INTI International College Penang
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FINAL
Examination Paper
(COVER PAGE)

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| Session | : | JANUARY 2015 |
| Programmes | : | **DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING (DEEI)** |
| Course | : | **EEE2109: ELECTRONIC COMMUNICATION SYSTEMS** |
| Date of Examination | : | 10 March 2015 (Tuesday) |
| Time | : | 2:00pm – 4:00pm Reading Time: Nil |
| Duration | : | 2 Hours |
| Special Instructions | : | |

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

**Students are not allowed to remove this question paper from the examination venue.**

Materials permitted : Non Programmable Scientific Calculator

Materials provided: Graph paper

Examiner(s) : **Mr. Koay Ting Hoo**

Moderator : **Dr. Mandeep Singh**

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

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAMME
(DEE/I)

EEE2109 ELECTRONIC COMMUNICATIONS SYSTEMS
FINAL EXAMINATION: JAN 2015 SESSION

This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks. Answer should be at least in 2 decimals. Boltzmann's constant (k) = $1.38 \times 10^{-23}$ J/K. Formula for parabolic antenna Gain = $6(D/\lambda)$ where D is diameter and $\lambda$ is wavelength of signal. Velocity of electromagnetic wave c= $3 \times 10^8$ m/s

**Question 1**

(1) (a) Describes FIVE (5) characteristics of ground wave propagation. (10 marks)

(b) A receiving parabolic antenna of Gain ($G_r$) = 40 dBi situated on earth station has a noise figure of NF = 5 dB, the receiver operates at 17 °C noise temperature. A communication satellite transmits signal to earth station at 5 GHz. The signal's bandwidth is 7 MHz. The effective radiated isotropic power (ERIP) is 30 dBm. The satellite is at 30,000 km from the earth. The atmospheric loss is 38dB. Calculate the :-

(i) Diameter of receiving parabolic antenna in meter. (3 marks)
(ii) Capture area of receiving antenna in $m^2$ (2 marks)
(iii) Received free space power density in $W/m^2$ on earth station. (3 marks)
(iv) Signal to noise ratio in decibel (dB). (7 marks)

**Question 2**

(2) (a) Sketch the construction of magnetron microwave amplifier and describe the differences it has when compared with Travelling Wave Tube (TWT) amplifier. (10 marks)

(b) A microwave link connects a Circular Waveguide (2.5 cm diameter) of 0.2 meter long between a transmitting horn antenna and a transmitter.

Table Question 2 : Value of (kr) for the Principal Modes in Circular Waveguides

| TE | | | | TM | | | |
|---|---|---|---|---|---|---|---|
| MODE | (kr) | MODE | (kr) | MODE | (kr) | MODE | (kr) |
| $TE_{0,1}$ | 3.83 | $TE_{0,2}$ | 7.02 | $TM_{0,1}$ | 2.4 | $TM_{0,2}$ | 5.52 |
| $TE_{1,1}$ | 1.84 | $TE_{1,2}$ | 5.33 | $TM_{1,1}$ | 3.83 | $TM_{1,2}$ | 7.02 |
| $TE_{2,1}$ | 3.05 | $TE_{2,2}$ | 6.71 | $TM_{2,1}$ | 5.14 | $TM_{2,2}$ | 8.42 |

Please turn to next page for Question

(b) (i) Determine the cutoff frequency for the dominant mode and voltage attenuation ratio for signal that is much lower than this cutoff frequency (5 marks)

(ii) Determine all possible principal modes of propagation beside dominant mode and their respective characteristic impedance for 12 GHz signal. (10 marks)

**Question 3 :**

(3) (a) Compare FIVE (5) differences between Moving Target Indicator (MTI) pulsed mode radar with Continuous Wave (CW) radar to detect the speed of moving object. (10 marks)

(b) A traffic police uses hand held radar operated in a stationary mode. The radar square patch antenna is made from Microstrip is as shown in Table Question 3.

