

# 國立彰化師範大學 97 學年度碩士班招生考試試題

系所： 工業教育與技術學系碩士班    組別： 乙組    科目： 工程數學

☆☆請在答案紙上作答☆☆

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1. Reduce the quadratic form to principal axes. Express  $[x_1, x_2]^T$  in terms of the new variable.

(Show the details), (10%)

$$x_1^2 - 12x_1x_2 + x_2^2 = 35$$

2. Find the eigenvalues and the eigenvectors of the following matrix and diagonalize the matrix,

$$\mathbf{A} = \begin{bmatrix} 3 & 10 & -15 \\ -18 & 39 & 9 \\ -24 & 40 & -15 \end{bmatrix}, \quad (10\%)$$

3. Find the Fourier integral representation of the function (10%)

$$f(x) = \begin{cases} 1 & \text{if } |x| < 1 \\ 0 & \text{if } |x| > 1 \end{cases} \quad \text{and determine } \int_0^{\infty} \frac{\sin w}{w} = ?$$

4. Solve: (10%)

$$\begin{cases} \frac{\partial u(x, t)}{\partial t} = c^2 \frac{\partial^2 u(x, t)}{\partial x^2} \\ u_x(0, t) = u_x(\lambda, t) = 0 \\ u_t(x, 0) = k \end{cases}, \text{ where } c \text{ and } k \text{ are constant.}$$

5. Solve: (10%)

$$(a) \int_{-\infty}^{\infty} \frac{1}{(x^2 + 1)(x^2 + 9)} dx = ?$$

$$(b) \int_0^{\pi} \frac{1}{\alpha + \beta \cos \theta} d\theta = ?$$

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6. To solve  $y' + (\tan x)y = \sin 2x$  (8%)

7. To solve  $(x^2 - 2xy)dx + (\sin y - x^2)dy = 0$  (8%)

8. To solve  $y''' + 27y = 0$  (8%)

9. To use power series to solve (To write out the first five terms of the solution)

$$y' + e^x y = x^2; y(0) = 4 \quad (8\%)$$

10. To use Laplace transform method to solve (8%)

$$y'' - 4y' + 4y = \cos t \quad y(0) = 1; y'(0) = -1$$

11. To find (i)  $\mathcal{L}^{-1}[ce^{at} \sin(wt + \theta)]$  (10%)

(ii)  $\mathcal{L}^{-1}\left[\ln \frac{s+1}{s-1}\right]$