(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE CODE: DEE 094

COURSE TITLE: ADVANCED COMMUNICATION SYSTEMS

DATE: Tuesday 26th July, 2022 **TIME:** 11.00 A.m – 1.00 p.m

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.
QUESTION ONE CARRIES 30 MARKS AND ALL OTHERS 20 MARKS EACH.

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

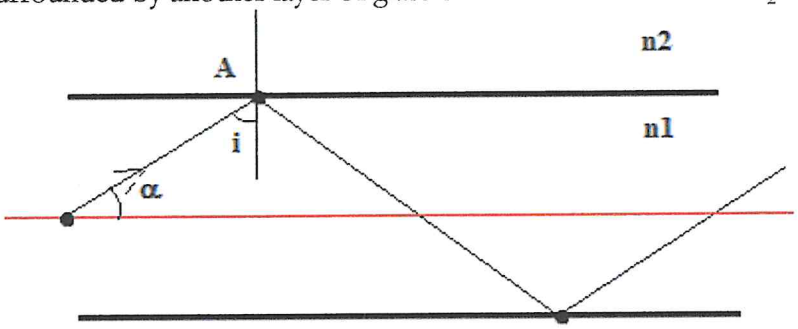
QUESTION ONE

a) Draw the diagram of a Basic Radar system and explain the operation of each block in detail.
(8 marks)

b) Determine the range and Doppler velocity of the target if the target is moving away from a FM-CW Radar. The beat frequency observed for triangular modulation is = 50kHz (uplink) and = 20 kHz (downlink). The modulating frequency is 2MHz and Doppler shift is 2kHz
(6 marks)

c) State and briefly explain the FOUR major parts of a fiber optic cable
(8 marks)

d) An optical fiber is made up of a core, where light travels, made of glass of refractive index n_1 = 1.5 surrounded by another layer of glass of lower refractive index n_2.



i) Find the refractive index n_2 of the cladding so that the critical angle at the interface core cladding is 80 °.
(3 marks)

ii) α is the angle made by the ray with the axis of the fiber. For what values of α is the incident angle i larger that the critical angle found in part i) above.
(2 marks)

e) Distinguish between Ground Wave Propagation and Sky Wave Propagation
(3 marks)

QUESTION TWO

a) State the kepler's laws. Discuss its importance in satellite communications.
(6 marks)

b) Explain how station keeping helps to keep a geostationary satellite in its correct Orbital slot
(4 marks)

c) A satellite is at a distance of 40,000 km from the earth station and radiates a power of 25W from an antenna with a gain of 22dB in the direction of VSAT at the earth station with an effective aperture area of $10m^2$. Find:

i) The flux density at the earth station
(4 marks)

ii) The power received by VSAT antenna
(3 marks)

iii) If the satellite operates at a frequency of 10GHz and the earth station antenna has a gain of 55 dB, determine the received power
(3 marks)

QUESTION THREE

a) i) Define a varactor diode

ii) State THREE applications of a varactor diode (1 mark)

b) Briefly describe the Gunn Effect (3 marks)

c) Distinguish between Transverse Electric and Transverse Magnetic modes in waveguides (2 marks)

d) State and briefly expound on any THREE characteristics of satellite orbits (2 marks)

e) Prove that for a real antenna, the received power is given by the equation:

$$P_r = \frac{P_t G_t A_e}{4\pi R^2} \text{ Watts}$$

QUESTION FOUR

a) Describe the working principle of the TWT

b) State TWO advantages and TWO disadvantages of the magnetron (4 marks)

c) Distinguish between negative resistance magnetron and cyclotron frequency magnetron (4 marks)

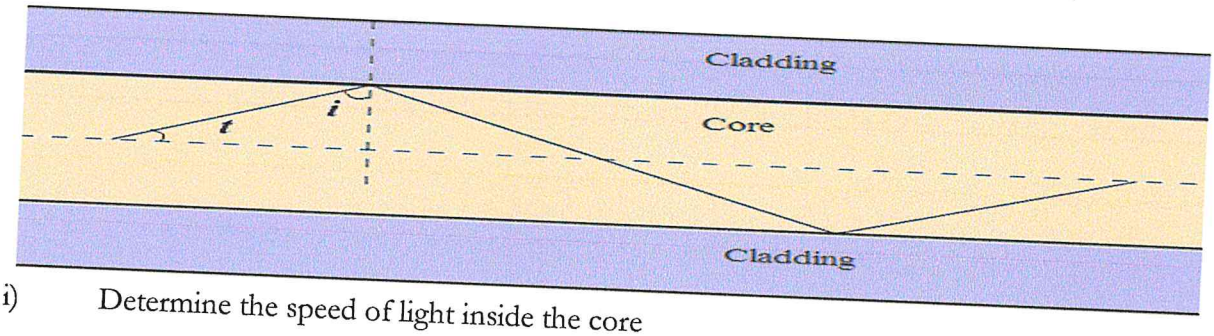
d) A TWT operates at 1GHz when a DC voltage of 12V and DC current of 500mA is applied at the cathode. Calculate its gain in dB, given that the helix has an impedance of $1K\Omega$. (Take electron velocity to be $0.593\times10^6 m/s$) (6 marks)

QUESTION FIVE

a) Define dispersion. What are its different types? How these affect the working of optical fibre communication system (6 marks)

b) Draw the elements of optical fiber transmission link and explain (5 marks)

c) In an optical fiber shown below the core has a refractive index of 1.7 and the cladding a refractive index of 1.5 (6 marks)



i) Determine the speed of light inside the core

ii) Calculate the critical angle at the core-cladding interface (3 marks)

iii) What is the maximum angle t that the rays leaving the source of light should make with the axis of the fiber so that total internal reflection takes place at the core cladding interface? (3 marks)