國立虎尾科技大學 110 學年度第 1 學期博士班資格考試題

系別：動力機械工程系機械與機電工程博士班

科目：機構學 Mechanisms

注意事項：

（1）本試題共有 6 題，合計 100 分。

（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。

（3）可 使用計算機 close book

1. There are 9 kinematic pairs shown in Fig. 1. (a). What kinematic pairs have 1 degrees of freedom? (b). What kinematic pairs have 2 degrees of freedom? and (c). What kinematic pairs have 3 degrees of freedom? (15%)

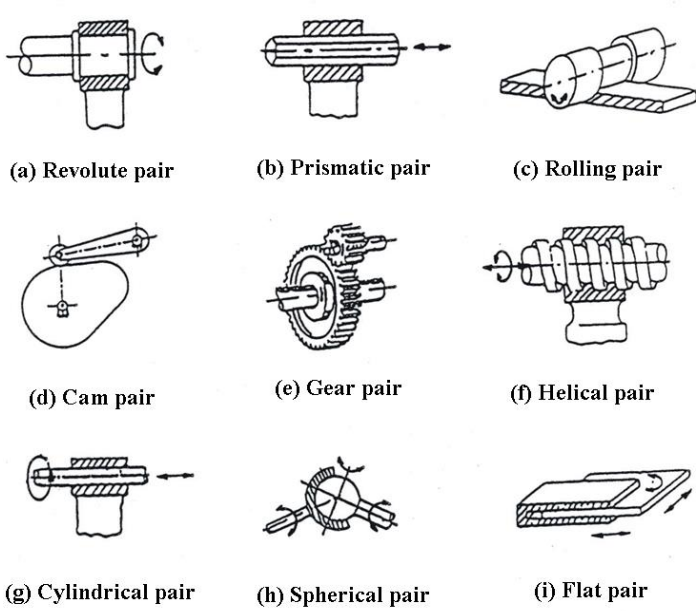
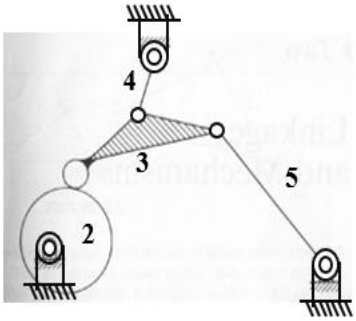
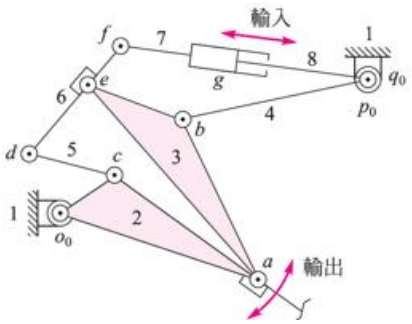
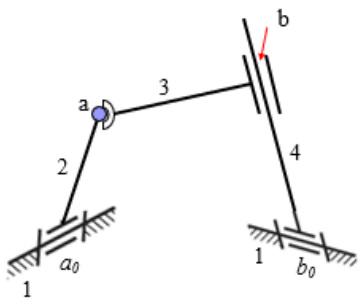


Fig. 1. The kinematic pairs of mechanism

2. Determine the mobility (number of degrees of freedom) of the following mechanical devices shown in Fig.2. (15%)







Fg.1. (a) (b) (c)

3. For the 4-bar mechanism shown in Fig. 3, crank 2 is to rotate continuously and link 4 is to oscillate. What are the maximum and minimum values in millimeters which can be used for the coupler length (l_3). (20%)

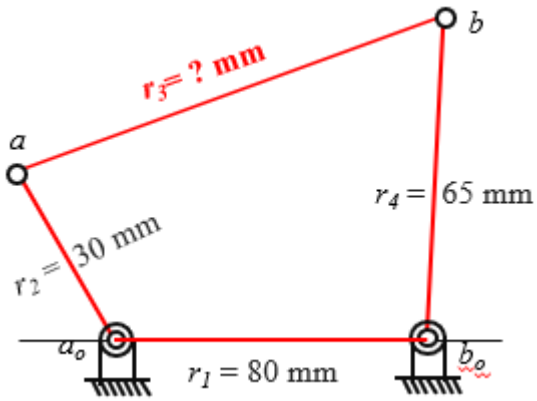


Fig. 3. 4-bar mechanism

4. For the 4-bar mechanism, shown in Fig. 3, with **r_1=70cm, r_2=30cm, r_3=95cm, and r_4=65cm.** When **θ_2 =120° and ω_2=1200rpm**, please find (a) the angular displacements of θ_3 and θ_4, (b) the angular velocities of ω_3 and ω_4. (20%)

5. A 2.5-module, 25° pinion of 18 teeth drives a 72-teeth gear. Calculate the pitch radii, base radii, addendum, dedendum, tooth thickness on the pitch circle, and the contact ratio. (15%)

6. For the planetary gear train shown in Fig. 4, gear 2 rotates at 600rpm in the clockwise direction. Calculate the output speed and direction of rotation of gear 5. (15%)

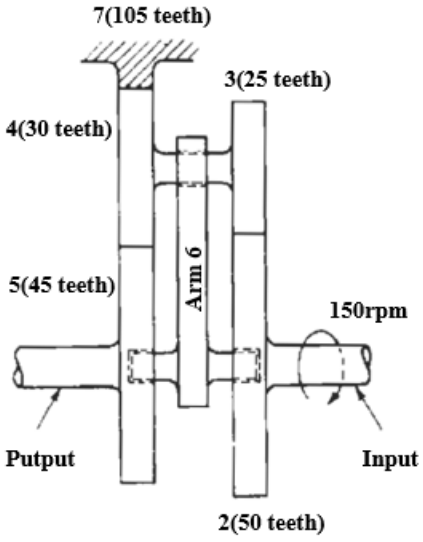


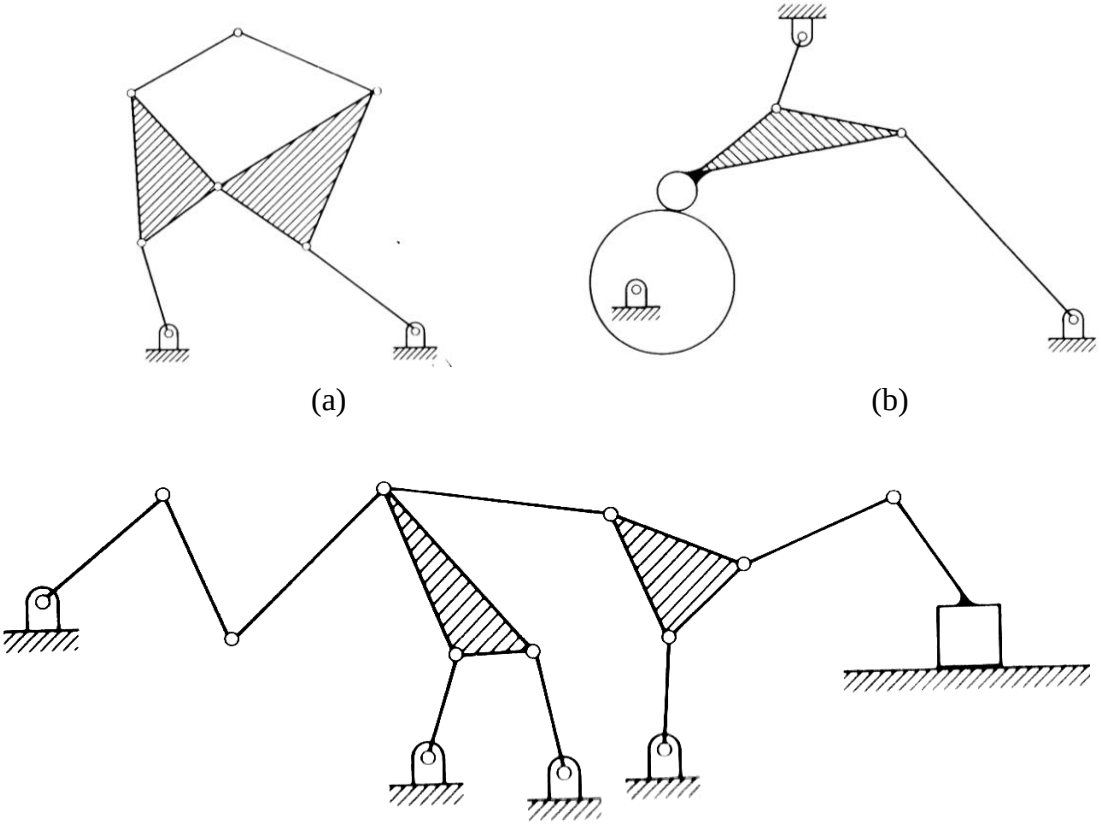
Fig. 4. A planetary gear train

國立虎尾科技大學 109 學年度第 2 學期博士班資格考試題

系別：動力機械工程系機械與機電工程博士班　　第 1 頁　共 5 頁
科目：機構學

注意事項：
（1）本試題共有 5 題，每題 20 分，合計一百分。
（2）請依序作**答於試題卷上**。
（3）可使用計算機 close book and can use calculator

1. Determine the mobility (number of degrees of freedom) of the following mechanical devices shown in Fig.1.



(a)　　(b)

(c)

Fig. 1　Some mechanical devices

2. Consider the slider-crank mechanism shown in Fig. 2, derive the equations for the displacement (r_4), velocity(v_4), and acceleration(a_4) of the slider. (ω_2 is constant)

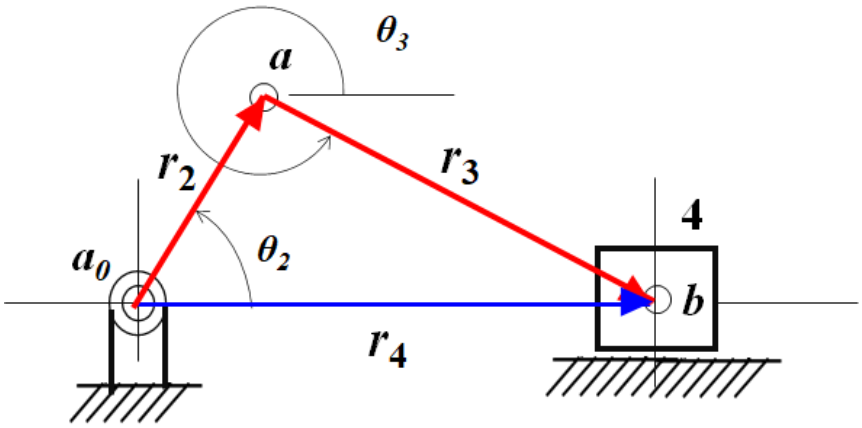


Fig. 2 Slider-crank mechanism

3. For the 4-bar mechanism shown in Fig. 3, crank 2 is to rotate continuously and link 4 is to oscillate. What are the maximum and minimum values in millimeters which can be used for the coupler length (l_3).

