INTI
International College Penang

FINAL
Examination Paper

(COVER PAGE)

Session	:	**January 2018**
Programme	:	Diploma in Electrical and Electronic Engineering (DEEI)
Course	:	**EEE2111: Telecommunication Systems**
Date of Examination	:	7 March 2018 (Wednesday)
Time	:	11:00am – 1:00pm
Duration	:	2 Hours Reading Time : Nil
Special Instructions	:	

This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

IMPORTANT NOTE : THIS PAPER SHOULD NOT BE TAKEN OUT OF THE EXAMINATION HALL

Materials Permitted :
Non Programmable Scientific Calculator

Materials Provided :
Nil

Examiner(s)	:	**Chong Kok Ming**
Moderator	:	Prof. Ir. Dr. Mandeep Singh Jit Singh

*This paper consists of **6** printed pages, including the cover page.*

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAMME (DEEI)
EEE2111: TELECOMMUNICATION SYSTEMS
FINAL EXAMINATION: JANUARY 2018 SESSION

Instructions: This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

a.) With help of a diagram, explain how skywave is used for long distance radio broadcasting. (3 marks)

b.) Illustrate the following parameters based on diagram shown in question 1 (a.)

i.) Critical angle

ii.) Skip zone

iii.) Skip distance

iv.) Groundwave coverage area

(4 marks)

c.) Compare two (2) advantages and disadvantages of Frequency Division Multiple Access (FDMA) and Time Division Multiple Access (TDMA)

(4 marks)

d.) With the help of a diagram, show implementation of a hybrid FDMA and TDMA and discuss what the advantages are.

(6 marks)

e.) A communication satellite is located on an orbit that is 40,000 km above ground. A person using a satellite phone is standing at a location of 48,000 km away from the satellite. This satellite is transmitting 4.5 GHz signal at 1.5 kW signal power with an antenna of 40,000X power gain. The receiver has a receiving antenna with 25X power gain. Calculate the: -

i.) Signal delay time the person has with ground station. (2 marks)

ii.) Power of signal received by the satellite phone. (6 marks)

Question 2

a.) Define the following terms and draw a waveform diagram for each signal

i.) Periodic signal (2 marks)

ii.) Deterministic signal (2 marks)

iii.) Random signal (2 marks)

iv.) Even symmetry signal (2 marks)

b.) An amplitude modulation (AM) signal,

$$V(t) = 20(1 + 0.5sin2\pi 10^3 t) \cdot sin2\pi 1.05 \times 10^6 t.$$

i.) Determine the modulating frequency and carrier frequency. (2 marks)

ii.) Write the equation in terms of carrier frequency, lower and upper sideband frequency. (3 marks)

iii.) Calculate the AM bandwidth. (2 marks)

iv.) Calculate the transmission power when signal loaded on an antenna with 50 Ω impedance. (3 marks)

c.) Using a super heterodyne receiver with intermediate frequency (IF) of 455 kHz to receive the above signal. Calculate the: -

i.) Tuned frequency of the local oscillator (2 marks)

ii.) Signal components output at IF mixer, including second harmonics (5 marks)

Question 3

a.) A 2 kHz sinusoidal signal is applied to an FM modulator with frequency deviation of 20 kHz. Calculate the: -

i.) Modulation index (2 marks)

ii.) FM signal bandwidth using Bessel function (2 marks)

iii.) FM signal bandwidth using Carson's rule (2 marks)

b.) FM radio has a standard reception band of 87.5 MHz to 108.0 MHz. Calculate the minimum and maximum bandwidth of a tuned radio frequency receiver that has a bandpass filter with Q factor 200?

(4 marks)

c.) Draw a block diagram of FM super heterodyne receiver and explain the functionality of each block.

(7 marks)

d.) Explain how super heterodyne receiver can overcome the limitations of tuned radio frequency receivers.

(4 marks)

e.) The FM signal is pre-emphasis at $f_{3dB} = 2120$ Hz. Draw a de-emphasis circuit with RC configuration that is suitable for this, and calculate an appropriate RC value.

(4 marks)

Question 4

a.) What are advantages and disadvantages of digital communication compare to analog communication?

(3 marks)

b.) Show using a table how to digitize an analog signal of 1.0V maximum using 3 bits binary words.

(5 marks)

c.) A voice signal with frequency range of 300 Hz to 3.4 kHz has a maximum signal level of 1.0 V is encoded with PCM using an 8 bits words. Calculate the: -

i.) Minimum sampling rate (2 marks)

ii.) Quantization resolution in mV (2 marks)

iii.) Dynamic range in dB (2 marks)

iv.) Bandwidth required for transmission (2 marks)

v.) Binary word coding for an input signal of 683mV (2 marks)

vi.) Quantization error at 683mV (2 marks)

d.) Considering to upgrade PCM system mentioned in 4-c.) above, what part of the system has to be changed if a music signal with frequency range of 50 Hz to 15 kHz is applied to the above mentioned PCM system, and an improvement of 24 dB sound quality is required in the transmission?

(5 marks)

Question 5

a.) Explain frequency division multiplexing (FDM) principle.

(3 marks)

b.) Show how 12 channels of telephony voice can be stacked on a CCITT group channel with bandwidth of 48 kHz (60 – 108 kHz). Mark clearly the carrier frequency of each telephony voice channel in the band.

(5 marks)

c.) Show vector diagram of BPSK, QPSK and 8-PSK signal. What is the phase difference between allowed coding for each of this case?

(6 marks)

d.) An 8 bits binary word 1-1-0-1-0-0-0-1 is to be sent out using Differential PSK (DPSK) coding.

i.) Draw a block diagram of DPSK encoder (3 marks)

ii.) Use a table to find out the encoded DPSK data word. (4 marks)

iii.) Show the decoding process to recover the DPSK code sent out in ii). (4 marks)

Question 6

a.) Explain this statement: "Antenna is a reciprocal device" (3 marks)

b.) A half wavelength dipole antenna has an isotropic radiation pattern with power gain of 2.15 dB is radiating a signal of 200 MHz at power level of 100W. Another same type dipole antenna is placed at a location 10 km away for reception. Calculate the: -

i.) Size of the dipole antenna (2 marks)

ii.) Distance where far field is detected. (2 marks)

iii.) Signal power received at the receiving antenna. (3 marks)

iv.) Voltage level of the received antenna. (3 marks)

v.) Draw the dipole antenna radiation pattern in 2D and 3D view. (3 marks)

c.) Discuss how can you

i.) Reduce the size of the dipole antenna by half (2 marks)

ii.) Improve directivity of the dipole antenna (2 marks)

iii.) Calculate what is the size parabolic reflector required to send a signal at 10 GHz with a beaming of 3°. (2 marks)

iv.) What is the power gain of this antenna in dB? (3 marks)

-- THE END –

Bessel Functions Table

Mod. index	Sideband amplitude														
	Carr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
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										
2.41	0.00	0.52	0.43	0.20	0.06	0.02									
2.5	−0.05	0.50	0.45	0.22	0.07	0.02	0.01								
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						
5.53	0.00	−0.34	−0.13	0.25	0.40	0.32	0.19	0.09	0.03	0.01					
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			
8.65	0.00	0.27	0.06	−0.24	−0.23	0.03	0.26	0.34	0.28	0.18	0.10	0.05	0.02		
9.0	−0.09	0.25	0.14	−0.18	−0.27	−0.06	0.20	0.33	0.31	0.21	0.12	0.06	0.03	0.01	
10.0	−0.25	0.04	0.25	0.06	−0.22	−0.23	−0.01	0.22	0.32	0.29	0.21	0.12	0.06	0.03	0.01