

國立臺灣科技大學
八十七學年度碩士班招生考試試題

所 別：纖維及高分子工程技術研究所 組別：控制組

科目：工程數學

1. Solve the following differential equations:

(a) $1 + (3x - e^{-2y})y' = 0$ (12%)

(b) $y'' + 6y' + 9y = e^{-3x} + e^x$ (12%)

(c) $x^2y'' + xy' + y = 4\sin(\ln x)$ $y(1) = 0$ $y'(1) = -2$ (14%)

(d) $\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + 2x = 1 + \delta(t - 4)$ $x(0) = \dot{x}(0) = 0$ (12%)

where $\delta(t)$ is the Dirac delta function.

拉 2 分

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2. Find out what type of conic section is represented by the given quadratic form. Transform it to principle axes. Express $\mathbf{x}^T = [x_1 \ x_2]$ in terms of the new coordinate vector $\mathbf{y}^T = [y_1 \ y_2]$. (14%)

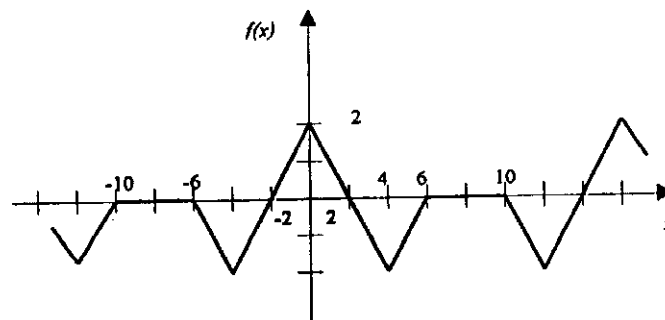
$$2x_1^2 + 2\sqrt{3}x_1x_2 + 4x_2^2 = 5$$

3. A differentiable scalar function $f(q_1, q_2, q_3)$ is expressed in orthogonal curvilinear coordinates q_1, q_2, q_3 . Please derive the general expression for the gradient ∇f in curvilinear coordinates. (12%)

4. Evaluate the surface integral $\iint_S \mathbf{F} \cdot \mathbf{n} \, dA$ by the divergence theorem, where

$\mathbf{F} = 10y\mathbf{j} + z^3\mathbf{k}$, S the surface of $0 \leq x \leq 6$, $0 \leq y \leq 1$, $0 \leq z \leq y$
 $\mathbf{n}$ is unit outer normal vector on surface S (12%)

5. Find the Fourier series of the periodic function $f(x)$ as follow figure. (12%)



Figure