

# 國立中山大學 101 學年度碩士暨碩士專班招生考試試題

科目：工程數學【資工系碩士班乙組】

題號：4079  
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1. (15%) Please find the solution of  $y$  for the first order differential equation.

$$y' + \frac{1}{x}y = 3x^2, \text{ and } y(1) = 5$$

2. (15%) Please find the particular solution of  $y$  for the second order differential equation.

$$y'' + 2y' - 3y = 4e^x$$

3. (18%) A signal  $x(t)$  is a periodic with period  $T_0=8$  and can be expressed as

$$x(t) = \sum_{k=-\infty}^{\infty} a_k e^{j(2\pi/8)kt}$$

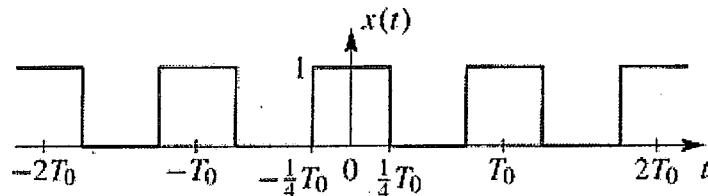
The Fourier coefficients of this particular signal are given by the integral  $\frac{1}{8} \int_{-4}^0 (4+t)e^{-j(2\pi/8)kt} dt$

3.1 (6%) In the integral expression for a  $a_k$  above, the integrand and the limits define the signal  $x(t)$ . Determine an equation for  $x(t)$  that is valid over one period.

3.2 (6%) Using the result from (3.1), draw a plot of  $x(t)$  over the range  $-8 \leq t \leq 8$  seconds. Label your plot carefully.

3.3 (6%) Determine the DC value of  $x(t)$ .

4. (12%) Considering the periodic function  $x(t)$  plotted in following Figure,



4.1 (6%) Find the DC value  $a_0$  and other Fourier coefficients  $a_k$  for  $k \neq 0$  in the Fourier series representation of  $x(t)$ .

4.2 (6%) Define a new signal as  $y(t)=2x(t-T_0/2)$ . Use the time shifting property to write down the Fourier series coefficient  $b_0$  and  $b_k$  for  $k \neq 0$  for the periodic signal  $y(t)$  without evaluating any integrals.

5. (20%) Find the inverse Laplace transform of  $G(s) = \frac{s}{(s+3)(s^2+4s+5)}$

6. (20%)

6.1 (10%) Find the LU-factorization of the matrix  $A = \begin{bmatrix} 1 & -3 & 0 \\ 0 & 1 & 3 \\ 2 & -10 & 2 \end{bmatrix}$ ,

6.2 (10%) Use the result of 6.1 to solve  $\begin{bmatrix} 1 & -3 & 0 \\ 0 & 1 & 3 \\ 2 & -10 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} -5 \\ 11 \\ -12 \end{bmatrix}$