

# 國立彰化師範大學 101 學年度碩士班招生考試試題

系所： 電信工程學研究所

科目： 工程數學

☆☆請在答案卷上作答☆☆

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1.  $f(x) = \sin(2\pi mx)$  and  $g(x) = \cos(2\pi nx)$ , where  $m$  and  $n$  are positive integers, in the vector space  $C(0, 1)$  with the standard inner product, find the inner product  $\langle f, g \rangle$ . (15%)

2. Find each determinant if  $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 0 & 2 & 4 & 6 \\ 0 & 0 & 3 & 6 \\ 0 & 0 & 0 & 4 \end{bmatrix}$ . (15%)

(a)  $|A|$    (b)  $|A^4|$    (c)  $|4A|$    (d)  $|AA^T|$    (e)  $|A^{-1}|$

3. Information from a binary source is organized in 40-bit message that are to be transmitted over a channel with bit error probability  $P_B = 10^{-5}$ . Find the message error probability. (10%)
4. Let  $X$  be normally distributed with mean  $\mu = 2$  and variance  $\sigma^2 = 16$ . Find the probability  $P(X > 18)$ . (10%)
5. A period function, called a pulse train of width  $a$  and period  $p$  ( $p > a$ ), is defined as

$$f(t) = \begin{cases} 0 & -\frac{p}{2} \leq t < -\frac{a}{2} \\ 1 & -\frac{a}{2} < t < \frac{a}{2} \\ 0 & \frac{a}{2} < t \leq \frac{p}{2} \end{cases}$$

Please find the complex Fourier series of this period function. (10%)

6. Use the Laplace transform to solve the integrodifferential equation. (15%)

$$y'(t) = 1 - \sin t - \int_0^t y(\tau) d\tau, \quad y(0) = 0$$

7. Determine the general solution of the given differential equations. (10%)

$$y^{(4)} + 2y'' + y = 3 + \cos 2t$$

8. Given that  $x$ ,  $x^2$ , and  $\frac{1}{x}$  are the solutions of the homogeneous equation corresponding to

$$x^3 y''' + x^2 y'' - 2xy' + 2y = 2x^4, \quad x > 0,$$

determine a particular solution. (15%)