

國立臺北科技大學

九十二學年度資訊工程系碩士班入學考試

通訊概論試題

填准考證號碼

第一頁 共一頁

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注意事項：

1. 本試題共 4 題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

Use the following formulae when necessary:

$$\text{sinc}(t) = \begin{cases} \frac{\sin(\pi t)}{\pi t}, & t \neq 0 \\ 1, & t = 0 \end{cases}$$

$$F[\text{rect}(t)] = \text{sinc}(f), \quad F[\text{sinc}(t)] = \text{rect}(f) \quad F[e^{-t}u(t)] = \frac{1}{1 + j2\pi f}$$

Problem 1. (25%, 5% each)

Consider the signal $x(t) = \text{sinc}(2t)$.

- (a) Sketch the signal $x(t)$ for $-2 \leq t \leq 2$.
- (b) Find the Fourier transform of $x(t)$, denoted by $X(f)$. Sketch $X(f)$.
- (c) What is the bandwidth of $x(t)$?
- (d) What is the minimum sampling rate for perfectly recovering $x(t)$ from its uniformly-spaced time samples?
- (e) Evaluate the energy of $x(t)$.

Problem 2. (20%, 5% each)

Consider a LTI (linear time-invariant) system with the impulse response $h(t) = e^{-t}u(t)$.

- Give the definition of a linear system.
- Evaluate the 3dB bandwidth of the system.
- If a signal $x(t) = \cos(t)$ passes through the system, find the output signal.
- If a signal $x(t) = \text{sinc}(2t)$ passes through the system, sketch the magnitude spectrum of the output signal.

Problem 3. (30%, 5% each)

A digital source generates data in 10 k bps (bits per second). The source data is protected by a (7,4) Hamming code and the resulting bits are transmitted across a channel using QPSK (quadrature phase shift keying). The generator matrix of the (7,4) Hamming code is

$$G = \begin{bmatrix} 1 & 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

- Find the coded output \mathbf{c} if $\mathbf{m} = (1010)$ (starting from the left) is input to the channel encoder.
- Decode the message if $\mathbf{r} = (1010101)$ is received.
- Give the definition of QPSK.
- What is the symbol rate (baud rate) over the channel?
- What is the required transmission bandwidth? Assume that half the null-to-null bandwidth is used for transmitting QPSK signals.
- Draw the block diagram of the receiver. Sketch the sample input/output signal or sequence for each block.

Problem 4. (25%, 5% each)

Explain each of the following terms in communications clearly and concisely.

- Multipath fading
- Quantization noise
- Digital modulation
- CDMA (code division multiple access)
- Uplink in mobile systems