

1522/205
1602/205
TELECOMMUNICATION SYSTEMS
June/July 2016
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
CRAFT CERTIFICATE IN ELECTRICAL AND ELECTRONIC TECHNOLOGY
(TELECOMMUNICATION OPTION)
MODULE II

TELECOMMUNICATION SYSTEMS

3 hours

INSTRUCTIONS TO CANDIDATES

*You should have Mathematical tables/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**, **ONE** question from
Section **B** and **ONE** question from Section **C** 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.*

This paper consists of 6 printed pages.

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

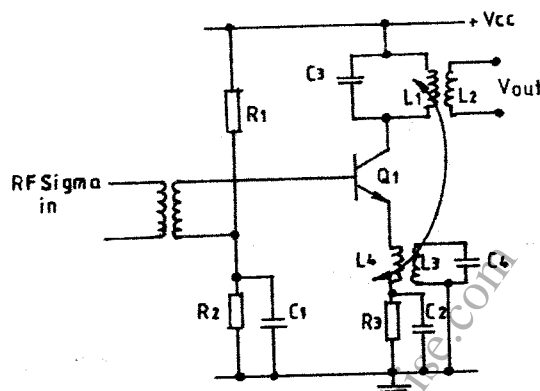
SECTION A: RADIO SYSTEMS

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

1. (a) (i) State any **three** factors that determine the choice of the intermediate frequency (IF) of a radio receiver.

- (ii) Figure 1 shows a circuit diagram of a self-oscillating mixer used in radio receivers. Describe its operations.

(9 marks)



- (b) A carrier signal of 100 V peak is amplitude modulated by a sinusoidal signal of peak value 60 V, 20 kHz. The modulated signal is fed to an antenna whose radiation resistance is $12\ \Omega$. The total current through the antenna is 8 A. Determine the:

- (i) modulation index;
- (ii) power due to the carrier component;
- (iii) total power dissipated by the antenna;
- (iv) current due to the carrier component;
- (v) bandwidth required to transmit the modulated signal.

(11 marks)

2. (a) Draw a labelled block diagram of an FM radio receiver.

(5 marks)

- (b) Table 1 shows the values of attenuation and frequency for determining the selectivity characteristics of a radio receiver.

Table 1

Frequency (kHz)	-40	-30	-20	-10	0	+10	+20	+30	+40
Attenuation (dB)	100	86	60	20	0	20	60	86	100

- (i) Plot the selectivity characteristic curve.
- (ii) Determine the frequencies at which the attenuation is 75 dB.

(5 marks)

- (c) A frequency modulated wave is represented by the expression
 $V = 6 \sin(8\pi \times 10^7 t + 4 \sin 1140\pi t)$ volts. Determine the:

- (i) carrier signal frequency;
 - (ii) modulated signal frequency;
 - (iii) frequency deviation;
 - (iv) bandwidth required to transmit the signal;
 - (v) maximum allowable modulating signal voltage if the sensitivity is 5.5 kHz/volt.
- (10 marks)

3. (a) (i) Define each of the following with respect to radio wave propagation:

- (I) critical frequency;
- (II) virtual height;
- (III) optimum usable frequency.

- (ii) Draw a labelled diagram illustrating ground wave, sky wave and space wave modes of radio wave propagation.

(10 marks)

- (b) (i) State any **two** functions of an aerial coupling network.

- (ii) Figure 2 shows a circuit diagram illustrating how a rod aerial is coupled to a radio receiver. Describe its operation.

(6 marks)

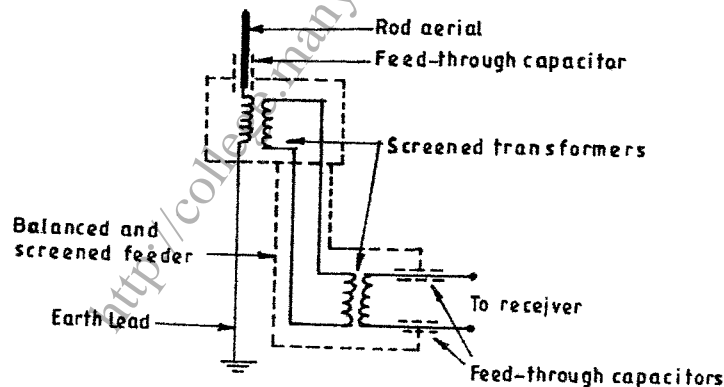


Fig. 2

- (c) The magnetic field strength 10 km from a transmitting aerial is 0.053×10^{-3} At/m. Determine the electric field strength 50 km away from the aerial in the same direction. Take impedance of free space = $120\pi \Omega$.
- (4 marks)