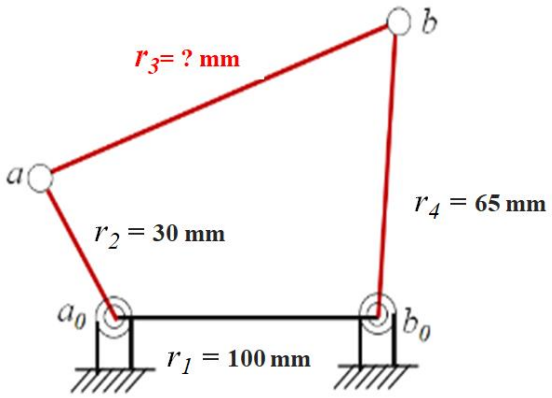


Fig. 3 4-bar mechanism

4. A 3-module, 20^{O} pinion of 18 teeth drives a 45-teeth gear. Calculate the pitch radii, base radii, addendum, dedendum, tooth thickness on the pitch circle, and the contact ratio.

5. In the planetary gear train shown in Fig. 4, gear 2 rotates at 600rpm in the direction shown and gear 1 (and gear 6) rotates at 300rpm in the opposite direction. Calculate the speed and direction of rotation of gear 7.

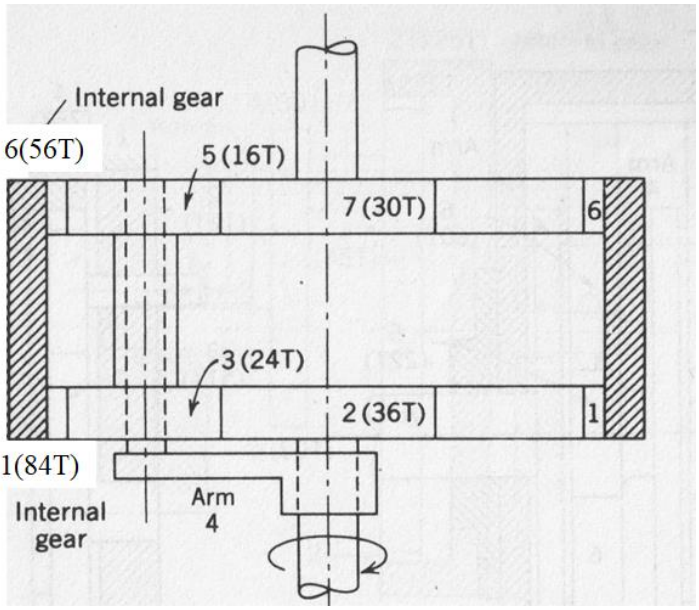


Fig. 4 A planetary gear train

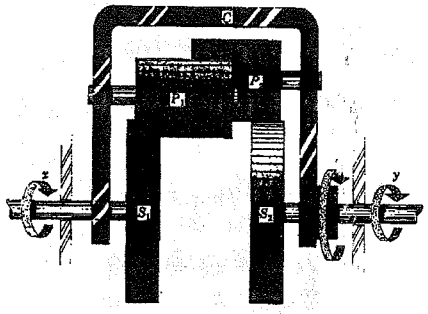
國立虎尾科技大學109學年度第1學期博士班資格考試題

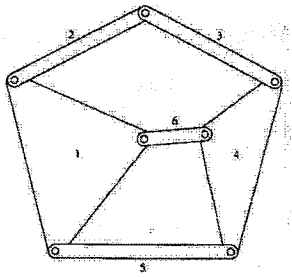
系別：動力機械工程系機械與機電工程博士班　　第1頁　共3頁
科目：機構學

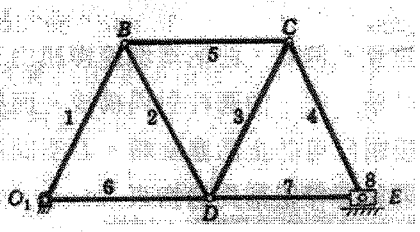
注意事項：
（1）本試題共有5題，任選5題作答，每題20分，合計100分。
（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。
（3）可以使用計算機並且可以攜帶一張 A4 大小之筆記(Bring engineering calculator and 1 page of A4 size note)

1. **Please use Grubler equation to determine the mobility (number of degrees of freedom) of the devices shown in Figs. (a) through (e) . (20%)**

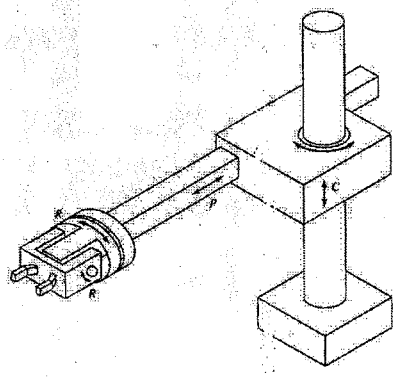
(a) Spur-Gear Differential　**(b) Watt Six-Bar Linkage**　**(c) Truss**



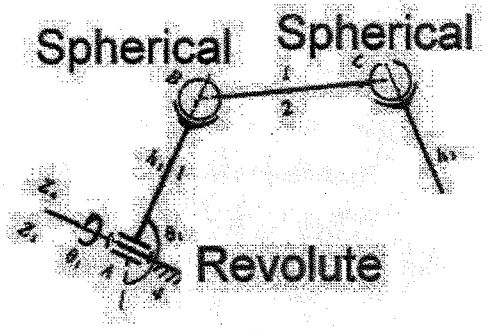




(d) Industrial Robotics

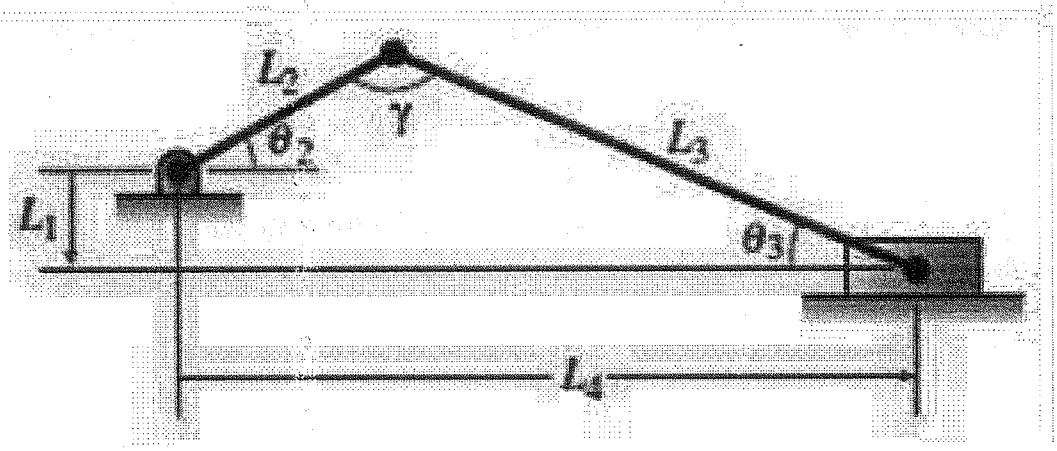


(e) Spacial Mechanism

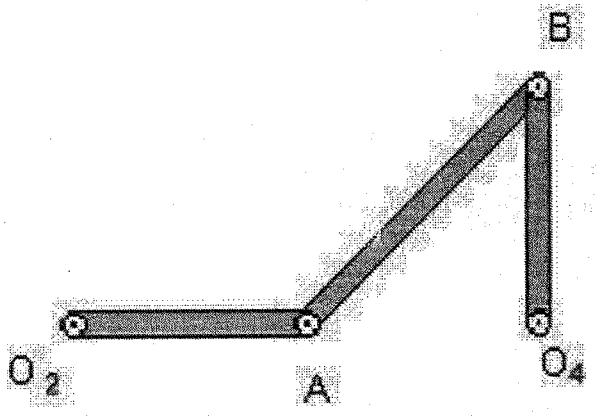


2. **In the offset crank slider mechanism shown in the figure below the constrained path of the pin on the slider does not extend through the**

center of rotation of the crank. Given the lengths L_1, L_2 and L_3 and the crank angle θ_2. Please determine (a)The interior joint angle γ and (b)The position of the slider L_4. (20%)

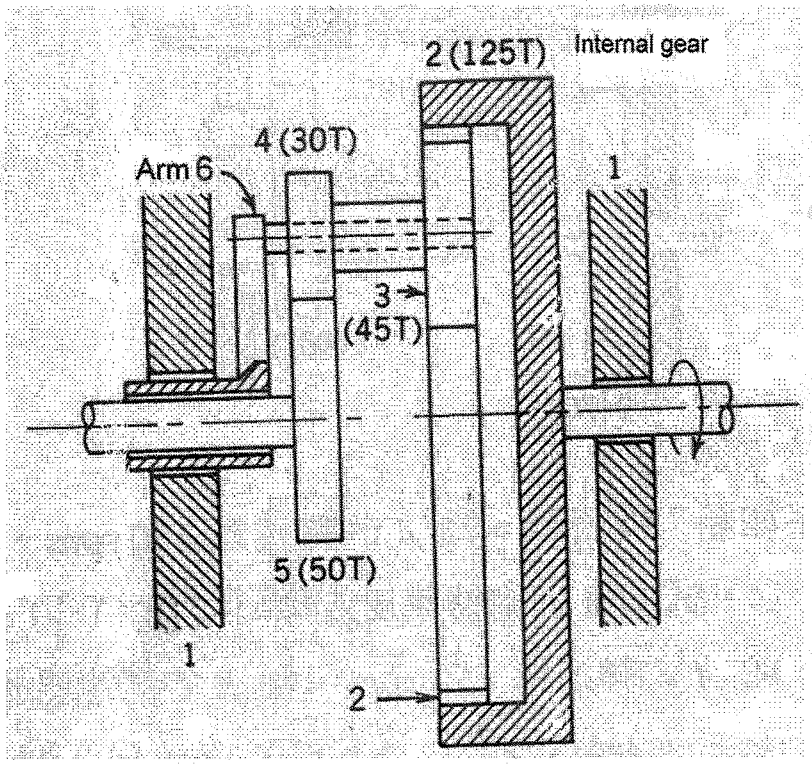


3. For the 4-bar linkage shown in the figure below, Link2 (O_2A) rotates with the angular velocity ω_2=10 rad/s (CCW) and angular acceleration α_2 =10 rad/s^2. Given the lengths O_2O_4=2m (Link1: Fixed), O_2A=1m (Link2), O_4B=1m (Link4), and Link2 (O_2A) overlaps with Link1 (O_2O_4), Link4 (O_4B) is perpendicular to Link1 (O_2O_4). Please use any analytical method to calculate the angular velocities ω_3 and ω_4, and the angular accelerations α_3 and α_4 of Link3 (AB) and Link4 (O_4B). (20%)



4. A 2-module, 20° pinion of 24 teeth drives a 40 teeth gear, calculate the pitch diameter, base radii, dedendum, addendum, tooth thickness on the pitch circle, circular pitch, length of action and the contact ratio. (20%)

5. **In the planetary gear train shown in the Figure below, gear 2 turns at 600 rpm in the direction indicated. Determine the speed and direction of rotation of arm 6 if gear 5 rotates at 350 rpm in the same direction as gear 2. (20%)**



