國立臺灣科技大學

115學年度碩士班招生

試題

系所組別：0330機械工程系碩士班丙組

科　　目：工程數學

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(總分為100分;所有試題務必於答案卷內頁依序作答)

1. (20%) Find the general solution to the following ODE.

   (a) (10%) $y' - y = e^{2x}$

   (b) (10%) $y'' - 2y' - 2y = 0$

2. (20%) Please answer the following questions about the Laplace transform:

   (a) (4%) What is the definition of the Laplace transform of a function f(t)?

   (b) (8%) Find the Laplace transform of $t^2 \sin \omega t$

   (c) (8%) Find the inverse Laplace transform of the following function.

$$\frac{se^{-2s}}{(s+2)^2(s^2+4s+8)}$$

3. (20%) Find the work done by a force $\vec{F} = x\,\vec{i} - z\,\vec{j} + 2y\,\vec{k}$ moves a particle from (0, 0, 0) straight to (1, 1, 0), then to (1, 1, 1), and back to (0, 0, 0).

4. (20%) Answer the following questions.

   (a) (15%) Solve the partial differential equation:

$$\frac{\partial u}{\partial t} - k\frac{\partial^2 u}{\partial x^2} = 0, (0 < x < L, t > 0)$$

   subject to the boundary conditions: $u(0,t) = u(L,t) = 0$ for $t > 0$

   and the initial condition: $u(x,0) = A$ (constant) if $0 < x < L$. A is a non-zero constant.

   (b) (5%) Determine the coefficients in the function of $u(x,t)$ based on the boundary and initial conditions.

5. (20%) Please solve the following initial value problem.

$$\begin{cases} x_1'(t) = 3x_1(t) - x_2(t) - x_3(t) \\ x_2'(t) = x_1(t) + x_2(t) - x_3(t) + t \\ x_3'(t) = x_1(t) - x_2(t) + x_3(t) + 2e^t \end{cases}, \quad x_1(0) = 1, \quad x_2(0) = 2, \quad x_3(0) = -2$$