

FIJI NATIONAL UNIVERSITY

College of Engineering, Science & Technology

**SCHOOL OF ELECTRICAL & ELECTRONICS
ENGINEERING**

DIPLOMA IN ELECTRONIC & ELECTRICAL ENGINEERING

EEE559 – ELECTRONIC COMMUNICATION TECHNOLOGY

FINAL EXAMINATION – TRIMESTER 3, 2015

DURATION : 3 HOURS

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:**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. The microwave frequency for the Ka band is from 27 to 40 GHz
2. One of the application of Phase Locked Loop (PLL) circuit is Frequency Synthesizer
3. Amplitude Modulation is generated by combining the carrier and intelligence frequencies through a linear device.
4. Internet service is classified as circuit switching.
5. A geostationary satellite is about 30,000Km above the earth.
6. A tuned amplifier has a tuned or resonance circuit that passes only a relatively narrow band of frequencies.
7. Vacuum tubes are still found in microwave transmitters used for producing high output power.
8. In Fiber Optic technology, optical signals are produced by LED or LCD for transmission.
9. When higher gain and directivity is desirable in microwave system, it can be easily obtained by using a horn antenna.
10. One of the requirements for an oscillator to oscillate is to have a loop gain much more than unity.

SECTION B – SHORT ANSWERS

[30 Marks]

1.	TWT (Travelling Wave Tubes) is a versatile RF power amplifier used in microwave. In your own words, explain its function.	
2.	What is an "oscillator circuit" and list the two conditions an oscillator circuit must adhere to?	
3.	Explain the physical structure of an Optical Fiber cable?	
4.	What is a waveguide and explain where and how they are used in Communication?	
5.	Explain the function and advantages of the "GUNN Oscillator" as used in Microwave frequency band?	
6.	What is your understanding about a "Transmitter" in a Communication system and list the 3 basic functions of a transmitter?	
7.	Give two (2) reasons why the RF stage of a receiver has less amplifications than the IF stage.	
8.	Discuss VSAT and MSAT systems as used in Satellite Communications.	
9.	What are the two fields of an electromagnetic wave and how are they created?	
10.	Discuss the difference between Frequency modulation and Amplitude modulation.	
11.	In your own words, explain the use of Filter circuits?	
12.	Explain the term "Resonance" in Small Tuned Amplifiers, condition at resonance and the reasons they are so important?	
13.	What is your understanding on "Package Switching" in Data Communication?	
14.	Give reasons why "vacuum tubes" are used in microwave equipment.	
15.	What is a "Transponder" in regards to Satellite Communications?	

Section C: Optional Explanation & Calculation. [30 marks]

In this section, answer **ONLY 2 questions out of the 4** given and write your answers in the answer sheet provided.

Question 1: PLL & Satellite Communication System

- (a) i) Draw and label a simple block diagram of a Phase Lock Loop (PLL) system and briefly explain its operation. **[4 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 **[4 marks]**
- (d) Draw a block diagram of a basic satellite transponder and explain the function of each block? **[3 marks]**

(Total 15 Marks)

Question 2:

Receiver & Transmitter System

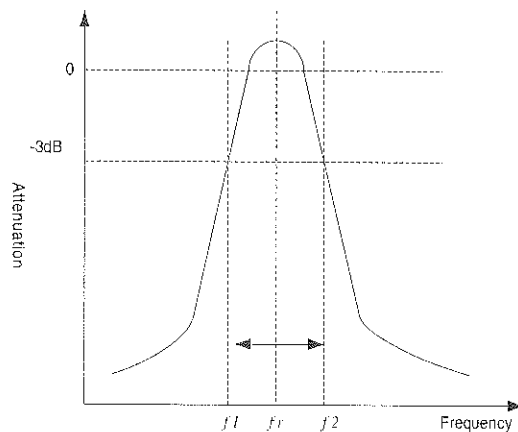
- (a) With the aid of a block diagram draw, label and explain the operation of a Super-heterodyne Receiver and the reasons why they are used commercially as compared to other receivers?

[5 marks]

- (b) The figure below is a selectivity curve of a tuned LC circuit. If we assume L of $20\mu\text{H}$ 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

[5 marks]



- (c) Describe the process of Pre-emphasis and how the circuit affects the communication process in FM. Also explain the frequency response of pre-emphasis circuit.

[5 marks]

[Total 15 marks]

Question 3: Microwave & Oscillators

- 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

[4 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?

[3 marks]

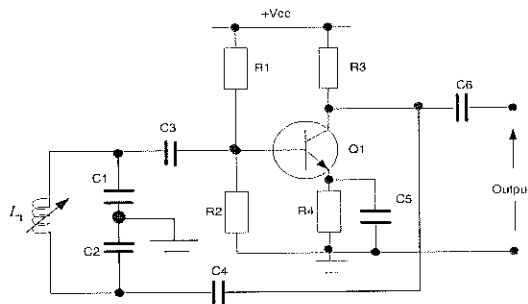
- c) Describe the operation of an oscillator circuit and the conditions to begin oscillation and sustaining it.

