

I. (50%)

一、是非題 (每小題三分, 答錯倒扣一分) 「注意: 請將答案寫在答案紙上」

1. Grashof law states that if the sum of the lengths of the longest link and the shortest link is less than the sum of the lengths of the other two, there will be formed a crank rocker when the shortest link is the fixed link.
2. Aronhold-Kennedy theorem states that any three bodies in plane motion will have exactly three instant centers, and they will lie on the same straight line.
3. As a rule of thumb, we would like the pressure angle to be between zero and about 30 degrees for translating roller-followers to avoid excessive side load on the sliding follower.
4. For crossed helical gears to mesh properly, there is only one requirement, that is, they must have common normal pitches or modules.
5. For the rise motion of a follower with the same lift and cam rotation angle, the cycloidal curve has the minimum peak value of velocity.

二、簡答題 (每小題五分)

1. List all possible planar six-link kinematic chains with simple revolute joints and having one degree of freedom.
2. Show the correct way to arrange two Hook's couplings so as to get unity constant velocity ratio of the input shaft to the output shaft.

三、填充題 (每小題五分)

1. Two standard 20° full-depth involute gears have pitch diameters of 4.5 and 12 inches. What is the largest tooth size, in terms of diametral pitch, that can be used without having any interference and undercutting? _____.
2. Figure 1 shows a planetary gear train used in an automotive rear-end differential (not to scale). The car has wheels with a 15-inch rolling radius and is moving forward in a straight line at 50 mph. The engine is turning 2,000 rpm. The transmission is in direct drive (1:1) with the driveshaft. As the car hits a patch of ice, the right wheel speeds up to 800 RPM. What is the speed of the left wheel? _____.

四、計算題 (十五分)

For the slider-crank mechanism shown in Fig. 2, solve the position analysis problem using the Newton-Raphson method.

- Write the scalar loop position equations.
- For $r_1 = 1$ in., $r_2 = 2$ in., $r_3 = 4$ in. and $\theta_2 = 60$ deg., the initial estimates of θ_3 and r_4 are 320 deg. and 4 in., respectively. Continue the iterations until you are within 0.5 deg. and 0.01 in. of the correct answers.

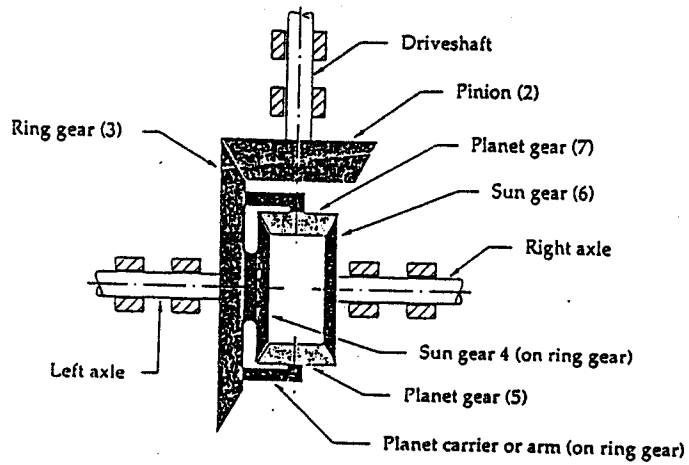


Fig. 1

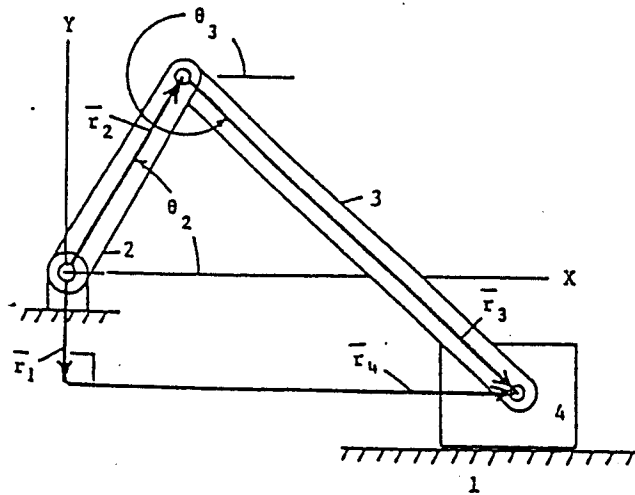


Fig. 2

II 機械設計試題 (50%)

(註:本科考試中不得參閱任何資料)

五. 請簡單解釋下列名詞:

- (a) 滾動軸承之 額定壽命 (Rating life) 與 基本額定負荷 (Basic load rating)。 (5%)
- (b) 鏈條傳動時之 弦速變化 (Chordal speed variation)。 (5%)
- (c) Goodman Line 與 Soderberg Line。 (5%)
- (d) 帶狀剎車自鎖作用 (Self-locking of band-type brake)。 (5%)

六. (a) 從生態(環保)上考慮, 選擇材料和機械設計時應注意那些事項? (5%)

(b) 機械元件承受衝擊 (Impact) 負荷時, 設計的主要考慮因素為何? 並請舉出可達成的方法? (5%)

(c) 何謂應力集中 (Stress Concentration)? 在何種負荷 (Static, Fatigue, or Impact) 及材料 (Ductile or Brittle) 下, 應力集中才重要? (5%)

七. 有一螺旋壓縮彈簧 (Helical compression Spring) 鋼線直徑 $d=3\text{mm}$, 線圈外徑 $D_o=28\text{mm}$, 有效圈數 $N_a=7$, 剪力校正因數 $K_s = \frac{2C+1}{2C}$, 綜合剪應力與應力集中校正因數 $K_b = \frac{4C+2}{4C-3}$, $C = \frac{D_o}{d}$ = 彈簧指數, 負荷 (Load) 由 0 變化至 60N . $S_{su} = 1154\text{MPa}$, $S_e = 310\text{MPa}$, 彈簧鋼線之 $G = 79.3\text{GPa}$ 。

(a) Spring rate $k = ?$ (5%)

(b) 應用 modified Goodman Theory, 求疲勞破壞之安全係數? (10%)