



**SCHOOL OF ELECTRICAL & ELECTRONICS  
ENGINEERING**

**DIPLOMA IN ELECTRONIC & ELECTRICAL ENGINEERING**

**EEE511 – ELECTRONIC COMMUNICATION SYSTEM TECHNOLOGY**

**FINAL EXAMINATION – Semester 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 **Question 1 and 3 others 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. Attenuation and diversion are the two critical characteristics that determine the maximum distance an optical signal can be transmitted before the receiver is unable to detect it.
2. At microwave frequencies, noise is high, so receivers require the highest possible input power to get a high SNR.
3. One of the requirements for an oscillator is to have a phase shift between input and output of  $0^{\circ}$  and multiples of  $360^{\circ}$ .
4. In satellite communication, the uplink frequency is always lower than the downlink frequency.
5. The PLL lock range and PLL capture range are centered around the VCO free running frequency.
6. 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).
7. Internet service is classified as packet switching.
8. Geostationary satellites are about 360,000Km above the equator.
9. Positive feedback is required to sustain oscillation.
10. Below the frequency of resonance; the circuit is capacitive.

SECTION B – SHORT ANSWERS

(2 Marks Each)

[Total: 30 Marks]

1.	Explain what is circuit switching?	
2.	What are the criteria for oscillation sometimes known as the Barkhausen criteria?	
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 main reason for multiplexing in communication?	
6.	What is your understanding about a "Transmitter" in a Communication system and list the 3 basic functions of a transmitter?	
7.	What is your understanding on the term "Frequency Division Multiplexing" (FDM) as used in Communication systems?	
8.	What does the term "Retrograde" mean in relation to satellite orbits?	
9.	What are the two main differences between a Microwave antenna to a half wave dipole?	
10	After building a Colpitts oscillator on the bread board, you found out that the output is damped. What is the most likely problem?	
11	What is a "semi-duplex" type communication and give an example?	
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	What are vacuum tubes as used in the microwave region?	
15	What is a Low Earth Orbit (LEO) Satellite?	

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

In this section, answer **question No 1 and 3 others** and write your answers in the answer sheet provided.

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

(a) Calculate the power received at a satellite given the following conditions:

- The power gain of the transmitting parabolic dish is 30,000.
- The transmitter drives 3KW of power into the antenna at a Carrier frequency of 6.35GHz.
- The satellite receiving antenna has a power gain of 30.
- The transmission path is 36,000Km. **[8 marks]**

(Formula given at the back page)

(b) Apply your troubleshooting skills in relation to satellite communication system as follows; a Sky Pacific TV receiver displays wavy lines on the TV screen. At some instant there is complete loss of picture on the screen. Determine the following

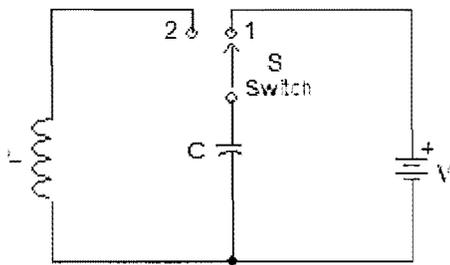
- i) The type of interference causing the problem?
- i) How will you check to determine what is bringing this interference on the TV screen? **[3 marks]**

(c) Draw a block diagram of a Phase Locked Loop (PLL) system and explain its operation. **[4 marks]**

**(Total 15 marks)**

**Question 2: Oscillator Circuit & Small Signal Amplifiers.**

- a) For LC Oscillators, the frequency of oscillation depends upon the component of the tank circuit. Explain the operation of the tank circuit as shown below. **[5 marks]**



LC tank circuit

- b) In your own words describe an oscillator circuit and its applications. **[2 marks]**
- c) Discuss what conditions are required to sustain oscillation? **[2 marks]**
- d) A tuned circuit at resonance is when  $X_L$  equals  $X_C$ . Explain what happens to the capacitance reactance ( $X_C$ ) as the frequency decreases and increases from the resonance frequency. **[2 marks]**
- e) With the aid of a diagram of "reactance versus frequency", explain resonance including the response as frequency changes above and below resonance? **[2 marks]**
- f) At resonance  $X_L = X_C$ ,  
Simplify and deduce the frequency at resonance  $f_r$  **[2 marks]**

