



**FIJI NATIONAL UNIVERSITY**

College of Engineering, Science & Technology

**SCHOOL OF ELECTRICAL & ELECTRONICS  
ENGINEERING**

**DIPLOMA IN ELECTRONIC & ELECTRICAL ENGINEERING**

**EEE559 – ELECTRONIC COMMUNICATION SYSTEM TECHNOLOGY**

**FINAL EXAMINATION – Trimester 2, 2016**

**DURATION: 3 HOURS**

**INSTRUCTIONS TO STUDENTS**

- 1 You are allowed 10 minutes 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** and **ANY four (4) from the six (6) 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. Negative feedback is required to sustain oscillation.
2. Attenuation and dispersion are the two critical characteristics that determine the maximum distance an optical signal can be transmitted before the receiver is unable to detect it.
3. Microwave signals, like light waves, travel in perfectly straight lines. Therefore, communication distance is limited to line-of-sight range.
4. One of the requirements for an oscillator is to have a phase shift between input and output of  $0^\circ$  and multiples of  $180^\circ$ .
5. A transponder is an electronic system on the satellite that receives the signal from earth, amplifies it, translates the frequency, amplifies it again before transmitting the signal back to earth
6. The PLL free running frequency is determined by its internal frequency determining components.
7. The two most widely used light sources for fiber optic communication systems are the light-emitting diode (LED) and the semiconductor laser, sometimes called a laser diode (LD).
8. Internet service is classified as packet switching.
9. A geostationary satellite is about 36,000Km above the equator.
10. At resonance  $X_C = X_L$ ; in this condition the circuit is inductive.

## SECTION B – SHORT ANSWERS

(2 Marks Each) [Total: 30 Marks]

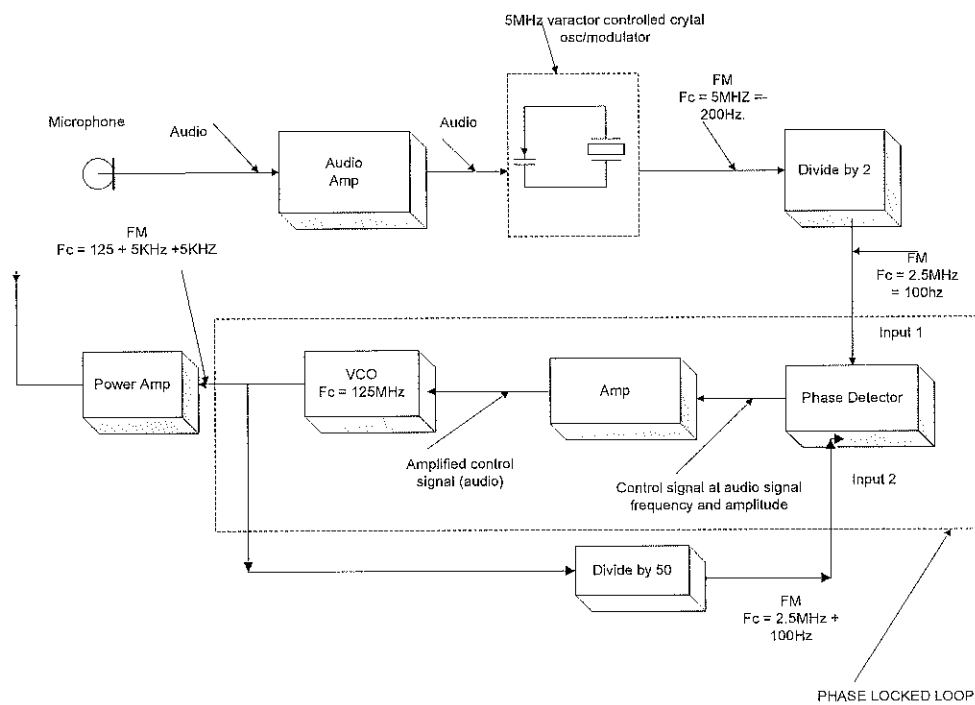
1.	Travelling Wave Tube (TWT) is a type of Microwave tube. In your own words explain its characteristics and application?	
2.	What is the purpose of an "oscillator circuit" and the reasons why an oscillator needs an amplifier and feedback loop in order to sustain oscillation?	
3.	What is your understanding about "optical-Fiber" technology and explain its physical structure?	
4.	What are waveguides and explain their structures and application in Communication?	
5.	What is the basic difference between a single mode fiber and a multi-mode fiber?	
6.	What is your understanding about a "Transmitter" in a Communication system and list the 3 basic functions of a transmitter?	
7.	What are the two most common optical sources that are used in Fiber communication technology?	
8.	Explain the reasons why highly directive antennas are used in microwave frequencies?	
9.	What are "vacuum tubes" and explain their use in microwave frequency band?	
10.	Discuss the term "modulation" and the reason why modulation is required in Radio Communication.	
11.	What are "Filter Circuits" designed to do?	
12.	Explain the term "Resonance" in Small Tuned Amplifiers, condition at resonance and the reasons they are so important?	
13.	In satellite communication, what does the term "geosynchronous orbit" mean?	
14.	Explain what is packet switching?	
15.	Explain 2 major differences between GEO and LEO in Satellite Communication?	

