

# 國立成功大學

## 113學年度碩士班招生考試試題

編 號：148

系 所：生物醫學工程學系

科 目：工程數學

日 期：0201

節 次：第 1 節

備 註：不可使用計算機

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

Please write the detailed solutions to the following questions.

1. (24 pts) Specify and prove that matrix multiplication of two matrices can be calculated by
  - (1) (12 pts) linear combination of columns
  - (2) (12 pts) linear combination of rows.

2. (40 pts) Solve the partial differential equation:

$$U_{tt}(x, y, t) = 17(U_{xx}(x, y, t) + U_{yy}(x, y, t)), \text{ for } 0 < x < 3, 0 < y < 5$$

$$U(x, 0, t) = 0, U(x, 5, t) = 0, \text{ for } t > 0, 0 < x < 3$$

$$U(0, y, t) = 0, U(3, y, t) = 0, \text{ for } t > 0, 0 < y < 5$$

$$U(x, y, 0) = \sin(x + 2y) - \sin(x - 2y), \text{ for } 0 < x < 3, 0 < y < 5$$

$$U_t(x, y, 0) = e^{-x-2y}, \text{ for } 0 < x < 3, 0 < y < 5$$

3. (36 pts) The Laplace Transform and Fourier Transform are defined as follows:

$$\mathcal{L}[f] = \int_0^{+\infty} f(t)e^{-st} dt,$$

$$\mathcal{F}[f] = \int_{-\infty}^{+\infty} f(t)e^{-i\omega t} dt,$$

$$H(t) = 1 \text{ for } t \geq 0, H(t) = 0, \text{ otherwise}$$

- (1) (12 pts) Solve  $y''(t) + 3y'(t) + 5y(t) = 5te^{-5t} H(t)$  using Fourier Transform. Specify the assumptions we need to obtain the solution.
- (2) (12 pts) Solve  $y''(t) + 3y'(t) + 5y(t) = 5te^{-5t} H(t)$  using Laplace Transform. Specify the assumptions we need to obtain the solution.
- (3) (12 pts) Solve  $y''(t) + 3y'(t) + 5y(t) = 5te^{-5t} H(t)$  using other methods. Specify the assumptions we need to obtain the solution.