

**SCHOOL OF ELECTRICAL & ELECTRONICS**  
**ENGINEERING**

**DIPLOMA IN ELECTRONIC & ELECTRICAL ENGINEERING**

**EEE511 – ELECTRONIC COMMUNICATION TECHNOLOGY**

**FINAL EXAMINATION – SEMESTER 2, 2012**

**TIME : 90 MINUTES**

**INSTRUCTIONS TO STUDENTS**

- 1 You are allowed 10 minutes extra reading time during which you are **NOT** to write.
- 2 **BEGIN** each **QUESTION** on a fresh page and use both sides of the sheet.
- 3 Write your candidate number at the top of each attached sheet.
- 4 Insert all written foolscaps, graph paper etc. in their correct sequence and secure with a string.
- 5 For all sheets of paper on which rough/draft work has been done, cross it through and you must attach all of them to your answer scripts.
- 6 Write clearly the number(s) of the question(s) attempted on the top of each sheet.
8. Attempt all questions in **Sections A, B, D** and pick **ANY two (2) QUESTIONS** in **Section C**.

**Section A: Multiple Choice [10 marks]**

*Answer ALL questions by writing down the alphabet besides the question number.*

1. In Microwave Communication system, which of the following frequency is allocated to the Ku Band?
  - (a). 27 – 40 GHz.
  - (b). 18 – 27 GHz.
  - (c). 30 – 50 GHz.
  - (d). 40 – 60 GHz.
  - (e). 12 – 18 GHz.
  
2. Which of the following statement best describes the ISDN Telephone system?
  - (a). Enables two simultaneous calls on the same line;
  - (b). Noisy and distorted;
  - (c). it's an analog system;
  - (d). Internet service is not allowed;
  - (e). used with fiber cable only.
  
3. In Data Communication and Digital telephony, which is the most common protocol in networks whose address consists of a 32 bits combination?
  - (a). IPv6
  - (b). VoIP
  - (c). OSI
  - (d). TCP/IP
  - (e). Frame Relay

4. Which statement does not describe microwave antenna
- (a). have longer wavelength
  - (b). generally used for point to point communication
  - (c). have high gain.
  - (d). highly directive
  - (e). sizes are smaller.
5. Select two most important criteria in achieving an oscillation in a oscillator
- (a). impedance and reactance.
  - (b). unity loop gain and phase shift of  $n \times 360^\circ$ .
  - (c). sensitivity and selectivity.
  - (d). bandwidth and frequency.
  - (e). capacitance and inductor.
6. Which of the following statement best describe a class-A amplifier?
- (a). conducts less than one-half cycle of sine wave.
  - (b). is switched "on" and "off".
  - (c). efficiency is close to 25%.
  - (d). used as audio amplifier
  - (e). conducts more than one-half cycle of sine wave
7. In a microwave system, which of the following statement best described the magnetron tube?
- (a). waveguide filter which tightly controls the frequencies allowed into antenna.
  - (b). amplifying signals picked up by antenna without amplifying noise.
  - (c). signals are sent to the up converters at around 70 MHz.
  - (d). high-power, fixed frequency oscillators, simple and relatively efficient.
  - (e). these units take digital data and modulate it onto a carrier.

8. Which formula describe the image frequency in AM receiver?
- (a).  $f_{\text{carrier}} + f_{\text{signal}}$
  - (b).  $f_{\text{signal}} - 2f_{\text{IF}}$
  - (c).  $f_{\text{local osc}} - f_{\text{signal}}$
  - (d).  $f_{\text{signal}} + 2f_{\text{IF}}$
  - (e). both (b) and (d).
9. Which statement below does not relate to the Optic Fiber cabling system?
- (a). optical receiver to demodulate the light and convert the output back to electrical signal
  - (b). Light sources include LED and LCD
  - (c). single mode optic fiber.
  - (d). circuitry to drive an optical transmitter from this signal.
  - (e). output circuitry to deliver the electrical output to its destination.
10. Identify the two most important things in a good Receiver circuit?
- (a). impedance and reactance.
  - (b). capacitance and inductor.
  - (c). sensitivity and selectivity.
  - (d). bandwidth and frequency.
  - (e). input impedance  $Z_i$ , appears as a parallel resonant circuit

**Section B : True OR False [ 10 marks ]**

*Answer the questions by writing T if it's true and F if it's false, beside the question number in your answer sheet provided.*