## Section C: Explanation & Calculation. [60 marks]

In this section, answer **ONLY 4 questions out of the 6** 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. [4 marks]
- (b) Let us assume that the "divide by 50" in the PLL is Channel 1, "divide by 51" as Channel 2 and "divide by 52" as Channel 3, determine the VCO frequencies and hence the frequencies of Channels 2 and 3? [4 marks]
- (c) With the aid of diagram, explain the terms capture range and lock range of the PLL. [3 marks]



- (c) Apply your troubleshooting skills in relation to satellite communication system as follows; a Sky Pacific TV receiver shows vertical bands of dots moving on the screen. Determine the following:

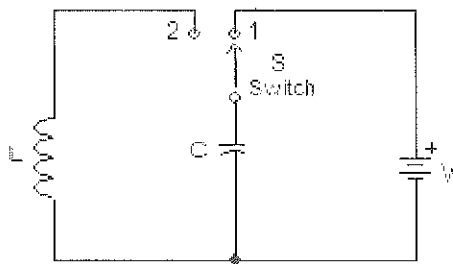
i) The type of interference causing the problem?

- ii) How will you check to determine what is bringing this interference on the TV screen? **[4 marks]**

**(Total: 15 Marks)**

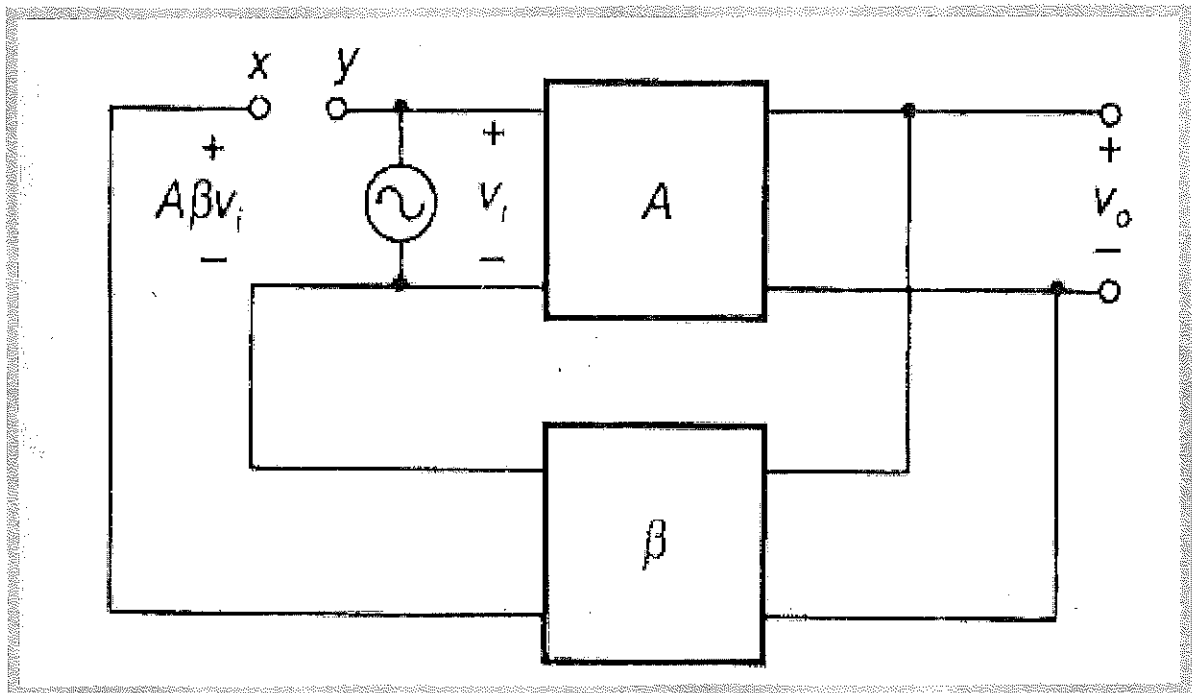
**Question 2: Oscillator**

- a) For LC Oscillators, the frequency of oscillation depends upon the component of tank circuit. Explain the operation of the tank circuit as shown below. **[6 marks]**



LC tank circuit

- b) What are the criteria for oscillation as stated by the Barkhausen criteria **[4 marks]**
- c) What kind of feedback is required to sustain oscillation? **[2 marks]**
- d) Consider the diagram below. By connecting point x to y, feedback voltage drives the amplifier.



