中原大學 102 學年度 **碩士班** 入學考試

102/3/2 10:00 ~ 11:30 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 1 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. Suppose that a large mixing tank initially holds 300 gallons of water in which 50 pounds of salt have been dissolved. Pure water is pumped into the tank at a rate of 3 gal/min, and when the solution is well stirred, it is pumped out at the same rate. Determine the amount *A(t)* of salt in the tank at time *t*. (20%)

2. Solve $x^2\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} - 4y = 0$ (20%)

3. The differential equation for the current *i(t)* in a single-loop *LR*-series circuit is

$$L\frac{di}{dt} + Ri = E(t)$$

Determine the current *i(t)* when *i(0)*=0 and *E(t)* is the square-wave function shown in Figure 1. (20%)

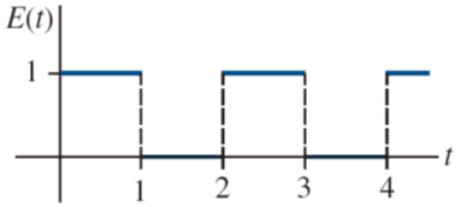

Figure 1

4. Expand $f(x) = \begin{cases} 0, & -\pi < x < 0 \\ \pi - x, & 0 \le x < \pi \end{cases}$ in a Fourier series (20%)

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

$$\begin{aligned} i_1 + i_2 + i_3 &= 0 \\ -R_1 i_1 + R_2 i_2 &= E_2 - E_1 \\ -R_2 i_2 + R_3 i_3 &= E_3 - E_2 \end{aligned}$$

(a) Express the system as a matrix equation **AX = B**. (5%)

(b) Show that the coefficient matrix **A** is nonsingular. (5%)

(c) Use $\mathbf{X} = \mathbf{A}^{-1}\mathbf{B}$ to solve for the currents. (10%)

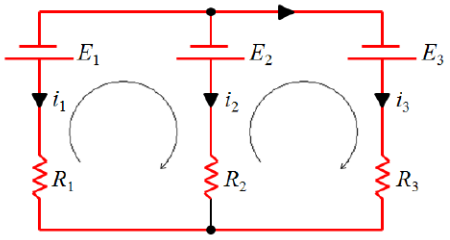

Figure 2