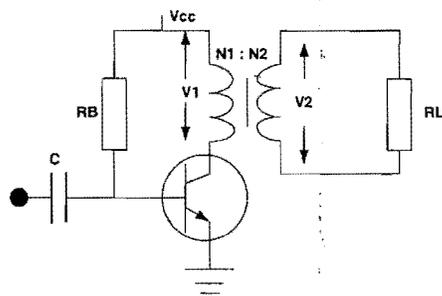
**(Total 15 marks)**

### Question 3 Tuned Power Amplifier & Filters

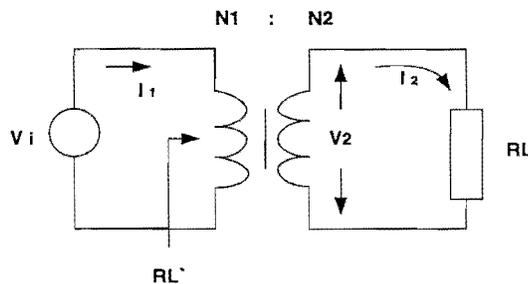
Large signal power amplifiers must operate efficiently and be capable of handling large amount of power – typically a few watts to hundreds of watts.

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

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



Transformer Coupled Audio Power Amp.



Determine the following:-

- The effective resistance  $RL'$  seen looking into the primary of the transformer
- From i) above, calculate the value of resistance looking into the primary of a 15: 1 transformer connected to an  $8\Omega$  load.
- What transformer ratio is required to match a  $16\Omega$  speaker load so that the effective load resistance seen at the primary is  $10K\Omega$ ?
- The maximum efficiency. **[8 marks]**

c) Draw a simple low pass RC filter circuit with its frequency response and explain how it passes low frequencies only and not high frequencies.

**[2 marks]**

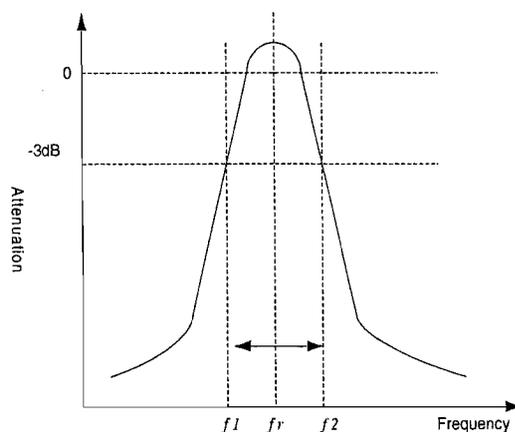
d) Draw a simple high pass RC filter circuit with its frequency response and explain how it passes high frequencies only and attenuates low frequencies.