The gain with feedback is given as:

$$A_f = \frac{A}{1 - A\beta}$$

Explain what happens to the output when  $AB > 1$ ,  $AB < 1$ , and  $AB = 1$ .

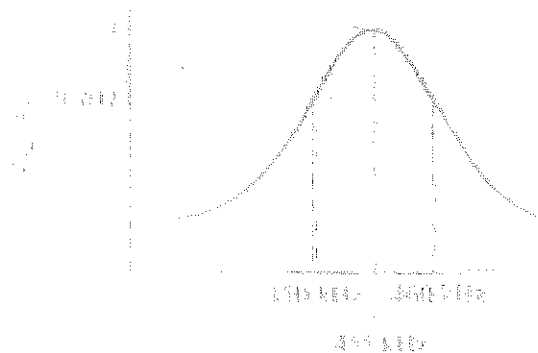
[3 marks]

(Total 15 marks)

**Question 3: Filters & Small Signal Amplifiers.**

- a) A tuned circuit at resonance is when  $X_L$  equals  $X_C$ . Explain what happens to the capacitive reactance ( $X_C$ ) as the frequency decreases and increases from the resonance frequency. [2 marks]

- b) With the aid of a diagram of "reactance versus frequency", explain resonance including the response as frequency changes above and below resonance? **[2 marks]**
- c) At resonance  $X_L = X_C$ ,  
Simplify and deduce the frequency at resonance  $f_R$  **[2 marks]**
- d) Draw a simple low pass RC filter and explain how it passes low frequencies only and not high frequencies. **[3 marks]**
- e) Draw a simple high pass RC filter and explain how it can pass high frequencies only and attenuate low frequencies. **[3 marks]**
- f) An LC band pass filter circuit has a frequency response shown below.



Determine the following:

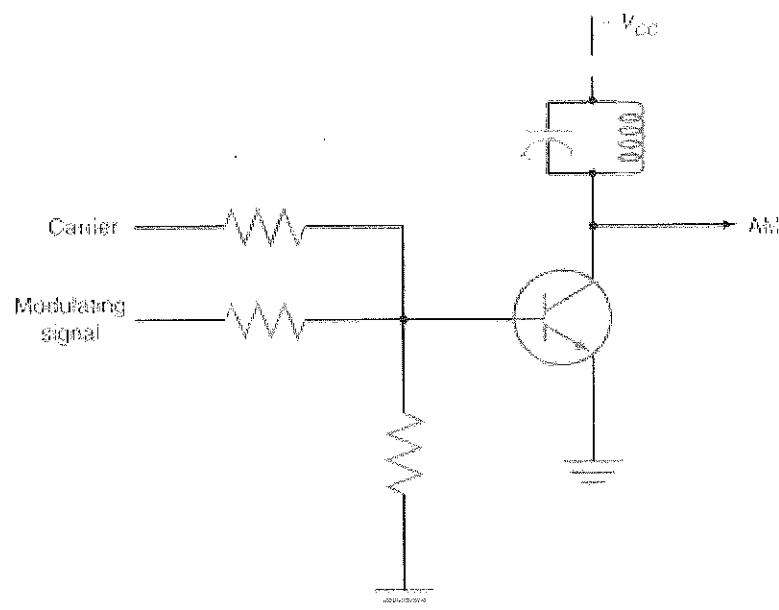
- i) The bandwidth
- ii) The Q factor
- iii) The value of inductance if  $C = 0.005\mu\text{F}$  **[3 marks]**

**(Total 15 marks)**

**Question 4:**

**Transmitter & Receiver System**

- a) An AM transmitter can be divided into two (2) major sections according to the frequencies at which they operate, name the 2 two sections. **[2 marks]**
- b) Shown below is a simple Low Level AM transistor modulator circuit. In your own words explain how AM can be generated from this circuit?



Simple transistor modulator.

**[4 marks]**

- c) Explain the following terms in relation to communication receivers: fidelity, double spotting, bandwidth and selectivity. **[4 marks]**
- d) Super-heterodyne Receiver was designed to overcome the problem in TRF (Tuned Radio Frequency).

