Menoufiya University **Faculty of Engineering, Shebin El-Kom** **Production and Mechanical Engineering Department** **First Semester Examination ,2013-2014** **Date of Exam : 12 /1 / 2014**	**Subject: Mechanisms** **Code : PRE615** **Level : (Postgraduate-600) .** **Time Allowed : Three hours** **Total Marks : 100 marks**

Answer the following three questions:

(Q.1) [35 marks]:

The following figure (1) indicates a compound mechanism which consists from two connected successive mechanism. The first mechanism is a four bar mechanism of linkages (a_1, a_2, a_3 & a_4). Second one is slider piston mechanism of links (a_4 & L & piston). The piston of this compound mechanism can be used as reciprocating punching tool through driving the compound mechanism by a suitable motor to give a rotation motion to the link (a_2). The links lengths in cm are (a_1=100, a_2=40, a_3=70, a_4=90 , L=100& E=30).

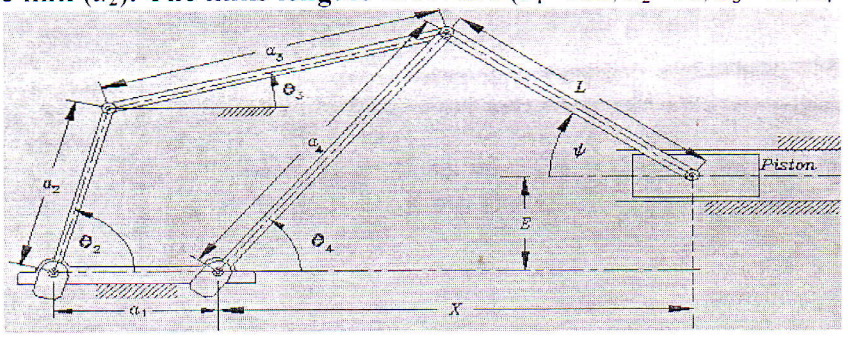

Figure (1)

a) Compute the degree of freedom of this compound mechanism and write the kind of the first mechanism of linkages (a_1, a_2, a_3 & a_4). (5 marks)

b) Draw this compound mechanism at crank angle (θ_2=60°) to determine the coupler angle (θ_3) and the output angle (θ_4) of link (a_1) and the travelling distance (X) of the piston. (5 marks)

c) Use the vector method to drive equations of (θ_3) & (θ_4) as a function of (a_1, a_2, a_3, a_4 & θ_2). Hence, check the calculated values of (θ_3,θ_4) at θ_2=60° with graphical ones. (15 marks)

d) Use the vector method to drive an equation of (X) as a function of (a_4, L , E&θ_4). Hence, check the calculated values of (X) at (θ_2=60°) with graphical one. (10 marks)

(Q.2) [35 marks]:

a) Draw the velocity and acceleration diagrams of mechanism which is indicated in Fig.1 at (θ_2=60°) to determine angular velocities and accelerations (ω_3 & α_3 of link a_3) and (ω_4 & α_4 of link a_4) and (ω_L &α_L of link L) if the angular constant velocity (ω_2=1 rad/sec) of link (a_2). (15 marks)

b) Use the vector method to drive equations of angular velocities (ω_3 & ω_4) as a function of ($a_{1,2,3,4}$,$\theta_{2,3,4}$& ω_2) and the equation of (ω_L) and (dx/dt) as a functions of (a_4, L, E,θ_4). Hence, check these calculated values (ω_3, ω_4, ω_L, & dx/dt)at a (θ_2=60°) with graphical ones. (10 marks)

c) Use the vector method to drive equations of angular accelerations (α_3 & α_4) as a function of ($a_{1,2,3,4}$,$\theta_{2,3,4}$, ω_2, α_2) and the equation of (α_L) and (d^2x/dt^2) as a functions of (a_4, L, E,θ_4&ω_L). Hence, check calculated values (α_3, α_4, α_L,&d^2x/dt^2)at (θ_2=60°) with graphical ones. (10 marks)

(Q.3) [30 marks]:

Calculate at (θ_2=60° of link a_2) the torque of the motor which can drive the crank link (a_2 in Fig.1) through driving it with a constant angular speed (1 rad/sec.) for giving a <u>pure reciprocating sliding motion</u> to the piston of this compound mechanism, if this mechanisms linkages have the following masses in Kilograms: (M_2=1 kg of a_2 , M_3=1 kg of a_3 , M_4=2 kg of a_4 , M_L=0 kg of L & M_{piston}=3 kg of piston)

With my best wishes *DR/ Khaled Khader*

This exam measures the following ILOs														
Question Number	Q1-a	Q1-b	Q1-c	Q1-d	Q2-a	Q2-b	Q2-c	Q2-b	Q2-a	Q2-b	Q3		Q1-a	
Skills	a1-1	a2-1	a3-1	a4-1	b1-1	b2-1	b3-1	b4-1	c1-1	c2-1	c3-1	c4-1	d1-1	
	Knowledge &Understand Skills				Intellectual Skills				Professional Skills				General SK.	