INTI
International College Penang
LAUREATE INTERNATIONAL UNIVERSITIES

FINAL
Examination Paper

(COVER PAGE)

Session	:	**April 2016**
Programme	:	Diploma in Electrical and Electronic Engineering (DEEI)
Course	:	**EEE2109: Electronic Communications Systems**
Date of Examination	:	26 July 2016, Tuesday
Time	:	5.00pm – 7.00pm
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 :

Nil

Materials Provided :

Answer Booklet

Examiner(s)	:	**Mr. Koay Ting Hoo**
Moderator	:	Dr. Mandeep Singh

This paper consists of 5 printed pages, including the cover page.

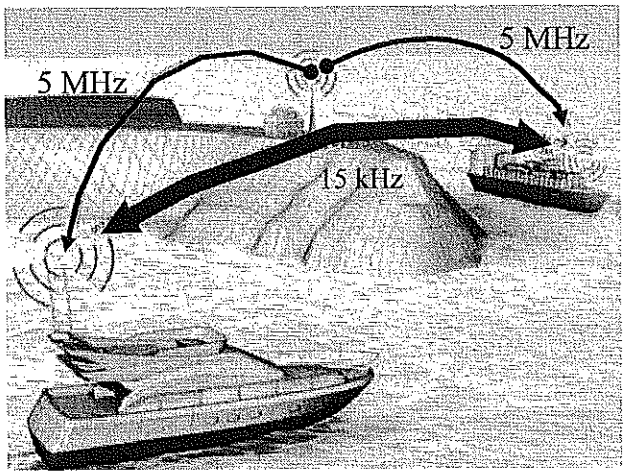
INTI INTERNATIONAL COLLEGE

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING (DEEI)
EEE2109 ELECTRONIC COMMUNICATIONS SYSTEMS
FINAL EXAMINATION: APRIL 2016 SESSION

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

Question 1

1 (a) Navy ships use 15 kHz for ship to ship navigation. Command center uses 5 MHz to broadcast news to ship as shown in Figure 1



(i) State the names of frequency range for 15 kHz and 5 MHz respectively.
(2 marks)

(ii) Discuss the types of wave propagation methods used by navy ships and command center.
(2 marks)

(iii) Explain reasons for eventual disappearance of Electromagnetic (EM) wave from Navy ship.
(2 marks)

(iv) Explain different layers of ionosphere and its effects on 5 MHz wave.
(2 marks)

(v) Discuss briefly two methods used to reduce fading effect of sky wave.
(2 marks)

(b) A high-gain Ground station (GS) receiver antenna (G_r = 35 dBi) has a noise figure of F=30 dB. A satellite transmitting signals of BW = 6 MHz at 2.45 GHz downward to the Ground station (GS) receiver. The electrical power of transmitter is 3 Watt according to the efficiency of transmitter is 70%. The transmitting antenna has (G_T = 5 dBi) Polarization loss is 3 dB and absorption is factored at 1 dB. The reception quality is considered acceptable if S/N ratio is from 28 to 40 dB and excellent if greater than 40dB. (Noise power = -174+10 Log (BW) + F (dB) BW is in Hz and the distance between ground station and satellite is 1160 km). Evaluate the :-

(i) Effective radiated power of satellite in dBm.

(7 marks)

(ii) Reception quality by calculating Signal power received and Signal to Noise ratio (S/N)

(8 marks)

Question 2

2 (a) (i) Sketch of a magnetron oscillator

(5 marks)

(ii) List down five (5) differences between the klystron oscillator and a magnetron oscillator.

(10 marks)

(b) A microwave link consists of a transmitting and receiving horn antenna. The length of the link is 50 meter. The frequency of carrier is 5 GHz. An engineer has to choose a proper waveguide from Table 2. The formula for cut off wavelength is

$$\lambda_c = \frac{2}{\sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2}}$$

Table Q2: Waveguide characteristic

Useful Frequency Range GHz	Outside Dimensions, mm	Wall thickness ,mm	RETMA Designation	Attenuation dB/m	Power Rating kW
1.12-1.70	169x86.6	2	WR650	0.0052	14,600
1.70-2.60	113x58.7	2	WR430	0.0097	6,400
2.60-3.95	76.2x38.1	2	WR284	0.019	2,700
3.95-5.85	50.8x25.4	1.6	WR187	0.036	1,700
5.85-8.20	38.1x19.1	1.6	WR137	0.058	635
8.20-12.40	25.4x12.7	1.3	WR90	0.11	245
12.40-18.00	17.8x9.9	1	WR62	0.176	140

(i) Select a suitable waveguide and determine the total losses in guide, referring to Table Q2

(2 marks)

(ii) Determine the cutoff frequency, guide wavelength and propagation velocity for TE(1,1) propagation mode of 8 GHz inside the guide.

