

科目：工程數學 適用：電機系(電子組)

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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本試題

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第 1 頁

(一) Multiple-Choice (20%) (at least one solution is correct; Show answers, not show details)

(a) Which is the solution of  $x^3 y''' - 3x^2 y'' + 6xy' - 6y = 0$ ? (5%)

- (A)  $x + x^2 + x^3$  (B)  $1 + x + x^2 + x^3$  (C)  $2 + x + x^2 + x^3$  (D)  $x^2 + x^3$  (E)  $x^3$

(b) Which is the solution of  $y' + y \tan x = \sin 2x$ ? (5%)

- (A)  $\cos x$  (B)  $\cos x + 2 \cos^2 x$  (C)  $\cos x - 2 \cos^2 x$  (D)  $-2 \cos^2 x$  (E)  $2 \cos x - 2 \cos^2 x$

(c) 
$$f(x) = \begin{cases} 0; & -2 < x < -1 \\ k; & -1 < x < 1 \\ 0; & 1 < x < 2 \end{cases}; k > 0, \text{ Period}(T) = 4;$$

$f(x) = a_0 + \sum_{n=1}^{\infty} \left( a_n \cos \frac{n\pi x}{L} + b_n \sin \frac{n\pi x}{L} \right)$ , Which is the correct? (5%)

- (A)  $f(x)$  is even function (B)  $L = 4$  (C)  $a_0 = 0$  (D)  $b_n = 0$  (E)  $f(1) = \frac{k}{2}$

(d) If Fourier Transform  $F\{f(x)\} = a(w)$ , Choose the correct? (5%)

- (A)  $F\{f'(x)\} = wa(w)$  (B)  $F\{f''(x)\} = -w^2 a(w)$   
 (C)  $F\{f(x-b)\} = e^{iwb} a(w)$  (D)  $F\{f(x)e^{iwb}\} = a(w-b)$   
 (E)  $F\{f(x)u(x)\} = a(w)$ ; ( $u(x)$ : step function)

(二) If Laplace Transform  $L\{f(t)\} = \frac{1}{s - \sqrt{a}}$  ( $a$ : positive constant), Find (show details) (24%; each 4%)

- (a)  $L\{f'(t)\}$  (b)  $L\{\int_0^t f(\tau) d\tau\}$   
 (c)  $L\{\frac{f(t)}{t}\}$  (d)  $L\{e^{at} f(t)\}$   
 (e)  $L^{-1}\{\frac{1}{(s - \sqrt{a})^2}\}$  (f)  $L^{-1}\{\frac{1}{(s - \sqrt{a})^n}\}$ ;  $n = 1, 2, 3, \dots$

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本 試 題

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(三) A differential equation for unknown function  $y(x)$  (24 %)

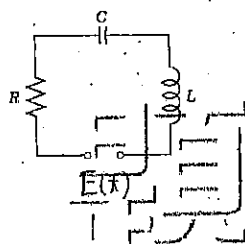
$$y'' - y' = 0$$

- (a) Let  $y = e^{mx}$ , Find the general solution for  $y(x)$ . (6%)
- (b) Use Laplace Transform Method to find the general solution for  $y(x)$ . (6%)
- (c) Use Power Series Method to find the general solution for  $y(x)$ . (6%)
- (d) Let  $y' = p$ , use Separable Variable Method to find the general solution for  $y(x)$ . (6%)

## (四) LRC circuit in the following Figure

A voltage  $E(t)$  is applied. Assume charge ( $q$ ) and current ( $i$ ) is zero at  $t = 0$ (Inductance= $L$ , Resistance= $R$ , Capacitance= $C$ ) (18%)

- (a) Write down the 2-order ordinary differential equation in terms of charge ( $q$ ) and current ( $i$ ). (6%) [ Use  $L, R, C, E(t)$  to express the answer]
- (b) If  $E(t) = (8\sin 2t) \text{ V}$ ,  $L = 1 \text{ H}$ ,  $R = 0 \text{ } \Omega$ ,  $C = 0.25 \text{ F}$ ; Find the current  $i(t)$ . (6%)
- (c) If  $E(t) = 600(\cos t + 4\sin t) \text{ V}$ ,  $L = 1 \text{ H}$ ,  $R = 6 \text{ } \Omega$ ,  $C = 0.04 \text{ F}$ ; Find the current  $i(t)$ . (6%)



## (五) Write down a Partial differential equation (PDE) and solve this equation. (14 %)