



MACHAKOS UNIVERSITY

University Examinations for 2023/2024 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR

**BACHELOR OF SCIENCE (TELECOMMUNICATION AND INFORMATION
TECHNOLOGY)**

SPH444: SATELLITE COMMUNICATION I

DATE:

TIME:

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Geostationary satellite in practical is termed as geosynchronous. However, there are multiple factors which make these satellite shift from the ideal geostationary condition. Outline at least three of these factors. (3 marks)
- b) Using sketches, define elevation and inclination angles of a satellite orbit. (4 marks)
- c) Write a note on Equivalent Isotropic Radiated Power (EIRP). Hence, a satellite downlink is at 12 GHz operate with a transmit power of 6 W and an antenna gain of 48.2 dB. Calculate the EIRP in dBW. (3marks)
- d) The classical development for the determination of rain attenuation on a transmitted radiowave is based on three assumptions describing the nature of radiowave propagation and precipitation. Outline these assumptions. (3 marks)
- e) State Kepler's third law and use a relevant example to illustrate the relationship between the distances of the satellite from the earth and their orbital period. (4 marks)

- f) An antenna has noise a temperature of 35^0 K and is matched into a receiver which has a noise temperature of 100^0 K. Calculate: (4 marks)
- Noise power density
 - The noise power for a bandwidth of 36 MHz
- g) Determine the angle of tilt required for polar mount used with an earth station at latitude 49^0 North. Assume a spherical Earth of mean radius 6371 km, and ignore the earth station latitude. (3 marks)
- h) Explain two types of rain structure that are important in the evaluation of rain effects on earth-space communications. (4 marks)
- i) Explain the two ways by which frequency pool is managed in satellite networks. (2 marks)

QUESTION TWO (20 MARKS)

- a) With the aid of relevant diagram (s), describe antenna look angles and derive an equation for the same. (5 marks)
- Hence,**
- b) A geostationary satellite is located 90^0 W. Calculate the azimuth angle for an Earth station antenna located at latitude 35^0 W and longitude 100^0 W. (3 marks)
- c) Discuss the phenomenon of Sun Transit Outage experienced in satellite communication. (10 marks)

QUESTION THREE (20 MARKS)

- a) Describe the effects of rain on link performance and thus derive the equations governing uplink and downlink rain fade margin. (10 marks)
- b) Describe FDMA as a channel access scheme in satellite networks. In Discuss channel reservation scheme for satellite communication. (10 marks)

QUESTION FOUR (20 MARKS)

- a) Discuss how noise temperature affects the performance of a satellite system. Derive the expression for overall system noise temperature at the receiving earth station (10 marks)
- b) Discuss using relevant diagrams how a GEO is launched using a transfer orbit to the GEO. (10 marks)

QUESTION FIVE (20 MARKS)

- a) What is meant by rain attenuation? Derive an equation for the same and show how is this is related to specific attenuation. (10 marks)
- b) Explain the technique of TDMA. How is TDMA network advantageous over FDMA network? (10 marks)