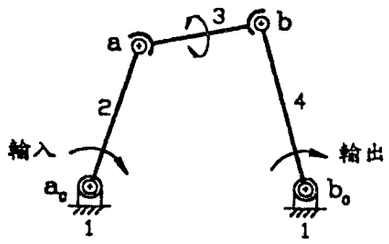
A1. (5%)
試解釋機構(Mechanism)與機器(Machine)的異同。

A2. (10%)
試說明一個圓球與一個圓筒相接觸的運動對(Kinematic pair)特性。

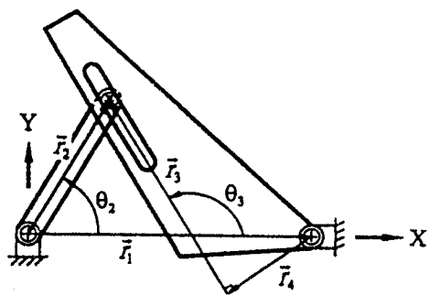
A3. (10%)
有一個RSSR空間四連桿機構，如圖A1所示，試：
1. 計算這個機構的自由度(Degrees of freedom)，
2. 說明這個機構是否做拘束運動(Constrained motion)。

A4. (5%)
針對滑件曲柄機構(Slider-crank mechanism)而言，試定義其傳力角(Transmission angle)。

A5. (20%)
有一個三桿機構，如圖 A2 所示，r_1=14cm 、 r_2=8cm 、 r_3=10cm 、 r_4=5.196cm ，θ_2=60° 、θ_3=120° ，桿 2 為輸入桿，以等角速度ω_2=1 rad/sec 順時針方向旋轉。當θ_2=50° 時，試利用向量迴路法(Vector loop approach):
(a) 導出位移方程式(Displacement equation)，
(b) 導出速度方程式(Velocity equation)，
(c) 導出加速度方程式(Acceleration equation)，
(d) 以數值法(Numerical method)進行二次疊代，求解未知的位置變數。



圖A1



圖A2

B1. A cam with a translating flat-faced follower is shown in Figure 1. This figure depicts an inversion of the cam-follower mechanism where the cam is fixed and the follower moves relative to it. In normal operation, the cam would rotate and the follower would translate in a guideway along the y axis. The cam, having base circle radius r_b, is assumed to rotate in the clockwise direction under normal operation. Thus, for a cam rotation θ, the follower will rotate counterclockwise relative to the cam through angle θ while experiencing a translational displacement s, as shown in the figure. It is assumed that the follower displacement is a known function of the cam angle. Point P is the intersection of the face of the follower and its axis. Point Q is the cam-follower contact point for cam angle θ. The distance l between points P and Q is the perpendicular distance from the follower centerline to the contact point.

(a) Derive expressions for the cam profile coordinates.(10%)

(b) Show that the expression for the distance l can be written as v/ω which is the translational follower velocity divided by the rotational cam velocity.(10%)

B2. (a) Design a gear train similar to Figure 2 so that ω_c =100 rad/s ccw for ω_s =300 rad/s cw when ring gear is fixed. Let the sun gear pitch diameter d_s be 80 mm and the module 4 mm. All gears are standard gears with full-depth involute teeth. Determine the tooth number N_R of ring gear and find the possible range of tooth number N_p of planet gears. Hint: Consider the addendum of teeth.(10%)

(b)Find the speed of each gear after selecting $N_{p_1} = N_{p_2} = N_s$, and then check the speed ratio using the formula method.(10%)

B3. (a) State the fundamental law of gearing.(5%)

(b) Describe the necessary conditions for parallel helical gears to mesh properly. (5%)

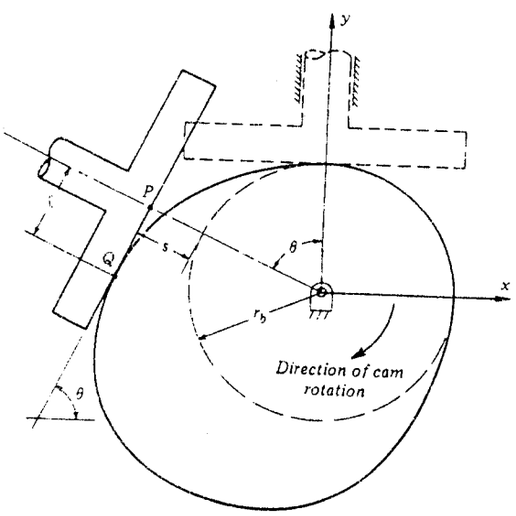


Figure 1

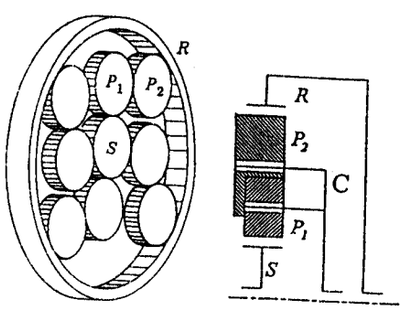


Figure 2