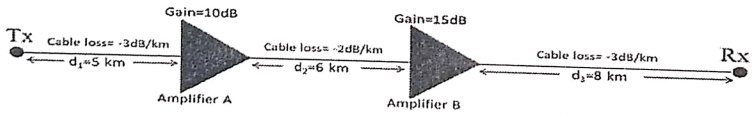
CT-1, ECE 3251(B), FM:10+20, Time:30 min, Date:30-09-2018

(Q.1) (True/False?): (i) If a signal doesn't change at all its frequency is infinite. (ii) Frequency spectrum of a composite aperiodic signal is discrete.(iii) For baseband transmission of a digital signal we need a high pass channel with a very wide bandwidth (iv) The SNR of a noiseless channel is ideally zero. (v) Optical amplifier can improve the SNR of a channel. **(Q2.)** A signal with -5 dBm power travels from Tx to Rx as shown in the following figure: (i) Calculate the power (in mW) of the received signal at Rx point. (ii) At room temperature what is the signal to noise ratio in dB at Rx point if its BW is 20 MHz? Take thermal noise alone into account whose noise power density is kT Watt/Hz, k being the Boltzmann's constant and T is the absolute temperature (iii) Determine the channel capacity of the link. (iv)How many signal levels are needed to achieve a data rate of half of the channel capacity?



CT-2, ECE 3251(B), FM:30(10+5+15), Time:30 min, Date:28-10-2018

(Q.1) (True/False?): (i) For a twisted pair cable, more twist means better quality. (ii) The most common UTP connector is BNC.(iii) The attenuation is much higher in coaxial cables than in twisted-pair cables. (iv) Modal dispersion is a very common problem in single mode step index fibers. (v) Keeping the material properties same, fibers with bigger core dimension will usually have higher numerical aperture than the fibers with smaller core dimension. **(Q.2)** Suppose a light beam from an optical source is launched into an optical fiber which propagates inside the core. Sketch the scenario neatly assuming ray-optics concept and show therein the critical incident angle, critical propagation angle and acceptance angle. **(Q.3)** Suppose a surface emitting LED couples 5.88μW of optical power into a step index multimode optical fiber whose numerical aperture and core index is 0.2425 and 1.465, respectively. Determine the output power of the optical source and the refractive index of the fiber's ~~core material~~ cladding material.

Date: 22/11/2018

Khulna University, Khulna

Computer Science and Engineering Discipline
3rd Year, Term II, Examination 2018
Session: 2017-2018
Course No: ECE 3251
Full Title of Course: Data Communication

Full Marks: 60 Time: 03 Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

Section A

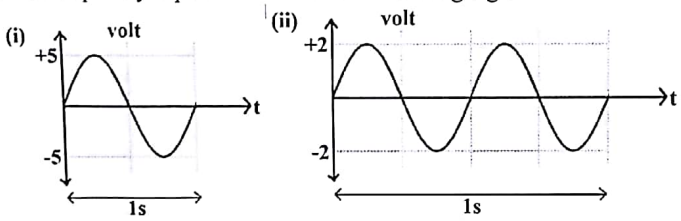
There are **FOUR** questions in this section. Answer any **THREE** questions

1 a) What do you understand by the term modulation? Why modulation is necessary in communication? 2+1

b) Calculate the antenna height for the frequency 3GHz 02

c) Consider the general expression for Amplitude-Modulated (AM) signal is $s(t) = [A + x(t)]\cos\omega_c t$; where $x(t) = V_m \cos\omega_m t$ is a single tone modulating signal. Show that the modulated signal will be $s(t) = A\cos\omega_c t\,[1 + m_a \cos\omega_m t]$. Here m_a represents the modulation index. 03

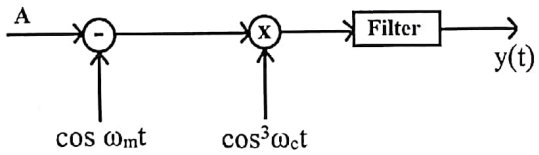
d) Draw the frequency representation of the following signals 02



ω

2 a) A 400 watts carrier is modulated to a depth of 75 percent. Find the total power in the amplitude-modulated wave. Assume the modulating signal to be a sinusoidal one. 03

b) Find out the output signal y(t) of the following system. Consider the filter allow to pass the frequency up-to $\left(2\pi f_c + \frac{2\pi f_m}{4}\right) Hz$. 03



Here, $\omega_c >> \omega_m$.

