جامعة المنوفيه – كلية الهندسة بشبين الكوم
قسم العلوم الأساسية الهندسية
إختبار تأهيلى ماجستير فى الميكانيكا الهندسية
الفصل الدراسي الأول

المقرر: ديناميكا مجموعات الأجسام الجاسئة
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الزمن المسموح: ثلاث ساعات

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Answer all the following questions:

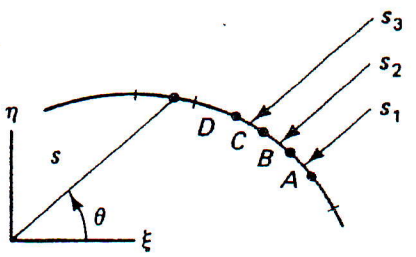
1-1) What are the elements and kinds of mechanisms?.

1-2) The kinematic constraints of a four-bar mechanism are: $2\cos\theta_1 + 4\cos\theta_2 - 3\cos\theta_3 = 3.5$, $2\sin\theta_1 + 4\sin\theta_2 - 3\sin\theta_3 = 1$. If the initial angular displacement of the crank is $\theta_1^o = 2.36$ rad, and its constant angular velocity is 2π rad/sec and $\theta_2 = 0.57$rad. Determine the initial angular velocity and the initial angular acceleration of each body of the mechanism.

2-1) Classify the kinematic pairs and illustrate six examples.

2-2) The curve of a cam follower is descritized and a porsion of the recorded data is listed as shown in the figure.

Point	θ (rad)	s (cm)
.	.	.
.	.	.
.	.	.
A	0.2	3.75
B	0.3	3.57
C	0.4	3.35
D	0.5	3.10
.	.	.
.	.	.
.	.	.



A spline function algorithm finds three cubic polynomials for three segments of the curve:

$s_1 = -6.538\theta^3 + 3.230\theta^2 - 2.173\theta + 4.108$ cm

$s_2 = 6.538\theta^3 - 8.538\theta^2 + 1.358\theta + 3.755$ cm

$s_3 = -9.515\theta^3 + 10.846\theta^2 - 6.396\theta + 4.788$ cm

Show that s_1 and s_2 and their first derivatives are contiouous at point B. Determine the slope of tangent ($d\eta/d\xi$) at the point P ahere $\theta^P = 0.26$ rad

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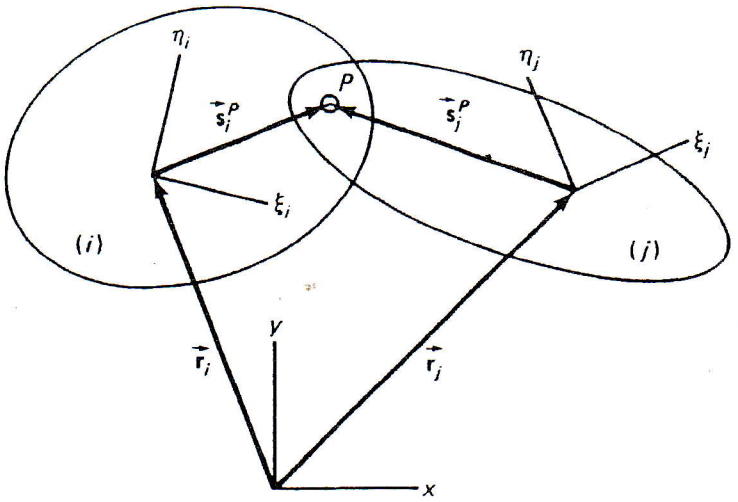
3-1) What are the four basic types of motion in solid mechanics, illustrate some examples.

3-2) Consider the shown system of two moving bodies connected by a revolute joint. The external forces acting on the system are gravity, a constant force of 10N acting on body i in the negative x dierction, and a constant force of 10N acting on body j in the positive x direction. The vectors of coordinates, velocities, and accelerations are:

$\mathbf{q}_i = [1.58, 1.59, 0.6]^T$, $\mathbf{q}_j = [3.4, 1.96, 0.2]^T$,

$\dot{\mathbf{q}}_i = [1.1, 0.2, -0.02]^T$, $\dot{\mathbf{q}}_j = [1.14, 0.24, 0.03]^T$,

The linear acceleration components of body i are: $\ddot{x} = 1.1\,\mathrm{m/sec^2}$ and $\ddot{y} = 0.2\,\mathrm{m/sec^2}$, and the constant quantities of this system are: $m_i = 1.2$ kg, $m_j = 2$ kg, $\mu_i = 2.5$ kgm^2, $\mu_j = 4$ kg.m^2,



i) Calculate the number of degrees of freedom of the system.
ii) Calculate the joint reaction forces at the instant.
iii) Calculate the angular acceleration $\ddot{\varphi}_i$ and the acceleration vector $\ddot{\mathbf{q}}_j = [\ddot{x}, \ddot{y}, \ddot{\varphi}]^T$
iv) Check your results.
v) Express the equations of motion of the system in matrix form.

4-1) Define the types of constraints and explain their differences.
4-2) Consider the classical problem of a circular disk D with radius R=√14 cm rolling on a rough flat horizontal surface S. Let $P(x_o,y_p,z_p)$ be the point of contact between D and S, where: $x_p=0.5t^2$ sec, $y_p=-0.5t$ sec, and let $C(x_c,y_c,z_c)$ be the center of mass of D where $z_c=0.75t^2$sec. Let x, y and z be coordinate axes fixed on S with origin o and with z being vertical, and let ξ, η and ζ be the moving coordinates fixed on D with origin C. Where the rotational transformation matrix of the coordinate systems is given by the matrix

$$A = \begin{bmatrix} 0.3 & 0.2 & -0.7 \\ 0.2 & 0.5 & -0.4 \\ -0.7 & -0.4 & 0.6 \end{bmatrix}$$

, (a) Deduce the components of the vector ρ from C to P and the position vector **r** from o to C at t=2sec. (b) Show that the rolling disk with no slipping condition is considered a non-holonomic constraint, while the rolling with longitudinal slipping is considered as a holonomic constraint.

5-1) Define the differences between a special purpose computer program and a general purpose computer program. What are four major tasks that must be performed by the general-purpose computer program for the dynamic analysis of multibody systems?
5-2) Write down the meanings of the following abbreviations CAE, CAM, CAD, CAP, DAP, ADAMS, MBOSS, DADS.

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