

國立高雄第一科技大學 100 學年度 碩士班 招生考試 試題紙

系所別：光電工程研究所

組別：不分組

考科代碼：1221

考科：工程數學 I

注意事項：

- 1、本科目得使用本校提供之電子計算器。
- 2、請於答案卷上規定之範圍作答，違者該題不予計分。

1.  $f(x) = \begin{cases} 0, & -\pi < x < 0 \\ x^2, & 0 \leq x < \pi \end{cases}$

(a) (10%) Expand the function  $f$  in a Fourier series

(b) (10%) Use the above result to show

$$\frac{\pi^2}{8} = 1 + \frac{1}{3^2} + \frac{1}{5^2} + \dots$$

2. (15%) Evaluate  $\oint_C \frac{1}{z(e^z-1)} dz$ , where the contour  $C$  is the circle  $|z| = 2$ .

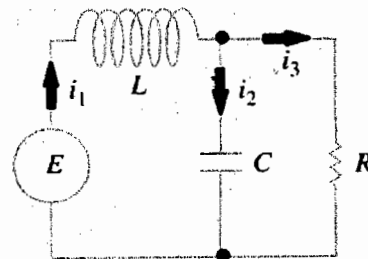
3. (15%) Evaluate the trigonometric integral  $\int_0^{2\pi} \frac{\sin^2 \theta}{13+12 \cos \theta} d\theta$

4. (a) (10%) Show the set  $\{\sin x, \sin 2x, \sin 3x, \sin 4x, \dots\}$  is orthogonal on the interval  $[-\pi, \pi]$ , (b) (10%) Is this set of functions complete?, please explain.

5. Solve the electrical network as shown below. (a) (5%) By applying Kirchhoff's law, please show the following system of differential equations that describes the currents  $i_1(t)$  and  $i_3(t)$  in the electrical network.

$$L \frac{di_1}{dt} + Ri_3 = E(t)$$

$$RC \frac{di_3}{dt} + i_3 - i_1 = 0$$



(b) (15%) Use the Laplace transform to obtain the currents  $i_1(t)$ ,  $i_2(t)$  and  $i_3(t)$  under the conditions  $E(t) = 12V$ ,  $L = 1 \text{ h}$ ,  $R = 5 \Omega$ ,  $C = 10^{-2} \text{ f}$ , and  $i_1(0) = 0$ ,  $i_3(0) = 0$ .

6. (10%) Solve the differential equation

$$(y^2 \cos t - 3t^2 y - 3t^2) dt + (2y \sin t - t^3 + \ln y) dy = 0, y(0) = e.$$