

# 大同大學 98 學年度研究所碩士班入學考試試題

考試科目：工程數學

所別：通訊工程研究所

第1/1頁

註：本次考試 不可以參考自己的書籍及筆記； 不可以使用字典； 不可以使用計算器。

1. [20 points] Consider the matrix  $A = \begin{bmatrix} 1 & 4 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 1 & 5 & 0 & 2 \end{bmatrix}$ .
- Find the determinant of  $A$ .
  - Find  $A^{-1}$ .
2. [15 points] Consider  $A = \begin{bmatrix} 1 & -6 & -2 \\ 0 & 6 & 3 \\ 1 & -5 & -2 \end{bmatrix}$  and  $\mathbf{b} = \begin{bmatrix} 11 \\ -9 \\ 9 \end{bmatrix}$ . Write  $\mathbf{b}$  as a linear combination of the columns of  $A$ .
3. [20 points] Two packet streams arrive at a switching node, one from a voice source and the other from a video source. Let  $X$  be the number of time slot until a voice packet arrives and  $Y$  the number of time slots till a video packet arrives. If  $X$  and  $Y$  are geometrically distributed with parameters  $p$  and  $q$  respectively, find the distribution of the time (in time slots) until a packet arrives at the switching node.
4. [15 points] A channel has inputs  $X \in \{0, 1\}$  and outputs  $Y \in \{0, 1, \varepsilon\}$ . Assume that  $P(X=0)=0.3$  and that  $P(Y=0|X=0)=0.7$ ,  $P(Y=\varepsilon|X=0)=0.3$ ,  $P(Y=0|X=1)=0$ ,  $P(Y=\varepsilon|X=1)=0.2$ .
- Evaluate the probability  $P(Y=\varepsilon)$ .
  - Evaluate the probability  $P(X=0|Y=\varepsilon)$ .
  - What is the most probable channel input if we observe an  $\varepsilon$  as output?
5. [15 points] Find the Fourier transform of  $f(t) = \begin{cases} t, & 0 \leq t < 1 \\ 0, & \text{otherwise} \end{cases}$ .
6. [15 points] Find the convolution of  $x(t)$  and  $y(t)$  with  $x(t) = e^{-t}u(t)$  and  $y(t) = e^{-2t}u(t)$  where  $u(t)$  is the unit step function.