GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY
Faculty of Engineering
Department of Electrical, Electronic and Telecommunication Engineering

BSc Engineering Degree
Semester 7 Examination – July 2025
(Intake 39 – ET)

ET4132 – COMMUNICATION SYSTEMS

Time allowed: 2 hours 29th July, 2025

ADDITIONAL MATERIAL PROVIDED

Boltzmann Constant = $1.38064852 \times 10^{-23}$ m^2 kg s^{-2} K^{-1}

INSTRUCTIONS TO CANDIDATES

This paper contains 4 questions on 5 pages

Answer all FOUR questions

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 square 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 script

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

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

Learning Outcome (LO)	Questions that assess LO	Marks allocated (Total 60%)
LO1	Q1	13
LO2	Q2	13
LO3	Q3	19
LO4	Q4	15

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Question 1

(a) Explain why VHF and UHF bands are commonly used in terrestrial broadcasting systems.
[02 Marks]

(b) Identify the most suitable frequency band for the following applications and justify your answer:
(i) FM radio
(ii) Satellite TV broadcasting - Ku
(iii) Wi-Fi communication - 2.4GHz or 5GHz
[03 Marks]

(c) Explain how the curvature of the Earth is significant in microwave communication systems.
[03 Marks]

(d) Calculate the maximum LOS distance between a tower of height 50 m and a receiver antenna of height 10 m. Assume Earth radius = 6371 km.
$d = \sqrt{2ht} + \sqrt{hr}$
[03 Marks]

(e) Given a terrain profile, suggest how you would design a microwave link with adequate fade margin and LOS clearance. Clearly, right all your assumptions.
[02 Marks]

$dc = \frac{4\lambda h_1 h_2}{\lambda^2}$

Question 2

(a) Compare broadcast networks, point-to-point networks, and VSAT networks in satellite communication.
[02 Marks]

(b) Discuss emerging trends in satellite communication, such as LEO satellite constellations
[02 Marks]

(c) Predict how satellite communication might evolve over the next decade in terms of applications and technologies. 3D Network 6G
[04 Marks]

(d) Explain Demand Assigned Multiple Access.
[03 Marks]

(e) Explain two methods of retirement used for Satellites.
LEO / GEO
[02 Marks]

Question 3

(a) Explain the main components of a typical television broadcasting chain.

[03 Marks]

(b) Identify the key advantages of digital broadcasting over analog in the context of rural area coverage.

[03 Marks]

(c) Explain the reason for satellite TV being preferred in remote or hilly areas.

[02 Marks]

(d) Explain the role of MPEG-2/MPEG-4 in digital TV broadcasting.

[03 Marks]

(d) Discuss the impact of streaming services on traditional broadcast TV.

[03 Marks]

(e) Explain key features of 6G and its applications.

[05 Marks]

Question 4

(a) A simplified earth station 4 GHz receiver has the following gains and noise temperatures.

Gain of the RF amplifier $G_{rf} = 23$ dB
Input noise temperature $T_{in} = 25$ K
Noise temperature of the mixer $T_m = 500$ K
Noise temperature of IF amplifier $T_{if} = 1000$ K
Noise of RF amplifier $T_{rf} = 50$ K.
Gain of the mixer G_m

Assume the overall system noise temperature is given with the following equation.

$$T_S = T_{in} + T_{rf} + \frac{T_m}{G_{rf}} + \frac{T_{if}}{G_m \cdot G_{rf}}$$

(i) Calculate the system noise temperature assuming that the mixer has a gain of $G_m = 0$dB.

(ii) Calculate the system noise temperature when the mixer has a 10 dB loss.

(iii) Explain a method to minimize the noise temperature of the receiver when the mixer has a loss of 10 dB.

[06 Marks]

(b) You are designing a satellite downlink and want to ensure a reliable communication link. Given the following parameters, calculate the **fade margin**:

- Transmit power (Pt): **40 dBW**
- Satellite transmit antenna gain (Gt): **30 dBi**
- Receiving antenna gain (Gr): **45 dBi**
- Free space path loss (Lp): **200 dB**
- Other losses (atmospheric, polarization, etc.): **3 dB**
- Required minimum received signal level for error-free reception: **-95 dBm**

[05 Marks]

(c) Explain Antenna Scan Angle & Cosine Roll-Off.

cos roll off log (cos θ)

[04 Marks]

End of the question paper