1. An oscillator in a circuit is capable of converting energy from DC to AC.
2. In Optical Fiber communication, multi mode cable is used for long distance connection.
3. Generating AM frequencies above 100MHz is expensive since available transistors and ICs are costly.
4. De-emphasis involves increasing the relative strength of the high frequency components of the audio signal to offset the noise interference.
5. In FSS, Fixed satellite system, the downlink frequency bands are 3.7 – 4.2 GHz
6. The “free running frequency” of a VCO in a PLL operates when its control voltage is zero.
7. Amplitude Modulation is generated by combining the carrier and intelligence frequencies through a linear device.
8. Sensitivity of the receiver determines the frequency to resonate while rejecting those on closely adjacent frequencies.
9. A geostationary satellite revolves around the earth at a constant speed once every 24hrs over the equator,

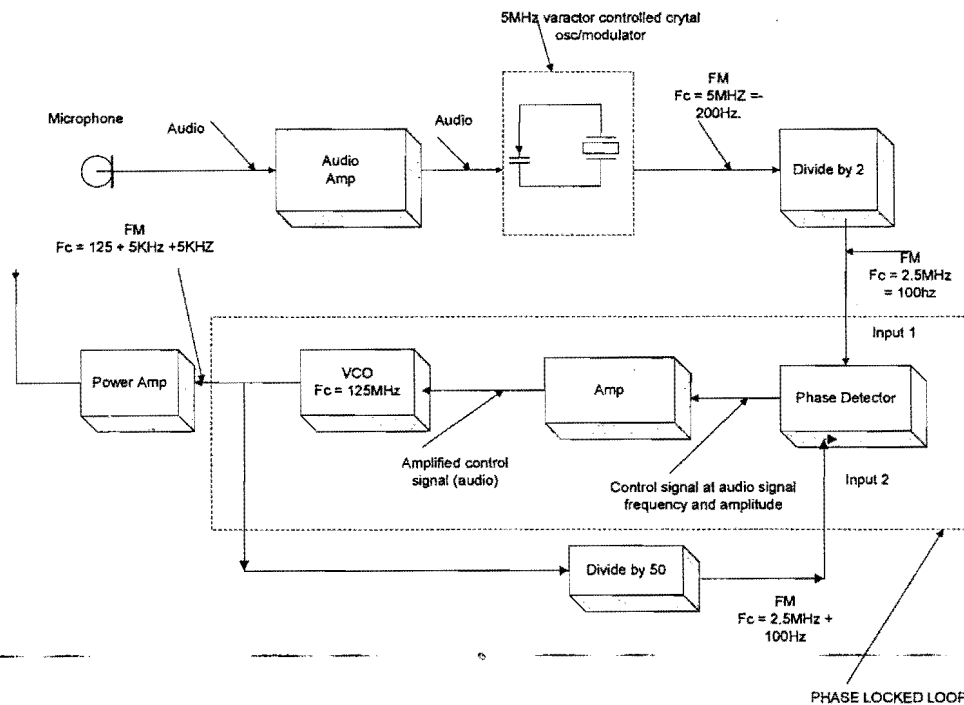
10. Fiber is not an electric conductor, so it can be used safely in the vicinity of high voltage equipment.

**Section C: Optional Explanation & Calculation. [40 marks]**

In this section, answer **ONLY 2 questions out of the 5** given and write your answers in the answer sheet provided.

**Question 1: PLL & Satellite Communication System**

- (a) Explain the operation of the Phase Locked Loop (PLL) FM transmitter shown in the figure below and in particular the capture range, lock range and the free running frequency. **[10 marks]**



- (b) Two satellites are orbiting above the earth; one at 500Km and the other at 36,000Km;

Determine the following:

- i) circumference of the orbit,
- ii) the velocity
- iii) and the orbital period

**[ 7 marks]**

- (c) Make a sketch of the earth and the orbit of a geosynchronous satellite and comment on the velocity. [3 marks]

[Total 20 Marks]

**Question 2: Oscillator & Modulation System**

- a) What are the 4 conditions that are necessary to begin and sustain the operation of an oscillator? [4 marks]
- b) Draw a schematic diagram for a Clap Oscillator and explain the reason it has better frequency stability than the Hartley and Colpitts oscillator. [4 marks]
- c) Derive the frequency of oscillation " $f$ " for Clap Oscillator. (Make assumptions on the capacitance value for ease of calculation) [2marks]
- d) With the aid of block diagrams, discuss the terms "low level modulation" and "high level modulation" in relation to AM transmitter. [6 marks]
- (e) Discuss the following terms in relation to transmitter:
- i) Parasitic oscillation [2 marks]
  - ii) Neutralization [2 marks]

[Total 20 marks]



**Question 3: Receiver & Transmitter System**

- (a) Identify 3 basic functions of a Transmitter. **[3 marks]**
- (b) Draw a diagram of a tuned radio-frequency (TRF) radio receiver and briefly explain its operation **[7 marks]**
- (c) A TRF receiver is to be tuned over the range 550 to 1550KH with a  $25\mu\text{H}$  inductor. Calculate the required capacitance range. Determine the tuned circuit's necessary Q if a 10 KHz bandwidth is desired at 1000 KHz. Also calculate the receiver's selectivity at 550 and 1550 KHz. **[10 marks]**

**[Total 20 marks]**

#### Question 4: Microwave & Optical Fiber Communication System

(a) A horn antenna operates a frequency of 12 GHz. Its aperture is 70mm in the E-plane and 120mm in the H-plane.

