FNU FIJI NATIONAL UNIVERSITY
College of Engineering, Science & Technology

DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING

EEE553 – ELECTRONIC COMMUNICATIONS SYSTEM.

FINAL EXAMINATION - TRIMESTER I - 2017.

DURATION: 3 HRS

INSTRUCTIONS TO STUDENTS:

1. You are allowed 10 minutes **EXTRA** as reading time during which you are **NOT** to write.
2. Begin each answer 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 foolscap, graph paper, drawing paper, etc. in their correct sequence and secure well.
5. For all sheets of paper on which rough/draft work has been done, cross it through and attach to your answer scripts.
6. Show all workings where necessary
7. Diagrams and graphs can be drawn in pencil.
8. Non- programmable calculators are allowed.
9. **Attempt all questions in Sections A, B & C and 2 questions in Section D.**
10. Check your work before you leave the room!!

Section A: TRUE or FALSE **(10 marks)**

Attempt all questions in this section and write down your answers, either true or false in your answer sheet provided.

1. All electronic communication systems consist of three basic components; a transmitter, a communication channel (medium) and a receiver.

2. PCM is a process of changing analog signals to digital signals.

3. Receivers are made up of number of components and circuits such as local oscillators, amplifiers, frequency mixer, demodulators and other circuits.

4. In a cellular telephone system, frequency reuse is allowed within a cluster.

5. In Frequency Modulation (FM), the instantaneous value of the carrier frequency changes in accordance with the amplitude variations of the modulating signal.

6. In AM, SSB is efficient compared to DSB.

7. Frequency synthesizers are variable frequency generators using a phase lock loop that provide the frequency stability of a crystal oscillator and the convenience of incremental tuning over a broad frequency range.

8. Yagi antennas are made up of a driven element and one or more parasitic elements.

9. When a signal generator is connected to an antenna, the voltage creates an electric field and the current creates a magnetic field.

10. The uplink frequency for a satellite link is always lower than the downlink.

Section B SHORT ANSWERS [2 marks each] **[30 marks]**

No	Question	Answer
1.	Discuss the difference between simplex and semi-duplex communication.	
2.	List two main sources of internal noise in a communication system and explain why noise is very important to a communication Engineer?	
3.	What are the two common ways of transferring information (communication) in the ancient days before telephony?	
4.	Why is full AM transmission inefficient and what are the solutions?	
5.	Each FM sound broadcast channel occupies 200KHz bandwidth. If the low frequency limit of one of the channels is 97MHz, what is the higher frequency limit?	
6.	Name the two signals that are required for modulation and the reason why modulation is required?	
7.	Give one reason why the RF stage of a Receiver has low amplification stage compared to the IF stage.	
8.	What is the sampling frequency of a PCM system with frequency signal band of 15KHz – 30 KHz.	
9.	Draw and explain how the carrier signal changes in AM?	
10.	In your own words discuss the term "Double sideband" in AM?	
11.	Define the terms "sensitivity and selectivity" in relation to communication.	
12.	Calculate the effective length of an antenna for best transmission at 300MHz signal? (Velocity of light is 3×10^8 m/s)	=
13.	What is multiplexing as referred to Communication System?	
14.	What is the bandwidth of the UHF Band in the frequency spectrum?	
15.	Calculate the modulation index of an Amplitude Modulated wave for a modulating signal of 5V peak and a carrier signal of 20V peak. Comment on the result.	

SECTION C **(Compulsory)**

Theory & Explanation **(30 marks)**

1. A Communication receiver consists of various components and circuits and one of its primary roles is to have the sensitivity and selectivity to fully reproduce the modulating signal at its output.

   i) Draw a block diagram of a typical super-heterodyne receiver, label all components and discuss the function of each block? (5 marks)

   ii) Explain why more amplification is done in the IF stage of the receiver as compared to the RF stage? (3 marks)

   iii) Explain the terms Selectivity and Sensitivity as used in Communication Receivers? (2 marks)

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2. A Communication Transmitter is an electronic device that accepts the information signal to be transmitted and converts it into an RF signal capable of being transmitted over a long distance.

   i) List down and discuss the four (4) basic function of a transmitter (2 marks)

   ii) Draw the block diagram of a transmitter module, label them and discuss their function. (4 marks)

   iii) Draw the block diagram of a "Frequency Synthesizer circuit" using Phase Lock Loop, label them and discuss its operation. (4 marks)

3. The greatest use of multiplexing in our everyday lives is in the use of telecommunication system where millions of calls are multiplexed on cables, long distance fiber optic and satellite to name a few;

i) Explain in your own words the reasons why multiplexing is done in telecommunication systems? (2 marks)

ii) Discuss the main differences between FDM and TDM (3 marks)

iii) A coaxial cable could accommodate several thousand 4 KHz voice channels. The fundamental basis is grouping 12 telephone channels multiplexed in the frequency band 12 KHz to 60 KHz. This forms the **basic group in FDM.** Illustrate in a diagram how the 12 telephone channels form the basic group? (5 marks)

Section D **(Select 2 from the 3 Questions)**

[30 marks]

Question1.

a) A receiver with a 75ohms input resistance operates at a temperature of 29°C. The receiver signal is at 86MHz with a bandwidth of 4MHz. The received signal voltage of 8.5μV is applied to an amplifier with a noise figure of 2.8dB.

