

# 國立中山大學 107 學年度碩士暨碩士專班招生考試試題

科目名稱：工程數學【光電所碩士班】

題號：435001

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（問答申論題）

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1. (15%) Find a real general solution of the following system. Show the details.

$$y_1' = 10y_1 - 10y_2 - 4y_3$$

$$y_2' = -10y_1 + y_2 - 14y_3$$

$$y_3' = -4y_1 - 14y_2 - 2y_3$$

2. (15%) Solve the nonhomogeneous linear ODE. Show the details.

$$y'' + 2y' + 2y = 4e^{-x} \sec^3 x$$

3. (15%) Given  $F(s) = \mathcal{L}(f)$ , find  $f(t)$ . Show the details of your work. ( $L$  is constant)

(a)  $\frac{s}{L^2 s^2 + 1/4\pi^2}$       (b)  $\frac{2}{s^4} - \frac{48}{s^6}$       (c)  $\frac{90}{(s+\sqrt{3})^6}$

4. (20%) Find the Fourier transform of  $f(x)$ .

(a)  $f(x) = \begin{cases} e^{kx} & \text{if } x < 0 \ (k > 0) \\ e^{-kx} & \text{if } x > 0 \end{cases}$

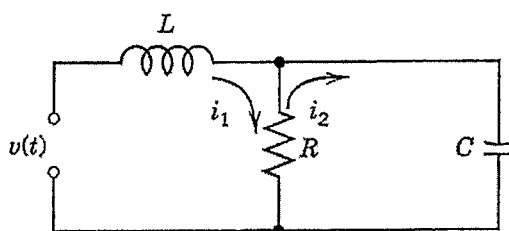
(b)  $f(x) = \begin{cases} xe^{-x} & \text{if } -1 < x < 0 \\ 0 & \text{otherwise} \end{cases}$

5. (15%) The current in network in picture are obtained from the system

$$Li_1' + R(i_1 - i_2) = v(t)$$

$$R(i_2 - i_1) + \frac{1}{C}i_2 = 0.$$

Solve this system, assuming that  $R = 10\Omega$ ,  $L = 20H$ ,  $C = 0.05F$ ,  $v = 20V$ ,  $i_1(0) = 0$ ,  $i_2(0) = 2A$ .



6. (20%) The tank in picture contains 80 lb of sugar dissolved in 500 gal of water. The inflow per minute is 20 lb of sugar dissolved in 20 gal of water. The outflow is 20 gal/min of the uniform mixture. Find the time when the sugar content  $y(t)$  in the tank reaches 95% of its limiting value (as  $t \rightarrow \infty$ ).

