2203/306
COMMUNICATION SYSTEMS
Oct./Nov. 2004
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN TELECOMMUNICATION ENGINEERING

COMMUNICATION SYSTEMS

3 hours

INSTRUCTIONS TO CANDIDATES:

You should have the following for this examination:

Answer booklet
Calculator.

Answer any **FIVE** of the following **EIGHT** questions.
All questions carry equal marks.
Maximum marks for each part of a question are as shown.

This paper consists of 6 printed pages

1. (a) Define the following with respect to antennas;

(i) aperture
(ii) radiation resistance (2 marks)

(b) The electric field strength due to a dipole of length dl is given by;

$$E_o = \frac{60\pi I}{\lambda r} dl Sin\theta \, {}^{v}/_{m}$$

With the aid of a diagram, derive an expression for the radiation resistance of the dipole. (13 marks)

(c) A unipole aerial is mounted on a perfect reflecting ground and has a triangular current distribution. Calculate its radiation resistance if it radiates a signal at 30 MHz (5 marks)

2. (a) Explain the causes and effect of the following

(i) Atmospheric noise.
(ii) Galactic noise (8 marks)

(b) (i) Define the term "noise figure".
(ii) Using the Norton models derive an expression for the open-circuit mean-square voltage $\bar{v}^2$ across the terminals A and B in figure 1. (8 marks)

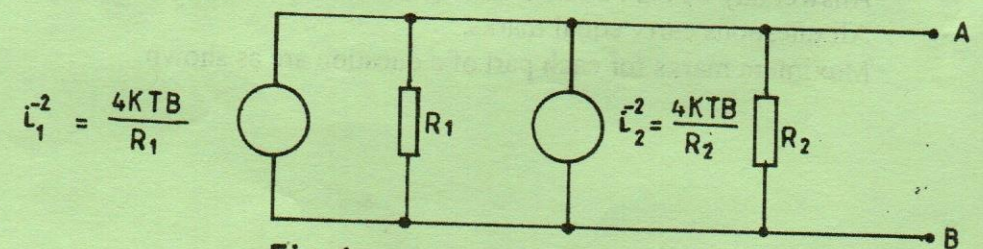

Fig. 1

(c) A certain high-gain amplifier has a noise figure of 9.03dB, an available gain of 50dB, and a one-side equivalent noise bandwidth of 10KHz. Determine the:

(i) effective noise temperature at 17°C.
(ii) available output power when the input is terminated in a matched source resistance whose noise temperature in 290°K. (4 marks)

3. (a) With reference to transmission lines, define the following terms:-

(i) reflection coefficient
(ii) characteristic impedance (4 marks)

(b) Explain how the line inductance and capacitance of an open-wire transmission line are minimized. (4 marks)

(c) (i) Define the "voltage standing wave ratio" as applied to transmission lines. (2 marks)

(ii) A lossless transmission line has a normalized load impedance of 0.5 +j0.7 and the guide wavelength of 40mm. Use the Smith chart to determine the:

I impedance 8mm towards the generator.
II SWR presented by the load.
III distance from the load to the first voltage minimum.

(10 marks)

4. (a) Define the following as applied to radar systems;

(i) back scatter wave
(ii) radar cross section (4 marks)

(b) With the aid of a block diagram, describe the operation of a simple pulsed radar system and show how the distance to the target can be obtained. (5 marks)

(c) (i) Derive the radar range equation.

(ii) Determine the minimum peak transmitter power needed in a pulsed radar system required to detect a target of $12m^2$ echoing area at a range of 100km given the following system parameters

operating frequency	=	1.5 GHz
receiver sensitivity	=	-100dBW
aerial gain	=	40dB
atmospheric attenuation	=	0.01dB per kilometre

(11 marks)

5. (a) Describe the following with respect to radio wave propagation;

(i) trapping
(ii) interference fading (4 marks)

(b) (i) With reference to radio wave propagation, state the causes of ground and ionospheric side-scatter.

(ii) State any TWO applications of side-scatter. (4 marks)

(c) An H.F radio wave, of electric field strength E $\frac{v}{m}$ is transmitted by ionospheric propagation.

Show, from first principles, that the critical frequency f_c is given by

$$f_c = \sqrt{\frac{Ne^2}{4\pi^2 \in_o m}}$$

where N is the number of electrons per cm^3
e is the electron charge
m is the electron mass
$\in_o$ is the permittivity of free space
State any TWO assumptions made. (12 marks)

6. (a) With the aid of sketches, explain the following terms as applied to microwave devices.

(i) Inductive window
(ii) Capacitive window (6 marks)

(b) (i) With the aid of current-voltage characteristics describe the operation of a tunnel diode.

(ii) State TWO important properties of the tunnel diode. (7 marks)

(c) Explain using a diagram the construction and operation of a rotary microwave attenuator. Indicate the relative field strengths in the centre section and output mode absorber of attenuator if the input signal has an amplitude E_o. (7 marks)

7. (a) (i) Draw a labelled block diagram to illustrate the main parts of an airborne satellite transmitter.

(ii) Describe the operation of the transmitter of (a)(i) in;

I Simplex mode
II Duplex mode and state how crosstalk is minimized.

(10 marks)

(b) A satellite communications system is to be used to transmit a video signal from the satellite to earth using FM. The following specifications are given;

Mid-frequency	=	3GHz
Bandwidth of modulating signal	=	4MHz
Satellite antenna gain	=	20dB
Earth station antenna gain	=	50dB
Distance from satellite to earth station	=	36,000 km
Receiving antenna noise temperature	=	20k
Receiver noise temperature	=	15k
Required detected signal –to-noise ratio	=	13dB

Determine the required value of transmitter power if the deviation ratio is 5.2.

(10 marks)

8. (a) Explain why it would be undesirable to use an ordinary sine-wave for scanning instead of the saw-tooth wave.

(4 marks)

(b) With the aid of a block diagram, explain the operation of a basic colour- TV broadcast system.

(10 marks)

(c) Explain how the flying-spot scanner is used for producing;

(i) slides
(ii) Motion-picture films

(6 marks)

Write your Candidate Number here →