4. (a) (i) State any **two** disadvantages of double sideband (DSB) as compared to single sideband (SSB) systems.
- (ii) With the aid of a labelled block diagram describe the phase-shift method of generating SSB signal. (10 marks)

- (b) A low frequency transmitting aerial has a loss resistance of 1.5Ω and efficiency of 16.67 per cent. The power radiated by the aerial is 750 watts. Determine the:
- (i) radiation resistance of the aerial;
 (ii) current fed into the aerial;
 (iii) input power to the aerial. (10 marks)

SECTION B: TV FUNDAMENTALS

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

5. (a) (i) State the functions of each of the following in a TV picture tube:
- (I) deflection yoke;
 (II) convergence yoke;
 (III) aquadug coating.
- (ii) Figure 3 shows a diagram for colour addition in a colour TV system. Determine the colours labelled A, B, C and D. (11 marks)

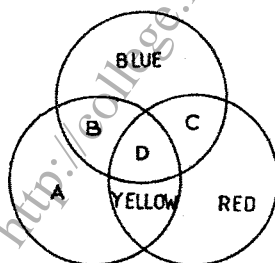


Fig. 3

- (b) (i) Describe the operation of a monochrome TV camera tube.
- (ii) A video amplifier has a gain of 20 dB. If the video signal input has a value of 1.5 V peak-to-peak, determine the peak-to-peak value of the output signal. (9 marks)

6. (a) (i) State any **three** symptoms produced by the power supply ripple interference in a TV receiver.
- (ii) Figure 4 shows a schematic diagram of a hold-down circuit used to kill the horizontal drive if the flyback high voltage rises above a predetermined level. Describe its operation.

(8 marks)

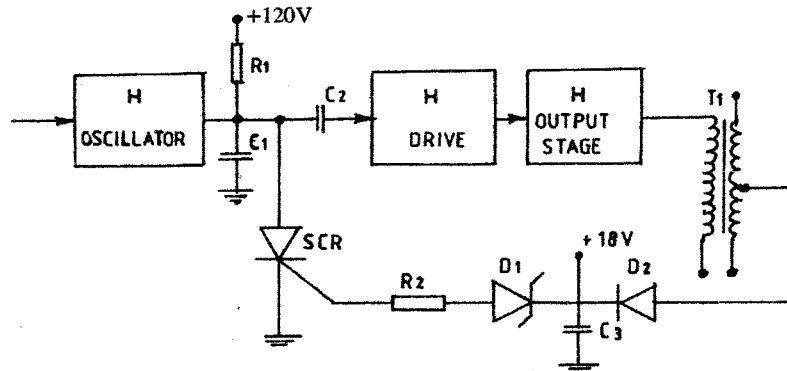


Fig. 4

- (b) For a PAL TV system standard, state each of the following:

- (i) number of lines per frame;
- (ii) number of frames per second;
- (iii) field frequency (in Hz);
- (iv) line frequency (in Hz).

(4 marks)

- (c) Sketch the symptoms you would observe on the raster of a TV screen for each of the following fault conditions:

- (i) insufficient output from horizontal amplifier;
- (ii) deflection not uniform at the edges of the raster compared with its centre;
- (iii) longer scanning lines at the top than at the bottom;
- (iv) insufficient output from vertical amplifier.

(8 marks)

SECTION C: DATA COMMUNICATION

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

7. (a) State any **three**:
- (i) advantages of using digital over analog circuits to carry data signals;
 - (ii) disadvantages of guided (wired) media as compared to unguided (wireless) media when used for data transmission. (6 marks)
- (b) With the aid of labelled block diagrams distinguish between half-duplex and full-duplex modes of data transmission. (6 marks)
- (c) (i) State any **three** causes of attenuation of light in an optic fibre.
- (ii) With the aid of a labelled diagram describe the measurement of attenuation in an optic fibre using a light source and a power meter. (8 marks)
8. (a) Define each of the following with respect to data transmission:
- (i) protocol;
 - (ii) transmission medium;
 - (iii) text. (6 marks)
- (b) Data is to be sent from device A to device B through the OSI layers. Draw a flow diagram illustrating the movement of data from device A to Device B. (8 marks)
- (c) Describe the use of diagnostic software in troubleshooting a data network. (6 marks)

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