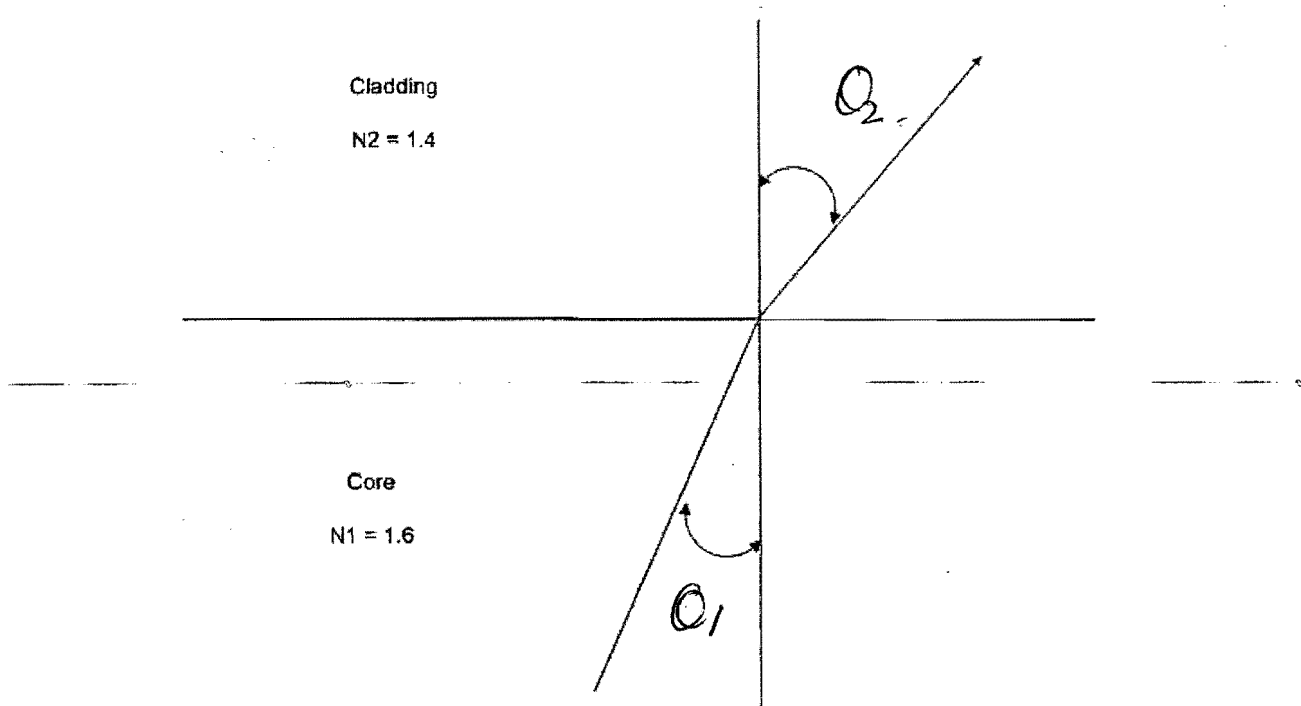
Calculate the following:

- i) Gain in dB
- ii) Beamwidth in degree in each plane. [5 marks]

(b) Horn is one method of feeding the microwave dish, can you identify three types of horn antenna and very briefly described their characteristics.

[5 marks]

(c) A fiber has an index of refraction of 1.6 for the core and 1.4 for the cladding.



**Calculate the following:**

- i) The critical angle
- ii)  $\Theta_2$  for  $\Theta_1 = 30^\circ$
- iii)  $\Theta_2$  for  $\Theta_1 = 70^\circ$  Comment on the results. **[10 marks]**

**[Total 20 Marks]**

**Question 5: DIGITAL TELEPHONE & DATA NETWORK AND EVOLUTION OF ANALOG TELEPHONE NETWORK.**

- a) What is a packet switching network? What are the advantages and disadvantages as compared to leased line and circuit switching **[5marks]**
- b) What is a protocol and explain the reason why they are necessary in data communication. **[5 marks]**
- c) List the seven levels of open system international (OSI) protocol model and explain the meaning of the lowest three levels. **[5 marks]**
- d) The E1 link is the most commonly used format with the E carrier system. Explain how a 2.048Mbps is derived from the intelligence of voice signal and draw a diagram of an E1 frame format. **[ 5marks]**