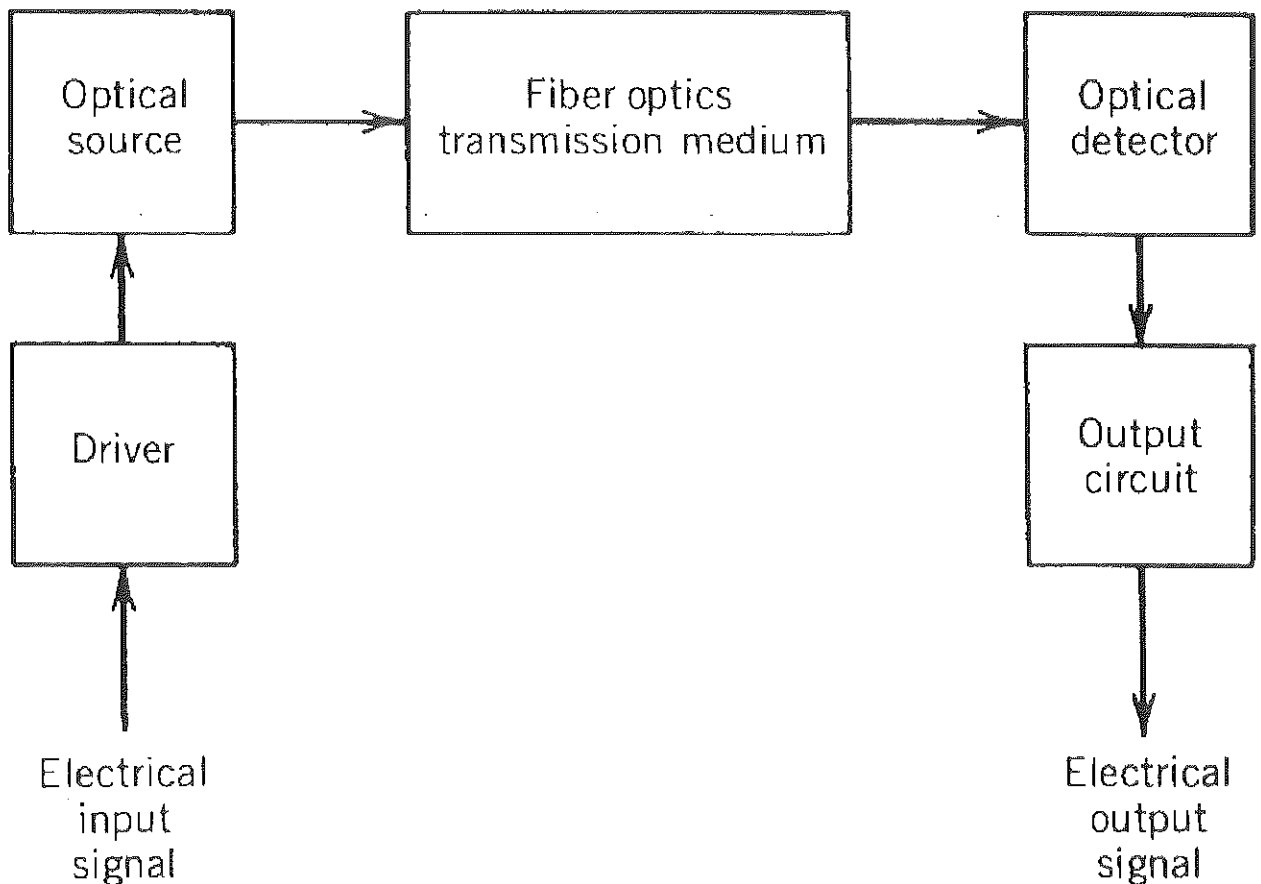
Explain the functions of the following circuits in the super-heterodyne receiver: RF Stage; Mixer & Local oscillator; IF; Detector Stage and AF Stage. **[5 marks]**

**(Total 15 marks)**



**Question 5: Optical Fiber Communication System & Microwave Technique.**

a) The figure below shows a model of a typical fiber optic communication link.



- i) Describe the concept and operation of the optical fiber communication system shown above. **[4 marks]**
- ii) Discuss the two basic impairments that limit the length of such a link without resorting to repeaters or that can limit the distance between repeaters. **[3 marks]**

iii) List down 6 advantages of Optical Fiber cable as compared to copper wire. **[3 marks]**

b)

i) One of the most widely used microwave tubes is the Magnetron. List down two (2) properties of the magnetron that makes it versatile and list one typical everyday application. **[3 marks]**

ii) List the three (3) basic forms of horn antennas and explain how they can be used to radiate electromagnetic waves **[2 marks]**

**(Total 15 Marks)**

**Question 6: DIGITAL TELEPHONE & DATA NETWORK.**

a) Discuss how Circuit switching differs from packet switching? **[3 marks]**

b)

i) What does the acronym OSI stand for and explain why this model is used for? **[3.5 marks]**

ii) Name the seven layers of the OSI model? **[3.5 marks]**

iii) At which layer of the OSI model is the path decision made based upon an IP address? **[2 marks]**

c) Explain the difference between the ADSL and ISDN technologies? **[3 marks]**

**(Total 15 Marks)**

-----**The End**-----