

科目：工程數學(線性代數+微分方程)

編號：352 適用：電機系

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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(一) (25分; 每小題 5分) Let $F(\mathbf{R})$ denote the set of all functions from \mathbf{R} to \mathbf{R} . Choose the following subsets of $F(\mathbf{R})$ which are linear independent.

(a) $\{t^2 + 3t - 5, -2t^2 - 6t + 10\}$

(b) $\{t^2 + 3t - 5, 2t^2 - 6t + 10, t^2\}$

(c) $\{\sin t, \cos t, t \sin t\}$

(d) $\{\sin t, \cos^2 t, \sin^2 t, 1\}$

(e) $\{e^t, e^{2t}, e^{3t}, \dots, e^{nt}, \dots\}$

(二) (25分; 每小題 5分) Consider the following system of three linear equations in three unknowns:

$$y_1 + y_2 + ay_3 = 1$$

$$y_1 + ay_2 + y_3 = 3$$

$$ay_1 + y_2 + y_3 = 2a$$

Where $a \in \mathbf{R}$

- (a) Find condition on a such that the system has a unique solution.
- (b) Find condition on a such that the system has no solution.
- (c) Find condition on a such that the system has many solutions.
- (d) Under the condition obtained in (a), use Cramer's rule to solve the system.
- (e) Under the condition obtained in (c), find solutions of the system.

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(三) (50 分; 每小題 5 分) ODE: $y'' + 3y' + 2y = r(t)$;(a) Determine the Order and Homogeneous of the above ODE.(b) $r(t) = 0$, Let $y = e^{\lambda t}$ to find the general solution of the above ODE.(c) $r(t) = 0$, Transform the above ODE to 1st-order ODE system.(d) Same as (c), Use eigenvalue/eigenvector method to solve 1st-order ODE system.(e) Define Laplace transform of $y(t)$ (f) If $L\{y(t)\} = Y(s)$; Prove $L\{y'(t)\} = sY(s) - y(0)$ (g) $r(t) = 0$, Use Laplace transform to solve the above ODE.[Let $y(0) = a, y'(0) = b$](h) $r(t) = 2e^{-t}$, Solve the above ODE.(i) $r(t) = u(t-1) - u(t-2)$, $y(0) = 0, y'(0) = 0$, Solve the above ODE.(j) $r(t) = \delta(t-1)$; $y(0) = 0, y'(0) = 0$, Solve the above ODE.