(8 marks)

Question 3 :

3 (a) Sketch a simple Continuous Wave (CW) speed radar tracker. Describe five differences in the operation of pulsed radar and CW Doppler radar.

(15 marks)

(b) The analog voice sensor has full range from 0 to 50 SPL (Sound Pressure Level), it is converted to digital signal with Dynamic Range (DR) = 54 dB, the current sound level is at 40 SPL.

(i) Determine the number of bits and smallest detectable SPL change.

(2 marks)

(ii) What is the binary representation for current 40 SPL.

(2 marks)

(iii) Determine a two-level matrix sum codes for 40 SPL.

(6 marks)

Question 4

4 (a) Describe the main differences between the following:

(i) Telemetry and telephone (2 marks)
(ii) Echo and Cross Talk (2 marks)
(iii) Chrominance and Luminance (2 marks)
(iv) Interlaced Scanning and Progressive Scanning (2 marks)
(v) Time Division Multiplexing (TDM) and Frequency Division Multiplexing (FDM).

(2 marks)

(b) A 50 meter optic fiber with core of flint glass (n=1.48) and a cladding of crown glass (n=1.42) connects two stations for one way communication. The light transmitted is 1550 nm at 1 W. A laser diode and PIN diode used as optical source and receiver. The numerical aperture for laser diode and pin diode are 0.389. The design aging margin is 1.5 dB / diode and modal dispersion margin is 0.5 dB. Manufacturer stated that the loss of fiber is 0.01 dB per meter. There is one splice loss (0.2 dB) at 25 meter. The receiver required minimum 10 mW Optical power to function. Interface means boundaries between core of fiber and air (n_a=1).

Calculate the :-

(i) Power budget of this optical fiber system in dB (3 marks)
(ii) Critical angle of the fiber (2 marks)
(iii) Cone of acceptance of the fiber (2 marks)
(iv) Numerical Loss of the system (2 marks)
(v) Fresnel Reflection loss at interface of the fiber in dB (2 marks)
(vi) Evaluate whether if the system has sufficient power budget (4 marks)

Question 5 :

5 (a) Describe with an aid of a diagram, the construction of a single-fiber cable and explain the purpose of each layer. (10 marks)

(b) The AN/FPS-16 guided-missile tracking radar operates at 5 GHz, with a peak pulse power of 400 W, a PRF of 2000pps and pulse width of 0.8 μs. If an antenna with a diameter of 3.0 m, and radar receiver has an Intermediate Frequency (IF) bandwidth of 3.0 MHz and a 10 dB noise figure at 17 °C. Boltzmann's constant $k= 1.38x10^{-23}$ J/K, Antenna gain = $6(D/\lambda)^2$ and $P_{min} = (F-1)* kT_o\delta f$.

Calculate the :

(i) Maximum Unambiguous range in miles. (2 marks)
(ii) Average transmitted power for this radar. (2 marks)
(iii) Minimum received power (P_{min}). (2 marks)
(iv) Antenna Gain in dBi. (3 marks)
(v) Maximum distance to intercept target of S=1 m^2. (4 marks)
(vi) Classification of target and radar band. (2 marks)

Question 6

6 (a) Sketch the construction layout of following antennas (rhombic, Yagi Uda antenna and Half wave dipole), properly label all elements and load (if any) and calculate the length of driven elements.

(i) 10 MHz rhombic antenna, (5 marks)
(ii) 4 elements 500 MHz Yagi Uda antenna and (6 marks)
(iii) 100 MHz Half wave dipole (4 marks)

(b) Gives five reasons why rhombic antenna is a non-resonant antenna. (10 marks)

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