



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (TELECOMMUNICATION AND INFORMATION
TECHNOLOGY)

SPH 445: SATELLITE COMMUNICATION

DATE: 9/12/2021

TIME: 8:30 – 10:30 AM

INSTRUCTIONS:

This paper consists of **FIVE** questions. Answer Question **ONE** and any other **TWO** questions
QUESTION ONE-COMPULSORY (30 MARKS)

- a) Explain the need of creating ripples on the surface of Hughes shaped reflector antennas. (3 marks)
- b) How are Non-Geostationary Orbit Satellites different from Geostationary Orbit Satellites? Outline any two of their advantages and disadvantages. (6 marks)
- c) List the four main design considerations of communication satellites. (4 marks)
- d) Draw the general configuration of an earth station. In your diagram label clearly all the functional elements contained in this configuration. (3 marks)
- e) Elaborate on X-Y mount antennas. How they are different from Azimuth mount antennas? (6 marks)
- f) State the main features in design optimization of a Satellite Service earth station. (4 marks)
- g) Outline the four main functions of telemetric tracking and command subsystem in satellite communication systems. (4 marks)

QUESTION TWO (20 MARKS)

- a) With the aid of relevant diagrams, derive and explain the combined Uplink and Downlink carrier to noise ratio. (10 marks)
- b) What is meant by rain attenuation? Derive an equation for the same taking into account the effective path length through rain. (10 marks)

QUESTION THREE (20 MARKS)

- a) What are double reflector antennas? With the aid of relevant diagrams, describe the two double reflector antennas used for satellite communication. (10 marks)
- b) Discuss any five design considerations of Non-Geostationary orbit satellites. (10 marks)

QUESTION FOUR (20 MARKS)

- a) With the aid of an appropriate diagram, explain the design and functionality of a travelling wave tube amplifier. (10 marks)
- b) Explain axisymmetric antenna configuration. This configuration has been used very widely until recently and depending on the feed arrangement, several types of configurations are possible. Discuss in details the three most commonly used configurations. (10 marks)

QUESTION FIVE (20 MARKS)

- a) Elaborate on the bus system and its subsystems that support the payload in communication satellites. (10 marks)
- b) Discuss fixed satellite service earth station. (10 marks)