

科目：工程數學乙 適用：電機所系統組

編號：441

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答；試題須隨卷繳回。

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1. Determine whether the following two matrices are diagonalizable or not, if they are diagonalizable, diagonalize them.

(1) (10 %) $\mathbf{A} = \begin{pmatrix} 1 & 2 & 1 \\ 6 & -1 & 0 \\ -1 & -2 & -1 \end{pmatrix}$.

(2) (10 %) $\mathbf{B} = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$.

2. Determine whether the following two matrices have inverse or not, if they have inverse, find the inverse.

(1) (10 %) $\mathbf{A} = \begin{pmatrix} 2 & 0 & 1 \\ -2 & 3 & 4 \\ -5 & 5 & 6 \end{pmatrix}$.

(2) (10 %) $\mathbf{B} = \begin{pmatrix} 1 & -1 & -2 \\ 2 & 4 & 5 \\ 6 & 0 & -3 \end{pmatrix}$.

3. Solve the following two systems.

(1) (10 %) $\mathbf{X}' = \begin{pmatrix} -3 & 1 \\ 2 & -4 \end{pmatrix} \mathbf{X} + \begin{pmatrix} 3t \\ e^{-t} \end{pmatrix}$.

(2) (10 %) $\mathbf{X}' = \begin{pmatrix} 4 & 2 \\ 2 & 1 \end{pmatrix} \mathbf{X} + \begin{pmatrix} 3e^t \\ e^t \end{pmatrix}$.

4. Let $n = 0, 2, 4, \dots$, and specify the function $E(t)$ as follows.

$$E(t) = \begin{cases} 1, & n \leq t \leq n+1 \\ 0, & n+1 \leq t < n+2 \end{cases}$$

- (1) (10 %) Find the Laplace transform of $E(t)$.

- (2) (10 %) Use $E(t)$ as the voltage source in a single-loop LR series circuit.

Determine the current $i(t)$ when $i(0) = 0$.

5. Find the power series solutions for the following two equations.

(1) (10 %) $(x^2 + 1)y'' + xy' - y = 0$.

(2) (10 %) $y'' - (1+x)y = 0$.