(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DIPLOMA
IN
ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE CODE: **DEE 094**

COURSE TITLE: **ADVANCED COMMUNICATION SYSTEMS**

DATE: Tuesday 11th April, 2023 **TIME:** 2.00 P.m – 4.00 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

This Paper Consists of 3 Printed Pages. Please Turn Over.

Question One

a) Explain what you understand by the term electromagnetic spectrum (2 marks)
b) With aid of sketches describe how a cavity klystron operates (8 marks)
c) State the FOUR main parts of the fiber optic cable (4 marks)
d) Light travels from air into an optical fiber with a refractive index of 1.45. if the incident angle is 25^{0}
   i) Calculate the angle of refraction inside the cable (4 marks)
   ii) Sketch path of the light as it changes media (3 marks)
e) Differentiate between electromagnetic waveguides and acoustic waveguides citing examples in each case (4marks)
f) List FIVE advantages of waveguides over transmission lines (5 marks)

Question Two

a) What is a microwave integrated circuit? (2 marks)
b) State TWO applications of travelling wave tube (2 marks)
c) A 5GHz receiver has the following gains and noise temperatures G_{rf} = 23 dB, T_{in} = 25K, T_m = 500K, T_{if} = 100K and T_{rf} = 50K
   i) Calculate the system noise temperature when the mixer has a gain of 0dB (2 marks)
   ii) Determine the system noise temperature when the mixer has a 10dB loss (2 marks)
   iii) How can the noise temperature of the receiver be minimized when the mixer has a loss of 10dB? (2 marks)
d) Calculate the maximum range of Radar for the following specifications –
   Peak power transmitted by the Radar, Pt = 300KW
   Gain of transmitting Antenna, G = 3000
   Effective aperture of the receiving Antenna, Ae=$4m^2$
   Radar cross section of the target, σ=$25m^2$
   Power of minimum detectable signal, Smin=10^{-10}W (4marks)
e) The interior of a 0.6m by 0.2m waveguide is completely filled with a dielectric of εr = 5. Calculate the velocity of propagation, cut off frequency and wavelength if its operating in TE11 mode (6marks)

Question Three

a) Define a magnetron (1 mark)
b) State and expound on THREE types of magnetrons (3 marks)
c) A Travelling Wave Tube operates at 1 GHz when a dc voltage of 12V and dc current of 500mAis applied at the cathode. Calculate its gain in dB given that the helix has an impedance of 1 KΩ. (take electron velocity to be 0.593 x 10^6 m/s) (6 marks)
d) With illustrations describe how a reflex klystron operates (8 marks)
e) State TWO applications of magnetrons (2 marks)

Question Four

a) State TWO types of radar and with the aid of block diagrams explain their functionality (8 marks)

b) Briefly explain how the idea of total internal reflection is achieved in fiber optics (4 marks)

c) A ray of light incident in water strikes the water-air interface with an incident angle of 10^0. If the refractive index of water is 1.3

   i) Calculate the angle of refraction (3 marks)

   ii) What should be the angle of incidence for an angle of refraction not to exceed 45^0? (3 marks)

   iii) Compute the critical angle (2 marks)

Question Five

a) Differentiate geostationary and geosynchronous orbits (4 marks)

b) A satellite downlink at 15GHz operates with a transmit power of 20W and an antenna gain of 50dB. Calculate EIRP in dBM (5marks)

c) State Three advantages of satellite communication over terrestrial networks (3marks)

d) Prove that for a real antenna, the received power in watts is given by:

$$P_r = \frac{P_t G_t A_e}{4\pi R^2}$$ (8 marks)