FIJI NATIONAL UNIVERSITY
College of Engineering, Science & Technology

SCHOOL OF ELECTRICAL & ELECTRONICSENGINEERING

TRADE DIPLOMA IN ELECTRONICS ENGINEERING (TELECOMM & NETWORKING)

EEE553 – ELECTRONIC COMMUNICATION SYSTEM

FINAL EXAMINATION – TRIMESTER 1, 2018

DAY/DATE: as per TT TIME : as per TT DURATION:3.10hrs

ROOM: SAMABULA CAMPUS

INSTRUCTION TO STUDENT

1. You are allowed 10 minutes extra reading time during which you are NOT to write.
2. **Begin each answer(each Question)** on a fresh page and use both sides of the sheet.
3. Write your candidate number at the top of each answer & 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.
7. Bessel Function Tables & formula on the Appendix.
8. **SECTION A. – Short Answer** - **20 marks**
   SECTION B. – Answer ALL question - **30 marks**
   SECTION C. – Answer ALL question - **50 marks**

Section – A: [20 marks]

No.	Question	Answer
1	Write down the Frequency Range of the UHF Bands	[1 mark]
2	Name the frequency bands, which the FM, TV broadcast…aircraft to aircraft communication used..	[1 mark]
3	Identify 3 main source of external noise source.	[1½ marks]
4	Find the shot noise current, with a DC biasing current of 0.5mA and bandwidth of 12.5 KHz, q = 1.6 x 10^{-19} C	[2½ marks]
5	Calculate the AM modulation depth if the signal peak of 1v and carrier peak of 4v	[2 marks]
6	In AM, by suppressing the carrier, identify the remaining signals?	[1 mark]
7	Identify one main purpose of multiplexing.	[1 mark]
8	What is the main purpose of oscillator in the FM transmitter?	[1 mark]
9	Name the two audio compression laws used in communication system.	[2 marks]
10	What is the name of the signalling system used in telephony communication in Fiji and European countries called.	[1 mark]

11	In FDM, how many 6 MHz TV channel can be multiplexed on an 900 MHz coaxial cable?	[2 marks]
12	What is SWR…..?	[1 mark]
13	Identify the minimum practical height a satellite can be located from the earth surface.	[1 mark]
14	Write down the commonly used directional antenna type.	[1 mark]
15	Identify the frequency range over which cellular phone system like Vodafone operates on	[1 mark]

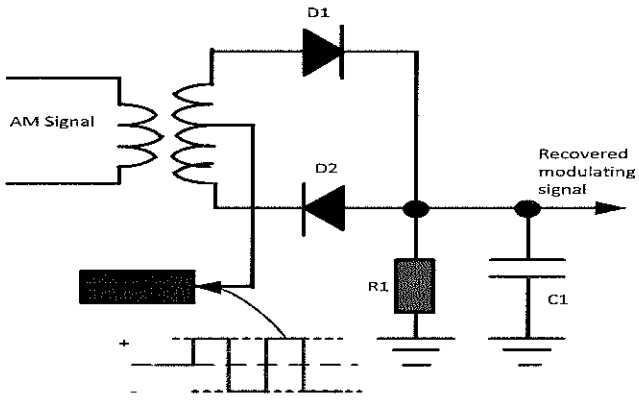
Section – B: - Answer all question in this section [30 marks]

1. Draw and briefly describe how a Technician or Radio Engineer can tuned an antenna to the transmitter, with a 50Ω impedance using the *Transmatch* technique.

[7 marks]

2. Clearly describe the operation of the Synchronous Detector below.

[7 marks]



3. Draw and label the block diagram of an AM Transmitter, and describe the basic operation of each block.

[6 marks]

4. Sketch and label clearly a block diagram of **TRF Receiver** and clearly showing the tuned circuit, filter, amplifiers & detector circuit and clearly describe its operation.

[10 marks]

Section – C: answer all question [50 marks]

Question 1. [Noise] [15 marks]

A receiver with a 100Ω input resistance operates at a temperature of 30°C. The received signal is at 95 MHz with the bandwidth of 8 MHz. The received signal voltage of 8.6 uV is applied to an amplifier with a noise-figure of 2.8 dB. Assuming the Boltzmann's constant is 1.38×10^{-23}, find the following:-

(i) input noise power. [3 marks]

(ii) input signal power. [2 marks]

(iii) S/N in dB, [4 marks]

(iv) noise factor and S/N of the amplifier. [4 marks]

(v) noise temperature of the amplifier. [2 marks]

Question 2. [AM, FM] [15 marks]

(a) Find out the maximum bandwidth of an FM signal with a deviation of 30kHz and a maximum modulating signal of 6 kHz, using

(i) the Bessel Function (attached in appendix-2)
(ii) Carson's rule.

[7 marks]

(b) When a single sine wave frequency modulating signal is used in amplitude modulation , it generates two sidebands. If the modulating signal is $v_{AM} = V_c \sin 2\pi f_c t + (V_m \sin 2\pi f_m t)(\sin 2\pi f_c t)$, use the trigonometry identity to identify the two sidebands signal .

