Total No. of Questions : 7]

SEAT No. :

P4131

[Total No. of Pages : 4

[4760] - 1067

M.E. (Mechanical) (Design Engg.) (Semester - II)

ANALYSIS AND SYNTHESIS OF MECHANISMS

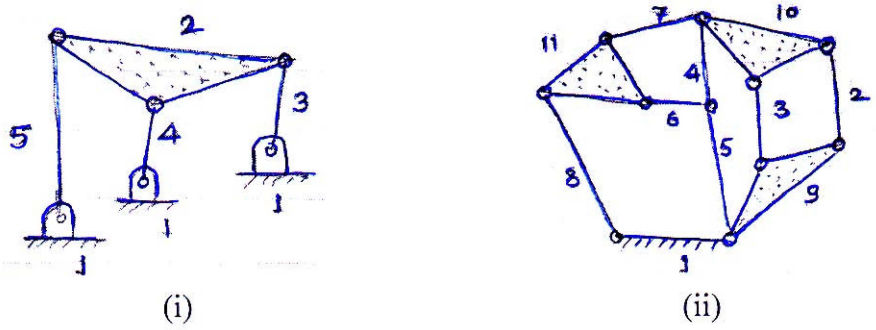
(2013 Pattern)

Time : 3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) *Answer any five questions.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right side indicate full marks.*
4) *Use of calculator is allowed.*
5) *Assume suitable data if necessary.*

Q1) a) Explain the term 'Mobility of a mechanism'. Find the mobility of the linkages shown in Fig. 1 (a). Based on this, state whether the linkages shown are mechanisms with 1 DOF. If not, make suitable changes. The number of links should not be varied by more than 1. **[5]**



(i) (ii)

Fig.1(a)

b) Explain the term 'Kinematically Complex' mechanism. Discuss the terms with suitable examples **[5]**

i) low degree of complexity &

ii) high degree of complexity.

P.T.O.

In the mechanism shown in the Fig.1 (b) below, ω_2 = 10 rad/sec (CW) (constant). Determine ω_6 & α_6. (Use method of Normal Accelerations.)
Given: O_2A = 7.5 cm, AB = 5 cm, BC = 7.5 cm, O_5C = 6.25 cm (and is vertical), CD = 10 cm, BD = 5cm, O_6D = 5cm, Angle O_2AB = 110°, Angle ABC = 115°, Angle = O_6DB = 117°.

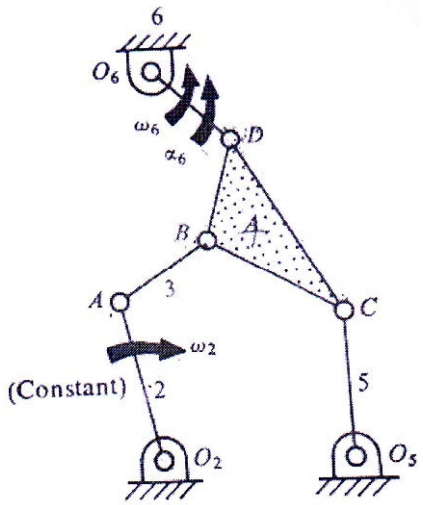


Fig.1(b)

Q2) a) State the 'Principle of Superposition'. Derive the equation of motion of a mechanism based on energy considerations. **[5]**

b) What are 'Elastic mechanisms'? Discuss the dynamic analysis of elastic mechanism. **[5]**

Q3) a) What is 'Inflection Circle? Discuss in details the method/construction to locate 'inflection circle'. **[5]**

b) Explain in brief following : **[5]**

i) Bobilliar Construction

ii) Hartmann Construction

iii) Forms of Euler - Savary equation

Q4) a) Define the term 'Cubic of Stationary curvature'. Determine the cubic of stationary curvature for plane motion equivalent to the rolling of a circle along a fixed straight line. **[5]**

b) Discuss 3-position graphical synthesis of a 4-bar mechanism for body guidance. Synthesize a 4-bar mechanism to guide a rod AB through the three consecutive positions A_1B_1, A_2B_2 & A_3B_3 as shown in Fig.4(b). **[5]**

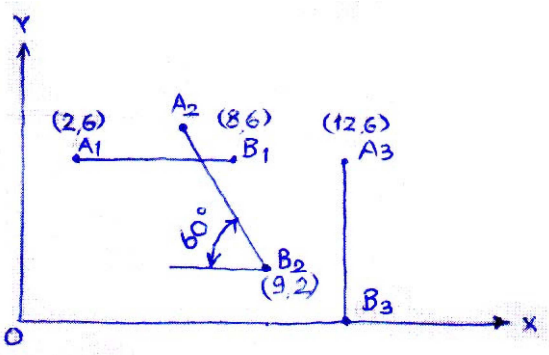


Fig.4(b)

Q5) a) Explain with suitable example - **[5]**

i) Motion generation

ii) Function generation

iii) Path generation

b) Discuss the term 'mechanical error'. Explain the analysis of 'mechanical error' & prove that the total mechanical error (ε_m) in the linkage is the sum of the individual errors due to each of the parameters considered separately. **[5]**

Q6) a) Derive 'Freudenstein's equation for planar 4-bar linkage. Explain the algebraic synthesis of slider crank with 4- accuracy points using this equation. **[5]**

b) Explain the method of algebraic synthesis using complex numbers for 4-bar mechanism with 3- accuracy points. Using this method, determine the link lengths of a 4-bar linkage that will in one of its position satisfy the following specifications of angular velocity & angular acceleration. Length of input link is to be unity. The subscript 1, 2, & 3 represent the input link, the coupler & the output link respectively. Draw the mechanism & comment on the resulting mechanism. (Use Complex number method.)**[5]**

Angular velocity	Angular acceleration
$\omega_1 = -10.00$ rad/sec	$\alpha_1 = 0$ rad/sec^2
$\omega_2 = 5$ rad/sec	$\alpha_2 = 0$ rad/sec^2
$\omega_2 = 0$ rad/sec	$\alpha_2 = 86.6$ rad/sec^2

Q7) a) Discuss Denavit-Hartenberg (D-H) parameters with their importance in analysis of spatial mechanisms. Use D-H parameters to write a symbolic equation for the following mechanisms. **[5]**

i) Planar 4R Mechanism

ii) Spherical 4R mechanism

b) Derive displacement equations for the 4R Spherical mechanism (Hooke's Joint) using matrix method. **[5]**

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