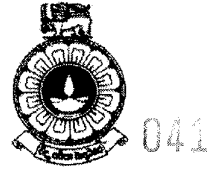


The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical and Computer Engineering



Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	: EEX4330 – Communication
Academic Year	: 2022/2023
Date	: 2nd February 2024
Time	: 1400-1700hrs
Duration	: 3 hours

General Instructions

1. Read all instructions carefully before answering the questions.
 2. This question paper consists of two parts. Part A contains ten (10) questions, and Part B consists of four(4) questions in four (5) pages.
 3. **Answer all questions.**
 4. Answer to each question in part B should commence from a new page.
 5. Relevant charts/codes are provided.
 6. This is a Closed Book Test (**CBT**).
 7. Answers should be in clear handwriting.
 8. Do not use a red color pen.
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Section A (20 Marks)

1. Draw the fundamental block diagram of communication. Highlight the primary components and their connections and provide a brief explanation of the main function of each element. **(2Marks)**
2. Explain how we can make future wireless networks better by using diversity and interference mitigation strategies. **(2Marks)**
3. List four types of signaling techniques used in communication systems. **(2Marks)**
4. State two advantages and two disadvantages of unguided media. **(2Marks)**
5. Discuss the best practice used in the optical telecommunication industry in terms of connectivity. **(2Marks)**
6. State true or false. Minus (-) mark will be given for incorrect answers. **(2Marks)**
 - a) Channel reuse in cellular mobile systems dramatically reduces the overall capacity of the network.
 - b) Handoff is a feature used in cellular communication that allows mobile units to move from one cell site to another without the call being dropped.
 - c) Vestigial Side Band modulation technique is considered to be the most suitable modulation technique for analogue TV broadcasting.
 - d) The picture resolution for Digital Terrestrial Television Broadcasting (DTTB) ranges from standard definition (SD) to ultra-high definition (UHD).
7. Sketch the QPSK modulated carrier signal for 11010011010110-bit pattern. **(2Marks)**
8. Explain what a Geostationary satellite is. **(2Marks)**
9. Differentiate FDM, TDM and WDM. **(2Marks)**
10. State two advantages gained using soft switches compared with the traditional switching techniques. **(2Marks)**

Section B

Q1. (20 Marks)

1. Define Pulse Amplitude Modulation and explain how it differs from Pulse Code Modulation (PCM). **(2Marks)**
2. State three advantages of using PAM for digital data transmission compared to PCM. **(3Marks)**
3. A PCM system is used to digitize an analog signal. The signal has a bandwidth of 4 kHz and a maximum amplitude of 10 V. The PCM system uses a uniform quantizer with 16 quantization levels. The sampling frequency is 20 kHz. **(15Marks)**
 - a. What is the minimum number of bits required to represent each sample?
 - b. Find the maximum quantization error?
 - c. Calculate the signal-to-quantization noise ratio (SQNR) in dB?
[$SQNR[dB] = 6.02n + 1.76 dB$]
 - d. Find the minimum required bit rate for the PCM system?
 - e. What is the maximum signal frequency that can be accurately represented by the PCM system?

Q2. (20 Marks)

1. Describe two different techniques used in cell planning to minimise the interference. **(4Marks)**
2. Compare CDMA, OFDMA and NOMA. **(6Marks)**
3. A cellular network uses a frequency reuse factor of 1/7. The total number of duplex channels available to use is 100. Answer the following sub-problems **(10Marks)**
 - a. What is the total number of duplex channels allocated to each cell?
 - b. Calculate the cluster size?
 - c. What is the maximum number of cells that can be supported by the system?
 - d. What is the minimum distance between two co-channel cells where the radius of the cell is 1km?
 - e. What is the capacity of the system if the cluster is replicated 3 times?

Q3. (20 Marks)

1. Draw the block diagram of the optical communication system and explain two reasons to migrate from traditional copper cables to optical transmission media. **(4Marks)**

2. Differentiate the propagation of skew rays and meridional rays through an optical fiber. **(4Marks)**

3. Compare SONET and NG-SONET/SDH. **(4Marks)**

4. A fiber optic cable has a length of 10 km and an attenuation coefficient of 0.2 dB/km. The transmitter at one end of the cable produces an optical power of 10 mW. The receiver at the other end of the cable requires an optical power of 1 mW to operate correctly. The cable has two connectors, each with a loss of 0.5 dB. **(8Marks)**
 - a. Calculate the total attenuation of the cable.
 - b. Find the total loss due to the connectors.
 - c. Calculate the total loss in the system.
 - d. Calculate the received power.
 - e. What is the maximum distance between the transmitter and receiver that will allow the system to operate correctly?

Q4. (20 Marks)

1. Define the following terms:
 - i. Terrestrial propagation
 - ii. Multipath reception **(4Marks)**

2. A television station is transmitting a live image with a resolution of 1920 x 1080 pixels. The aspect ratio of the display is 16:9. The frame rate is 60 Hz. The video signal has a bandwidth of 6 MHz. The cable used to transmit the signal has an attenuation coefficient of 0.2 dB/km. The cable has a length of 10 km and has two connectors, each with a loss of 0.5 dB. **(8Marks)**
 - a. Calculate the total number of vertical scan lines.
[$Total\ No\ of\ Vertical\ Scan\ Lines = \frac{Aspect\ Ratio * Total\ Number\ of\ Horizontal\ Pixels}{K}$]
 - b. Calculate the Kell factor.
[$Kell\ Factor = Total\ No\ of\ Vertical\ Scan\ Lines / FrameRate$]
 - c. Calculate the total signal bandwidth.

$$\text{Total Signal Bandwidth} = \frac{1}{2} \left[(K * AR * V_{LT}^2 * F_R) * \left(\frac{K_H}{K_V} \right) \right];$$

Where,

K = Kell factor

AR = Aspect ratio (width of the display divided by the height of the display)

V_{LT} = Total number of vertical scan lines

F_R = Frame rate or refresh rate

K_H = Ratio of total horizontal pixels to active pixels

K_V = Ratio of total vertical lines to active lines

3. A satellite is transmitting a signal with a frequency of 4 GHz. The transmitter has an output power of 10 W and an antenna gain of 20 dB. The signal is received by a ground station with an antenna gain of 25 dB. The distance between the satellite and the ground station is 50,000 km. The signal is transmitted through free space, which has a loss of 187 dB at this frequency. The system noise temperature is 300 K.

(8Marks)

- Calculate the received power at the ground station.
- Calculate the carrier-to-noise ratio (C/N) at the ground station.
- Calculate the minimum required antenna gain at the ground station to achieve a C/N of 20 dB.

[Noise power = Boltzman Constant * System Noise Temperature * Bandwidth]

$$\text{Boltzman Constant} = 1.38 * 10^{-23} \text{ J/K}$$

$$\text{System Noise Temperature} = 300 \text{ K}$$

$$\text{Bandwidth} = 6 \text{ MHz}$$