WORKFORCE DEVELOPMENT AUTHORITY

P.O. BOX 2707 Kigali, Rwanda Tel: (+250) 255113365

ADVANCED LEVEL NATIONAL EXAMINATIONS, 2016, TECHNICAL AND PROFESSIONAL STUDIES

EXAM TITLE: Telecommunication Systems

OPTION: Electronics and Telecommunication (ETL)

DURATION: 3hours

INSTRUCTIONS:

The paper is composed of **three (3) main Sections** as follows:

Section I: Fifteen (15) compulsory questions.	**55 marks**
Section II: Attempt **any three (3)** out of five questions.	**30 marks**
Section III: Attempt **any one (1)** out of three questions.	**15 marks**

Note:

Every candidate is required to carefully comply with the above instructions. Penalty measures will be applied on their strict consideration.

Section I. Fifteen (15) Compulsory questions   **55marks**

01. Differentiate ultrasonic, sonic and infrasonic sound.   **3marks**

02. What is a transducer device?   **2marks**

03. Give examples of two (2) most popular transducers used in audio field and explain them.
                                                                                     4marks

04. a) Define antenna

b) What does it mean polarization of antenna?   **4marks**

05. Explain the principle of antenna reciprocity.   **3marks**

06. Explain what is a scanning in television system and give the two (2) types of scanning.

                                                                                     5marks

07. Define phase modulation.   **3marks**

08. List out THREE (3) advantages and TWO (2) disadvantages of angle modulation.   **5marks**

09. Find the far-field distance for an antenna with maximum dimension of 1 meter and operating at frequency of 900 MHz.   **3marks**

10. What are the sources of antenna system losses?   **4marks**

11. Differentiate multiplexing to de-multiplexing techniques.   **4marks**

12. What is image frequency?   **2marks**

13. Explain the different techniques of multiplexing systems in telecommunication. **5marks**

14. Identify the frequency band of electromagnetic waves from 3Mhz to 300 Ghz.   **5marks**

15. What are the degrees of modulation?   **3marks**

**Section II. Choose and answer any three (3) questions.**   **30marks**

16. Find the required solutions to the following problems:

A. A transmitter puts out a total power of 25 Watts of 30% AM signal. How much power is contained in the carrier and each of the sidebands?

B. An AM signal has a depth of modulation of 70%. What is the power saving if:
a) The carrier is suppressed and
b) The carrier and one sideband is suppressed?
                                                                                     10marks

17. Write fully and correctly the sentence by filling in the following statements:

1) The main purpose of modulation is to: ....
- combine two waves of different frequencies
- achieve wave-shaping of the carrier wave
- transmit low-frequency information over long distances efficiently.
- produce sidebands.

2) Demodulation is ....
✓ performed at the transmitting station
✓ removes side-bands
✓ rectifies modulated signal
✓ opposite of modulation.

3) When modulation of an AM wave is decreased, ...
- percentage carrier power is decreased
- percentage carrier power is increased
- total transmitted power is increased
- Percentage sideband power is unaffected.

4) In an AM system, full information can be conveyed by transmitting only ......
- the carrier
- the upper sideband
- the lower sideband
- any one sideband.

5) In FM, when frequency deviation is doubled ....
- modulation is doubled
- modulation is halved
- carrier swing is halved
- modulation index is decreased.

10marks

18. Find answers to the following questions:

A. A signal has an rms value of $V_s = 2.4$ V. The rms noise level is $V_n = 7$ nV. Calculate the signal-to-noise ratio.

B. Redraw and indicate the parts labeled on the coaxial cable in figure below.
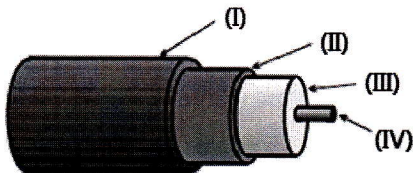

C. For a UHF transmitter operating at 554MHz. Calculate:
  i. the wavelength
  ii. the dipole length

10marks

19. Give answers of the following questions:

A. A half-wave dipole is needed to transmit a 300 MHz broadcast. Determine the electrical length of the dipole.

B. From the figure below, give the other colors created with **red, green,** and **blue light** according to the shown labels (1, 2, 3, and 4).

