FNU FIJI NATIONAL UNIVERSITY
College of Engineering, Science & Technology

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

DIPLOMA IN ELECTRONIC & ELECTRICAL ENGINEERING

EEE511 – ELECTRONIC COMMUNICATION TECHNOLOGY

FINAL EXAMINATION – SEMESTER 2, 2013

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 band is allocated to the Ka Band?

     (a).   27 – 40 GHz.
     (b).   18 – 27 GHz.
     (c).   30 – 50 GHz.
     (d).   40 – 60 GHz.
     (e).   12 – 18 GHz.

2.   Which one of the following statement best describes Digital Subscriber Line (DSL) technology?

     (a).   Noisy and distorted;
     (b).   bring high bandwidth information to homes;
     (c).   it's an analog system;
     (d).   Internet service is not allowed;
     (e).   used with twisted pairs 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).   X25
     (b).   TCP/IP
     (c).   OSI
     (d).   xDSL
     (e).   Frame Relay

4.   Which statement does not describe microwave antenna

     (a).   generally used for point to multipoint communication
     (b).   have short wavelength
     (c).   have high gain.
     (d).   highly directive
     (e).   sizes are smaller.

5.   Select two most important elements in achieving resonance in a tuned circuit

(a). impedance and resistance
(b). unity loop gain and phase shift of n x 360^0.
(c). sensitivity and selectivity.
(d). bandwidth and frequency.
(e). capacitor and inductor.

6. Which of the following statement best describe a class-A transformer coupled amplifier?
     (a). conducts less than one-half cycle of sine wave.
     (b). is switched "on" and "off".
     (c). maximum efficiency is close to 50%.
     (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 formulae describe the bandwidth of an AM receiver?
     (a). $f_{carrier} + f_{signal}$
     (b). $f_{signal} - 2f_{IF}$
     (c). $f_{carrier} - f_{signal}$
     (d). $f_{signal} + 2f_{IF}$
     (e). both (a) and (c).

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 criteria in a good receiver circuit?

    (a). impedance and reactance.
    (b). capacitance and inductor.
    (c). sensitivity and selectivity.
    (d). bandwidth and frequency.
    (e). oscillation and strays

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. In a microwave system, a magnetron operates as an amplifier.

2. In Fiber Optic technology, the intelligence is impressed on the light by varying the lights amplitude.

3. When higher gain and directivity is desirable in microwave system, it can be easiy obtained by using a horn in conjunction with a parabolic reflector.

4. One of the requirements for an oscillator is to have a loop gain equals to unity.

5. The satellite uplinks of the Ku band are from 11.7 to 12.2 GHz and the downward links are in the 14 to 14.5GHz range.

6. The filtered output of a PLL adjusts the VCO frequency in an attempt to correct for the original frequency or phase difference.

7. Amplitude Modulation is generated by combining the carrier and intelligence frequencies through a non linear device.

8. Internet service is classified as circuit switching.

9. A geostationary satellite is about 3,000Km above the earth.

10. Tuned circuits are frequency-selective, they respond best at their resonant frequency.

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)   Draw and label a simple block diagram of a Phase Lock Loop (PLL) system and briefly explain the function of each block.

[6 marks]

(b)   What is your understanding on the terms listed below in relation to PLL. Illustrate your answer with the use of a diagram.
i) Capture range
ii) Lock Range   **[4 marks]**

(c)   Explain in your own words the following terms as relate to satellite communication system?

i)   GPS
ii) Geosynchronous Orbit   **[6 marks]**

(d)   Draw a block diagram of a basic satellite transponder and explain the function of each block?   **[4 marks]**

[Total 20 Marks]

Question 2:   **Oscillator & Modulation System**

a) Amplitude Modulation is generated by combining the carrier and the intelligence frequencies through a non-linear device. Draw and describe the operation of a PIN diode modulator that is used in communication systems.   **[6 marks]**

b) Describe the operation of an oscillator circuit and the conditions to begin oscillation and sustaining it. **[4 marks]**

c) With the aid of block diagrams, discuss the terms "low level modulation" and "high level modulation" in relation to AM transmitter. **[6 marks]**

(d) Refer to the figure below and answer the following:
i) Name the type of oscillator
ii) Determine the resonance frequency given C1 = 0.01μF, C2 = 0.002μF and L = 100mH **[4 marks]**
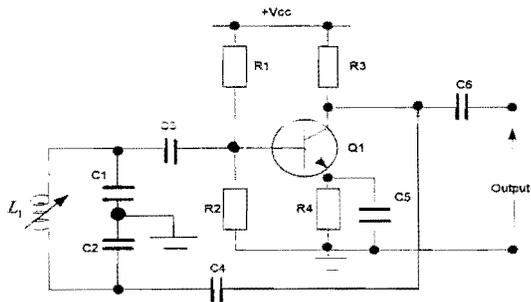
[Total 20 marks]

Question 3:   **Receiver & Transmitter System**

(a)   List the 3 basic functions of a Transmitter.

                                                                        [3 marks]

(b)   With the aid of a block diagram draw, label and explain the
             operation of an AM transmitter.