國立虎尾科技大學 108 學年度第 2 學期博士班資格考試題

系別：動力機械工程系機械與機電工程博士班　　第 1 頁　共 3 頁

科目：機構學

注意事項：

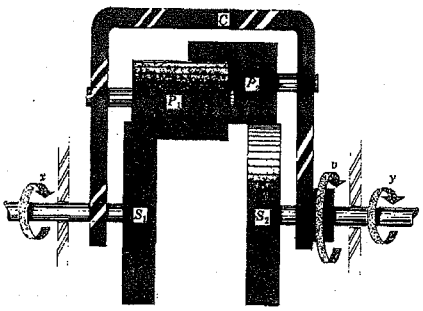
（1）本試題共有 5 題，任選 5 題作答，每題 20 分，合計 100 分。

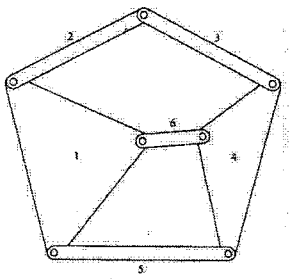
（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。

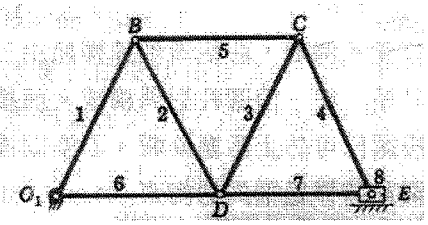
（3）可以使用計算機並且可以攜帶一張 A4 大小之筆記(Bring engineering calculator and 1 page of A4 size note)

1. Please use Grubler equation to determine the mobility (number of degrees of freedom) of the devices shown in Figs. (a) through (e) . (20%)

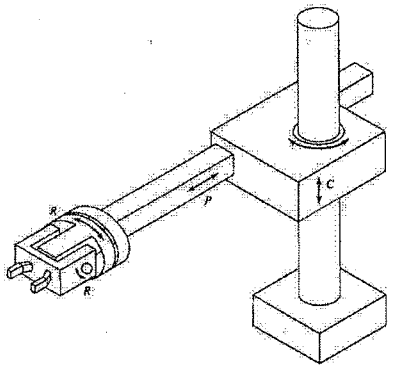
(a) Spur-Gear Differential　**(b) Watt Six-Bar Linkage**　**(c) Truss**



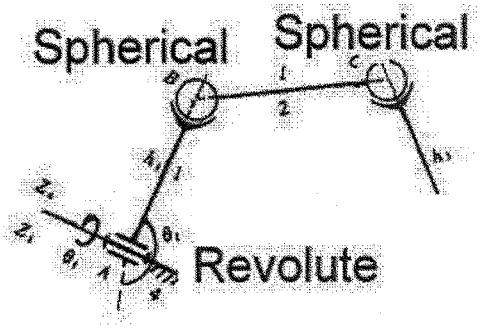




(d) Industrial Robotics

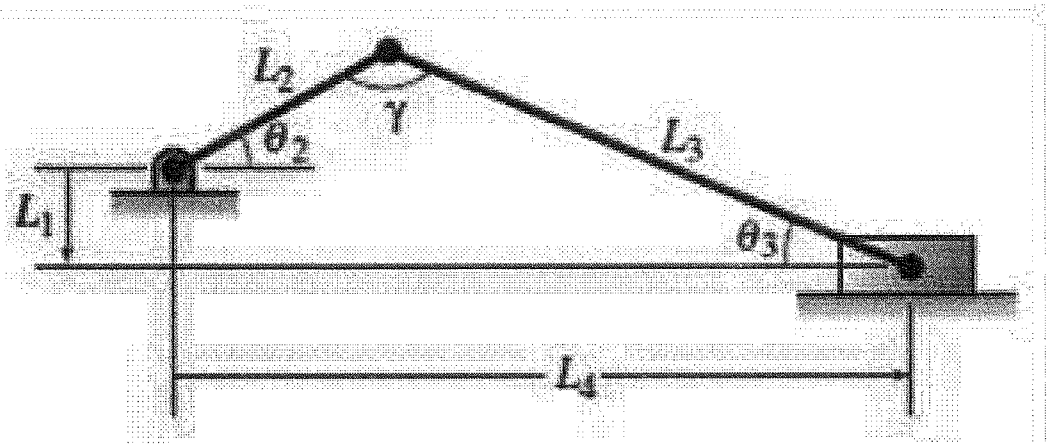


(e) Spacial Mechanism

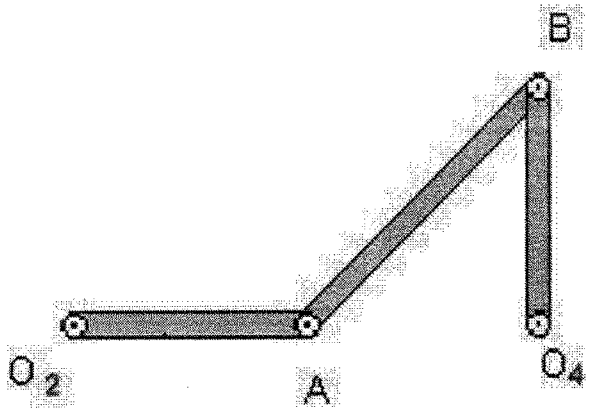


2. In the offset crank slider mechanism shown in the figure below the constrained path of the pin on the slider does not extend through the

center of rotation of the crank. Given the lengths L_1, L_2 and L_3 and the crank angle θ_2. Please determine (a)The interior joint angle γ and (b)The position of the slider L_4. (20%)

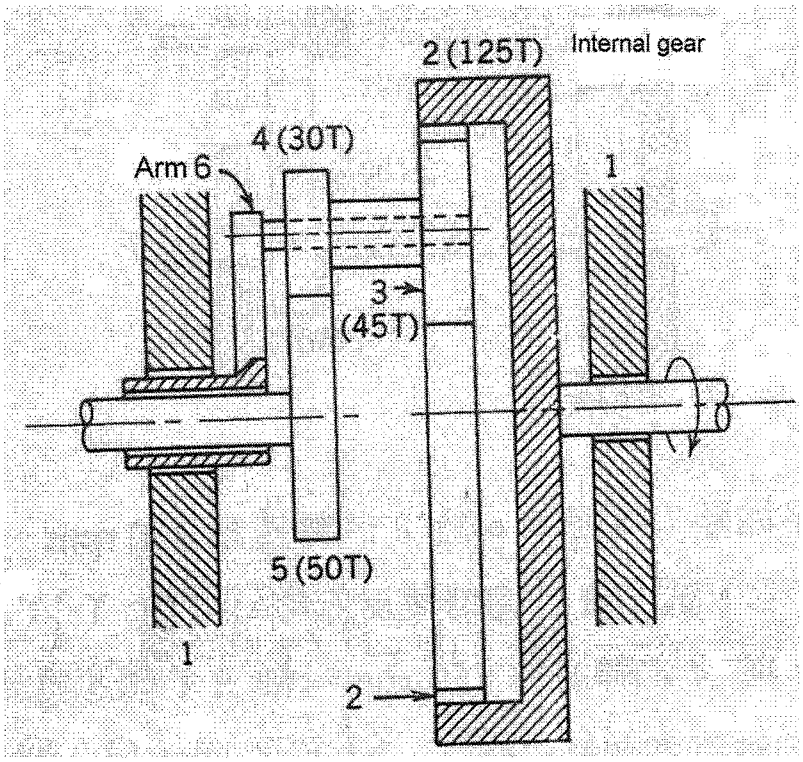


3. For the 4-bar linkage shown in the figure below, Link2 (O_2A) rotates with the angular velocity ω_2=10 rad/s (CCW) and angular acceleration α_2 =10 rad/s^2. Given the lengths O_2O_4=2m (Link1: Fixed), O_2A=1m (Link2), O_4B=1m (Link4), and Link2 (O_2A) overlaps with Link1 (O_2O_4), Link4 (O_4B) is perpendicular to Link1 (O_2O_4). Please use any analytical method to calculate the angular velocities ω_3 and ω_4, and the angular accelerations α_3 and α_4 of Link3 (AB) and Link4 (O_4B). (20%)



4. A 2-module, 20° pinion of 24 teeth drives a 40 teeth gear, calculate the pitch diameter, base radii, dedendum, addendum, tooth thickness on the pitch circle, circular pitch, length of action and the contact ratio. (20%)

5. **In the planetary gear train shown in the Figure below, gear 2 turns at 600 rpm in the direction indicated. Determine the speed and direction of rotation of arm 6 if gear 5 rotates at 350 rpm in the same direction as gear 2. (20%)**



國立虎尾科技大學 108 學年度第一學期博士班資格考試題

所別：機械與機電工程研究所　　共 3 頁

科目：機構學

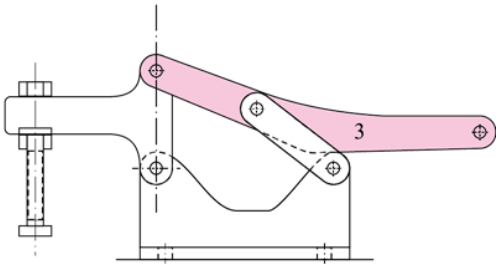
注意事項：

（1）本試題共有 5 題，每題 20 分，合計一百分。

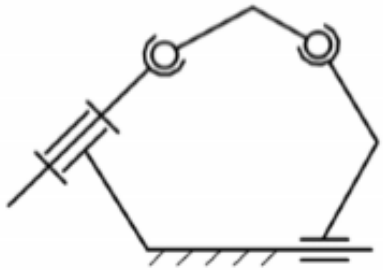
（2）請依序作答於答案卷上並註明題號。

（3）可使用計算機。

1. For the mechanism as shown in Fig. 1 (a) and (b), please determine its degree of freedom, and give those in detail you need (such as: No. of links and joints, types of joints, etc.) for determining the degree of freedom



(a)



(b)

Fig. 1

2. Given r_1 = 10 mm and r_3 = 25 mm for a slider crank mechanism as shown in Fig. 2
(a) Determine the range of values of the length of link 2 so that link 2 can make a full rotation, and the transmission angle remains in the range $45° \le \varphi \le 135°$.
(b) Continue from (a), determine the maximum stroke from the range of values of the length of link 2 you found in (a).

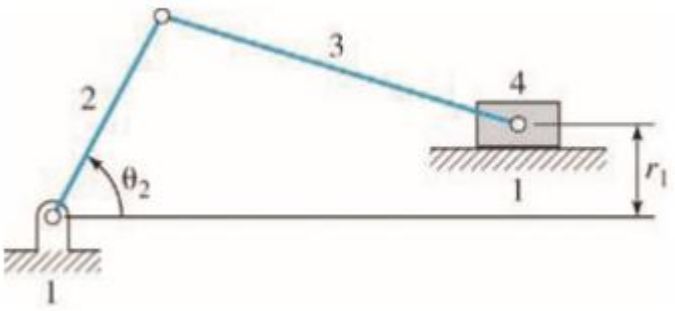


Fig. 2

3. For the mechanism as shown in Fig. 3, the origin of the coordinate system is on O_2, and the x axis is along the horizontal and directs to the right. The angular positions of links 2 and 3 are measured CCW from (positive) x axis. The distance between O_2 and B is 5 cm, and that between B and C is 17 cm. If $\theta_2 = 210^o$, and $\omega_2 = 60$ rad/sec CW (constant), please write the **vector equation** for the linkage shown and determine analytically the angular position, velocity, and acceleration of link 3.

