

大葉大學九十學年度研究所碩士班招生考試試題紙

| 系 所 組 別 | 考 試 科 目<br>(中 文 名 稱) | 考 試 日 期        | 備 註 |
|---------|----------------------|----------------|-----|
| 電機所戊組   | 通訊原理                 | 4 月 22 日 第 三 節 |     |

註：考生可否攜帶計算機或其他資料作答，請在備註欄註明（如未註明，一律不准攜帶）

1. (15%) The input and output relation of a non-linear system is given by

$$y(t) = 1 + x(t) + 0.5x^2(t),$$

where  $x(t)$  and  $y(t)$  represent the input and output signals, respectively. Find the output spectrum for an input spectrum of  $X(f) = \text{rect}\left(\frac{f}{2B}\right)$ , where  $\text{rect}\left(\frac{f}{2B}\right)$  is a rectangular function having a width of  $2B$ .

2. (15%) A commercial FM radio transmitter that has a carrier frequency of 100 MHz and a maximum frequency deviation of 40 kHz is designed to transmit voice signals ranged from 0 to 4 kHz. Determine
- the modulation index or the deviation ratio,
  - the transmission bandwidth,
  - and the transmission bandwidth for a modulation signal ranged from 0 to 400kHz.

3. (20%) In radio communication system, the received signal for a transmitted signal of  $x(t)$  is

$$y(t) = a_1x(t - t_1) + a_2x(t - t_2) + a_3x(t - t_3)$$

due to multi-path transmission, where  $a_1$ ,  $a_2$ ,  $a_3$ ,  $t_1$ ,  $t_2$ , and  $t_3$  are constants. In order to ensure a distortionless transmission, a channel equalizer is needed to compensate the distortion created by the channel. Determine the transfer function of

- the radio channel and
- the equalizer.

4. (20 %) A coaxial cable has a transmission bandwidth from 0 to 900 MHz and is also capable of providing a digital transmission rate up to 900 Mbps. This cable is used to carry numbers of video signals, where a bandwidth of 6 MHz (including the necessary guard band) and a transmission data rate of 6 Mbps are required for the analog and the digital video transmissions, respectively. Determine the number of channels that can be accommodated by this cable for
- (a) analog video using Frequency Division Multiplexing (FDM) technique, and
  - (b) digital video using Time Division Multiplexing (TDM) technique, where a 5% of overhead is needed for signaling and guard time in TDM systems.
5. (20%) Consider a digital base-band transmission system that transmits  $A/2$  and  $-A/2$  for the logical one and zero, respectively. The digital signal is transmitted in a loss-less Additive White Gaussian Noise (AWGN) channel. If the AWGN has a power level of  $N=\sigma^2$ , where  $\sigma^2$  is the variance of the AWGN, derive the probability of bit error in the receiver in terms of the received signal-to-noise power ratio (SNR).
6. (10%) There are two digital modulation schemes that are widely used in modern wireless communications, namely Quadrature Phase Shift Keying (QPSK) and Gaussian shape Minimal Shift Keying (GMSK). Describe their operation principle and compare their bandwidth efficiency.