

中原大學 100 學年度 碩士班 入學考試

3 月 19 日 10:30~12:00

生物醫學工程學系

誠實是我們珍視的美德，
我們喜愛「拒絕作弊，堅守正直」的你！

科目：工程數學

(共 2 頁 第 1 頁)

■ 可使用計算機，惟僅限不具可程式及多重記憶者

□ 不可使用計算機

1. Solve $y''+10y'+25y=100\sinh 5x$, $\left[\sinh 5x = \frac{1}{2} (e^{5x} - e^{-5x}) \right]$ (10%)

2. Solve $(2xy + 2x^4)y' + 4x^3y = y^2$ (10%)

3. $x \frac{dy}{dx} - 4y = x^6 e^x$ (10%)

4. 寫出以下三種特定方程式的標準型式。(10%)

(a) Bernoulli equation

(b) Cauchy-Euler equation

(c) 常係數非齊次微分方程式

5. Using Laplace transformation method, solve the ordinary differential equation.

$$y''' + 2y'' - y' - 2y = \sin 3t, y(0) = 0, y'(0) = 0, y''(0) = 1 \quad (10\%)$$

6. The foot segment is subjected to the pull of the two plantarflexor muscles (Figure 1.)

Determine the moment of each force about the point of contact A on the ground.

(10%)

7. Prove that the vector $\mathbf{n} = a\mathbf{i} + b\mathbf{j}$ is perpendicular to the line whose equation is

$$ax + by + c = 0 \quad (10\%)$$

8. The system of equations for the currents i_1 , i_2 , and i_3 in the network shown in Figure 2. is

$$i_1 + i_2 + i_3 = 0$$

$$-R_1 i_1 + R_2 i_2 = E_2 - E_1$$

$$-R_2 i_2 + R_3 i_3 = E_3 - E_2$$

(a) Express the system as a matrix equation $\mathbf{AX} = \mathbf{B}$.

(b) Show that the coefficient matrix \mathbf{A} is nonsingular.

(c) Use $\mathbf{X} = \mathbf{A}^{-1}\mathbf{B}$ to solve for the currents.

9. Expand $f(x) = x^2$, $0 < x < L$, (a) in a cosine series, (b) in a sine series, (c) in a Fourier series.

(10%)

10. Find the frequency spectrum of the periodic square wave or periodic pulse shown in Figure 3.

The wave is the periodic extension of the function f : (10%)

$$f(x) = \begin{cases} 0, & -\frac{1}{2} < x < -\frac{1}{4} \\ 1, & -\frac{1}{4} < x < \frac{1}{4} \quad \#\# \\ 0, & \frac{1}{4} < x < \frac{1}{2} \end{cases}$$

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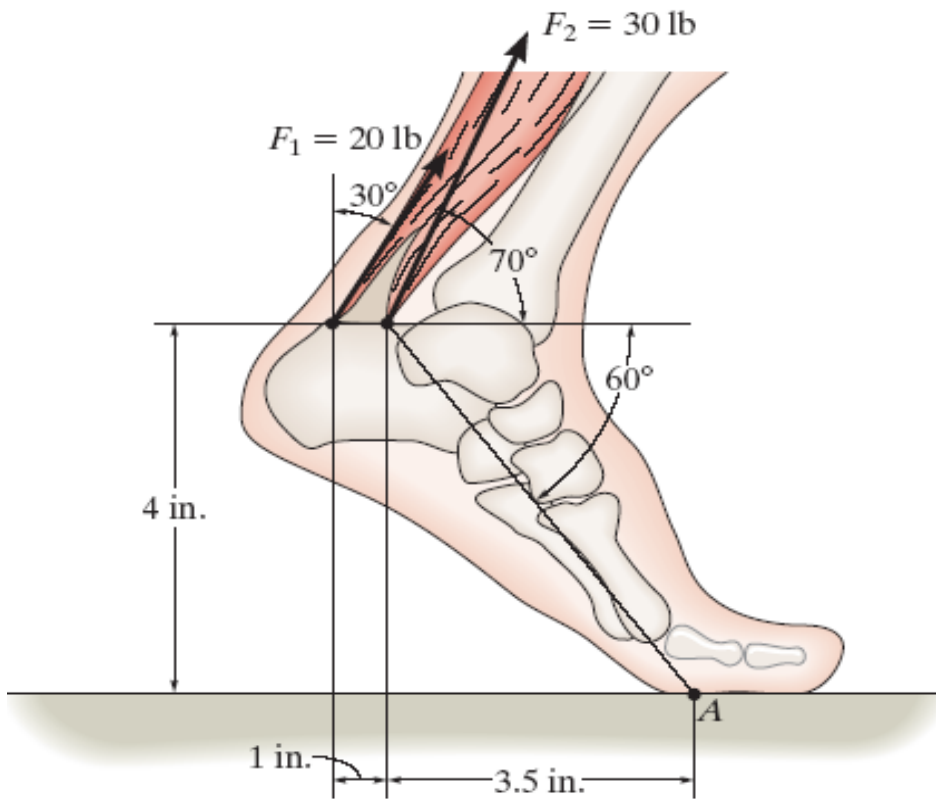


Figure 1

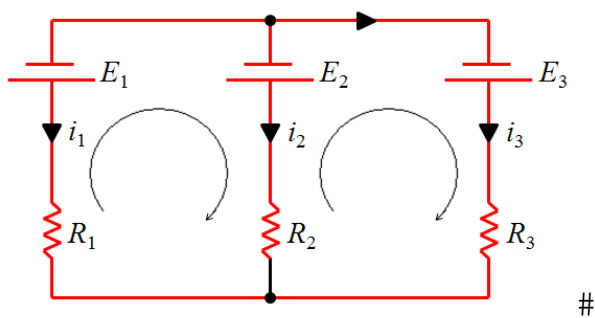


Figure 2

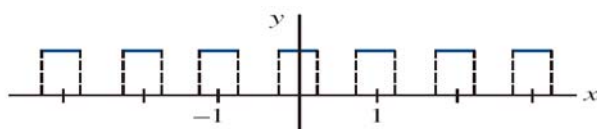


Figure 3