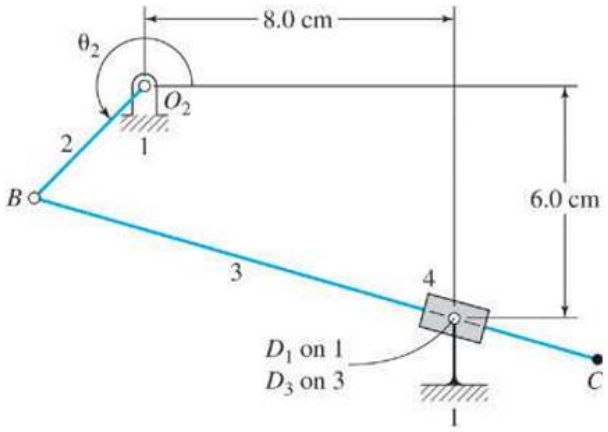


Fig. 3

4. In Fig. 4, the displacement–time, velocity–time, and acceleration–time curves are sketched for a follower. The cam rotates at a constant angular velocity ω and the maximum (peak) value of the acceleration is 5 units. The equation for the acceleration-time curve is as follows

$$A = \left(\frac{2\pi h\omega^2}{\beta^2}\right)\sin\left(\frac{2\pi}{\beta}\phi\right)$$

(a) Write the equations for the velocity-time and displacement–time curves.

(b) Determine the maximum values of displacement and velocity

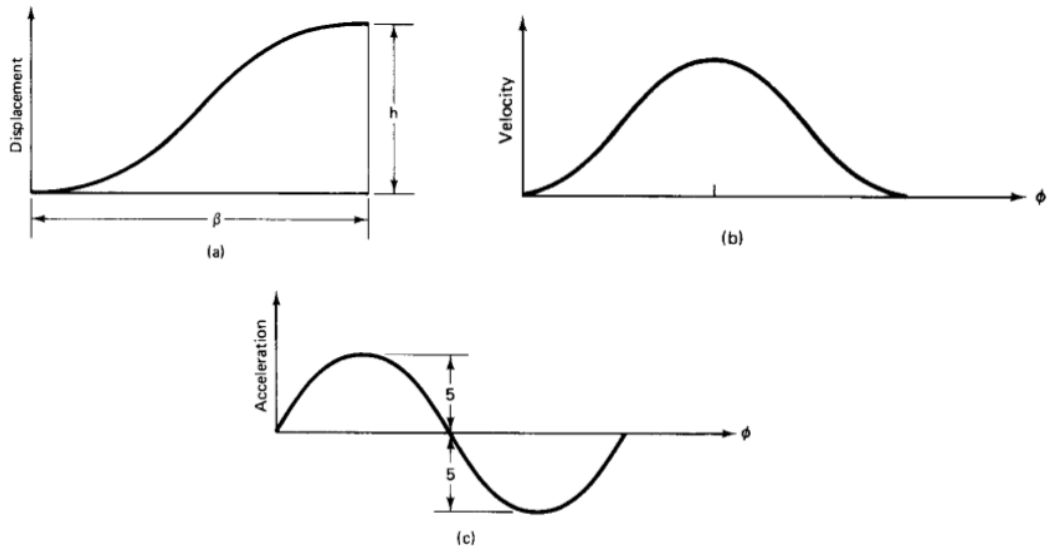
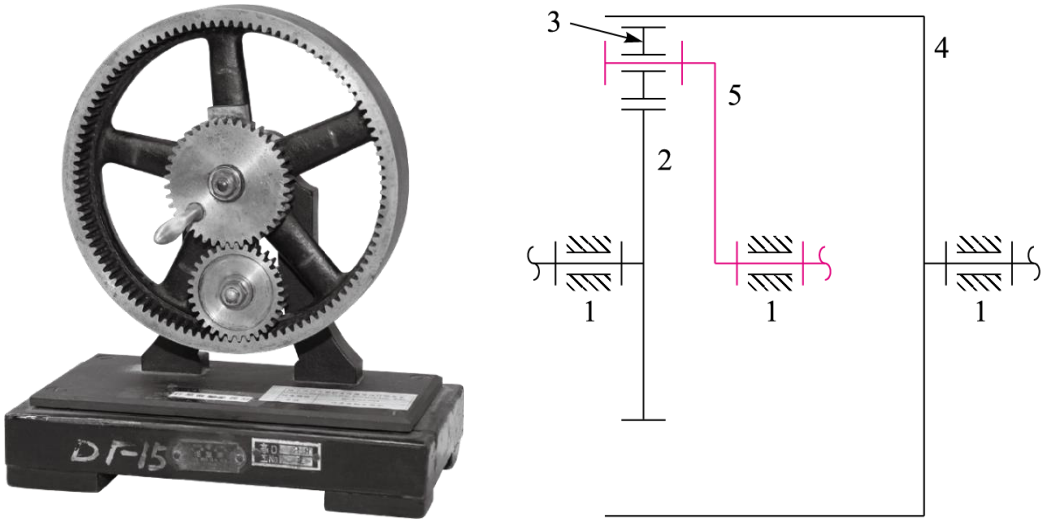


Fig. 4

5. The kinematic skeleton of the planetary gear train shown in Fig. 5(a) is shown in Fig. 5(b). This gear train has gear 2 as the sun gear ($T_2 = 75$) and gear 3 as the planet gear ($T_3 = 15$). Gear 4 is a ring gear ($T_4 = 105$). Between gear 2 and gear 3 is carrier 5. Analyze the velocity ratios of this gear train.



(a) (b)

Fig. 5

國立虎尾科技大學 107 學年度第二學期博士班資格考試題

所別：機械與機電工程研究所　　共 3 頁

科目：機構學

注意事項：
（1）本試題共有 5 題，任選 題作答，每題 20 分，合計一百分。
（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。
（3）可 使用計算機

1. Fig. 1 show a four-bar linkage, which is a crank-rocker mechanism. If r_2=100cm, r_3=150cm, r_4=200cm, please find the length range of r_1. (15%)

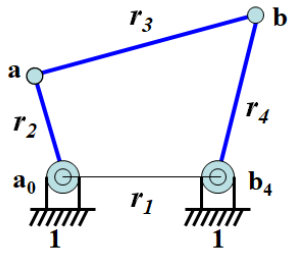


Fig.1.　Four-bar linkage

2. Fig. 2 show an offset crank-slider.　For the mechanism, if e=50cm，r_2=200cm，r_3=400cm, (a) Max. transmission angle and Min. transmission angle, (b) The stroke of this offset crank-slider. (15%)

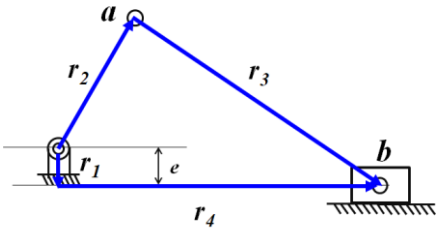


Fig. 2　An offset crank-slider

3. Fig. 3 show a four-bar linkage. For the mechanism, if r_1=180cm, r_2=100cm, r_3=150cm, and r_4 =200cm, (a) write down the vector loop equation, (b) if θ_2=60° and ω_2=2400rpm, please find the values of θ_3, θ_4, and transmission angle μ, (c) if ω_2=2400rpm, please find he values of ω_3 and ω_4. (20%)

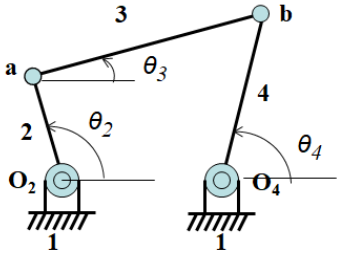


Fig.3. Four-bar linkage

4. For the mechanism shown m Fig.1, (a) please write down the vector loop equation, (b) find the close form equation for r_4, (c) if θ_2 =60° and ω_2=2400rpm, please find r_4, θ_3, V_b, and ω_3.(20%)

5. Figs. 5(a) and 5(b) show two mechanisms. Please draw all instantaneous centers. (15%)

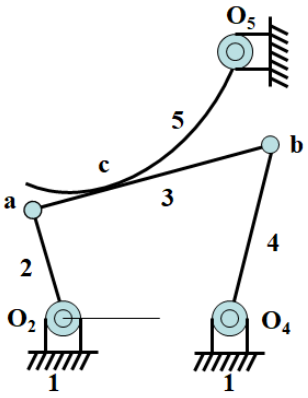


Fig. 5(b) Five-bar mechanism

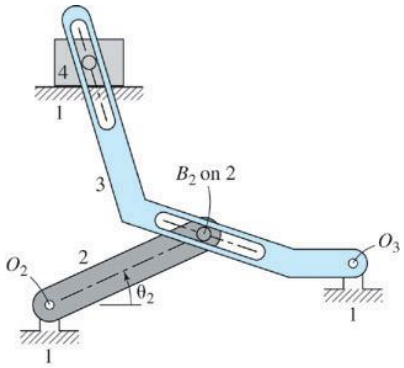


Fig. 5(a) Four-bar mechanism

6. Fig. 6 show a crank-slider. For the mechanism, if aa_o=200cm，a_ob=400cm，ad=800cm，cd=600cm，be=500cm，and ω_2=100 rad/s。(a) According to the real dimensions of mechanism, please redraw this mechanism, (b) Using instant center method, find the angular velocity of link 3 (ω_3) and linear velocity of point c (V_c). (15%)

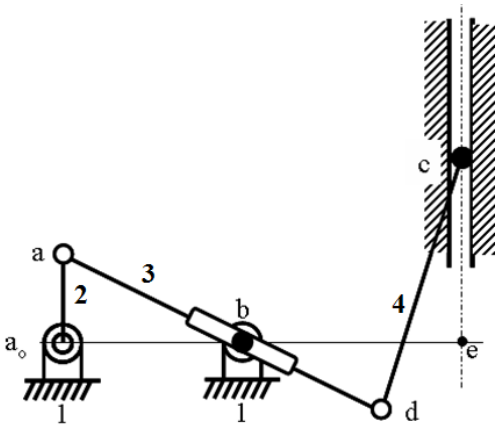


Fig. 6 Four-bar mechanism

國立虎尾科技大學 107 學年度第一學期博士班資格考試題

所別：機械與機電工程研究所　　共 3 頁

科目：機構學

注意事項：
（1）本試題共有 5 題，任選 題作答，每題 20 分，合計一百分。
（2）請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。
（3）可 使用計算機

1. Figure 1 show a four-bar linkage. For the mechanism, if r_1=250cm, r_2=100cm, r_3=250cm, and r_4 =150cm, (a) write down the vector loop equation, (b) if θ_2 = 120° , please find find the values of θ_3,θ_4, and transmission angle μ.(20%)

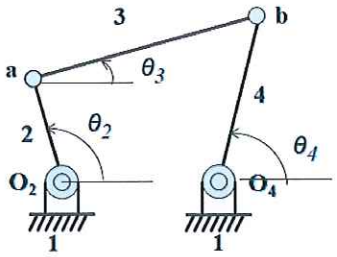


Fig.1. Four-bar linkage

2. Figure 2 show a offset crank-slider. For the mechanism, if e=2cm，r_2=6cm，r_3=10cm, (a) write down the vector loop equation, (b) find the close form equation for r_4, (c) if θ_2 =90° and ω_2=2400rpm, please find r_4 , θ_3, V_4, and ω_3.(20%)

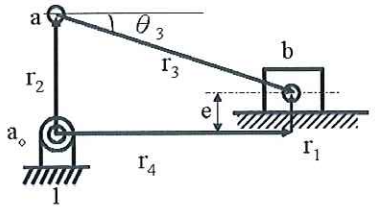


Fig. 2. Offset crank-slider

3. For a gear pair with module m=3.0 and pressure angle $\psi=14.5^{O}$, a pinion(N_2=28) drives a gear (N_3=72). Please find (a) Contact length (L_c), (b) Contact ratio (γ_c). If center distance (C) increases 1.5mm, please find (c) New pressure angle ψ'= ? , (d) new Contact length (L_c'), and (e) new Contact ratio (γ_c'). (20%)

4. For a gear pair with module m=3.0 and pressure angle ϕ=14.5°, if their addendums just pass the interference point and contact ratio (γ_c =1.2348), please find (a) Number of teeth N_2=N_3=?, (b) Addendum radius *Ro*. (20%)

5. Fig. 5 shows a gear reducer with ring gear 7 fixed. If sun gear 2 is the input link and sung gear 5 is the output link, if ω_2=2400rpm (CCW), please find ω_5 (value and its direction).