**[2 marks]**

**(Total 15 marks)**

**Question 4: Transmitter & Receiver Modules**

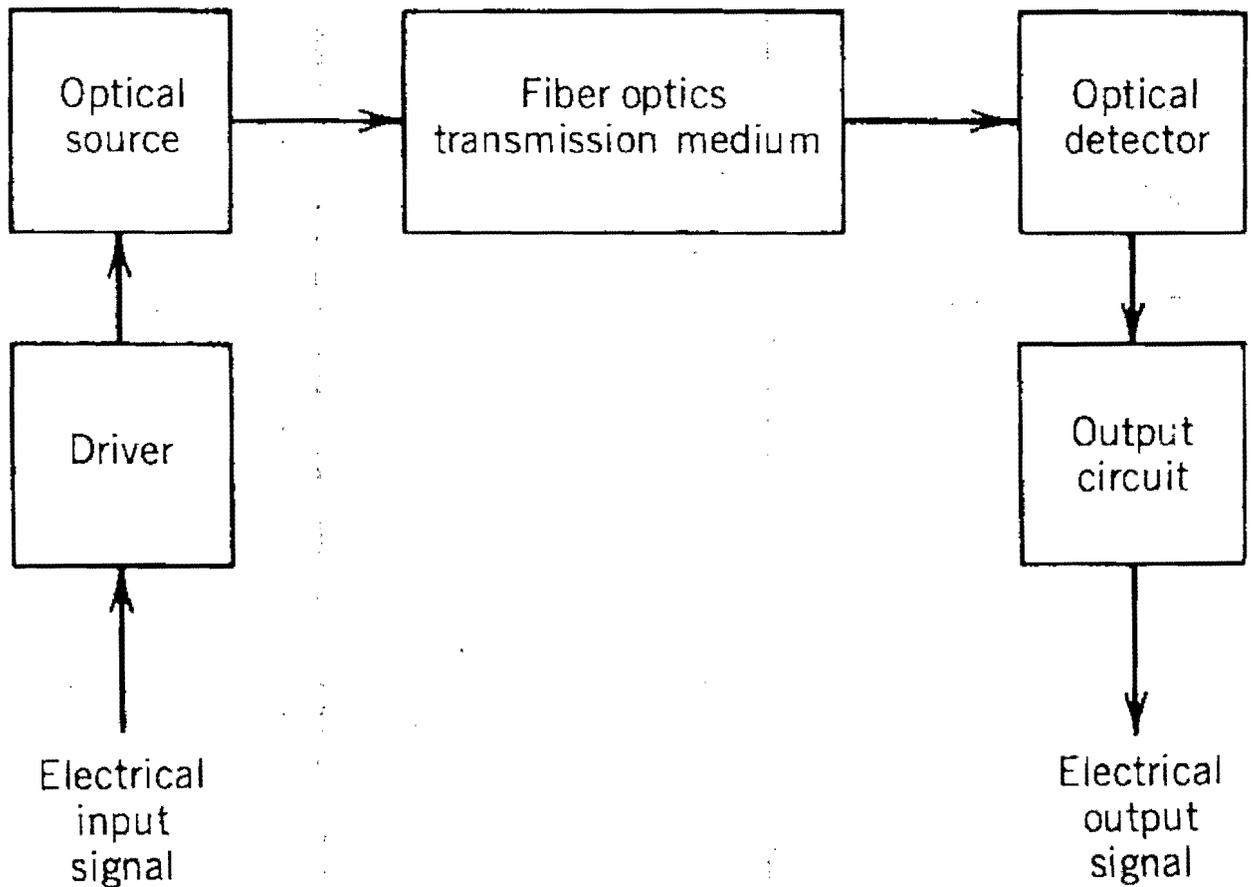
- (a) List the 3 basic functions of a Transmitter. **[3 marks]**
- (b) With the aid of a block diagram draw, label and explain the operation of an AM transmitter. **[5 marks]**
- (c) In your own words, explain the terms fidelity and sensitivity in relation to communication receivers? **[4 marks]**
- (d) The figure below is a selectivity curve of a tuned LC circuit. If we assume L of  $20\mu\text{H}$  with a resistance of  $30\Omega$  is connected in parallel with a  $100\text{pF}$  capacitor, calculate the following:
- i) the resonance frequency
  - ii) The Q of the circuit
  - iii) the Bandwidth of the circuit
- [3 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 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 AND EVOLUTION OF ANALOG TELEPHONE NETWORK.**

- a) Discuss how Circuit switching differs from packet switching? **[3 marks]**
- b) What is your understanding on Digital Subscriber Line (DSL) technology and explain how it works. **[3 marks]**
- c) Discuss ISDN telephone system and its advantages over analog systems? **[3 marks]**
- d) Both E1 and T1 switch provide Time Division Multiplexing (TDM) support. Given the voice signal of 0.3 – 4 KHz, derive the E1 communication switch in terms of bit rate? **[6 marks]**

**(Total 15 Marks)**

-----The End-----

### Formulae you can use

To calculate receive power at the Satellite transponder

- $Pr/Pt \text{ dB} = (Gt) \text{ dB} + (Gr) \text{ dB} - [32.5 + 20 \log d + 20 \log f] \text{ dB}$ .
- Where: Pr:- receive power; Pt: – transmit power; Gt: - gain of transmitting antenna; Gr: – gain of receiving antenna; d: – distance (KM) between antennas; f: – frequency (MHz).