國立雲林科技大學 111 學年度 碩士班招生考試試題

系所：電機系

科目：工程數學(1)

1. (15%) Solve the general solution of the following differential equations:
[解下列微分方程式之通解]

(1) $y' = 5\sin 3x$ (5%); (2) $y' + 5x^4 y = 3x^2 e^{-x^5}$ (5%); (3) $x^2 y' = y^2 + xy$ (5%).

2. (10%) Solve the following initial value problems: $y'' + 9y = 16\sin x$; $y(\pi) = 0, y'(0) = 0$ (10%)

3. (15%) Use the Laplace transform or inverse transform to solve the given problems:

(1) $f(t) = t^2 + e^{-6t} + \sin 6t$; 求 $F(s) = L[f(t)]$ (5%);

(2) $F(s) = \dfrac{8}{s(s-2)^2}$; 求 $f(t) = L^{-1}[F(s)]$ (5%);

(3) $y'(t) + \int_0^t y(\tau)d\tau = 2 - 2\sin t, \quad y(0) = 0$; 求 $y(t)$ (5%).

4. (10%) Use the Laplace transform to solve the given initial value problem [利用拉氏轉換求解微分方程式]: $\dfrac{dy(t)}{dt} - 3y(t) = te^{3t}\sin t, \quad y(0) = 0$。 (10%)

5. (20%) Let $A = \begin{bmatrix} 0 & 0 & 3 \\ 0 & 2 & 1 \\ 2 & 0 & 1 \end{bmatrix}$.

(a) Find the eigenvalues and associated eigenvectors (10%)

(b) Factor $A$ into a product $XDX^{-1}$, where $D$ is a diagonal matrix, and then use the factorization to compute $A^5$. (10%)

6. (10%) Determine whether the set S is linearly independent or linearly dependent.

(a) S={(-4, 3, 4),(1, -2, 3),(6, 0, 0)} (5%)

(b) S={(6, -7, 8, 6),(4, 6, -4, 1),(2, 19, -16, -4)} (5%)

7. (10%) Consider the matrix $A = \begin{bmatrix} 1 & 4 & 2 & 1 \\ 0 & 1 & 1 & -1 \\ -2 & -8 & -4 & -2 \end{bmatrix}$, find the null space, rank, and nullity of $A$. (10%)

8. (10%) For a matrix $A = \begin{bmatrix} 1 & 0 & 1 \\ 7 & 7 & 8 \\ 1 & 2 & 1 \\ 7 & 7 & 6 \end{bmatrix}$, apply the Gram-Schmidt process to find an orthonormal basis for the column space of $A$. (10%)

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系所：電機系

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1. Find the equivalent capacitance $C_{eq}$ in the circuit shown in **Fig. 1**. (10%)

2. Find voltage $V_x$ and current $I_x$ in the circuit of **Fig. 2**. (20%)

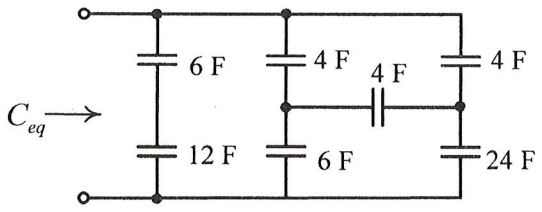


**Fig. 1**

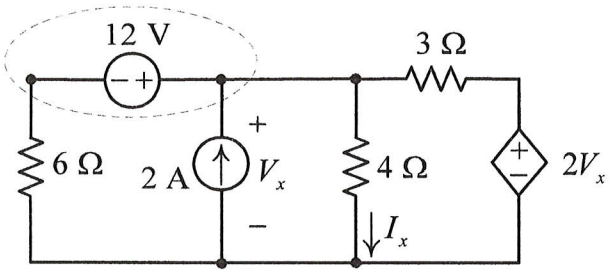


**Fig. 2**

3. In the circuit of **Fig. 3**, the sinusoidal voltage source is given by $v_s(t) = 10\sqrt{2}\sin(10t)$ V. The switch closes at $t$=0. Find the current $i(t)$ for $t$>0. (20%)

4. The current waveform in **Fig. 4** is flowing through a 2-Ω resistor. Determine the rms value of the waveform and the average power delivered to the resistor. (16%)

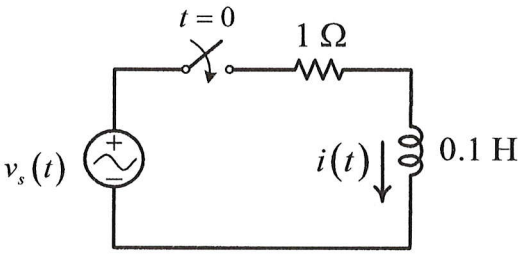


**Fig. 3**

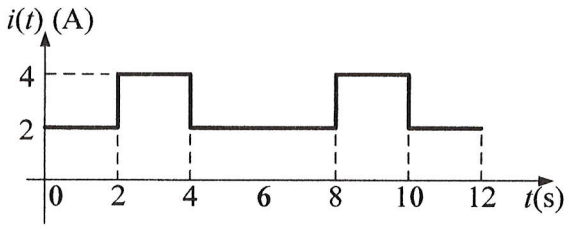


**Fig. 4**

5. In the balanced three-phase system shown in **Fig. 5**, the line voltage is 13.8 kV rms. Find the values of the capacitors $C$ such that the total load has a power factor of 0.95 lagging. (16%)

6. Realize the transfer function $\dfrac{\mathbf{V}_o(s)}{\mathbf{V}_i(s)} = \dfrac{-2s}{s+10}$ using the circuit in **Fig. 6**. Determine $C_1$ and $C_2$. (18%)

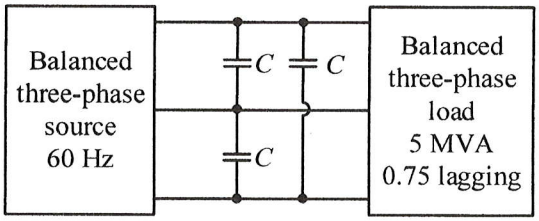


**Fig. 5**

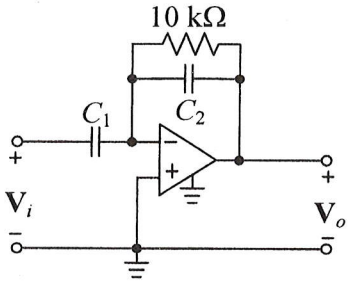


**Fig. 6**