                                                                        [7 marks]

(c)   In your own words, explain the terms selectivity and sensitivity in
             relation to communication receivers   **[4 marks]**

(d)   The figure below is a selectivity curve of a tuned LC circuit. If we
             assume L of 20µH with a resistance of 30Ω is connected in parallel
             with a 100pF capacitor, calculate the following:

             i) the resonance frequency
             ii) The Q of the circuit
             iii)the Bandwidth of the circuit   **[6 marks]**
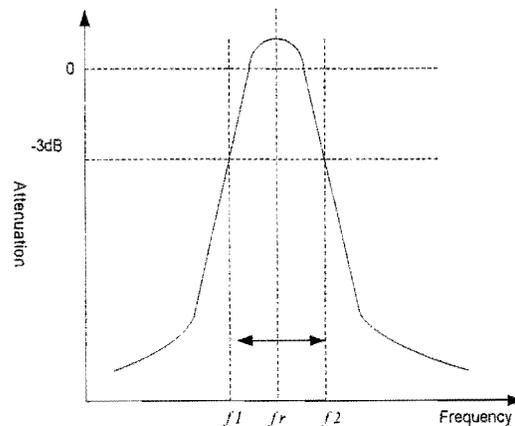
                                                                [Total 20 marks]

Question 4: Microwave & Optical Fiber Communication System

a) A parabolic reflector antenna has a diameter of 6meters. The frequency of operation is 20GHz.

     Calculate the following:
       i)   Gain in dB
       ii)   Beam width   **[5 marks]**

(b)   If power transistors are limited to say an upper limit of 100Watts, explain what devices can be used to amplify the power rating in the order of thousands of watts of microwave power?.

                                                        [5 marks]

c) i).   Draw and label a block diagram of a fiber-optic communication system and explain the function of each block.   **[5marks]**
     ii).   Explain the terms "Attenuation" and "Dispersion" as used in optical fiber communications   **[5 marks]**

                                                       [Total 20 Marks]

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

a) Discuss the differences between Packet switching and Circuit switching and give examples?   **[8marks]**

b) What is your understanding on Digital Subscriber Line (DSL) technology and explain how it works.   **[8 marks]**

c) What is VoIP and discuss its application.   **[4 marks]**

                                                       [Total 20 Marks]

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

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).Large signal power amplifiers must operate efficiently and be capable of handling large amount of power – typically a few watts to hundreds of watts.

Identify 3 features that are of greatest concern for the amplifier to be able to produce what is required of it?   **[4 marks]**

  b). Refer to the transformer-coupled audio power amplifier shown in the figures below.
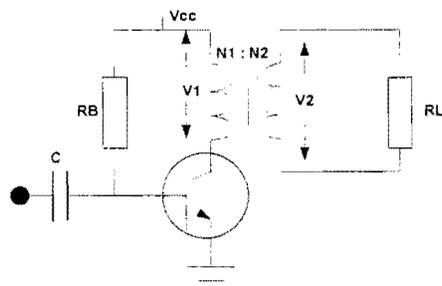

Transformer Coupled Audio Power Amp.
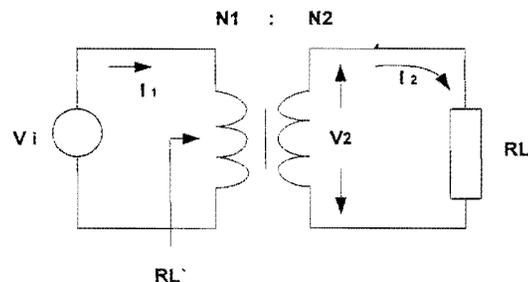
Determine the following:-

  i).The effective resistance RL´ seen looking into the primary of the transformer
  ii).From i) above, calculate the value of resistance looking into the primary of a 15: 1 transformer connected to an 8Ω load.
  iii).What transformer ratio is required to match a 16Ω speaker load so that the effective load resistance seen at the primary is 10KΩ?
  iv).The maximum efficiency.   **[4 marks each]**

                                 [Total 20 Marks]

Question 2:   Small Signal Amplifier System and Filters
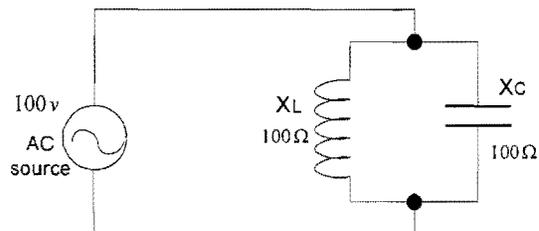
a) Define the term "resonance" with regards to the parallel LC circuit shown above and determine the resonant frequency 'f_r'. **[4 marks]**

b) Calculate the resonance frequency given that the value of capacitance is 2.7_{pF} and 33_{nH} inductor.   **[4 marks]**

c) Draw a vector diagram of the current relationships of the parallel resonance circuit.   **[4 marks]**

d) Draw a simple Low Pass and High Pass RC filter and sketch their frequency responses.   **[8 marks]**

[Total 20 marks

-------------THE END -------------

Appendix 1

Formulas

1. Snell's Law: $\quad n1 \sin\theta_1 = n2 \sin\theta_2$

2. Gain $(G) = 6(D/\lambda)^2$
3. Beam width $= 70/D/\lambda$
4. Velocity of Light $= 300 \times 10^6$ m/s
5. $V_1/V_2 = N_1/N_2$
6. $I_2/I_1 = N_1/N_2$
7. $RL'/RL = (N_1/N_2)^2$
8. $Q = X_L/R$
9. $BW = F_r/Q$