Menoufiya University
Faculty of Engineering, Shebin El-Kom
Production Engineering and Mechanical Design Department
Second Semester Examination,2014-2015

Subject: *Materials Handling and Systems Design*
Code: PRE325 / Year: Third Year
Time Allowed : three hours
Total Marks : 120 marks
Date of Exam : 23 / 5 / 2015

**Answer all following six questions** [Note: each question has 20 marks] **"Assume any required data"**

**(Q.1)** [20 marks]

A) Define the tasks of the dimensional synthesis.

B) **Date:** The three prescribed coupler ($R_3$ = AB = 5 cm) point coordinates ($x$ , $y$) of A and $\theta_3$ positions are as;
$A_1(2 , 4)$ , $\theta_{31}=307^o$ , $A_2(1.55 , 5)$ , $\theta_{32}=310^o$ and $A_3(0.0 , 6)$ , $\theta_{33}=325^o$

**Req.:**
1) Construct 4b planer mechanism by graphical synthesis method in plane { $x\ O_4\ y$ }.
2) Study this mechanism (name , $\gamma$'s , $\phi_4$ and $T_R$ ).
3) If ($x$ , $y$) of the coupler point "P" at the 1st position is $P_1(8 , 0.0)$, find ($x$ , $y$) of $P_2$ and $P_3$
4) What is the generation problem type ? why?
5) Is this mechanism used as hoisting or conveying handling system? why?

**(Q.2)** [20 marks]

**Date:** A fork-lift truck shown if *Fig.*1

**Req.:** 1) Show all forces acting on the system due to motions of machine "m" and fork "F"
2) Draw the relation between the lifting load Q by fork at c.g.Q and both $K_t$ and $K_s$ . Consider $\theta=10^o$ , $W_m$=12 tons, b=2a=2$h_q$=(4/3)c=4m, $\mu$=0.15, $\ddot{x}_m$= -20 km/$h^2$, $\ddot{y}_F$=-9 m/$s^2$

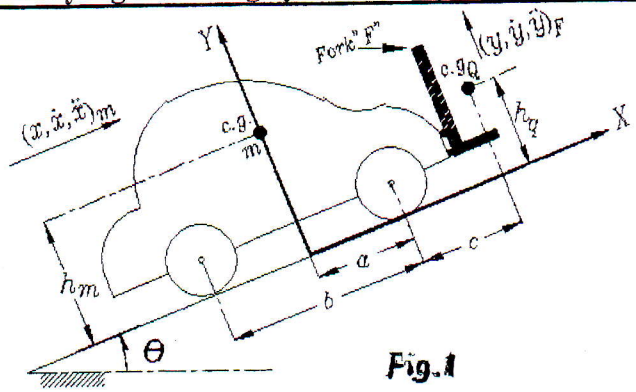

Fig.1

**(Q.3)** [20 marks]

A): **Date:** Inclined conveyor trough (*Fig.*2) conveys load weight W.

**Req.:** Driving motion ( $\ddot{x}$ ) which satisfies positive sliding conveying stage.
Consider $\theta=10^o$, $\mu$=0.15

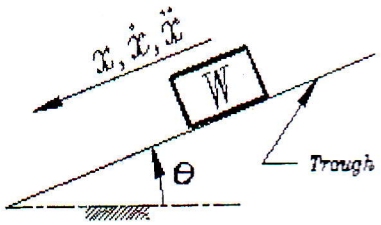

*Fig.*2

B): **Date:** Three flexible hoisting systems (*Fig.*3)

**Req.:**
1) Illustrate the type of motions of each pulley.
2) Drive $\eta=f(n_p , \varepsilon)$ for each system.
3) Find Q and h if $F_p$=100N and s=4m for each system.
4) Choice the best system! why?

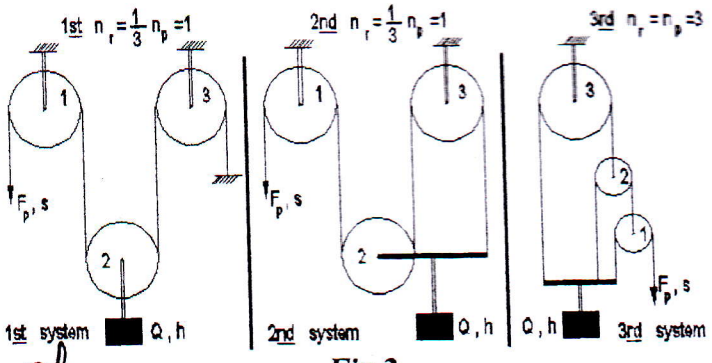

*Fig.*3

*With my best wishes* *(Prof. /Sabry El-Shakery*

**(Q.4)** [20 marks] [Note: point (A) has 10 marks and point (B) has 10 marks ]

A) Write ( √ ) only beside each correct of following statements or write ( $X$ ) if the statement contains any mistake, then write corrections of mistakes over mistakes directly :-

1) Cartesian robot advantage is independent of gravity loadings and collision-free movement.
2) Medium-Technology robots are only operated by air pistons and operate as fast as (3HZ).
3) Clamping elements of gripper are coming into direct contact with manipulated object.
4) Polar robot has disadvantage as "short joint travel for many motions".
5) Good obstacle avoidance and collision prevent is an advantage of spherical robots.

