FIJI NATIONAL UNIVERSITY
College of Engineering, Science & Technology

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

ADVANCED DIPLOMA IN ENGINEERING

(ELECTRICAL & ELECTRONICS)

EEE607 – ELECTRONIC TECHNOLOGY (TELECOMMUNICATION)

SEMESTER 2, 2015

DAY/DATE: As timetabled DURATION : Three hours

ROOM: As timetabled

INSTRUCTION TO STUDENTS

1. You are allowed 10 minutes extra reading time during which you are **NOT** to write.
2. Answer ALL questions.
3. Each question may carry a different mark.
4. **Begin the answer to each Question on a fresh page** and use both sides of the sheet.
5. Write clearly the number of the question attempted on the top of each sheet
6. Write your candidate number at the top of each sheet & attach them.
7. Insert all written foolscaps, graph paper etc. in their correct sequence and secure with a string.
8. All sheets of paper on which rough/draft work has been done, cross it through and attach all of them to your answer scripts.
9. Some useful formulae and Table of Bessel coefficients are given on page 5

Total number of pages 5

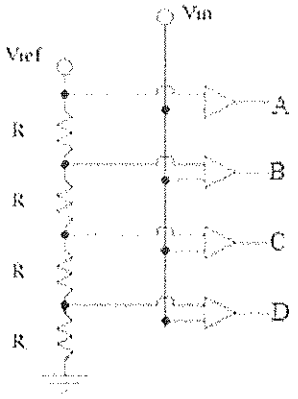
1. Write the *i*) Hartley's law for the total information
ii) Shannon-Hartley theorem and
iii) Shannon limit as a mathematical equation. Explain all the symbols, and their units used in the equations.

A television broadcast station is allocated a bandwidth of 6 MHz and a signal to noise ratio of 35 dB. A signal is transmitted along this line using a16 -four-level code. Stating the reasons, give the maximum theoretical data rate.

(15 marks)

2. a) Give four advantages and one disadvantage of using digital, rather than analog techniques for the transmission of voice signals.

b) On type of A/D converter is the flash 4 bit converter shown in the diagram. A, B, C D are the output bits. The reference voltage $V_{ref} = 5$ V. The components indicated by ▷ are comparators.



i) In this converter, identify the LSB and MSB.

ii) Copy the table below and complete it

V_{in} (V)	A	B	C	D
2				
3				
4				

c) Represent the Binary number **1101001** in the following codes

1. Unipolar NRZ, 2. Unibipolar RZ, 3. Bipolar NRZ, 4. Bibipolar RZ and the Manchester code

(Use the graph paper provided)

d) The above number (**1101001**) is to be transmitted in the serial mode. Write down and indicate ALL the bits that would be transmitted.

e) List the different layers of the OSI protocol model and describe the functions of two of the layers

(25 marks)

3. Explain the difference between balanced and unbalanced transmission lines , and give an example of each.

Define the velocity factor of a transmission line and explain why it can never be greater than one

When a voltage wave travel along a transmission line connected to a load Z, the voltage reflection coefficient R_v is $R_v = \frac{Z - Z_0}{Z + Z_0}$.

a) The inductance and capacitance per unit length of a transmission line are 225 nH m^{-1} and 90 pF m^{-1} respectively. Calculate the velocity factor and the characteristic impedance Z_0 of the line.

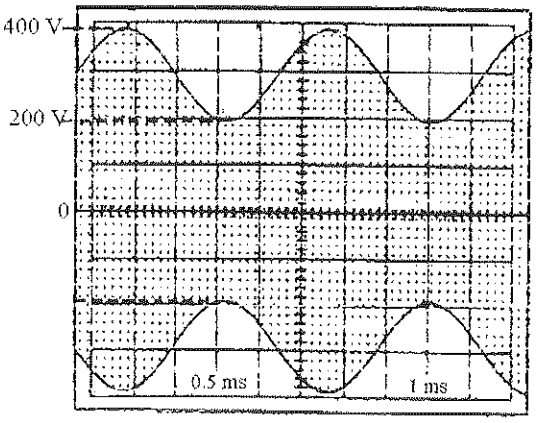
b) If $Z = 75\ \Omega$, calculate R_v. What is the phase difference between the incident and the reflected waves? How will you interpret these values?

c) If $Z = 25\ \Omega$, calculate the new R_v and the phase difference between the incident and the reflected waves. How will you interpret these values?

(15 marks)

4. What is meant by the *envelope* of an AM waveform?

The signal shown in the figure is the CRO display of the output of an AM transmitter with a carrier frequency of 12 MHz and a carrier power 150 W.



Calculate:

a) Carrier voltage maxima

b) Information voltage maxima

c) Calculate the percent (%) modulation

d) Calculate the rms voltage of the carrier and use it to find the transmitters load resistance.

e) Sketch the signal in the frequency domain, with power in dBm in the vertical axis.

(25 marks)

5. What two types of modulation are included in the tern *angle modulation*.

An FM transmitter has a carrier frequency of 220MHz. Its modulation index is 3 with a modulating frequency of 5 kHz. The total output power is 100W into a 50Ω load.

a) What is the deviation?

b) sketch the spectrum of this signal, including all the sidebands with more than 1% on the signal voltage. Indicate all the magnitudes.

c) What is the bandwidth of this signal according to the criteria used in part b)?

(20 marks)

THE END

Bessel coefficients

						Side Frequencies							-
Modulation Index m_f	*Carrier*	*1st*	*2nd*	*3rd*	*4th*	*5th*	*6th*	*7th*	*8th*	*9th*	*10th*	*11th*	*12th*
	Jo	*J1*	*J2*	*J3*	*J4*	*J5.*	*J6*	*J7*	*J8*	*J9*	*J10*	*J111*	*J12*
0	1												
0.25	0.98	0.12	0.01										
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	035	0.13	0.03	0.01							
2.4	0	0.52	0,43	0.20	0.06								
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	0.01			
5.5	0	-0.34	-0.12	0.26	0.40	0.32	0.19	0.09	0.03	0.01			
6.0	0.15	-0.28	- 0.24	0.11	0.36	9.36	0.25	0.13	0.06	0.02	0.01		
7.0	0.30	0	-0.30	-0.1}	0.16	0.35	0.34	0.23	0.13	0.06	0.02	0.01	
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	0.01
8.65	0,	0.27	0..06	-0.24.	-0.23	0.03	0.26	0.34	0.28	0.18	0.10	0.05	0.02

$\text{Log}_2 X = 3.32 \times \log_{10} X$