

國立成功大學

112學年度碩士班招生考試試題

編 號：82

系 所：資源工程學系

科 目：工程數學

日 期：0206

節 次：第 3 節

備 註：不可使用計算機

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (18%)

(a) If $\frac{dy}{dx} = y + \sin(x)$, $y(0) = \frac{1}{2}$, find $y(x)$, $x > 0$?

(b) If $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 25\sin(2x)$, $y(0) = 0$, $y'(0) = 0$, find $y(x)$, $x > 0$?

2. (12%)

(a) Calculate the Laplace transform of $\cos(3t - 2)$?

(b) Find the inverse Laplace transform of $\frac{s^2 + 4s + 2}{(s+1)(s+2)s}$?

3. (16%)

(a) $[A] = \begin{bmatrix} 1 & 1 & 2 & 2 \\ 1 & -1 & 1 & -2 \\ 1 & 2 & 2 & 1 \\ 1 & 2 & 1 & -1 \end{bmatrix}$

(a-1) find the row reduced echelon form of $[A]$?

(a-2) find the rank of $[A]$?

(a-3) find the null space of $[A]$?

(b) Find the eigenvalues and the corresponding eigenvectors of $\begin{bmatrix} 1 & 1 & 0 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$?

4. (18%)

(a) Find the curl of $3x^3y^2\bar{i} - 2y^2z^3\bar{j} + x^2z^3\bar{k}$ at $(-1, 2, 1)$?

(b) Find the direction and its magnitude of maximum rate of increase in $f(x, y, z) = xy^2z^3$ at $(3, 2, -1)$?

(c) State the Gaussian theorem?

5. (24%)

(a) Determine the Fourier series expansion of the periodic function: $f(x) = \begin{cases} -x, & -1 < x < 0 \\ x, & 0 < x < 1 \end{cases}$ with a fundamental period 2?

(b) Find the Fourier sine integral of the function $f(x) = e^{-2x}$, $x > 0$?

(c) Find the inverse Fourier transform of the function $f(w) = \begin{cases} ke^{-aw}, & w > 0 \\ 0, & w < 0 \end{cases}$?

6. (12%)

(a) Write down the governing equation of $x(t)$ for a 1D mass(m)-damper(c)-spring(k) system subjected to an external force $f(t)$ in which x is the displacement of the mass as a function of time, t ?

(b) Write down the governing equation of $i(t)$ for a simple circuit of inductor(L)-resistor(R)-capacitor(C) system subjected to an external voltage supply $E(t)$ in which i is the current of the circuit as a function of time, t ?