

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 Communications
Academic Year	: 2023/2024
Date	: 02 nd March 2025
Time	: 1330 - 1630 hrs
Duration	: 3 hours

General Instructions

1. Read all the instructions carefully before answering the questions.
 2. This is a Closed Book Test (CBT).
 3. 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.
 4. Answer **all questions**.
 5. All questions carry equal marks.
 6. The answer for each question should commence from a new page.
 7. Answers should be in clear handwriting.
 8. Do not use Red color pen.
 9. All the notations have their usual meaning.
 10. Assume any missing parameters with suitable values.
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Section A (20 Marks)

1. Identify two major milestones in the historical development of the telecommunication industry. [2 marks]
2. Identify three basic blocks of a telecommunication system and their functions. [2 marks]
3. State two technologies commonly used in the access network of telecommunication systems. [2 marks]
4. Name two technologies used in the core network of telecommunication systems. [2 marks]
5. State an advantage and a disadvantage of digitization in telecommunication networks. [2 marks]
6. State the sampling theorem. [2 marks]
7. Name three common types of switching techniques used in modern telecommunication systems. [2 marks]
8. Identify two types of interference in cellular mobile systems. [2 marks]
9. List two benefits of using optical fiber in telecommunication networks. [2 marks]
10. State two key differences between AM and FM broadcasting in terms of audio quality and coverage. [2 marks]

Section B

Q1. (20 marks)

- I. Compare manual switching, message switching, circuit switching, and packet switching in terms of: [5 marks]
- Transmission delay
 - Bandwidth utilization
 - Scalability
 - Cost
 - Implementation complexity
- II. In a packet-switched network, consider the following parameters:
Packet Size: 1,500 bytes
Transmission Speed: 10 Mbps
Distance between Source and Destination: 2,000 km
Propagation Speed: $2 * 10^8$ m/s
Queueing Delay at Each Router: 10 ms
Number of Routers between Source and Destination: 5
- a) Calculate the total transmission delay for sending one packet from the source to the destination. [4 marks]
- b) Calculate the total propagation delay for sending the packet over the 2,000 km distance. [4 marks]
- c) Calculate the total queueing delay in the network for one packet. Assume the queueing delay at each router is independent and there are 5 routers. [4marks]
- d) Calculate the total end-to-end delay for the packet transmission, considering all the delays (transmission, propagation, and queueing). [3 marks]

Q2. (20 marks)

- I. Explain the concept of antenna gain in communication systems and what higher antenna gain indicates. [4 marks]
- II. An antenna must be fed with 8 kW of power to produce the same field strength at a given point as a half-wave dipole ($\lambda/2$) fed with 20 kW of power.
- a) Calculate the gain of the antenna relative to a half-wave dipole. [4 marks]
- b) Calculate the gain relative to an isotropic radiator if the gain of a half-wave dipole relative to an isotropic radiator is approximately 2.15 dB. [4 marks]

- III. If the antenna is modified to produce three times the field strength at the same point with the same 8 kW input power, calculate the new antenna gain relative to a quarter-wave monopole. Assume the gain of a quarter-wave monopole relative to an isotropic radiator is 2.15 dB. [8 marks]

Q3. (20 marks)

I.

- a) Define the concept of frequency reuse in cellular networks and explain its importance in enhancing overall network capacity. [2 marks]
- b) Identify two key factors that should be considered in cellular network planning to ensure optimal coverage and maximize capacity. [2 marks]
- c) Define the minimum distance required between cells using the same frequency to minimize interference [2 marks]

- II. In an LTE system, a provider has been allocated a bandwidth of 15 MHz, with 200 kHz reserved for guard bands on each side. Each resource block occupies 180 kHz. Calculate the maximum number of resource blocks that can be accommodated. [6 marks]

- III. In a 5G NR network covering an area of 10,000 km², with 1,000 channels and a cell radius of 3 km, determine the maximum number of simultaneous connections if the frequency reuse factor is 7. [8 marks]

Q4. (20 marks)

- I. Explain how sampling and quantization are performed in a digital communication system. [4 marks]
- II. Consider a digital communication system where an analog signal with a bandwidth of 10 kHz is sampled and converted into PCM words. Each PCM word has 8 bits. The peak-to-peak voltage is 5 V, and the maximum quantization error must not exceed 0.01 of the peak-to-peak voltage.
- a) Find the maximum quantization error (maximum value of e). [2 marks]
- b) Calculate the number of quantization levels (L). [3 marks]
- III. Define Frequency Division Multiplexing (FDM), Time Division Multiplexing (TDM), and Wavelength Division Multiplexing (WDM). [6 marks]
- IV. Calculate the bandwidth required for a TDM system that multiplexes 10 signals, each with a bandwidth of 3 kHz. The system must add a guard band of 1 kHz between each signal. [5 marks]