THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

083 RADIO AND TV SERVICING

(For Both School and Private Candidates)

Time: 3 Hours **ANSWERS** **Year: 2008**

Instructions

1. This paper consists of SIXTEEN questions.

2. Answer all questions in section A and B and two questions from section C.

(i) In electronics the term “LED” stands for
A. Linear electronic devices
B. Lamp equipment devices
C. Light encoding devices
D. Light emitting diode
E. Light electrons display

Answer: D. Light emitting diode
Reason: LED stands for Light Emitting Diode, a semiconductor device that emits light when current flows through it.

(ii) Which of the following is the formula in which power, voltage and current gains are related?
A. Av = Ai × Ap
B. Ap = Av × Ai
C. Av = Ap × Ai
D. Av = Av × Ap
E. Av = Ai - Ap

Answer: B. Ap = Av × Ai
Reason: Power gain (Ap) is equal to voltage gain (Av) multiplied by current gain (Ai).

(iii) Sky wave is returned to the earth by the
A. receiving aerial
B. earth surface
C. molecules
D. high frequency
E. ionosphere

Answer: E. ionosphere
Reason: The ionosphere reflects certain frequencies of radio waves back to Earth, enabling long-distance communication.

(iv) In the oscillator tuned circuits, the impedance in series resonance is always
A. maximum
B. minimum
C. equal to its capacitance
D. parallel with the inductor
E. less than its resistance

Answer: B. minimum
Reason: At series resonance, the impedance of the circuit is minimum due to cancellation of inductive and capacitive reactances.

(v) The band-width of the tuned amplifier is given by
A. $f_1 - f_2$
B. $2f_1$
C. $f_1 \times f_2$
D. Bw
E. $\sqrt{(L/C)}$

Answer: A. $f_1 - f_2$
Reason: Bandwidth (BW) is the difference between the upper and lower cut-off frequencies, i.e., BW = $f_2 - f_1$.

(vi) The mixer stage of the superhet radio receiver is sometimes known as
A. mixer amplifier
B. detector stage
C. AF amplifier
D. oscillator
E. frequency changer

Answer: E. frequency changer
Reason: The mixer stage is also called a frequency changer since it converts the incoming RF signal to an intermediate frequency (IF).

(vii) What is meant by NTSC as used in television?
A. National television society corporation
B. National assembly in television colour
C. National transmission system of communication
D. National television society cooperation of Japan
E. National Television systems committee of America

Answer: E. National Television systems committee of America
Reason: NTSC stands for National Television Systems Committee, the standard for analog television used in America.

(viii) If a radio receiver produces no sound, what would be the possible cause?
A. Poor selectivity
B. Image frequency
C. Defective loud speaker
D. Signal to noise ratio
E. Fading

Answer: C. Defective loud speaker
Reason: No sound production is often due to a faulty loudspeaker, which converts electrical signals to sound.

(ix) The voltage at which the electrons start to flow from the cathode to the anode through a diode is called
A. break down voltage
B. peak inverse voltage
C. knee voltage
D. pinch off voltage
E. cut off voltage

Answer: C. knee voltage
Reason: Knee voltage is the minimum forward voltage at which a diode starts conducting significantly.

(x) The type of radio receiver where the incoming radio frequency signal is changed to another frequency is known as a
A. tuned radio frequency receiver
B. super heterodyne receiver
C. continuous wave receiver
D. frequency modulated receiver
E. super-regenerative receiver

Answer: B. super heterodyne receiver
Reason: Superheterodyne receivers convert incoming signals to an intermediate frequency for easier processing and better selectivity.

2. What is a d.c. loadline?
A d.c. loadline is a graphical representation that shows all possible combinations of collector current (Ic) and collector-emitter voltage (Vce) for a given load resistance in a transistor circuit under d.c. conditions. It is drawn by applying Kirchhoff's voltage law to the output loop of the transistor and helps determine the operating point (Q-point) of the transistor.

3. Mention three (3) main parts of oscillator.
The three main parts of an oscillator are:
- Amplifier (usually a transistor or op-amp)
- Frequency determining network (such as LC, RC or crystal)
- Feedback network (to feed part of the output back to the input with correct phase)

4. Write a formula for the impedance of a speaker coil having both inductive reactance and resistance.
The impedance Z of a speaker coil is given by:
$Z = \sqrt{(R^2 + X_L^2)}$
Where R is the resistance and $X_L = 2\pi fL$ is the inductive reactance

5. When a carrier wave (fc) is amplitude modulated by another signal (fm), three (3) separate frequencies are produced. Mention the frequencies.
The three frequencies produced are:
- Carrier frequency (fc)

- Upper sideband (fc + fm)
- Lower sideband (fc - fm)

6. How can the overall gain of a radio receiver be varied automatically with the changing strength of the received signal?
The overall gain of a radio receiver can be varied automatically using an Automatic Gain Control (AGC) circuit. AGC adjusts the amplifier gain based on the strength of the received signal to maintain a constant output level despite variations in input signal strength.

7. (a) When the base-emitter bias is about +0.2V, electrons cross the junction into the base. What material is this transistor made of?
The transistor is made of germanium.
Reason: In germanium transistors, the base-emitter voltage required for conduction is approximately 0.2V, while in silicon it is about 0.7V.

