2507/206
COMMUNICATION AND
TELECOMMUNICATION SYSTEMS
June/July 2017
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN AERONAUTICAL ENGINEERING (AVIONICS OPTION)

MODULE II

COMMUNICATION AND TELECOMMUNICATION SYSTEMS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Scientific calculator;
Answer booklet.
*This paper consists of **EIGHT** questions in **TWO** sections; **A** and **B**.*
*Answer any **THREE** questions from **Section A** and any **TWO** questions from **Section B** in the answer booklet provided.*
All questions carry equal marks.
Maximum marks for each part of a question are as indicated.
Candidates should answer the questions in English.

Take velocity of light, $C = 3.0 \times 10^8 m/s$,
Free space wave impedance $\text{£} = 377\Omega$

This paper consists of 5 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

SECTION A: COMMUNICATION SYSTEMS

*Answer any **THREE** questions from this section.*

1. (a) Outline **three** functions of radio transmitters. (3 marks)

(b) With the aid of a block diagram, describe the operation of a high level AM transmitter. (8 marks)

(c) (i) State **two** merits of frequency modulation. (2 marks)

(ii) An AM transmitter has power carrier of 50 W and when modulated by a sinusoidal signal, it increases the power to 59 W.

Determine the :

(I) depth of modulation;
(II) maximum power;
(III) minimum power;
(IV) ratio of maximum to minimum values of the wave envelope. (7 marks)

2. (a) State **three** merits of digital TV. (3 marks)

(b) With the aid of a diagram, describe the process of interlaced scanning in television screens. (7 marks)

(c) A TV system uses 625 interlaced scan lines occurring at a rate of 25 frames per second.
The horizontal scanning rate is 15,625 Hz. 80% of one complete horizontal scan time is used to display the video and 20 % is used in horizontal blanking. The horizontal resolution, R_H, is 512 lines and only 580 horizontal scan lines are displayed on the screen.

Determine the:

(i) time for one complete horizontal scan;
(ii) time for one horizontal line scan;
(iii) period for one horizontal line scan;
(iv) bandwidth. (10 marks)

3. (a) State **three** features of 3G Technology. (3 marks)

(b) Describe the following mobile phone technologies stating the type of generation in each case:

(i) GSM;
(ii) WCDMA. (6 marks)

(c) Highlight the difference between WI-FI and WI-MAX technologies based on:

(i) range;
(ii) data transfer rates. (4 marks)

(d) With the aid of a diagram, describe the principle of operation of a WI-FI network. (7 marks)

4. (a) State Kepler's law of satellite motion. (3 marks)

(b) Describe the following satellite orbits:

(i) geo-synchronous;
(ii) polar;
(iii) elliptical. (9 marks)

(c) A geostationary satellite is located 90°W. An earth station antenna is located at a latitude of 35°W and longitude 100°W.

Determine the:

(i) angle between the satellite and antenna;
(ii) angle between radius of the earth and radius of the satellite path;
(iii) azimuth angle. (6 marks)

(d) State **two** applications of satellite systems. (2 marks)

5. (a) List **three** applications of radar systems. (3 marks)

(b) With the aid of a labelled block diagram, describe the operation of a distance measuring equipment (DME) radar. (8 marks)

(c) A radar system operating at 750 MHz over a range of 10 km produces a minimum receivable power of 600 pW. The antenna capture area is 5 m^2 and the target cross-sectional area is 16 m^2.

Determine the:

(i) peak pulsed power radiated;
(ii) range over which receivable power would reduce to 90 pW. (7 marks)

(d) State **two** types of radar systems. (2 marks)

SECTION B: TELECOMMUNICATION PRINCIPLES

*Answer any **TWO** questions from this section.*

6. (a) Distinguish between diffraction and refraction as used in wave propagation. (2 marks)

(b) Describe the following atmospheric layers stating their effects on radio wave propagation:

(i) troposphere;
(ii) stratosphere;
(iii) ionosphere. (9 marks)

(c) The electric field strength at a receiving station is $10\ \mu V/m$.

Determine the:

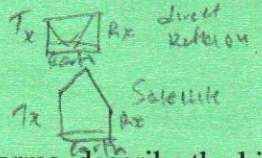
(i) magnetic field strength;
(ii) power density of the station;
(iii) amount of power incident on a receiving aerial with an effective area of 5 m^2.
(6 marks)

(d) Highlight **three** functions of the Communication Authority of Kenya (CAK).
(3 marks)

7. (a) Define polarisation as used in radio wave propagation. (1 mark)

(b) With the aid of diagrams, describe the following types of radio waves:

(i) surface wave;
(ii) space wave. (8 marks)



(c) With the aid of waveforms, describe the binary phase shift keying modulation technique. (7 marks)

(d) A fibre optic cable has a core refractive index of 1.48 and a cladding refractive index of 1.46.

Determine the:

(i) numerical aperture;
(ii) critical angle. (4 marks)

8. (a) State **three** advantages of matched transmission lines. (3 marks)

(b) In a lossless transmission line, the velocity of propagation is $2.5 \times 10^8 m/s$. The capacitance of the line is $30\ pF/m$.

Determine the:

(i) inductance of the line per metre;
(ii) phase constant at 100 MHz;
(iii) characteristic impedance of the line. (6 marks)

(c) A rectangular waveguide measures $3\ cm \times 4.5\ cm$ internally. It has a 10 GHz signal propagated through it:

Determine the:

(i) cut-off wavelength;
(ii) wavelength of propagated signal;
(iii) guide wavelength. (7 marks)

(d) With the aid of a polar diagram, describe the Yagi-Uda array. (4 marks)

THIS IS THE LAST PRINTED PAGE.