CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF DEGREE OF BACHELOR OF SCIENCE IN PHYSICS

PHYS 373 : COMMUNICATION ELECTRONICS

STREAMS: **TIME:2 HOURS**

DAY/DATE: FRIDAY 21/04/2023 **8.30 A.M. –10.30 A.M.**

INSTRUCTIONS

You should have the following for this examination:

- *Answer booklet*
- *Scientific calculator*

Where necessary use the following constants

- Stefan-Boltzmann $\sigma=5.67 \times 10^{-8}$

This paper contains FIVE questions
*Attempt question **ONE** and any other **TWO** questions.*

*Question **ONE** carries **30** marks, all other questions carry **20**marks*

QUESTION ONE (30 MARKS)

a) Define a transmission line and list four types of transmission lines in use today (5 marks)

b) A coaxial cable RG-8A/U has a capacitance of 88.5pF/m and inductance of 221.25nH/m .Determine its characteristic impedance for a 1-m section and for a length of 3.6 km. (5 marks)

c) A certain electromagnetic wave has a maximum electric field of 321μV/m . Find the maximum magnetic field (3 marks)

d) Describe briefly three properties of electromagnetic waves (3 marks)

e) What is the average intensity of a plane travelling electromagnetic wave if B_m, the maximum value of its magnetic component, is 1.0×10^{-4}T? (3 marks)

f) Describe features of mono-pole and loaded antennas (4 marks)

g) A radar receiver indicates that the transmitted pulse is returned as an echo 40 μs after transmission. How far is the reflecting object? (3 marks)

h) Explain the following terms in relation to electromagnetic waves

(i) Dispersion

(ii) ii) Linear Polarization (4 marks)

QUESTION TWO (20 MARKS)

a) Describe four types of transmission line losses (4 marks)

b) A 1-m section of RG-8A/U coaxial cable used as a delay line that has a capacitance of 88.5.5pF/m and inductance of 221.25nH/fm. Determine

(i) The amount of delay

(ii) The velocity of propagation,

(iii) Velocity vector and

(iv) Line wavelength of a 200MHz signal traveling in RG-8A/U coaxial (8 marks)

c) Draw a well labelled diagram of a transmission line (2 marks)

d) A 400-Ω load is required to match a 600-Ω transmission line to reduce the SWR to 1. What must be the characteristic impedance of the quarter wave transformer for this purpose, if it is connected directly to the load? (3 marks)

e) Define the following terms (i) attenuation, (ii) crosstalk and (iii) return loss (3 marks)

QUESTION THREE (20 MARKS)

a) Define the following terms (4 marks)

(i) Isotropic point source,

(ii) Radio horizon,

(iii) Attenuation,

(iv) Resonant line

b) A band transmitter operating at 98MHz with 4.9W output is connected via 10m of RG-8A/U cable to an antenna that has an input resistance of 200Ω. (Zo= 50Ω and V=2.07 $\times10^8$ m/s for

RG-8A/U cable) Determine: (i) The reflection coefficient ,(ii) The electrical length of the cable in wavelengths (λ) (iii) the amount of transmitters 4.9W output absorbed by the antenna (5 marks)

c) Determine the distance from a λ/2 dipole to the boundary of the far field region if the λ/2 is used in a 450 MHz communication system (4 marks)

d) Two λ/2 dipoles are separated by 25km . They are aligned for optimum reception. The transmitter feeeds its antenna with 10W at 144 MHz. Calculate the power received. (4 marks)

e) A λ/2 dipole is build to receive 200MHz broadcast. Determine the optimum length of the dipole. (3 marks)

QUESTION FOUR (20 MARKS)

a) Define the following terms (i) geostationary orbit, (ii) uplink, (iii) Earth station, (iv) Transponder (4 marks)

b) Determine the ghost width on a TV screen 28 inches wide when a reflected wave results from an object ½ mi "behind" a receiver (4 marks)

c) Calculate the azimuth and elevation angles for an earth station (ground station) antenna given a satellite longitude of 83° west , a site longitude of 90° west, and a latitude of 35° north. (4 mark)

d) Describe the global positioning satellite (GPS) (3 marks)

e) Calculate the distance from an uplink at 32 o 44' 36" N latitude and 106o 16' 37" to a satellite parked in geostationary at 99 o W longitude (5 marks)

QUESTION FIVE (20 MARKS)

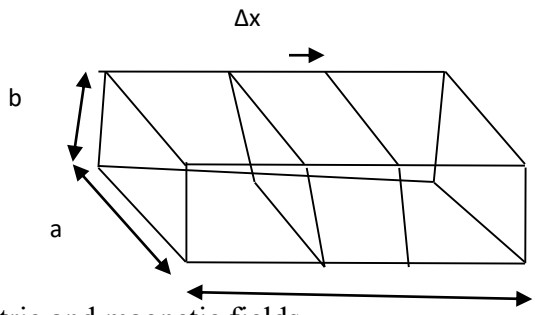
a) Starting with equation $\nabla \times E = -\partial B/\partial t$ and $\nabla \times B = \mu_o \varepsilon_o \frac{\partial E}{\partial t}$ show that E (x,t) and B(x,t), are the electric and field components of a plane travelling waves must satisfy the wave equation

$\nabla^2 E = \frac{1}{v^2}\frac{\partial^2 E}{\partial x^2}$ and $\nabla^2 B \quad c^2 \frac{\partial^2 B}{\partial x^2}$ (6 marks)

b) A radar receiver indicates that the transmitted pulse is returned as an echo 40 μs after transmission. How far is the reflecting object? (3 marks)

c) Explain the following terms in relation to electromagnetic waves i) Reflection and ii)Refraction (4 marks)

d) A rectangular wave guide is shown below. For the (m, n) = (1, 0) TE mode Calculate.



e) i) x,y components of the electric and magnetic fields (3 marks)

ii) The power transmitted down the guide (3 marks)

iii) The attenuation constant K (1 marks)
