Name: _____ Index No: _____/_____

1522/205
1602/205
TELECOMMUNICATION SYSTEMS
June/July 2015
Time: 3 hours

Candidate's Signature: _____

Date: _____

THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN ELECTRICAL AND ELECTRONICS TECHNOLOGY (TELECOMMUNICATION OPTION) MODULE II

TELECOMMUNICATION SYSTEMS

3 hours

INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces provided above.
Sign and write the date of examination in the spaces provided above.
You should have Mathematical tables and a Scientific calculator for this examination.
*This paper consists of **EIGHT** questions in **THREE** sections; A, B and C.*
*Answer any **THREE** questions from section A; and any **ONE** question from section B and **ONE** question from section C in the spaces provided in this question paper.*
All questions carry equal marks.
Maximum marks for each part of a question are indicated.
*Do **NOT** remove any pages from this booklet.*
Candidates should answer the questions in English.

For Examiner's Use Only

Section	Question	Maximum Score	Candidate's Score
A		20	
		20	
		20	
B		20	
C		20	
		TOTAL SCORE	

This paper consists of 20 printed pages.

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

Turn over

SECTION A: RADIO SYSTEMS

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

1. (a) With the aid of a circuit diagram describe the operation of a balanced diode modulator and sketch the output modulated waveform. (9 marks)

   (b) (i) Define modulation index of an amplitude modulated wave.

   (ii) A 10 V carrier wave is amplitude modulated to a depth of 25%. Determine the:

   I. amplitude of the modulating signal;

   II. maximum amplitude of the modulated wave;

   III. minimum amplitude of the modulated wave.

   (11 marks)

2. (a) (i) State any **three** telecommunication services that use frequency modulation (FM).

   (ii) Draw a labelled block diagram of an FM transmitter employing Automatic Frequency Control (AFC) system. (7 marks)

   (b) A 2.4 V, 1.2 kHz audio signal is used to frequency modulate a carrier wave and the resulting modulation index is 20. Determine the:

   (i) maximum deviation, in kHz;
   (ii) required bandwidth, in kHz;
   (iii) sensitivity of the modulator, in kHz/V.

   (6 marks)

   (c) An oscillator employs a parallel-tuned circuit consisting of a $0.2\mu H$ inductor and a 8pF capacitor. A variable-capacitance (varactor) diode is connected across the tuned circuit to frequency modulate the oscillator output. Determine the range of the diode capacitance required to tune the oscillator from 88 MHz to 108 MHz. (7 marks)

3. (a) (i) Define co-channel interference with respect to radio receivers.

   (ii) With the aid of a characteristic curve describe ideal automatic gain control (a.g.c) response. (6 marks)

(b) Figure 1 shows the circuit diagram of a Foster-Seleey detector. Describe its operation.
(4 marks)

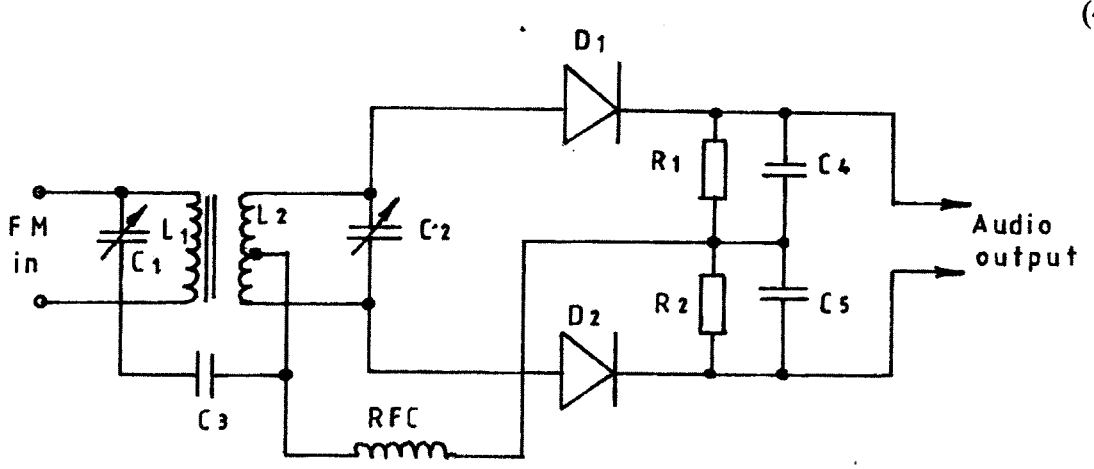

Fig. 1

(c) A superheterodyne radio receiver has an intermediate frequency of 465 kHz and is tuned to receive an unmodulated carrier at 1200 kHz. The IF bandwidth is 9 kHz.

(i) Determine the:

I. lower cutoff frequency of the IF amplifier;
II. upper cutoff frequency of the IF amplifier;
III. local oscillator frequency.

(ii) A signal at 1193 kHz appears at the mixer input. Determine whether the signal will pass throgh the IF amplifier.

(10 marks)

4. (a) Define each of the following with respect to radio wave propation:

(i) fading;
(ii) critical frequency.