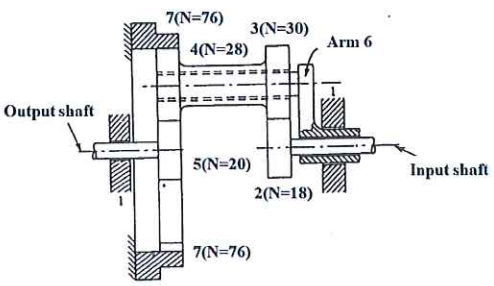


Fig.5. Planetary gear train

國立虎尾科技大學 104 學年度第一學期博士班資格考試題

所別：機械與機電工程研究所　　共 3 頁

科目：機構學（可 使用計算機）

1. Figures 1(a) and 1(b) show two mechanisms. Please draw all instantaneous centers. (20%)

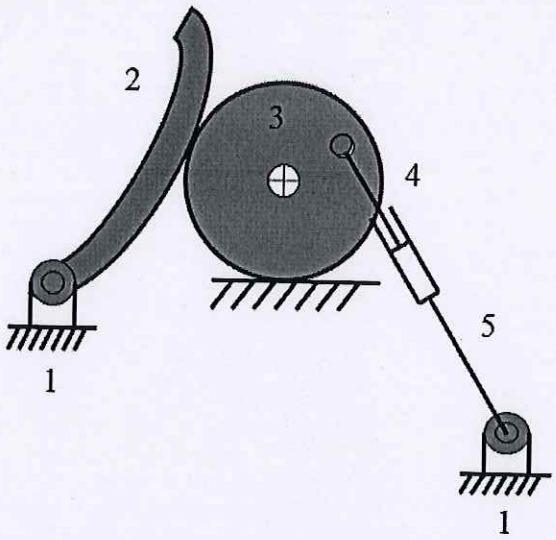


Figure 1(a)　Five-bar mechanism

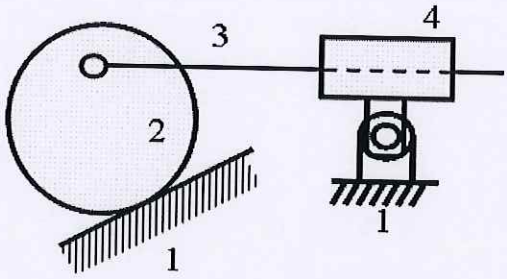


Figure 1(b)　Five-bar mechanism

2. A four bar linkage as shown in Fig. 1, r r_1 =6cm、r_2=2cm、r_3=5cm、r_4=5cm、$\theta_2 = 60°$.(a) According to the real dimensions of mechanism, please redraw this mechanism, (b)Please find θ_3 and θ_4. (20%)

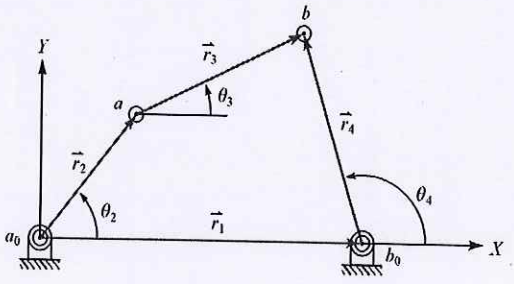


Fig. 1　Four-bar linkage

3. Figure 3 show a crank-slider. For the mechanism, if r2=6cm，r3=4cm，and θ_2=60°. Using instant center method, find the linear velocity of slider 4 (V_C). (20%)

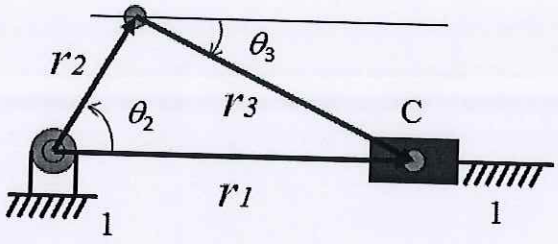


Figure 3 Slider-crank

4. For a planetary gear train as shown in figure 4, if ω_2=1800rpm (CCW), please find the rotation speed of gear 5 and its rotation direction. (20%)

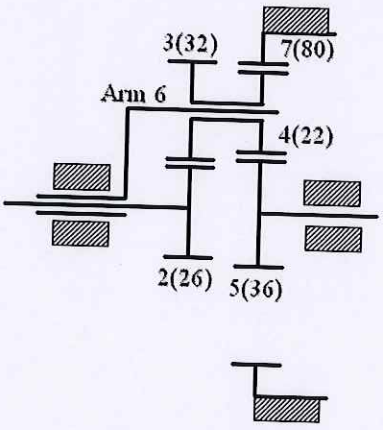


Figure 4 Planetary gear train

5. For a gear pair with module m=2.0 and pressure angle $\phi=20^{O}$, a pinion(N=21) drives a gear (N=63). Please find (a) Contact length (L_c), (b) Contact ratio (γ_c). If center distance (C) increases 0.08mm, please find (c) New pressure angle $\phi'=?$, (d) new Contact length (L'_c) and Contact ratio (γ'_c). (20%)

國立虎尾科技大學 101 學年度第一學期博士班資格考試題

所別：機械與機電工程研究所　　共 3 頁

科目：機構學（可 使用計算機）

1. Figure 1 shows a crank-rocker-slider mechanism. (a) Draw the corresponding specified kinematic chain. (b) Identify the link and joint types. (c) Identify the mobility number. (d) Calculate its degrees of freedom. (15%)

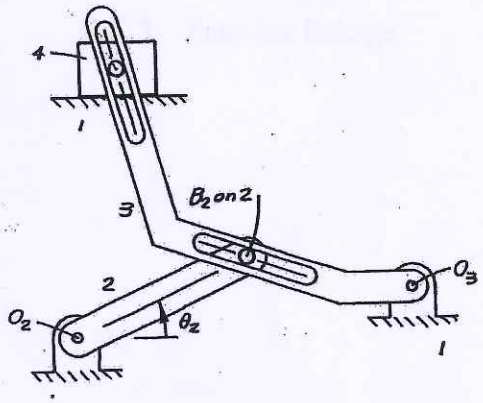


Figure 1 Crank-rocker-slider

2. Figures 2(a) and 2(b) show two mechanisms. Please draw all instantaneous centers. (20%)

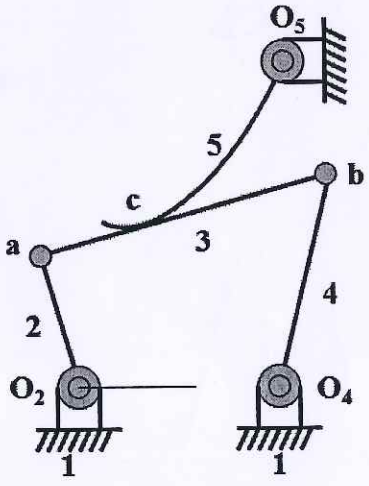


Figure 2(a)　Five-bar mechanism

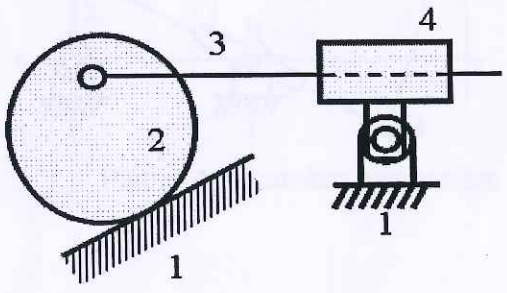


Figure 2(b)　Five-bar mechanism

3. A four bar linkage as shown in Fig. 3, $r1$、$r2$、$r3$、$r4$、and θ_2 are given.，Please find (a) and θ_3 和, (b)when r_1 =6cm、r_2=2cm、r_3=5cm、r_4=5cm、$\theta_2 = 60^\circ$，find the values of θ_3 and θ_4. (15%)

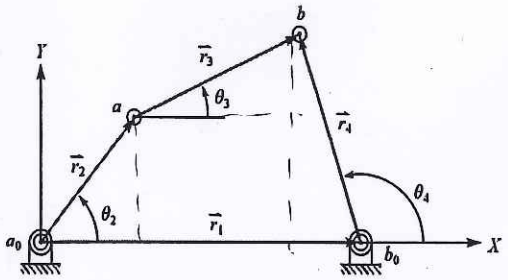


Fig. 3 Four-bar linkage

4. Figure 4 show a crank-slider. For the mechanism, if aa_o=2cm，a_ob=4cm，ad=8cm，cd=6cm，be=5cm，and ω_2=10 rad/s。(a) According to the real dimensions of mechanism, please redraw this mechanism, (b) Using instant center method, find the angular velocity of link 3 (ω_3) and linear velocity of point c (V_c). (15%)

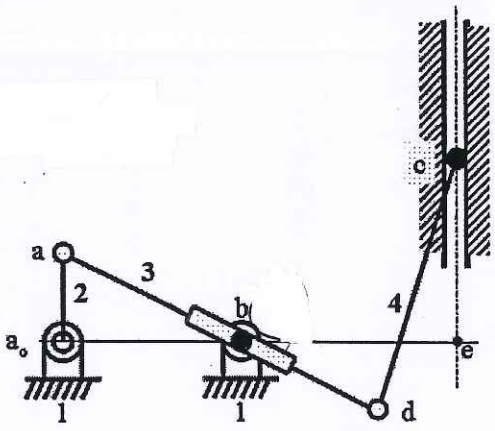
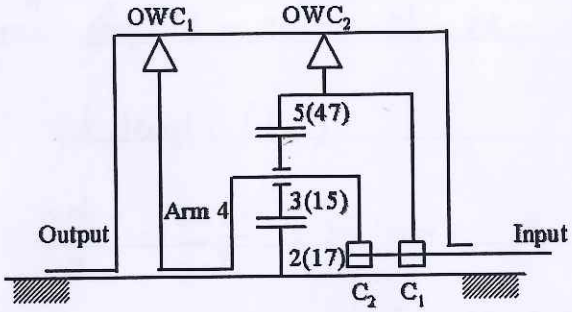


Figure 4 Four-bar mechanism

5. For the 3-speed internal gear hun shown in figure 5, please find the reduction ratios of the 3 speeds. (15%)



	C_1	C_2	OWC_1	OWC_2
1st speed	◎		◎	Control not engaged
2nd speed	◎			◎
3rd speed		◎		◎

