# 國立臺北科技大學九十六學年度碩士班招生考試

## 系所組別：1820 資訊工程系碩士班乙組

## 第二節 通訊概論 試題



**注意事項：**

1. 本試題共四題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

一、(20%) Consider the signal $g(t) = 2\ \mathrm{sinc}(3t - 1)$. (Note: $\mathrm{sinc}(x) = \frac{\sin(\pi x)}{\pi x}$ for $x \neq 0$ and $\mathrm{sinc}(0) = 1$.)

1. Sketch $g(t)$ for $-1 \le t \le 1$. (5%)
2. Find $G(f)$, the Fourier transform of $g(t)$. Note that the Fourier transform of $\mathrm{sinc}(t)$ is $\mathrm{rect}(f)$, a rectangular pulse whose amplitude is 1 for $-0.5 \le f \le 0.5$. (5%)
3. What is the (one-sided) bandwidth of $g(t)$? (5%)
4. Evaluate the energy of $g(t)$. (5%)

二、(30%) Suppose that the bandwidth efficiency of BPSK (binary phase shift keying) is 1 bit/s/Hz. That is, it takes 1 kHz physical bandwidth for sending 1 kbps data.

1. Draw the signal constellation (signal space diagram) for BPSK, 16-PSK, and 16-QAM (quadrature amplitude modulation), respectively. (5%)
2. What is the required bandwidth for sending 1 kbps data using 16-PSK and 16-QAM, respectively? (5%)
3. Under what circumstances will we prefer BPSK to 16-QAM? Under what circumstances will we prefer 16-QAM to BPSK? Under what circumstances will we prefer 16-PSK to 16-QAM? (10%)
4. Draw the block diagram of the 16-QAM ML (maximum likelihood) receiver. Be precise as possible. (10%)

三、(20%) A rate ½ convolutional code is specified by its generator polynomials $g^{(1)}(D) = 1 + D + D^2$ and $g^{(2)}(D) = 1 + D^2$. Suppose that the initial state is 00.

1. Draw the state diagram for the encoder. (5%)
2. Determine the encoder output produced by the message 11010. (5%)
3. Decode the received sequence 1001011001 using the Viterbi algorithm. You have to draw the trellis diagram and show the survivor paths. (10%)

四、(30%, 10% each) Answer the following essay questions in your own words.

1. An analog signal transmitted via analog communication incurs no quantization noise. Why do we assert that digital communication provides better quality than analog communication, even for analog signal sources?
2. What is called the channel capacity? How can we approach the channel capacity for a noisy bandwidth-constrained channel? List and explain all the technical resolving skills.
3. How does the direct-sequence spread-spectrum technique achieve multiple access (CDMA)?