**[Total 20 Marks]**

**Section D: Compulsory Section – Application & Calculation [40 marks]**

*Answer ALL questions in this section and write your answers in the answer sheet provided. Show ALL your working to justify maximum marks.*

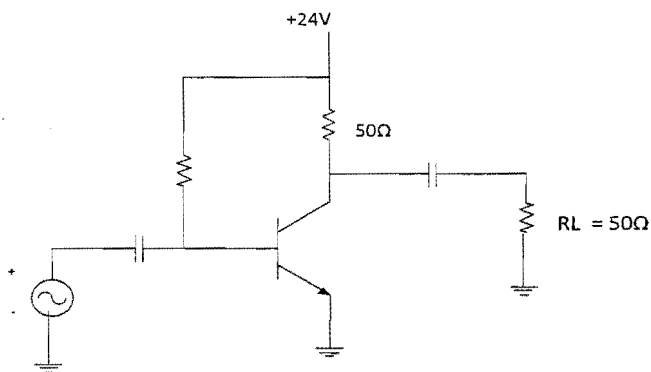
**Question 1: Tuned Power Amplifier System**

a) What 2 criteria a Power Amplifiers must have to do its operation effectively and efficiently? [4marks]

b). A class-C amplifier shown below is biased at  $V_{CE} = 12V$ . The output voltage is the maximum possible without distortion.

Determine the following:-

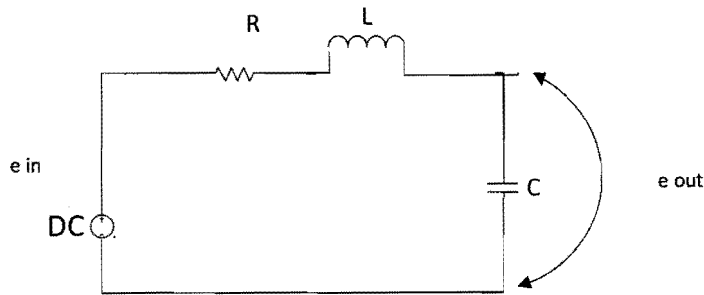
- i). The average power from the dc supply;
- ii). The average power delivered to the load;
- iii). The efficiency; and
- iv). The collector efficiency. [4 marks each]



**[Total 20 Marks]**

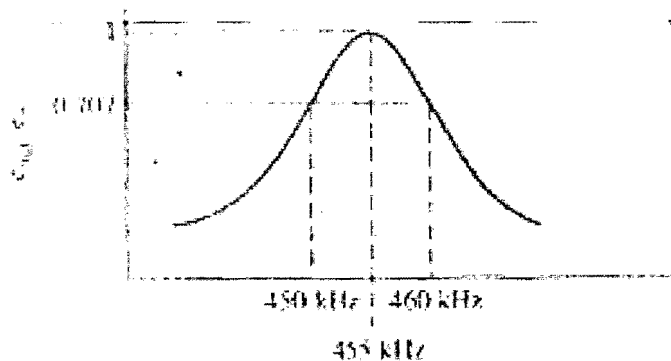
**Question 2: Small Signal Amplifier System and Filters**

- a) Define the term “resonance” with regards to a series RLC circuit shown below. Pay particular emphasis on its use and effects and determine the resonant frequency ‘f’. **[4 marks]**



Series RLC Circuit

- b) Calculate the resonance frequency given that the value of capacitance is  $2.7_{\text{pF}}$  and  $33_{\text{nH}}$  inductor. **[4 marks]**
- c) Draw a vector diagram of the voltage and current across the capacitor and inductor of a series resonance circuit. **[2 marks]**
- d) An LC bandpass filter circuit has a frequency response as shown below.



Determine the following:

- i) The bandwidth
  - ii) The Q factor
  - iii) The value of inductance if  $C = 0.001\mu\text{F}$       **[6 marks]**
- e) Draw a simple Low Pass and High Pass RC filter and sketch their frequency responses.      **[4 marks]**

**[Total 20 marks]**

-----**THE END**-----

## Appendix 1

### Formulas

1. Snell's Law:  $n_1 \sin \theta_1 = n_2 \sin \theta_2$

2. Gain =  $7.5 d_e d_H / \lambda^2$

3.  $\Theta_H = 70 \lambda / d_H$

4.  $\Theta_E = 56 \lambda / d_E$

5. Velocity of Light =  $300 \times 10^6$  m/s

6. Radius of earth = 6400Km

7. Velocity of satellite orbiting the earth =  $\sqrt{\frac{4 \times 10^{11}}{d + 6400 \text{Km}}}$