Find the following:

i) The input noise power; (2marks)
ii) The input signal power; (2 marks)
iii) S/N in dB; (2 marks)
iv) The noise factor & S/N of the amplifier; (2 marks)
v) The noise temperature of the amplifier. (2 marks)

b) TDM (Time Division Multiplexing) can be configured to support E1. From voice frequency (0.3 – 4 KHz), explain how an E1 can be derived? (5 marks)

Question 2.

a) A 600.0 KHz RF Carrier signal is Amplitude Modulated with a 5 KHz sine wave signal. The modulated carrier voltage is 25 V maximum and 6V minimum across 50 ohms resistive load impedance.

Determine the following:

i) The RF Carrier voltage without modulation;
ii) The modulation index;
iii) The Carrier power;
iv) The sideband power;
v) Total power;
vi) Sideband frequencies;
vii) Bandwidth

(1 mark each)

b) The purpose of an antenna is to receive and transmit electromagnetic radiation

i) In terms of "frequency and wavelength", explain why it is impractical to transmit "voice frequency" in an antenna. (4 marks)
ii) Draw a four (4) element Yagi antenna naming all elements and their spacing and functions including the direction of the main lobe. (4 marks)

Question 3

a)

i) Draw and label a block diagram of a satellite transponder and briefly explain its operation. (3 marks)

ii) Determine the downlink transmit frequency if the uplink transmitter is 5080MHz. Assume Local Oscillator frequency of 2GHz. (2 marks)

iii) List down one main advantage and one disadvantage of satellite communication (2 marks)

b). An FM broadcast signal has the deviation of 100 KHz and a maximum modulating signal of 20 KHz.

Determine the maximum bandwidth using:

i) The Bessel Function table (see attached)
ii) Carson's rule.
iii) Why do we call frequency wave "electromagnetic waves"?

(8 marks)

THE END

Formulae you can use

$V_n = \sqrt{4KTBR}$

Boltsman Constant: 1.38×10^{-23}

$S/N = \frac{P_s}{P_n}$; Carrier Power; $P_c = V^2/R$;

NF = 10 log NR

$NR = \frac{S/N_{input}}{S/N_{output}}$

$T_N = 290(NR - 1)$

$Vc = \frac{V_{max} + V_{min}}{2}$

Modulation index = $\frac{V_{max} - V_{min}}{V_{max} + V_{min}} \times 100\%$

dB = 10log P (where P = Pout/Pin)

Speed of light $V = f\lambda$ where $V = 3 \times 10^8$

Sideband Power; $P_{sb} = \frac{m^2 P_c}{2}$

$m_f = \frac{f_d}{f_m}$ Bandwidth = $2f_m N$; $2(f_{d(max)} + f_{m(max)})$

Bessel Function Table

Modulation Index	Carrier	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	14th	15th	16th
0.00	1.00															
0.25	0.98	0.12														
0.5	0.94	0.24	0.03													
1.0	0.77	0.44	0.11	0.02												
1.5	0.51	0.56	0.23	0.06	0.01											
2.0	0.22	0.58	0.35	0.13	0.03											
2.5	-0.05	0.50	0.45	0.22	0.07	0.02										
3.0	-0.26	0.34	0.49	0.31	0.13	0.04	0.01									
4.0	-0.40	-0.07	0.36	0.43	0.28	0.13	0.05	0.02								
5.0	-0.18	-0.33	0.05	0.36	0.39	0.26	0.13	0.05	0.02							
6.0	0.15	-0.28	-0.24	0.11	0.36	0.36	0.25	0.13	0.06	0.02						
7.0	0.30	0.00	-0.30	-0.17	0.16	0.35	0.34	0.23	0.13	0.06	0.02					
8.0	0.17	0.23	-0.11	-0.29	-0.10	0.19	0.34	0.32	0.22	0.13	0.06	0.03				
9.0	-0.09	0.24	0.14	-0.18	-0.27	-0.06	0.20	0.33	0.30	0.21	0.12	0.06	0.03			
10.0	-0.25	0.04	0.25	0.06	-0.22	-0.23	-0.01	0.22	0.31	0.29	0.20	0.12	0.06	0.01		
12.0	-0.05	-0.22	-0.08	0.20	0.18	-0.07	-0.24	-0.17	0.05	0.23	0.30	0.27	0.20	0.07	0.03	0.01
15.0	-0.01	0.21	0.04	0.19	-0.12	0.13	0.21	0.03	-0.17	-0.22	-0.09	0.10	0.24	0.25	0.18	0.12

Fig 1