Total No. of Questions : 7]

SEAT No. :

P4261

[Total No. of Pages : 3

[4860] - 1068
M.E. (Mechanical)
DESIGN ENGINEERING
Analysis and Synthesis of Mechanisms
(2013 Credit Pattern) (Semester - II) (502207)

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) Define the term 'Mobility of a mechanism' & discuss in brief following criterion with suitable examples. **[5]**

i) Kutzbach Criterion

ii) Grubler Criterion

iii) Grashof's Criterion

A linkage has 14 links & 5 loops. Calculate its

i) Degree of freedom

ii) Number of joints

iii) Maximum number of ternary links

b) Discuss the term 'Transmission angle' & explain how this parameter can be used to measure the performance of a mechanism. **[5]**

Explain the term 'Kinematically Complex' mechanism. Discuss the steps in kinematic analysis of complex mechanism. State the importance & applicability of the 'Auxiliary-point method'.

P.T.O.

Q2) a) What are equivalent linkages? Discuss the need of the same also state its limitation. Fig. Q.2 (a) shows generalized cam mechanism. Find out an equivalent mechanism with lower pairs only. **[5]**

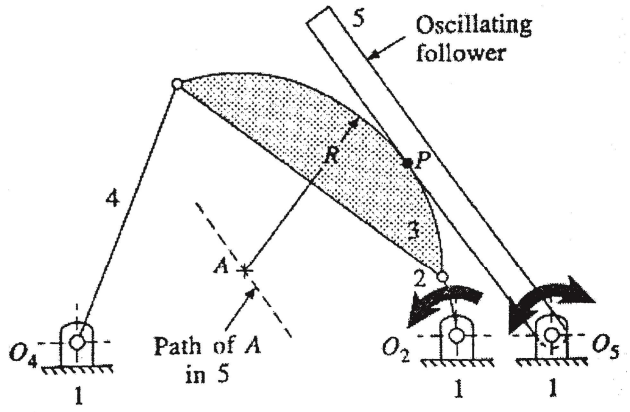

Fig. Q.2 (a)

b) Explain the steps in the dynamic force analysis for slider crank mechanism in brief. What are elastic mechanisms? **[5]**

Q3) a) Derive Euler-Savary equation. Discuss its importance. State different forms of Euler-Savary equation. **[5]**

b) What is 'Inflection Circle'? Explain Bobillier Construction. **[5]**

Q4) a) Explain 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 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. Q.4 (b). **[5]**

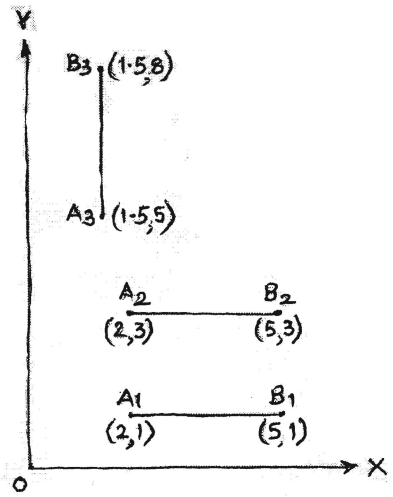

Fig. Q.4 (b)

Q5) a) Discuss spacing of accuracy points using Chebyshev polynomial. Explain the 'error curve with three accuracy points' & 'optimum error curve'. What are the branch and order defects? **[5]**

b) Discuss the procedure to synthesize 4-bar linkage for given angular velocity & acceleration using Freudenstein's equation. Using this method, design a 4-bar linkage meeting the following specifications of position, velocity & acceleration. **[5]**

Parameters	Crank (Input link)	Follower (Output link)
Angle	$\phi = 90^{\circ}$	$\psi = 90^{\circ}$
Angular velocity	$\omega_{\phi} = 3 \text{rad/sec}$	$\omega_{\psi} = 1.20 \text{rad/sec}$
Angular acceleration	$\alpha_{\phi} = 0 \text{rad/sec}^2$	$\alpha_{\psi} = 1.62 \text{rad/sec}^2$

Q6) a) Using complex number notations, derive the link lengths a_1, a_2, a_3 & a_4 for a 4-bar mechanism in terms of angular velocity & angular acceleration. Using Complex number method, determine the proportions of a 4-bar linkage that will in one of its position have parallel crank & follower & satisfy the following specifications, **[5]**

Parameters	
Angular velocity	Angular acceleration
$\omega_1 = 3.00 \text{rad/sec}$	$\alpha_1 = 0 \text{rad/sec}^2$
$\omega_2 = 0 \text{rad/sec}$	$\alpha_2 = 1 \text{rad/sec}^2$
$\omega_2 = 1 \text{rad/sec}$	$\alpha_2 = 0 \text{rad/sec}^2$

b) What is 'cognate mechanism'? Discuss Robert Chebyshev theorem for the same. State the factor on which the choice of cognate mechanism depends. **[5]**

Q7) a) What is 'Spatial Mechanism'? Discuss it in brief with examples. What are Denavit-Hartenberg (D-H) parameters. Explain the use of D-H parameters with suitable example. **[5]**

b) Discuss the steps involved in matrix method of analysis of spatial mechanism taking 4R Spherical mechanism (Hooke's Joint) as an example. **[5]**