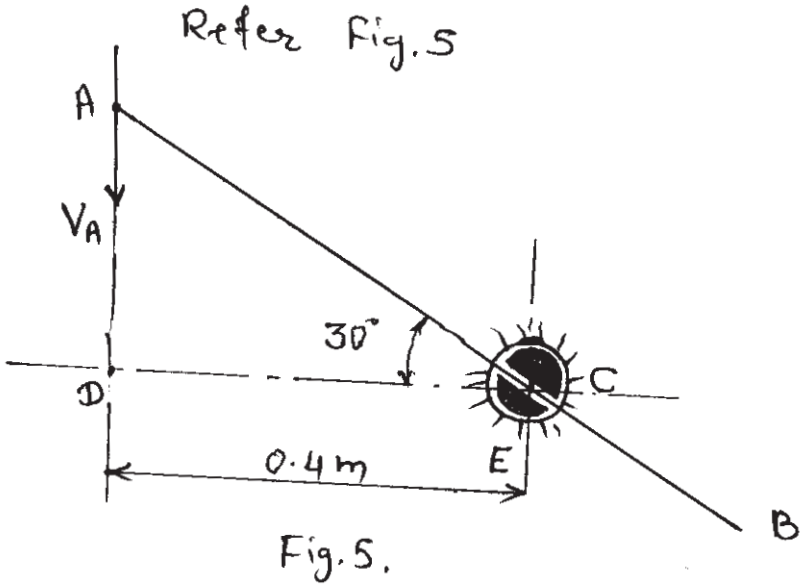

Fig. 5.

b) In a slider crank mechanism having stroke length 30 cm and obliquity ratio 4, the crank is rotating uniformly clockwise. The velocity of slider is 6 m/sec when the crank has turned 120° from IDC. Find using Klein's construction. **[6]**

i) Acceleration of slider.

ii) Angular velocity & Angular acceleration of the connecting rod.

SECTION - II

Unit - IV

Q7) a) A reciprocating engine has a crank 60 mm long and the connecting rod is 240 mm long. It runs at 1200 r.p.m. Find by analytical method :

i) Maximum velocity of piston and the corresponding crank angle.

ii) Acceleration of piston when the crank is at 120° past IDC.

[8]

b) The driving shaft of a single Hooke's joint rotates at 800 r.p.m. The angle between driving and driven shafts is 15°. Find the highest and lowest magnitude of driven shaft speed in r.p.m.

What are the shaft rotation angles starting from standard initial position, for which the velocity ratio is one?

Also draw the schematic polar diagram of the Hooke's joint, including all the important values. **[8]**

OR

Q8) a) Derive formula for analytically calculating instantaneous linear velocity of slider from a slider crank mechanism. **[4]**

b) Derive loop closure equation for four bar chain mechanism. **[4]**

c) In an I.C. Engine mechanism, the stroke of piston is 400 mm and obliquity ratio is 4.5. The crank rotates uniformly at 600 r.p.m. in clockwise direction. Find velocity and acceleration of piston when the crank is approaching IDC and connecting rod is perpendicular to the crank. Also find angular velocity of connecting rod. **[8]**

Unit - V

Q9) a) A function varies from 0 to 10. Find the Chebychev spacing for six precision points. **[6]**

b) Explain with the help of neat sketches, what is meant by "Path generation", "Function generation", and "Motion generation". **[6]**

c) Explain the following terms : **[6]**

i) Type synthesis.

ii) Number synthesis &

iii) Dimensional synthesis.

OR

Q10) a) 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 positions from Chebychev spacing if the initial values of the crank angle and follower angle is 30° and 200° respectively.

Take $\Delta\theta = \Delta\phi = 90°$. Find the corresponding values of θ & ϕ. **[12]**

b) Derive an expression for Freudenstein's equation. **[6]**

Unit - VI

Q11) a) With the help of neat schematic diagram derive frequency equation of compound pendulum. **[8]**

b) Explain the concept of two point mass dynamically equivalent system. **[4]**

c) What is meant by "Correction couple"? When do we need to consider it? **[4]**

OR

Q12) a) A rigid link, 500 mm long, has mass 2 kg and radius of gyration 200 mm. Replace this link by dynamically equivalent system of two concentrated masses located at the ends of the link. **[6]**

b) A disc like machine component of 7 kg mass is placed on a horizontal circular platform, which is suspended by three equal wires, each 1m long, from a rigid support. The wires are equally spaced around the circumference of a circle with 200 mm diameter. When the mass center of the component coincides with the rotational axis of the platform, it takes 30 seconds for 10 oscillations. Find Moment of Inertia of the machine component as well as its radius of gyration about the axis through its mass centre. **[6]**

c) Compare "Compound Pendulum Method" and "Bifilar Suspension Method", of finding moment of inertia of a rod like body. **[4]**