國立嘉義大學 104 學年度
生物機電工程學系碩士班招生考試試題

科目：工程數學（※禁止使用計算機）

1. Find the Fourier series of the function on the interval. (25%)

   (a) $f(x) = 4,\ -3 \le x \le 3.$

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

2. Use the Laplace transform to solve the system. (25%)

   (a) $x' - 2y' = 1,\ x' + y - x = 0;\ x(0) = y(0) = 0.$

   (b) $x' + y' + x - y = 0,\ x' + 2y' + x = 1;\ x(0) = y(0) = 0.$

3. A steady fluid moves through a space with velocity vector

   $$\underline{F} = (3x^4 + 7y^2 + 2z^3)\underline{i} + (6x^2 - 12x^3 y + 2z^2)\underline{j} + (x^2 + y^2)\underline{k}.$$

   What is the outflow rate across the upper hemisphere $x^2 + y^2 + z^2 = 9$, $z > 0$ and the lower hemisphere $x^2 + y^2 + z^2 = 9,\ z < 0$, respectively? (25%)

4. Solve the initial value problem $y'' + 4y = f(t);\ y(0) = y'(0) = 0,$ in which
   $f(t) = \begin{cases} 0, & t < 3, \\ 3, & t \ge 3. \end{cases}$ (25%)