[4 marks]

- (d) Refer to the figure below and answer the following:

- i) Name the type of oscillator
- ii) Determine the resonance frequency given $C1 = 0.01\mu\text{F}$, $C2 = 0.002\mu\text{F}$ and $L = 100\text{mH}$

[4 marks]



(Total 15 marks)

Question 4: DIGITAL TELEPHONE & DATA NETWORK

- a) Discuss the differences between Packet switching and Circuit switching and give examples? [5marks]

- b) What is your understanding on Digital Subscriber Line (DSL) technology and explain how it works. [5 marks]

- c) What is VoIP and discuss its application. [5 marks]

[Total 15 Marks]

Section D: Compulsory Section

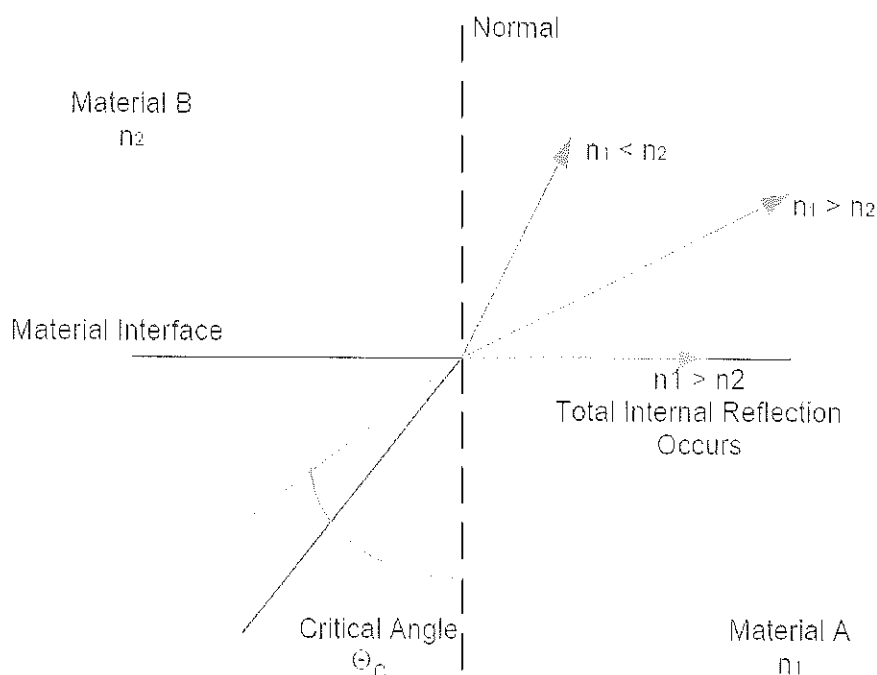
[30marks]

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: FIBER OPTICS SYSTEMS

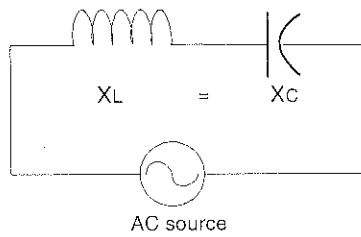
- a) Consider a ray of light passing between two media of different refractive indexes n_1 and n_2 as shown in the figure below. In your own words explain how the light rays behave on the conditions given below (ie when $n_1 > n_2$; $n_1 < n_2$; at critical angle etc)

[4 marks]



- b) Draw and label a block diagram of a fiber-optic communication system and explain the function of each block. **[7 marks]**
- c) Explain the terms "Attenuation" and "Dispersion" as used in optical fiber communications **[4 marks]**

Question 2: Small Signal Tuned Amplifier and Filters



- a) Define the term "resonance" with regards to the series LC circuit shown above and calculate the resonance frequency. **[4 marks]**
- b) Calculate the resonance frequency given that the value of capacitor is $2.7\mu\text{F}$ and inductor 33nH . **[2 marks]**
- c) Draw a vector diagram of the voltage and current through the series resonance circuit? **[2 marks]**
- d) What is the purpose of filters? **[3 marks]**
- e) Draw a circuit of a simple High Pass RC filter, sketch and discuss its frequency responses. **[4 marks]**

(Total 15 marks)

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

Appendix 1

Formulas

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

2. Gain (G) = $6(D/\lambda)^2$

3. Beam width = $70/D/\lambda$

4. Velocity of Light = 300×10^6 m/s

5. $Q = X_L/R$

6. $BW = F_r/Q$
