GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY
Faculty of Engineering
BScEngHons in Electronic and Telecommunication Engineering Degree

Bachelor of the Science of Engineering Honours Degree
Semester 8 Examination – November 2024
(Intake 38 – ET)

ET 4283 – WIRELESS AND MOBILE COMMUNICATION

Time allowed: 3 hours 25th November 2024

INSTRUCTIONS TO CANDIDATES

This paper contains 4 questions on 3 and 4 pages. Answer all FOUR questions and each question carrier equal marks.

This is a closed book examination. This examination accounts for 60% of the module assessment. A total maximum mark obtainable is 100. The marks assigned for each question and parts thereof are indicated in brackets

If you have any doubt as to the interpretation of the wordings of a question, make your own decision, but clearly state it on the answer script

Assume reasonable values for any data not given in or provided with the question paper, clearly make such assumptions made in the answer script

All examinations are conducted under the rules and regulations of the KDU

DETAILS OF ASSESSMENT

Learning Outcome (LO)	Questions that assess LO	Marks allocated (Total - 60)
LO1	Q1, Q2	10
LO2	Q2, Q3	15
LO3	Q3, Q4	15
LO4	Q2, Q3, Q4	20

Question 1

a) Differentiate multiple components of the GSM physical channel structure, providing brief explanations of their functions. (6 marks)

b) Explain the process of hybrid ARQ, showing how its components work together. (4 marks)

c) Compare the incremental redundancy-based retransmission scheme with the chase combining-based retransmission scheme in HARQ , highlighting their interrelationships. (4 marks)

d) Analyze the system architecture of the GSM network and explain how its components interact. (5 marks)

e) Examine the authentication procedure for mobile communication in GSM networks, explaining how its components interact. Evaluate the effectiveness of the process by analysing its strengths and weaknesses in ensuring secure communication. (6 marks)

A3 - auth
A5 - encry
A8 - key generation

↳ Authentication
↳ Confidentiality
↳ Anonimity.

Question 2

a) Discuss the additional entities required and their roles in extending the GSM network to a GPRS network. (4 marks)

RU

SGSN
GGSN
PCRF

b) Illustrate the advantages and disadvantages of the spread spectrum technique used in UMTS, providing separate explanations for each aspect. (4 marks)

DSSS

c) Explain the purpose of scrambling codes and channelization codes in HSPA systems and analyze how these codes interact to ensure efficient system performance. (6 marks)

d) Discuss the implementation of the Adaptive Modulation Coding (AMC) scheme in HSPA systems, examining how it enhances performance through the interplay of its key components. (5 marks)

e) In a CDMA system, where the user input data sequence is (1, -1, -1, 1, 1) and the orthogonal chip sequence is (-1, 1, 1, -1), critically analyze and generalize the process of spreading a data sequence. Formulate the transmitted signal and propose how variations in chip sequences could impact system performance in diverse scenarios. (6 marks)

Question 3

a) Explain the concept of the physical resource block (PRB) in LTE, providing a detailed description along with a graphical illustration. (6 marks)

b) Illustrate the E-UTRAN network architecture, describing its components and highlighting their key functionalities. (6 marks)

c) Examine the differences between the PDSCH and PDCCH physical channels in LTE, explaining their specific roles and functionalities and how they work together to enable effective communication in the network. (6 marks)

d) Analyze why single-carrier frequency domain multiple access (SC-FDMA) is used for the uplink and orthogonal frequency division multiple access (OFDMA) is used for the downlink in the LTE system, explaining how each method contributes to system performance and efficiency. (7 marks)

Question 4

a) Describe the Service-Based Architecture of the 5G network, listing its key components and explaining how each interacts within the overall structure. (5 marks)

b) Explain the following key technologies used in 5G networks, outlining their purpose and the specific 5G usage scenarios they are designed to address:

I. Network Function Virtualization (NFV)

II. Software Defined Networks (SDN)

III. Network Slicing" (9 marks)

c) Compare the 5G usage scenarios of eMBB (enhanced Mobile Broadband), uRLLC (ultra-Reliable Low Latency Communication), and mMTC (massive Machine Type Communication), analyzing how each scenario meets specific requirements of 5G technology. (6 marks)

d) Critically analyze the concept of 5G numerology and its role in shaping the design and functionality of the 5G network. (5 marks)

End of question paper