Additive color mixing
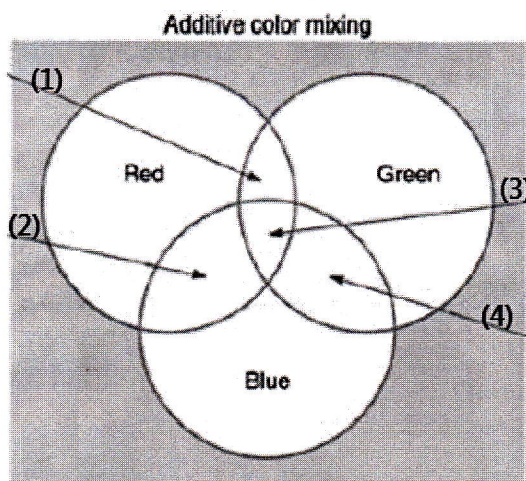
10marks

20. A 3m parabolic reflector is used to receive a 10 GHz signal. If the illumination efficiency of the antenna is 0.55 and the focal length is 0.6 m, determine:

   a) effective area,
   b) directivity,
   c) half-power beam-width,
   d) the beam-width between the nulls, and
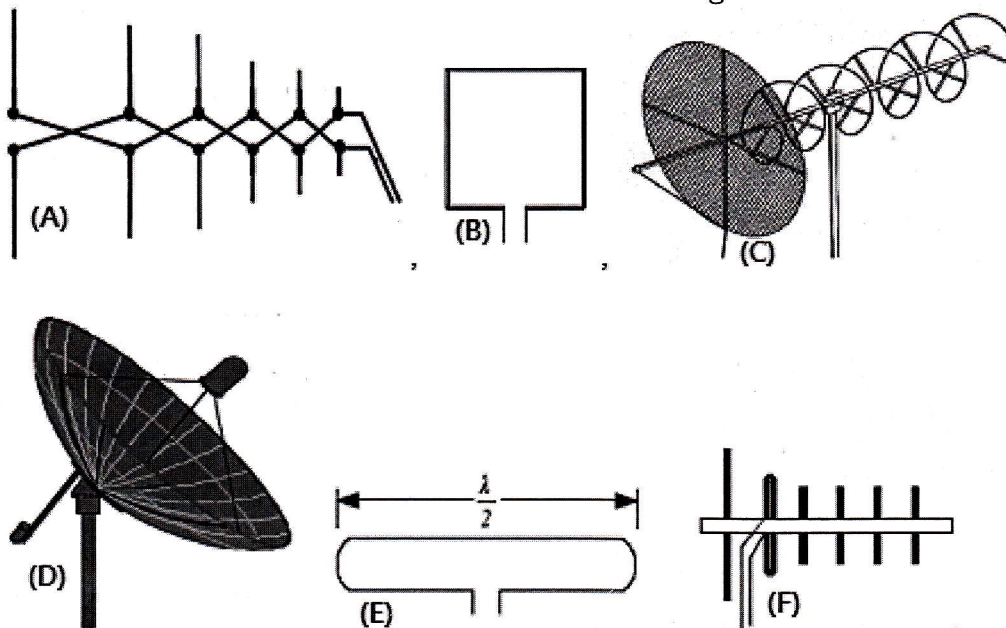   e) the depth of the reflector.

10marks

Section III. Choose and answer any one (1) question.   **15marks**

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21. A. Give the names of different antennas shown in figures below.   **12marks**

B. Define the Kell factor in TV system?   **3marks**

22. Assume that you are required to match a 300 Ω antenna to a 75 Ω feeder line at 2 MHz.

   a) If the L-network is used determine the values of the elements required to provide the match.
   b) If transformer matching is used, determine the turn's ratio of the RF transformer.
   c) If quarter-wave transformer is used, determine the impedance of the quarter-wave line section required to provide the required match.

15marks

23. An AM signal is represented by the equation
   $v = (15 + 3 \sin(2\pi*5*10^3 t)* \sin(2\pi*0.5*10^6 t)$ volts.
   (i) What is the value of the carrier,
   (ii) What is the value of modulating frequency?
   (iii) What is the amplitude of each side frequency?
   (iv) What is the modulation index?
   (v) What is the bandwidth of this signal?

15marks