

2507/206

COMMUNICATION AND  
TELECOMMUNICATION SYSTEMS

June/July 2023

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:*

*Non-programmable 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 shown.*

*Candidates should answer the questions in English.*

**This paper consists of 4 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) List **three** areas of application of a radio telemetry system. (3 marks)
- (b) With the aid of a labelled block diagram, describe the operation of a high level A.M radio transmitter. (7 marks)
- (c) The R.F. bandwidth for an F.M transmitter is 120 kHz when the modulation index is 4. If the modulation signal level is increased by 5 dB, determine the:
- (i) modulating signal frequency;
- (ii) new bandwidth. (8 marks)
- (d) State **two** requirements of a radio transmitter. (2 marks)
2. (a) Define each of the following properties as applied in T.V systems:
- (i) monochromaticity;
- (ii) brightness;
- (iii) pincushion distortion. (3 marks)
- (b) List any **five** common faults occurring in TV systems. (5 marks)
- (c) A closed circuit TV system consist of four TV camera, a control unit, a video recorder and other peripherals. Draw a block diagram of the system and describe its operation. (7 marks)
- (d) Draw a layout of GSM network. (5 marks)
3. (a) Define each of the following with respect to radar systems:
- (i) duty cycle;
- (ii) range resolution;
- (iii) maximum unambiguous range. (3 marks)
- (b) With the aid of a labelled diagram, describe the lobe switching radar antenna tracking method. (5 marks)

- (c) A 7 GHz radar system uses an antenna whose mouth diameter is 2.5 m to radiate 300 kW towards a target. The target cross-sectional area is 5 m<sup>2</sup> and the system operates over a bandwidth of 600 kHz with a noise figure of 5 dB. Determine the maximum radar range in km. (7 marks)
- (d) Draw a labelled block diagram of a direct measuring equipment (D.M.E) radar. (5 marks)
4. (a) State **three** merits of geostationary satellite communication. (3 marks)
- (b) Draw a block diagram of an up-link section of a satellite system and describe the function of each block. (8 marks)
- (c) Describe geosynchronous orbit as used in satellite transmission. (3 marks)
- (d) A satellite link operates at 9 GHz using a transmitting antenna whose gain is 80 dB. The receive antenna has a gain of 65 dB and the link path loss is 1 dB. Determine the range of the link. (6 marks)
5. (a) State **three** merits of digital TV. (3 marks)
- (b) With the aid of a scanning pattern, describe interlaced scanning. (7 marks)
- (c) Explain the Global System for Mobile Communication (GSM) technology. (4 marks)
- (d) Draw a labelled block diagram of a monochrome TV transmitter. (6 marks)

## SECTION B: TELECOMMUNICATION PRINCIPLES

*Answer any TWO questions from this section.*

6. (a) Define each of the following with respect to antennas:
- (i) beamwidth;
  - (ii) effective radiated power;
  - (iii) polar diagram. (3 marks)
- (b) Distinguish between travelling wave and standing wave antennas. (4 marks)
- (c) With the aid of a diagram, describe the operation of a rhombic antenna. (6 marks)

- (d) An isotropic antenna radiating 4 kW is located 50 km away from the receiver. Determine the:
- (i) electric field intensity;
  - (ii) power flux density;
  - (iii) electric field intensity, if the transmitting antenna has a gain of 20 dB. (7 marks)
7. (a) State the following with respect to waveguides:
- (i) classes of transverse modes;
  - (ii) boundary conditions to be satisfied in waveguides. (4 marks)
- (b) With the aid of a circuit diagram, explain impedance matching by use of a single stub. (8 marks)
- (c) A lossless transmission line has distributed inductance of 1.2 mH/km and a distributed capacitance of 0.05  $\mu$ F/km. Determine the:
- (i) characteristic impedance;
  - (ii) propagation constant;
  - (iii) velocity of propagation. (6 marks)
- (d) State **two** areas of applications of waveguides. (2 marks)
8. (a) State **three** types of losses that occur in an optic fibre communication system. (3 marks)
- (b) Draw a block diagram of an optic fibre transmitting system, stating the function of each component. (9 marks)
- (c) Explain each of the following layers as used in wave propagation:
- (i) D-layer;
  - (ii) E-layer. (6 marks)
- (d) Draw a ray diagram of a single mode optic fibre cable. (2 marks)

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