The Open University of Sri Lanka

Faculty of Engineering Technology

Department of Electrical and Computer Engineering

049

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: EEX4330 – Communication**
Academic Year	: 2021/2022
Date	: 02nd February 2023
Time	: 1330-1630hrs
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 (4) 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 colour pen.

9. Equations are available at the last page.

Section A (20 Marks)

1. Draw and label a block diagram of a typical telecommunication system, highlighting the main components and their functions.

   (02Marks)

2. Outline the two most significant contributions made by the 3rd Generation Partnership Project (3GPP) in the field of telecommunications standards. (02Marks)

3. State two technical aspects that need to be satisfied to implement the metaverse.

   (02Marks)

4. Differentiate SIP (Session Initiation Protocol) and RTP (Real-time Transport Protocol).

   (03Marks)

5. State true or false. Minus (-) mark will be given for incorrect answers.   (02Marks)
   a. Software-Defined Networking (SDN) is a technology that allows for centralized control of network devices, making it easier to manage and configure networks.
   b. Multiprotocol Label Switching (MPLS) is a method of directing data from one network node to the next based on short path labels rather than long network addresses.
   c. Cognitive radio technology does not allow devices to automatically adjust their communication parameters based on the surrounding environment and other devices in the network.
   d. IMS uses a centralized architecture where all services are provided by a single server located in a specific location.

6. QAM is a combination of which two types of modulation?   **(02Marks)**

7. Digital modulation can be grouped as Amplitude-shift keying (ASK), Frequency-shift keying (FSK) and Phase-shift keying (PSK). Sketch the wave forms for each. You can assume the bit pattern.

   (03Marks)

8. Compare and contrast baseband and broadband signals in telecommunication networks

   (02Marks)

9. State two differences between digital terrestrial television (DTT) and digital audio broadcasting (DAB).

   (02Marks)

Section B

Q1. (20 Marks)

1. State two purposes of measuring Signal-to-Noise Ratio (SNR) and Bit Error Rate (BER) in telecommunication networks.
(02Marks)

2. A baseband signal has a bandwidth of 50kHz. This signal is sampled, quantized, and binary coded to obtain a PCM (linear quantization) signal. Assuming that the audio signal is a pure sinusoid with peak value equal to the peak value accepted by the analog-to-digital converter. Minimum number of bits required to encode a sample is 8bits. Maximum peak voltage of the signal is 2.56V.

   (i) Determine the sampling rate if the signal is to be sampled at a rate 20% above the Nyquist rate.
   (ii) Determine the resolution and maximum quantization error that can occur in this system.
   (iii) Calculate the SNR value for the given signal.
   (iv) Find the bit rate of the channel assuming bandwidth of the channel is equal to 20times of the sampling rate in (i)
   (v) Find the equivalent binary representation for a 1.3V.
   (vi) Write a relationship between SNR and BER.
   (vii) Comment on how changing the number of quantization levels affects the SNR value and BER.
(16Marks)

3. In E1 systems, multi-frame transmission occurs when Channel Associated Signaling (CAS) is applied. CAS uses channel 16 of the E1 frame to transmit signaling information. Each channel in the E1 frame consists of 8 bits of data, and the 8-bit data space of channel 16 is divided among 30 subscriber channels and 2 auxiliary channels for synchronization and alarms.

   (i) What is the transmission capacity of E1 Frame?
   (ii) How many subscriber channels can be supported by the signaling multi-frame in total?
(02Marks)

Q2. (20 Marks)
1. Define the following terms:
   (i) Cluster
   (ii) Cochannel cells
   (iii) Adjacent cells
(03Marks)

2. Given a cellular system with a total bandwidth of 29.7 MHz which uses two 25 kHz simplex channels to provide full duplex voice and control channels. Assuming that the system uses a nine-cell reuse pattern and 1.35 MHz of the total bandwidth is allocated for control channels.

(i) Calculate the total available channels
(ii) Find the number of control channels
(iii) Calculate the number of voice channels per cell
(iv) Determine an equitable distribution of control and voice channels in each cell
(v) If there are 10 clusters in the area, what is the total number of voice calls that can be served simultaneously.

(10Marks)

3. Explain specific solutions and technologies implemented in 5G networks to mitigate path loss, reflection, and diffraction in mobile communication propagation?

(04Marks)

4. Compare closed loop and open loop power control in mobile communication in term of feedback mechanism, adaptability and power consumption.

(03Marks)

Q3. (20 Marks)

1. What are the two types of losses that can occur in fiber optic cables and two types of losses that can occur in fiber optic networks?   (04Marks)

2. Compare and contrast the differences between the optical core, optical metro, and optical access networks in terms of their network architecture, transmission distance, and scalability.   (06Marks)

3.
   (i) The input power to an optical fiber is 5 mW while the power measured at the output end is 3 µW. If the fiber attenuation is 0.5 dB/km. Calculate the length of the fiber.

   (ii) Every 10km there is a splicing joint and joint loss is 1dB. It is required to maintain output power level of 3 µW at the receiving end. Recalculate the minimum input power level that must be launched into the fiber.   (08Marks)

4. Discuss the significance of marine fiber optic cables in relation to the economic development of Sri Lanka.   (02Marks)

Q4. (20 Marks)

1. 16-QAM can be used for higher data rate transmissions.
   i.   How many bits are transmitted with each symbol?
   ii. If 4 different phases and 4 different amplitudes are used in a 16-QAM modulation system, sketch a constellation diagram that could be associated with the system
   (04Marks)

2. Write one application for each of these antenna types.
   i.   Parabolic antenna
   ii. Helical antenna
   iii. Yagi antenna   (03Marks)

3. A terrestrial microwave link has a frequency of 9GHz. The transmitter antenna gain is 25dB and the receiver antenna gain is 30dB. The free space loss is 128dB. Transmitter output power is 45dBm. What is the minimum receiver sensitivity required in dBm?

(08Marks)

4. State four sub-systems of the DTTB model and explain main purpose of these sub-systems.

(05Marks)

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Equations

According to Shannon's Law, the following formula depicts this correlation that forms the capacity dependent relationship:

$$C = W \log2 (1 + S)$$

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C = maximum data rate of channel(bits/s)
W = bandwidth of channel (Hz)
S = signal-to-noise ratio
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For linear PCM, SNR is defined as,

$$SNR_{dB} = 1.8 + 6n$$

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n = Number of Bits
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