Figure 3 3-speed internal gear hub

◎:Engaged

6. For a gear pair with module m=3.0 and pressure angle $\phi=20^{O}$, a pinion(N=24) drives a gear (N=72). Please find (a) Contact length (L_c), (b) Contact ratio (γ_c). If center distance (C) increases 0.08mm, please find (c) New pressure angle $\phi'=?$, (d) new Contact length (L_c'). (20%)

國立虎尾科技大學 103 學年度第一學期博士班資格考試題

所別：動力機械系機械與機電工程博士班　　共 3 頁

科目：機構學 (可使用計算機)

1. There are 9 kinematic pairs shown in figure 1. (20%)

_____、_____、_____、_____ have 1 degrees of freedom.

_____、_____、_____ have 2 degrees of freedom.

_____、_____ have 3 degrees of freedom.

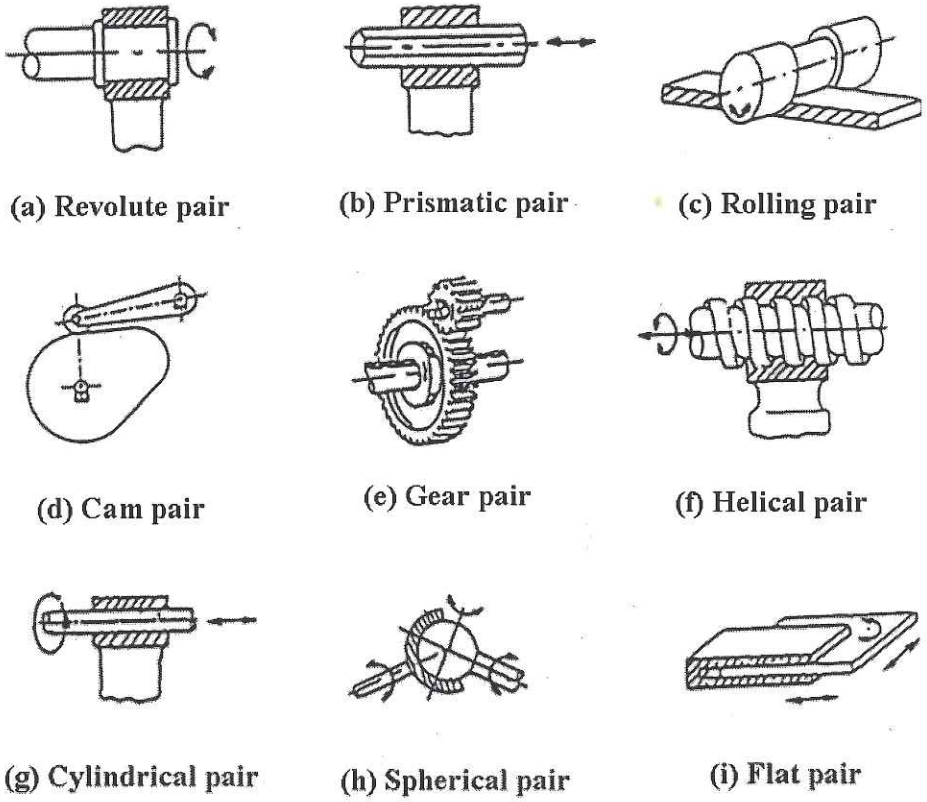


Fig. 1　The kinematic pairs of mechanism

2. Figures 2(a) and 2(b) show two mechanisms. Please draw all instantaneous centers. (20%)

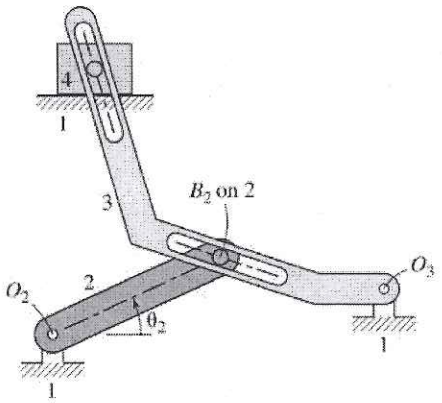


Fig. 2(a)　Four-bar mechanism

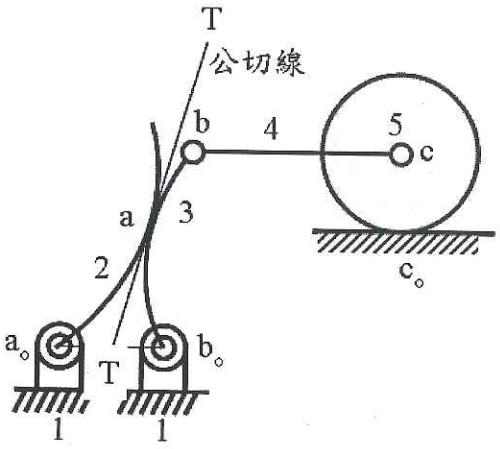


Fig. 2(b) Five-bar mechanism

3. Figure 3 show a offset crank-slider. For the mechanism, if aa_o=6cm，ab=13cm, (a) write down the vector loop equation, (b) Find the close form equation for r_4, (c) please find $r_4$and θ_3 when θ_2 =90°.(20%)

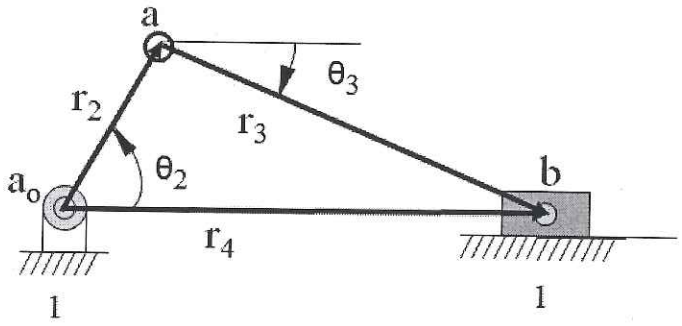


Figure 3 Offset crank-slider

4. For a gear pair with module m=2.0 and pressure angle ϕ=20^{O}, a pinion(N=24) drives a gear (N=72). Please find (a) Contact length (L_c), (b) Contact ratio (γ_c). If center distance (C) increases 0.05mm, please find (c) New pressure angle ϕ'= ? , (d) new Contact length (L_c'). (25%)

5. For the planetary gear train shown in figure 5 (Ring gear 5 is fixed), if ω_2=3600rpm (CCW), please find ω_4 (value and its direction). (15%)

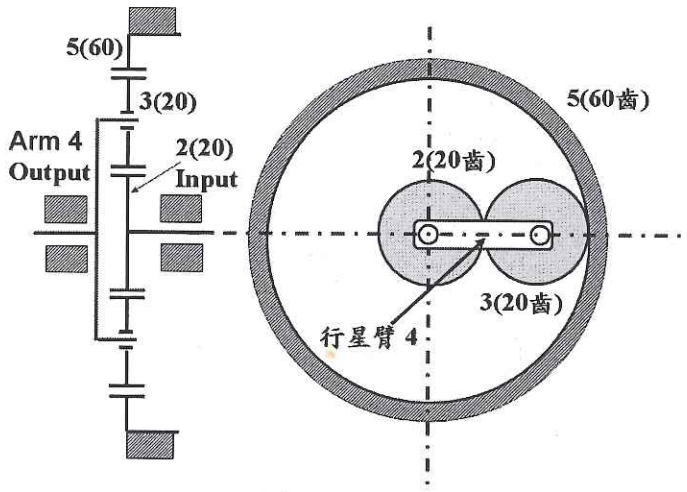


Fig. 5 Planetary gear train

國立虎尾科技大學 102 學年度第二學期博士班資格考試題

所別：動力機械系機械與機電工程博士班　　共 3 頁

科目：機構學 (可使用計算機)

1. (　　) A **(A)civil device (B)mechanical device (C)chemical device (D)electrical device** is a piece of equipment, mechanical in nature, designed to serve a special purpose or perform a special function. It generally consists of mechanical members connected by joints. (5%)
2. (　　) Links can be classified based on the number of incident joints. A **(A)singular (B)binary (C)ternary (D)quaternary** link is one with three incident joints. (5%)
3. (　　) A **(A)chain (B)power screw (C)belt (D)cam** is an irregularly shaped link that serves as a driving member and imparts a prescribed motion to a driven link called follower. (5%)
4. (　　) In order to make mechanical members useful, they must be connected by joint (kinematic pair) The two members formed a kinematic pair are called **(A)kinematic element (B)matching element (C)spouse element (D)pairing element**. (5%)
5. (　　) For a prismatic or sliding pair, the relative motion between two incident members is **(A)translation along an axis (B)rotation about an axis (C)the combination of rolling and sliding (D)pure rolling without slipping.** (5%)
6. There are 9 kinematic pairs shown in figure 1. (10%)

_____、_____、_____、_____ have 1 degrees of freedom.

_____、_____、_____ have 2 degrees of freedom.

_____、_____ have 3 degrees of freedom.

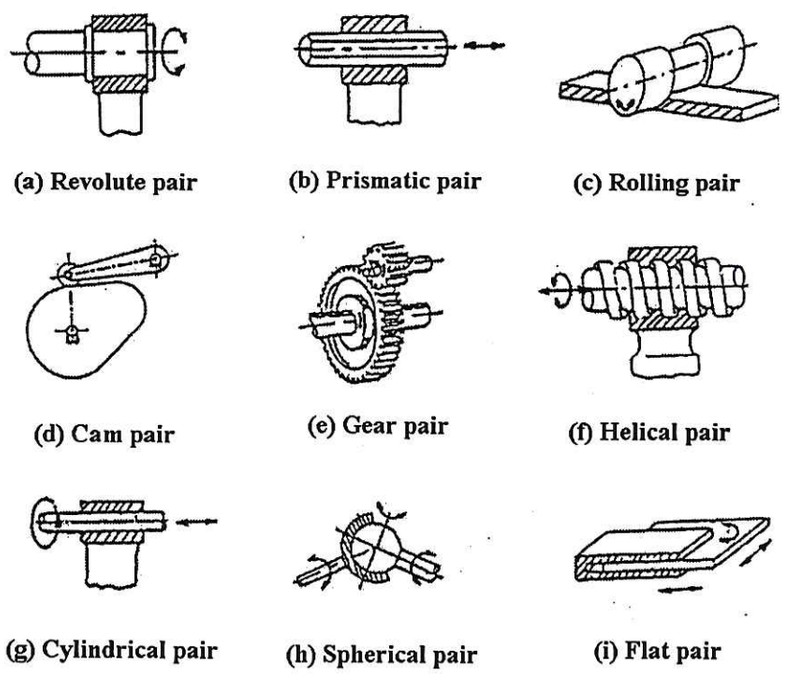


Fig. 1　The kinematic pairs of mechanism

7. Figures 2(a) and 2(b) show two mechanisms. Please draw all instantaneous centers. (20%)

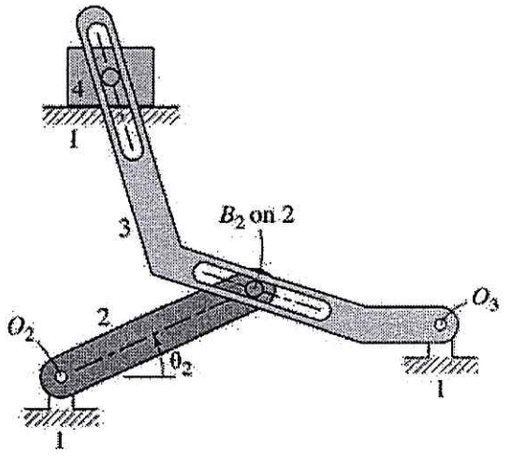


Fig. 2(a) Four-bar mechanism

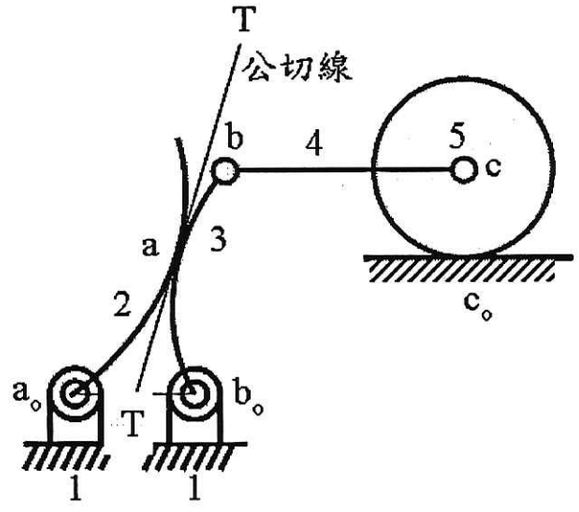


Fig. 2(b) Five-bar mechanism

8. Figure 3 show a offset crank-slider. For the mechanism, if e=2cm，aa_o=6cm，ab=13cm, (a) write down the vector loop equation, (b) Find the close form equation for r_4, (c) please find $r_4$and θ_3 when θ_2 =90°.(15%)