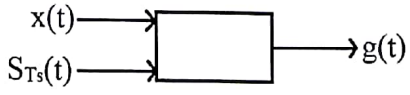
c) Why should you consider Double-Sideband-Suppressed Carrier (DSB-SC) Amplitude Modulation technique in place of Double-Side-Band-Full Carrier (DSBFC) Amplitude Modulation technique. 02

d) Do you think, for Amplitude Modulation, Upper Side Band (USB) and Lower Side Band (LSB) contain similar kind of message information? Justify your answer. 02

3 a) A single-tone Frequency Modulated (FM) signal is represented by the voltage equation as: $v(t) = A\cos(\omega_c t + m_f \sin\omega_m t)$. For this scenario find out the following terms. 4x1 =04

(i) Carrier frequency
(ii) Modulating frequency
(iii) Modulation index
(iv) Maximum frequency deviation

b) Consider a continuous time signal x(t) is multiplied by a continuous impulse train $S_{T_s}(t)$ of period T_s. This system is represented by the following figure: 04



Prove the frequency domain representation of the signal g(t) is

$$G(\omega) = \frac{1}{T_s} \sum_{n=-\infty}^{\infty} X(\omega - n\omega_s)$$

c) What do you understand by the following two terms 02
   (i) Mid-Rise Quantization
   (ii) Mid-Tread Quantization

4 a) An analog signal is expressed by the equation 03

$$x(t) = 4\cos 50\pi t + 18\cos 300\pi t - \cos 100\pi t$$

Calculate the Nyquist rate for the signal

b) What do you understand by 03
   (i) Binary Phase Shift Keying (BPSK)
   (ii) Binary Amplitude Shift Keying

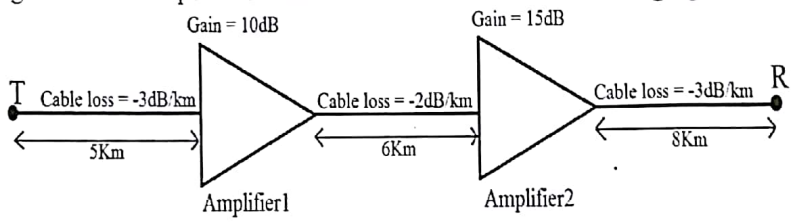
c) Describe the following terms 4x1 =04
   (i) Pulse Position Modulation (PPM)
   (ii) Pulse width Modulation (PWM)
   (iii) Pulse Amplitude Modulation (PAM)
   (iv) Quantization Noise

Section B

There are **FOUR** questions in this section. Answer any **THREE** questions

5 a) Explain Shannon's channel capacity theorem. Prove that for an infinite bandwidth of channel, the capacity is finite. 04

b) A signal with 5dBm power travels from T to R as shown in following figure. 06



   (i) Calculate the signal power at R
   (ii) At room temperature what is the signal to noise ratio at R if its bandwidth is 30 MHz? Take thermal noise alone into account whose noise power density is kT watt/Hz, k being the Boltzmann's constant and T is the absolute temperature.
   (iii) Determine the channel capacity of the link.
   (iv) How many signal levels are needed to achieve a data rate of half of the channel capacity?

6 a) Define Line Coding. 01

b) A signal has four data levels with a phase duration of 1ms. Calculate the Pulse Rate and Bit Rate. 2+2

c) Describe following terms 2+2
   (i) Frequency Division Multiplexing
   (ii) Time Division Multiplexing

d) What do you understand by Microwave? 01

7 a) What is the Hamming distance? A code scheme has a minimum Hamming distance of 5. What is the error detection and correction capability of this scheme? 02

b) Show the possible structure of the encoder and decoder for a Hamming code and explain its operation. How can this code be used to correct burst errors? 04

c) What are the advantages of the cyclic codes? What are the characteristics of a good polynomial generator? Given the dataword 1010011110 and the divisor 1011, show the generation of the codeword at the sender side using polynomials. 03

d) For a CRC-32 polynomial, what is the probability of detecting a burst error of size 55? 01

8 a) What are the major classes of guided media? What is the significance of the twisting in twisted pair cable? 02

b) What is meant by the numerical apertures (NA) of an optical fiber? Show that $NA = \sqrt{n_1^2 - n_2^2}$, *where* n_1 *and* n_2 are the refractive indexes of core and cladding layer of an optical fiber. 03

c) Draw the basic block diagram of an optical fiber transmission link. What is WDM? Explain with necessary figure. 05