B) For a robot;

1) Find Trans. matrix $A_1^2 = T(Z_1, d_2 = 1cm)\, R(X_1, \alpha_2 = 45^0)$ and $B_2^3 = R(Z_2, \theta_3 = 30^0)\, T(Z_2, d_3 = 2cm)$
2) Find the equivalent Trans. matrix as; $R = A_1^2\ B_2^3$

**(Q.5)** [20 marks] [Note: point (A) has 5 marks and point (B) has 15 marks ]

A) List the basis parameters for gripping device design.

B) The following *Fig.*4 shows a simple gripper which consists from two symmetric four-bar mechanism, the first one is OABP mechanism, where OP is the fixed link of length ($a_1$) and point O has a coordinate ($x,y$) equal to (0,0). The extension of link PB is forming the gripper finger. The link OA is connected to sliding block at point C through link AC. Find;

1) The equation of $\theta_4 = f(\theta_2, a_1, a_2, a_3, a_4)$ and the equation of $X = f(\theta_2, L, a_2)$
2) Analytically find lengths ($a_3$) of AB and ($a_4$) of BP and (L) of AC at $\theta_2 = 30^0$ if $a_1$=45 cm, $a_2$=35 cm and $X$=68.15 cm if the coordinate ($x,y$) of point (B) is ($X_B$=55, $Y_B$=49) related to O of (0,0).
3) Compute ($\theta_4$, X) "and check graphically" at $\theta_2 = 60^0$, ($a_1$=45, $a_2$=35)cm, use calculated ($a_3$, $a_4$& L) .

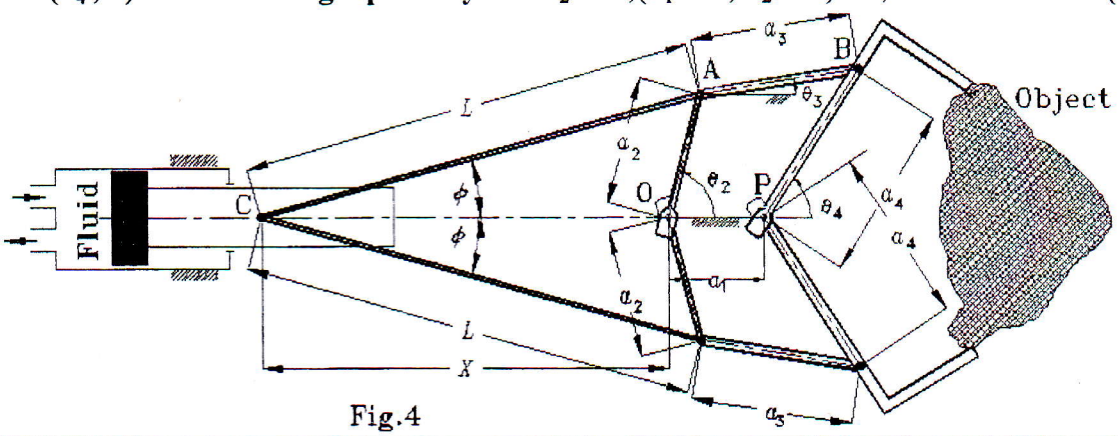


Fig.4

**(Q.6)** [20 marks] [Note: point (A) has 5 marks and point (B) has 15 marks ]

A) List the five type elements of the grasping mechanism.

B) *Fig.*5 shows a simple slider crank mechanism OAB has a piston block which can push an object against a resistant force ( $F$ ).

1) For piston, drive the equation $X = f(\theta, R, L)$ and its linear speed $\dot{X} = f(\omega, \theta, R, ....etc)$ and its acceleration $\ddot{X} = f(\alpha, \omega, \theta, ...etc)$
2) At $\theta = 53.13^0$ , R=30cm, L=40 cm, constant $\omega$=1 r/s and F=500N, find analytically the values ($X$, $\dot{X}$, $\ddot{X}$) "and check these values graphically". Try to find torque (T) which must applied to OA if mass $m_2$=10Kg of OA concentrated at mid of OA and mass $m_p$=50Kg of piston block concentrated at B, assume link AB is massless $m_{AB}$=0, friction coefficient $\mu$=0.1 of piston and ground

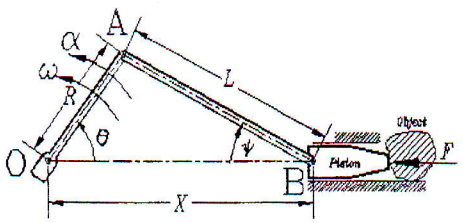


*Fig.*5

*With my best wishes* *(DR/ Khaled Khader )*

| This exam contributes "by measuring" in achieving Programme Academic Standards according to NARS | | | | | | | |
|---|---|---|---|---|---|---|---|
| Question Number | Q1-a | Q4-a | Q5-a, Q6-a | Q1-b, Q2, Q5-b | Q3-b, Q4-b | Q3-a | Q5-b, Q6-b |
| Skills | a3-1 | a16-1 | a16-2 | b12-1 | b13-1 | c5-1 | c6-1 |
| | Knowledge & Understanding Skills | | | Intellectual Skills | | Professional Skills | |