(4 marks)

(b) With aid a labelled diagram describe the operation of a loop aerial and sketch its radiation pattern in the equatorial plane. (7 marks)

(c) Figure 2 shows a diagram of a high frequency single hop transmission between points A and B on a flat earth. The virtual height of the ionospheric layer is 300 km and the critical frequency is 8 MHz. Determine the:

(i) angle of incidence, θ;
(ii) maximum usable frequency;
(iii) optimum working frequency;
(iv) skip distance, AB.

(9 marks)

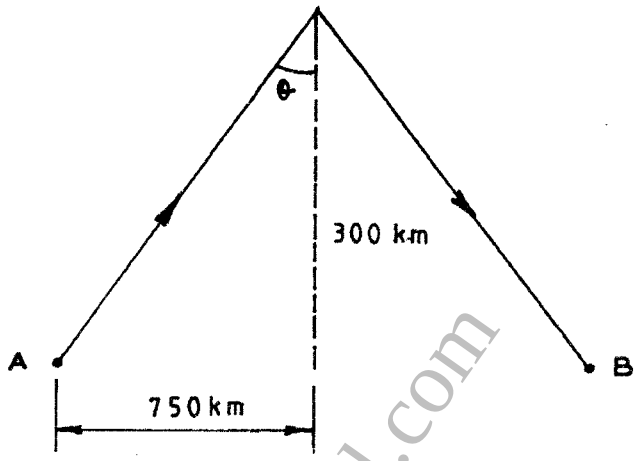

Fig. 2

SECTION B: TV FUNDAMENTALS

*Answer any **ONE** question from this section.*

5. (a) (i) Define each of the following with respect to TV receivers:

I. field frequency;
II. brightness.

(ii) With the aid of a circuit diagram describe the operation of a single-phase full-wave voltage doubler.

(10 marks)

(b) Sketch the waveforms at the following test points in a TV receiver:

I. output of video amplifier;
II. output of sync separator;
III. output of vertical oscillator.

(6 marks)

(c) Explain the effect of each of the following faults in a colour TV receiver:

(i) failure in the chroma amplifier;
(ii) failure in the automatic colour control circuitry.

(4 marks)

6. (a) (i) State the function of each of the following in a colour TV receiver:

I. colour killer;
II. burst amplifier;
III. colour matrix adder.

(ii) Figure 3 shows the circuit diagram of a colour demodulator. Describe its operation.

(9 marks)

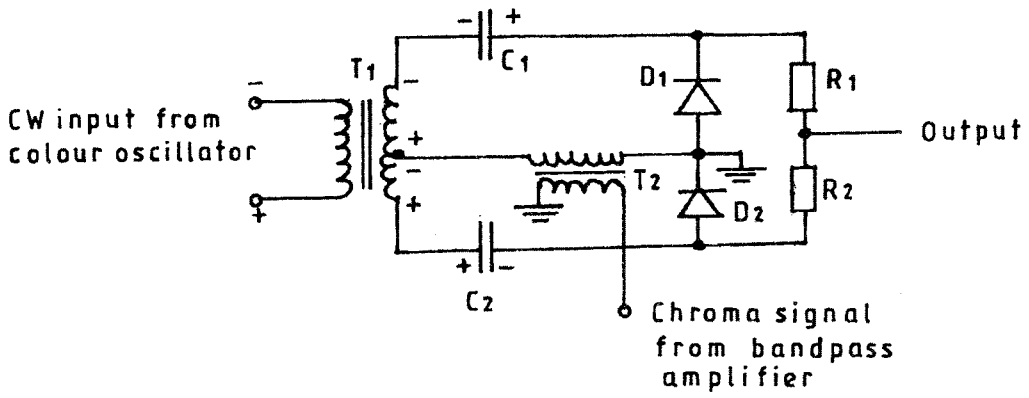

Fig. 3

(b) (i) With the aid of a labelled diagram and waveform describe the measurement of depth of modulation of an AM wave using an oscilloscope with the internal timebase switched off.

(ii) In the measurement of depth of modulation using an r.m.s. responding ammeter, the modulated current was found to be 55A at 65% modulation depth. Determine the value of the unmodulated carrier current.

(11 marks)

SECTION C: DATA COMMUNICATION

*Answer any **ONE** question from this section.*

7. (a) (i) Distinguish between serial and parallel transmission of data.

(ii) With the aid of a labelled block diagram describe data transfer in a point to multi point data network. (8 marks)

(b) (i) State any **two** telecommunication services that are supported by the Broadband Integrated Service Digital Network (B-ISDN).

(ii) Given two computers, a switch, a router and UTP cables, sketch the network layout for internet connection. (6 marks)

(c) A pulse code modulation system use 128 quantization levels at a sampling frequency of 8 kHz. Assuming that each sample signalled to the line is accompanied by one synchronization bit, determine the:

(i) bit rate;
(ii) bandwidth.

(6 marks)

8. (a) (i) State, with reasons, any **two** advantages of using privately leased lines over public switched telephone network for data transmission.

(ii) Describe the function of each of the following network devices:

I. bridges;
II. routers.

(10 marks)

(b) With the aid of a labelled diagram describe the operation of a terrestrial microwave link.
(4 marks)

(c) A data signal is represented by the bits 10111001. With the aid of waveforms represent the data in:

(i) manchester;

(ii) alternate mark inversion.

(6 marks)