國立臺灣科技大學 106 學年度碩士班招生試題

系所組別：材料科學與工程系碩士班乙組

科　　目：工程數學

(總分為 100 分)

1. Solve differential equation by variation of parameters

   $y'' + 2y' - 8y = 2e^{-2x} - e^{-x}$, $y(0) = 1$, $y'(0) = 0$ (10%)

2. The differential equation for instantaneous charge *q(t)* on the capacitor in an RLC-series circuit is $L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{1}{C}q = V(t)$, Use the Laplace transform to find *q(t)* when *L = 1 h, R = 20 Ω, C = 0.005f, V(t) =150 V, t >0, q(0)* = 0, and *i(0)* = 0. What is the current *i(t)*? [*i(t) = q'(t)*] (10%)

3. Use the power series method to solve the initial-value problem.

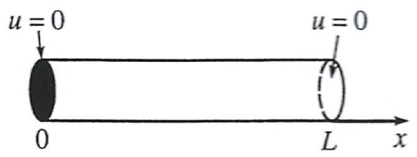
   $y'' - 2xy' + 8y = 0$, $y(0) = 3$, $y'(0) = 0$ (10%)

4. Solve the heat equation: $k\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t,}$, $0 < x < L, t > 0$. Subject to the following conditions:

   $u(0, t) = 0, u(L, t) = 0, u(x, 0) = f(x) = x(L - x)$.

   [reminder: (1) u(x, t) = X(x)T(t), -λ as the separation constant; (2) $A_n = \frac{2}{L}\int_0^L f(x)\sin\frac{n\pi}{L}xdx$*]*

   (20%)



國立臺灣科技大學 106 學年度碩士班招生試題

系所組別：材料科學與工程系碩士班乙組

科　　目：工程數學

(總分為 100 分)

5 . Find the volume of the parallelepiped for which the given vectors are three edges. (10%)

$\mathbf{a} = \mathbf{i} + \mathbf{j}$, $\mathbf{b} = -\mathbf{i} + 4\mathbf{j}$, $\mathbf{c} = 2\mathbf{i} + 2\mathbf{j} + 2\mathbf{k}$

6 . Use Gaussian elimination to solve the given system. (10%)

$$x_1 + x_3 - x_4 = 1$$
$$2x_2 + x_3 + x_4 = 3$$
$$x_1 - x_2 + x_4 = -1$$
$$x_1 + x_2 + x_3 + x_4 = 2$$

7 . Find the inverse of the given matrix. (10%)

$$\begin{bmatrix} 2 & 0 & 1 \\ -2 & 3 & 4 \\ -5 & 5 & 6 \end{bmatrix}$$

8 . Find the unit tangent of the given position function. (20%)

$\mathbf{r}(t) = e^t \cos t\, \mathbf{i} + e^t \sin t\, \mathbf{j} + \sqrt{2}\, e^t\, \mathbf{k}$