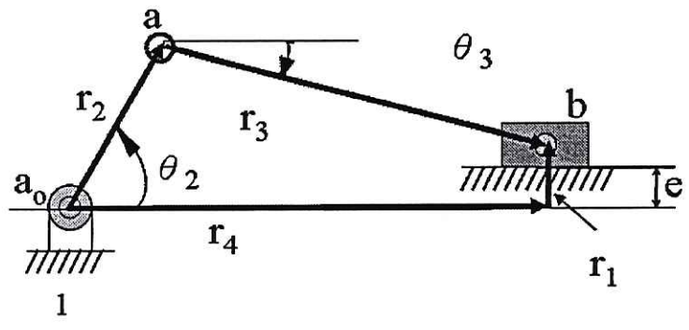


Figure 3 Offset crank-slider

9. For a gear pair with module m=1.5 and pressure angle ϕ=20^{O}, a pinion(N=24) drives a gear (N=72). Please find (a) Contact length (L_c), (b) Contact ratio (γ_c). If center distanct (C) increases 0.04mm, please find (c) New pressure angle ϕ'=?, (d) new Contact length (L_c'). (15%)

10. For the planetary gear train shown in figure 8, if ω_4=3600rpm (CCW), please find ω_5 (value and its direction). (15%)

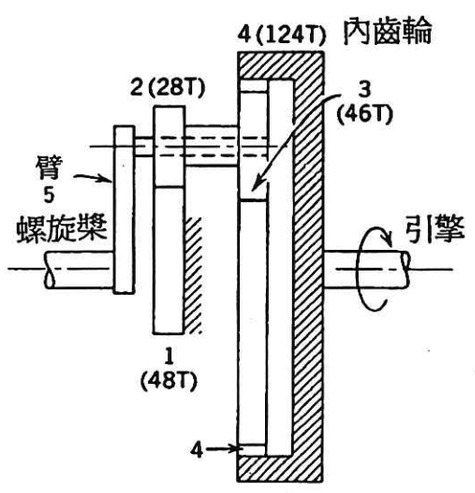


Fig. 8 Planetary gear train

國立虎尾科技大學　機械與機電工程研究所

100 學年度第 2 學期　博士班資格考 【機構學 】

一、有關機構自由度，請回答下列問題。

(a) 解釋機構自由度的意義。(5%)

(b) 說明機構自由度的計算式。(5%)

(c) 試舉一例應證題(a)與題(b)。(10%)

二、如圖 1 所示，有一個牛頭刨床機構 (Crank-shaper mechanism)，桿長為已知。$a_0b_0 = 3.0cm$ ， $a_0a = 1.5cm$ ， $b_0b = 6.0cm$ ， $bc = 3.5cm$ ， $b_0c = 6.0cm$ (垂直距離)，若桿 2 為輸入桿，即 $\theta_2 = 30^o$ (桿 2 與 x 軸夾角)，$\omega_2 = 10 \ \ rad/s$ (ccw)，$\alpha_2 = 0 \ \ rad/s^2$ 為已知，請回答下列問題。

(a) 利用繪圖法，求滑塊 c 的位置。(5%)

(b) 以題(a)利用瞬心法求滑塊 c 的速度。(10%)

(c) 利用向量迴路法求滑塊 c 的位置、速度、及加速度。(15%)

三、有關四連桿組，請回答下列問題。

(a) 若桿 1、桿 2、以及桿 4 的長度分別為 300cm、100cm、以及 280cm，試求出耦桿 3 的長度 r_3的範圍，使其為曲柄搖桿機構。(10%)

(b) 承題(a)，若 r_3=400 cm，試表示出曲柄搖桿機構的極限位置，並求出搖桿的運動範圍。(10%)

(c) 承題(a)，若 r_3=400 cm，試求出曲柄搖桿機構的最大與最小傳力角。(10%)

四、有關齒輪，請回答下列問題。

(a) 何謂徑節(Diametral pitch)、何謂壓力角。(10%)

(b) 如圖 2 齒輪系，若齒輪 6 固定，試求速比(ω_7/ω_2)。(10%)

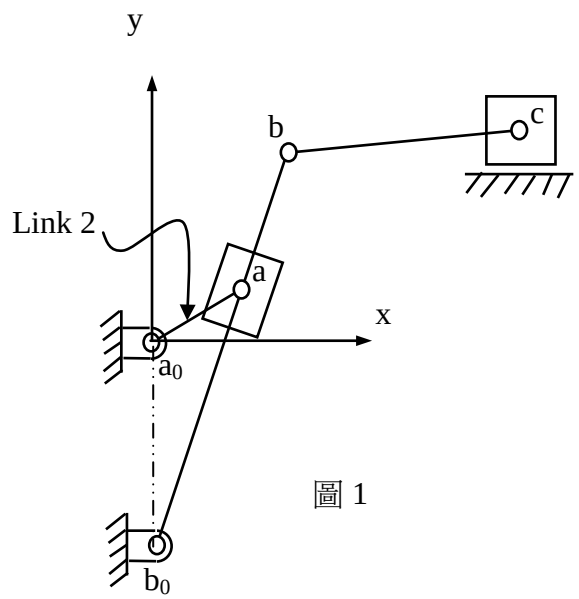


圖 1

各齒數：
N_2=16
N_3=64
N_4=30
N_6=80
N_7=40

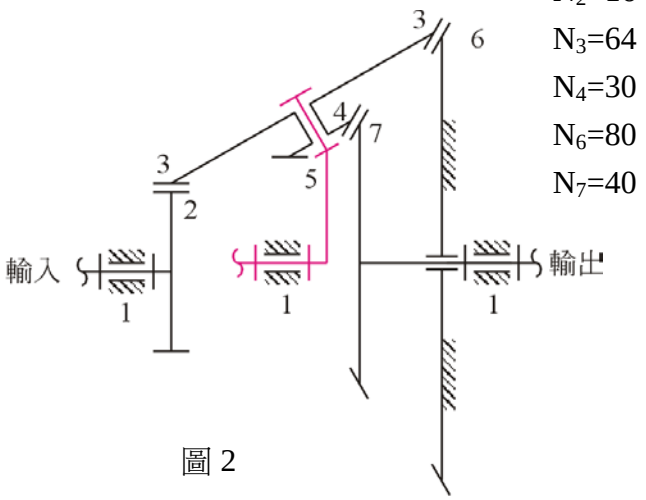


圖 2

國立虎尾科技大學　機械與機電工程研究所

99 學年度第 1 學期　博士班資格考 【機構學】

1. Calculate the *DOF* of the linkages shown in Figure 1. (20%)

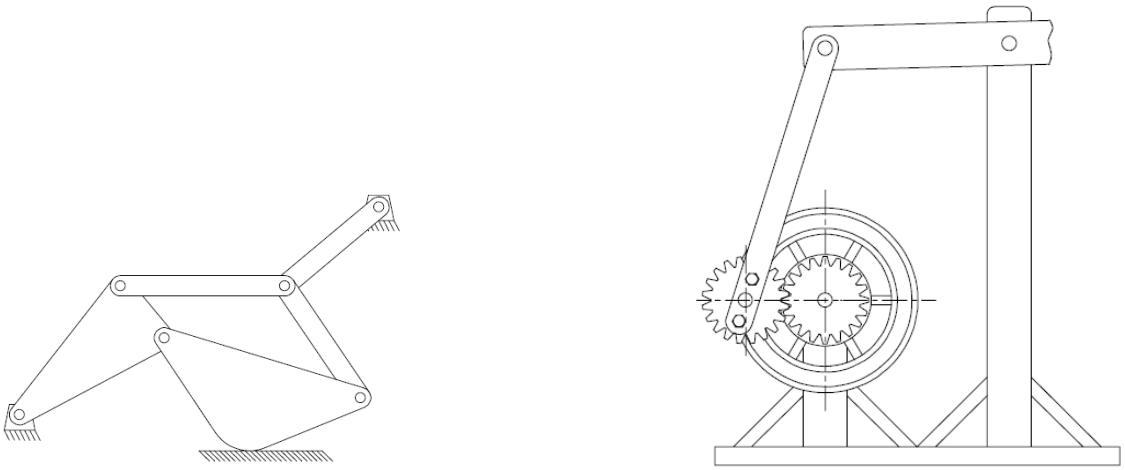


Figure 1

2. An inverted four-bar slider-crank linkage is shown in Figure 2. The length of input crank (link *a*) O_2A is 2.0 *in* and the angular velocities $\omega_a = 10\ rad/s$ (c.c.w.). The length of coupler (link *c*) O_4B is 4 *in*. Using relative velocity method cooperates with velocity polygon method to find the velocities of the pin joints *A* and *B* and the velocity of slip at the sliding joint. Draw the linkage to scale. (30%)

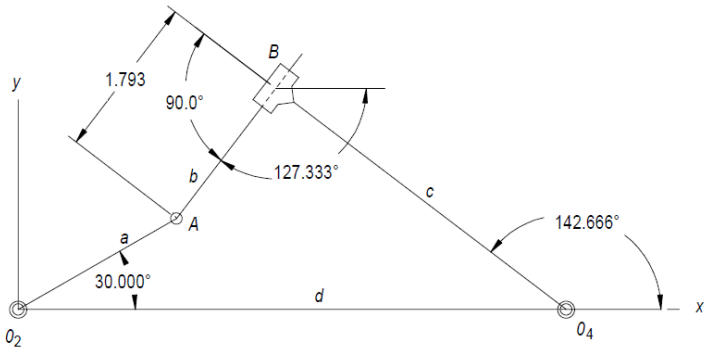


Figure 2 Fourbar slider-crank linkage

3. In the gear train of Figure 3, the inputs are the sun gear 5 and the ring gear 2. For given angular velocities of $\omega_{51} = 300$ rpm and $\omega_{21} = 500$ rpm (both counterclockwise as seen from the right), find the resulting rotation of ram 6. (25%)