(b) If the transistor is operating with Vce = 9V, and it is properly biased, calculate the value of VCB.
VCB = VCE - VBE
VCB = 9V - 0.7V
VCB = 8.3V

8. In radio receiver a tuner stage is formed by three (3) combined stages. Mention them.
- R.F. amplifier
- Local oscillator
- Mixer

9. (a) One of the qualities of the tuned circuit of a radio receiver is its ability to extract the desired signal and reject all the other unwanted signals. Give the name of that quality.
Selectivity

(b) State three (3) ways in which radio waves travel.
- Ground wave propagation
- Sky wave propagation
- Space wave propagation

10. Define the following terms as used in amplitude modulation:
(a) Modulation index
Modulation index is the ratio of the amplitude of the modulating signal to the amplitude of the carrier wave. It indicates the extent of modulation and is given by:
m = Am / Ac

(b) Modulation depth
Modulation depth refers to how much the carrier wave is being modulated by the input signal. It is often expressed as a percentage and is related to the modulation index.

11. If your superhet radio receiver produces twice the IF away from the wanted signal, predict the possible problem at output.
The problem is the occurrence of image frequency interference. The receiver is picking up an unwanted signal at a frequency that also produces the same intermediate frequency (IF) as the desired signal due to poor image frequency rejection.

12. (a) What is the function of the following stages of the superhet radio receiver?
(i) Local oscillator
Generates a stable frequency that mixes with the incoming signal to produce an intermediate frequency (IF).

(ii) I.F. amplifier
Amplifies the intermediate frequency signal to a higher level for further processing.

(iii) Mixer stage
Combines the incoming RF signal with the local oscillator signal to produce the intermediate frequency (IF).

(iv) Detector stage
Extracts the original audio or information signal from the modulated IF signal.

(v) A.F. amplifier
Amplifies the recovered audio signal to a level suitable for driving the loudspeaker.

(b) What purpose does AGC line serve in a superhet radio receiver?
The AGC (Automatic Gain Control) line helps maintain a consistent audio output level by adjusting the gain of amplifying stages according to the strength of the received signal.

13. Name three (3) passive components used in electronic circuits.
- Resistor
- Capacitor
- Inductor

14. (a) (i) A pure inductor L (i.e. one possessing negligible resistance) is connected to a 230V, 50Hz domestic supply. A current of 2A flows. Determine the value of the inductance.
Given:
V = 230V
I = 2A
f = 50Hz

XL = V / I = 230 / 2 = 115Ω
XL = 2πfL
115 = 2π × 50 × L

$L = 115 / (2\pi \times 50)$
$L = 115 / 314.16$
$L = 0.366$ H

(ii) If the inductor L in 13(a)(i) above has 100 turns of wire and another coil X is wound with 150 turns but having identical dimensions as that of inductor L, calculate the current that will pass if X is connected to the same supply.
Induced voltage is proportional to number of turns, so:
$V_X / V_L = N_X / N_L = 150 / 100 = 3 / 2$

So the new reactance:
$XL_X = 115 \times (3/2) = 172.5\Omega$

Current through X:
$I = V / XL = 230 / 172.5 = 1.33$ A

15. (a) What is the general function of antennas in electronic systems?
The general function of antennas is to convert electrical signals into electromagnetic waves (during transmission) and vice versa (during reception).

(b) Mention four (4) types of radio receiving antennas.
- Dipole antenna
- Loop antenna
- Yagi antenna
- Parabolic dish antenna

(c) If the frequency of the transmitted signal is 1 kHz, what will be the value of its wavelength?
Wavelength $\lambda = c / f$
$c = 3 \times 10^8$ m/s, $f = 1 \times 10^3$ Hz
$\lambda = 3 \times 10^8 / 1 \times 10^3 = 3 \times 10^5$ m = 300,000 m

(d) Draw a neat sketch of a Yagi antenna and show its three (3) important elements.
(Answer requires a diagram; elements are:
- Reflector
- Driven Element
- Director)

16. (a) Mention two (2) types of video tape recorders and state one (1) use of each type.
- VHS recorder: Used for home video recording and playback.
- Betamax recorder: Used in professional video recording and broadcasting.

(b) Make a neat and well labelled sketch of a video tape construction.
(Answer requires a labelled diagram showing parts such as magnetic tape, plastic backing, tape reels, etc.)

(c) Draw a block diagram of a video cassette recorder (VCR) and label all of its parts.
(Answer requires a diagram with blocks such as tuner, RF modulator, head drum, playback amplifier, capstan motor, video output, etc.)

(d) If the emitter terminal of the NPN transistor is blown, what two (2) effects will be noted?
- No current flow in the circuit
- Transistor will fail to amplify signals

(e) Why do you expect if a junction diode at the detector stage of the superhet radio receiver is dead?
The detector will fail to demodulate the signal, resulting in no sound or output signal.

(f) What could be the problem in the superhet radio receiver if the output signal strength is varying either higher or low?
The AGC circuit may be faulty, failing to stabilize the gain of the receiver.

(g) What will happen if the 3.58 MHz crystal is removed in a television circuit?
The color signal will be lost or distorted, leading to black and white picture instead of color.

(h) State two (2) possible causes for a TV to produce a very clear picture with no sound.
- Faulty audio amplifier
- Damaged loudspeaker or open connection in the audio path