[5 marks]

(c) Name three(3) application system using Half-duplex packet mode networks based on carrier sense multiple access in a modern communication system

[3 marks]

Question 3. **[Transmitter, Antenna]** **[20 marks]**

(a) In an AM transmitter, the transmission line connected to the antenna has an impedance of 75Ω. An unmodulated AM signal producing a current of 7.4A. The modulation percentage is 90%, calculate the following:-

(i) Carrier Power [2 marks]

(b) Total Power [3 marks]

(c) Sideband Power [3 marks]

(b) An antenna has gain of 15dB. It is fed by an RG-8/U transmission line 400 ft long whose attenuation is 4.8 dB per 100 ft at 220MHz. The transmitter output is 80W. Calculate the following:

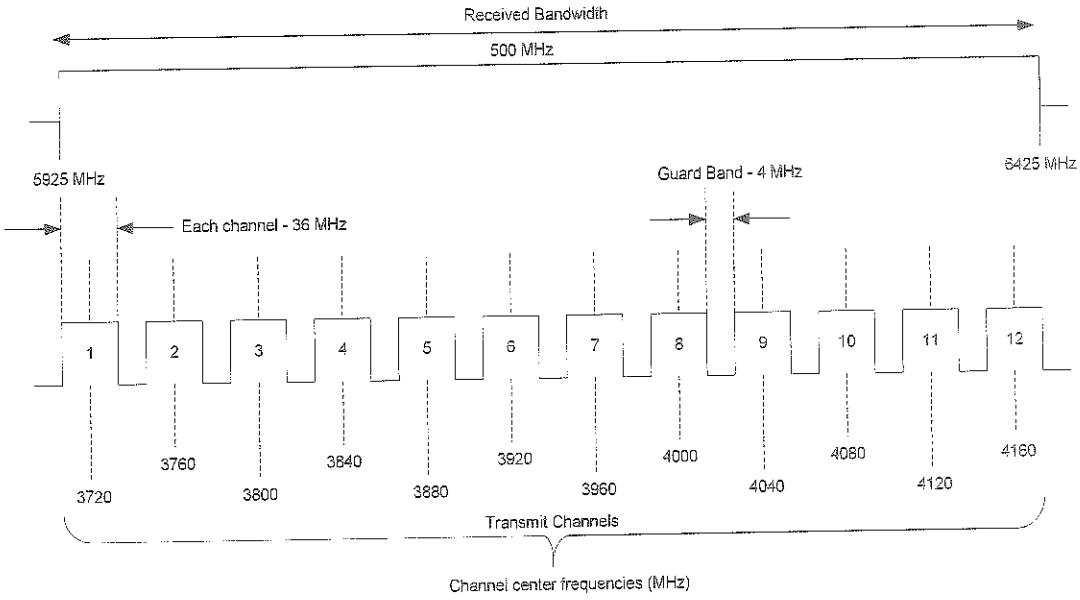
(i) Transmission Line Loss in Watts [5 marks]

(ii) Effective Radiated Power [2 marks]

(c). A communication satellite transponder operates in the **C band** (3400 - 6425 MHz), as shown the chart below, with its local oscillator operating at the frequency of 2 GHz. Calculate the following:-

(i). Uplink frequency if the down link transmitter is on channel **5**?. [3 marks]

(ii). Maximum theoretical data rate if one transponder is used for binary transmission?. [2 marks]


Received Bandwidth
500 MHz
5925 MHz
6425 MHz
Guard Band - 4 MHz
Each channel - 36 MHz
1
2
3
4
5
6
7
8
9
10
11
12
3720
3760
3800
3840
3880
3920
3960
4000
4040
4080
4120
4160
Transmit Channels
Channel center frequencies (MHz)

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Appendix 1

Formulas

1. $\omega_1 = R/2L + \sqrt{(R/2L)^2 + 1/LC}$ $\omega_2 = -R/2L + \sqrt{(R/2L)^2 + 1/LC}$

2. $v = \sqrt{4kTBR}$ $I_T = I_C\sqrt{(1 + m^2/2)}$; $NF = 10\log NR$

3. $f_0 = 1/2\pi\sqrt{LC}$ $\omega_0 = \dfrac{1}{\sqrt{LC}}$

4. $Q = \dfrac{1}{\omega_0 CR}$ $BW = 2[f_{d(\max)} + f_{m(\max)}]$

5. $B = \omega_0^{\,2} CR$

6. $X_L = 2\pi fL$ $X_C = \dfrac{1}{2\pi fC}$

7. $\sin A \sin B = \dfrac{\cos(A-B)}{2} - \dfrac{\cos(A+B)}{2}$ $I_x = \sqrt{2qIB}$

9. $I_D = I_{DSS}\left(1 - \dfrac{V_{GS}}{V_P}\right)^2$, $\beta_1\left[(V_{DD} - 2V_T)V_{ON} - 0.5^2{}_{ON}\right]$

10. $f_H = \pm\dfrac{8fo}{Vc}$, $V_{DS} = V_{DD} - I_D R_D$

Appendix 2 – 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