Duration: 1 Week **Deadline:** 29th July 2021

Open-Book Controlled Assignment (Module Weight: 50%)

Tick all the correct answer(s) to each of the following questions. Choose all that apply.

Section A (50 marks)

1. Which technology provides the most optimal rate vs. range vs. power consumption?

A) 3G
B) Bluetooth
C) IEEE 802.11n
D) UWB

2. Deflection of a signal takes place when the wavelength of the obstacle is _____ than the wavelength of the signal.

A) Much larger
B) Much smaller
C) equal
D) None of the above

3. Which of the following is (are) usually delay-sensitive?

A) Data
B) Speech
C) Video Conferencing
D) Online Gaming

4. _____ encoding has a transition at the beginning of each bit representing space.

A) NRZ-I
B) Manchester
C) AMI
D) Differential Manchester

5. Which of the following devices can be considered as transducers?

A) Photo-detector
B) Telephone
C) Cathode Ray Tube
D) None of the above

6. If the bandwidth of a signal is 5 KHz and the highest frequency is 55 KHz, what is the lowest frequency?

A) 5 kHz
B) 11 kHz
C) 50 kHz
D) 60 kHz

7. A periodic signal completes one cycle in 0.1 ms. What is the frequency? .

A) 10 Hz
B) 100 Hz
C) 10 kHz
D) 1 MHz

8. _____ are used for cellular phone, satellite, and wireless LAN communications.

A) Radio-waves
B) Micro-waves
C) Infra-red waves
D) None of the above

9. _____ is a type of transmission impairment in which the signal loses strength due to the resistance of the medium.

A) Attenuation
B) Crosstalk
C) White Noise
D) All of the above

10. _____ is a type of transmission impairment in which an outside source such as crosstalk corrupts a signal.

A) Attenuation
B) Distortion
C) Interference
D) None of the above

11. For a _____ channel, the Nyquist bit rate formula defines the theoretical maximum bit rate.

A) noisy
B) noise-less
C) error-free
D) low-pass

12. When the propagation speed of a signal is multiplied by propagation time, we get the _____.

A) throughput
B) wavelength of the signal
C) distortion factor
D) distance the signal has travelled

13. In ___, the level of the voltage determines the value of the bit.

A) NRZ-L
B) NRZ-I
C) Both NRZ-I and NRZ-L
D) Neither NRZ-I nor NRZ-L

14. The advantage(s) of digital communication over analogue include:

A) noise performance
B) regeneration
C) digital signal processing
D) All of the above

15. If the frequency spectrum of a signal has a bandwidth of 500 Hz with the highest frequency at 700Hz, what should be the minimum sampling rate, according to the Nyquist Sampling Theorem?

A) 1600 sample/s
B) 1000 sample/s
C) 1400 sample/s
D) 1200 sample/s

16. If the bit rate for a 16-QAM signal is 4000 bps, the baud rate is _____?

A) 300
B) 1000
C) 16,000
D) 64000

17. Which of the following is true if you increase the channel bandwidth available?

A) Channel capacity increases
B) Noise power increases
C) Signal power increases
D) Attenuation increases

18. Which of the following technology uses the least power consumption for the highest data rate and longest range?

A) Zigbee
B) 802.11n
C) 3G
D) 802.11b

19. What is the Gain in decibels for a signal whose strength at a certain distance is 50% from that of the original transmitted signal? ?

A) 0.5 dB
B) - 3 dB
C) 50 dB
D) - 0.5 dB

20. In B8ZS encoding, each string of eight consecutive zeroes produces _____?

A) One violation bit
B) Two violations bits
C) Three violations bits
D) None of the above

[20 X 2.5 marks]

Section B (50 marks)

21. A CRC is constructed to generate a 4-bit FCS for an 11-bit message. The divisor polynomial is x^4+x^3+1

    a. Encode the message bit sequence 00111011001 using long division and give the resulting codeword.
    b. Assume that **7th MSB** in the message bit sequence above gets corrupted during transmission, show how the detection algorithm detects the error. (bit in error is in **bold underlined**)
    c. Assume now that Hamming Code is used instead of CRC, illustrate in detail how the error above can de **detected** and **corrected**.

[4+3+5 marks]

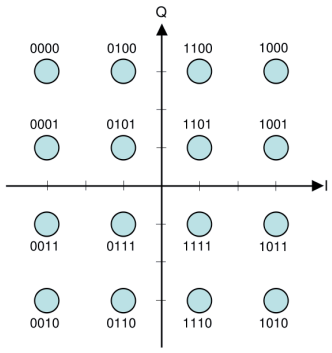
22. A wireless technology uses Multiple Frequency Shift Keying (M-FSK). Assuming that M = 4 and that the difference frequency (f_D) is 400 kHz at a carrier frequency of 2400 MHz.

    a. Give the four corresponding frequencies f_1, f_2, f_3 and f_4.
    b. Calculate the maximum bit rate achievable by this technology.

[4+2 marks]

23. Given the constellation diagram to the right:
    Sketch the QAM output of the following digital bit stream:

    00111111100001000000



[15 marks]

24. Given a channel with an intended capacity of 32 megabytes per second, the bandwidth of the channel is 4 MHz. What SNR in dB is required to achieve this capacity?

[4 marks]

25. Which is better, 5KHz media with a signal power of 10W and noise power of 1W or 10KHz media with a SNR of 5dB? Why?

[5 marks]

26.

    a. Sketch an AMI (*Alternate Mark Inversion)* waveform for the following bit-stream pattern: **10110010**. Assume that the most recent preceding 1 bit had a negative voltage.

    b. The following waveform belongs to a Manchester encoded bit-stream. Sketch the beginning and end if bit periods (i.e. extract clock information) and give the bit sequence.

[4+4 marks]

Total Marks: 100