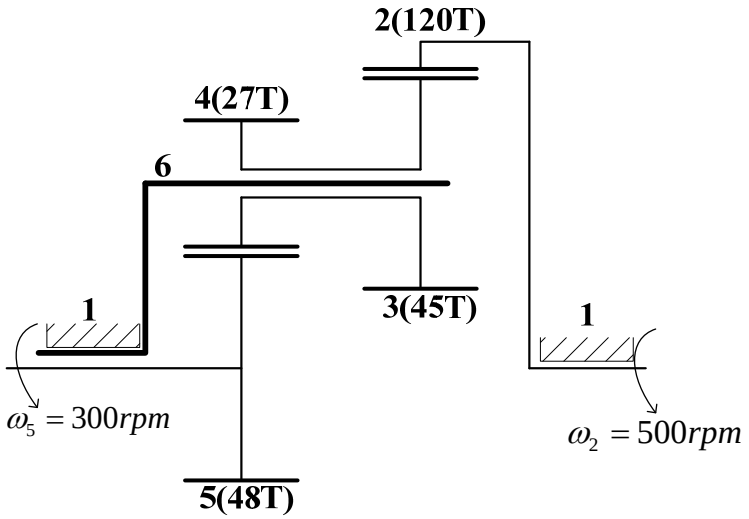


Figure 3 Gear train

4. Figure 4 shows a four-bar linkage. The angular velocity $\omega_2 = 2\ rad/s$ (c.w.) of the input crank (link *2*) is given; find the angular velocity of link 4 by using instant centers method. (25%)

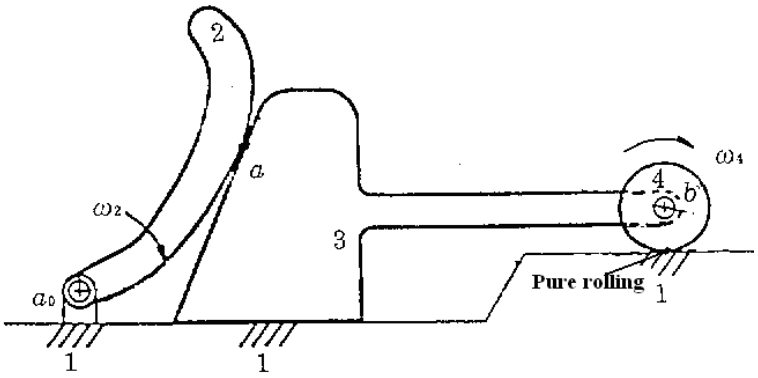


Figure 4 A four-bar linkage

*Close book **Answer in Chinese or in English *** Using a calculator is permitted

1. (a) Find the degrees of freedom of the mechanisms shown in Fig. 1a. (10%)

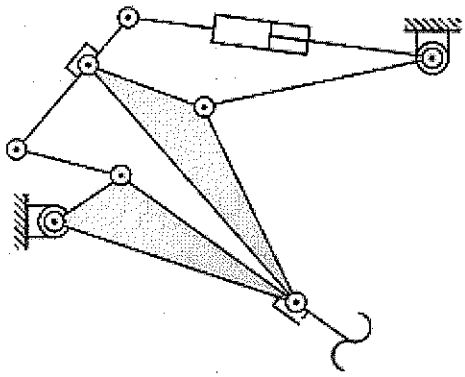


Fig. 1a

(b) Sketch the Structural sketch of the mechanism shown in Fig. 1b, and find its degrees of freedom. (10%)

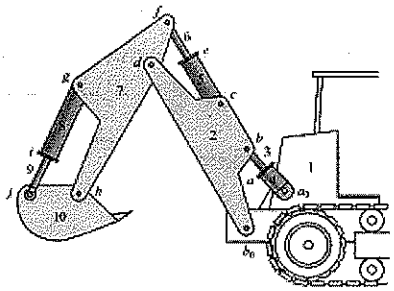


Fig. 1b

2. Fig. 5 shows a cam with a translating roller follower, derived its cam profiles by the envelope method. (20%)

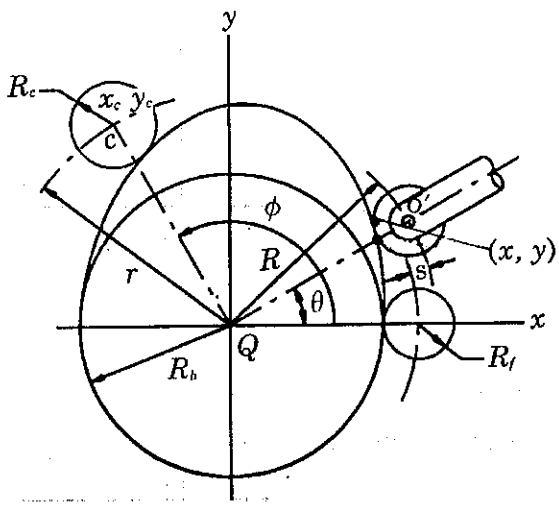


Fig. 2

3. Determine the speed ratio between the input shaft (gear 4) and the output shaft (arm 5) of the gear train shown in Fig. 3. Gear 2 is fixed, and the numbers of teeth for the gears are T_2=75, T_3=15, and T_4=105, respectively, in the mechanism. (20%)

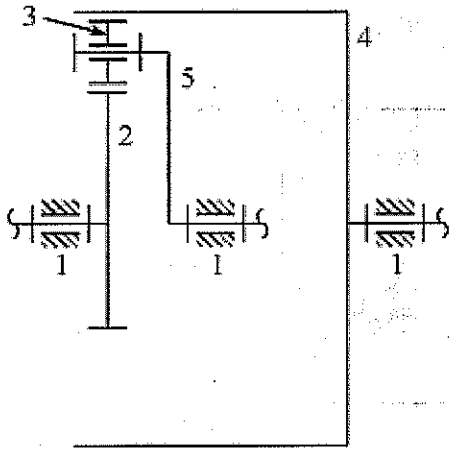


Fig. 3

4. Fig. 4 shows a crank-shaper crank mechanism, where Link 2 is the input. Find the closed form solution for the position of each link by using the vector loop closure approach. (20%)

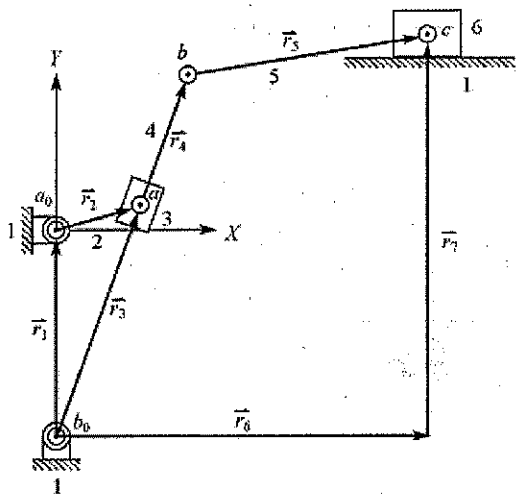


Fig. 4

5. Illustrate the following terms. (20%)
   (1) Toggle position
   (2) Transmission angle
   (3) Contact ratio of gearing
   (4) Involute tooth profile and its interference

國立虎尾科技大學機械與機電工程研究所 九十七 學年度 第 一 學期 博士班資格 考試題

科目名稱 機 構 學 班級 _____ 學號 _____ 姓名 _____ 第 1 頁共 2 頁

*Close book **Answer in Chinese or in English *** Using calculator is permitted

1. Calculate the degrees of freedom of the mechanisms shown in Fig. 1a and Fig. 1b. (20%)

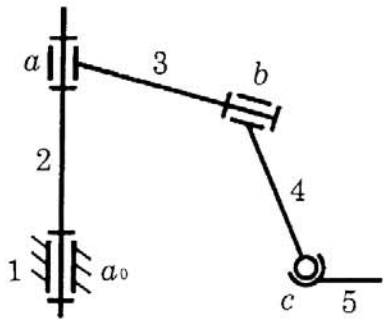


Fig. 1a

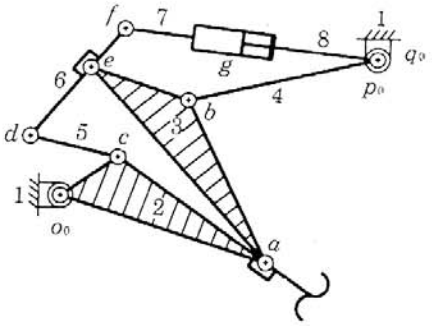
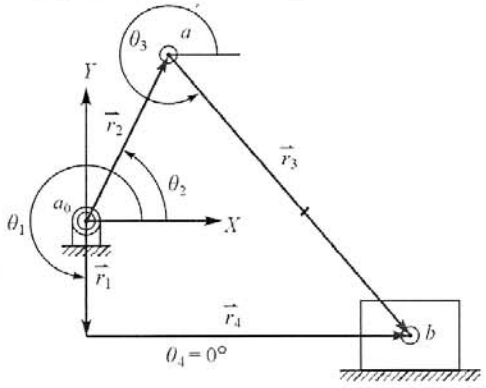


Fig. 1b

2. Fig. 2 shows a slider crank mechanism with the offset distance r_1, the lengths of link i (i=2-3) are r_i. If link 2 is the input link, that is, θ_2 is given. In addition, θ_1 is 270^O, θ_4 is 0^O. Find the closed form solution for the position r_4 of the slider 4 by using the vector loop closure approach. (25%)



(b)

Fig. 2

3. Fig. 3 shows a slider crank mechanism with dimensions a_0a=10cm, ab=30cm, $\theta_2 = 60^\circ$. If the crank rotates at a constant angular velocity of ω_2 = 100 rad/sec(counterclockwise). (25%)
   (1) Find the angular velocity of the link 3 and the velocity of the slider 4. (10%)
   (2) Find the angular acceleration of the link 3 and the acceleration of the slider 4. (15%)

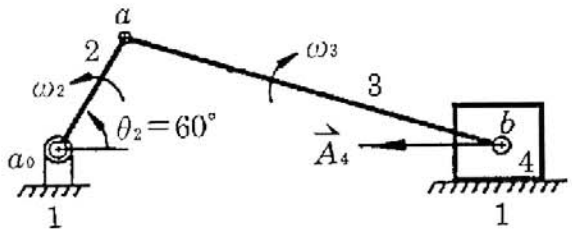


Fig. 3

4. Determine the speed ratio between the input and the output shafts of the gear train shown in Fig. 4, the numbers indicated in the figure are the number of teeth. (20%)

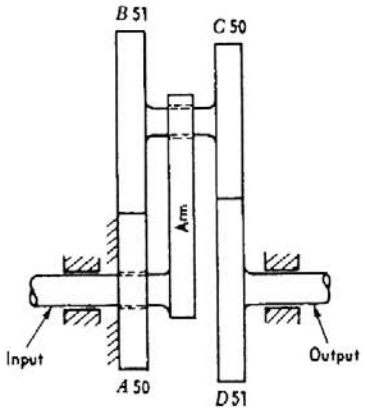


Fig. 4

5. Illustrate and explain the fundamental law of gearing. (10%)