Table Question 3

| | |
|---|---|
| Metal Deposition | Copper |
| Metal Width (W) | 500 mils |
| Metal Thickness (Tmet) | 1.4 mils |
| Dielectric material | FC-4 |
| Dielectric Permittivity ($\varepsilon_r$) | 4.8 |
| Dielectric Height (H) | 60 mils |

The Microstrip is connected to resonator of 10.6 GHz. The microwave is targeted at approaching vehicle travels at 90 km/h.

(i) Produce the cross sectional view of above Microstrip antenna with proper labels of height (H), width (W) and thickness and materials used. (6 marks)
(ii) Calculate the maximum gain of this patch antenna (3 marks)
(iii) Calculate the wavelength and band of operation of this radar. (3 marks)
(iv) Calculate the frequency of radar returned signal from the vehicle. (3 marks)

**Question 4**

(4) (a) Describe the differences between NTSC (National Television Standard Committee) and PAL (Phase Alternating Line) TV transmission method. (12 marks)

(4) (b) An 800 cm fiber optic cable with core of flint glass ($n_1$ = 1.46) and a cladding of crown glass ($n_2$ = 1.42). A laser diode and photo diode are used as an optical source and a receiver. The numerical aperture for laser diode or pin diode is 0.389. Manufacturer stated the attenuation is 1 dB per meter. There is a mechanical splice at 100 cm, a fusion splice at 200 cm and 500 cm respectively, one macro band at 700 cm. The fiber cable is tested using an optical time-domain reflectometer (OTDR). The loss for connection method is as shown in Table Question 4.

Table Question 4

| Connection Method | Loss |
|---|---|
| Mechanical Splice Loss | 0.1 dB |
| Fusion Splice Loss | 0.05 dB |
| Macro Band Loss | 2 dB |

(i) By using a graph paper, draw the OTDR results. (6 marks)
(ii) Calculate the critical angle and cone of acceptance for the fiber. (3 marks)
(iii) Calculate the maximum diameter in μm of fiber for single mode transmission at 1300 nm. . (3 marks)
(iv) Calculate the numerical aperture (NA) loss of the system in dB (1 mark)

**Question 5 :**

(5) (a) Discuss FIVE (5) reasons why fiber optics communication is better than wireless communication.

(10 marks)

(b) The Air Traffic Control (ATC) primary radar operates at 1.5 GHz with a peak power of 150 kW. The radar's Pulse Repetition Frequency (PRF) is 800 Hz and pulse width is 3.3 μs. The effective capture area of radar's antenna is 160 $m^2$ and IF (Intermediate Frequency) bandwidth is 3.0 MHz. The receiver has 5 dB Noise Figure operating at noise temperature of 17 °C. An airplane appears as an echo pulse at 200 μs in "A" scope.

Calculate the :

(i) Distance of airplane in radar miles. (2 marks)
(ii) Maximum Unambiguous Range for this radar in radar miles. (3 marks)
(iii) Average transmitted power for this radar in dBm. (3 marks)
(iv) Timing diagram in "A" scope. (4 marks)
(v) Signal to Noise ratio in dB if the power density of echo at receiver's antenna is $3.93 \times 10^{-8}$ W/$m^2$. (3 marks)

**Question 6**

(6) (a) Illustrates three main differences between the following antennas, the answer should include the sketch of structures, radiation pattern and application.

(i) 5 elements Yagi Uda antenna (6 marks)
(ii) Loop antenna (6 marks)

(b) A motor tachometer registers variations as high as 10,000 revolutions per second. This data is digitized. Each digitized sample has maximum dynamic range of 60 dB, pulse width =0.625 μs. There are many motor tachometers. Time Division Multiplexing (TDM) is used with a synchronization bit to identify frame of TDM.

(i) Calculate sampling interval in micro seconds. (2 marks)
(ii) Calculate time in micro seconds required to transmit a message (2 marks)
(iii) State THREE (3) differences between TDM and FDM (Frequency Division Multiplexing). (3 marks)
(iv) Determine the maximum number of tachometer channels per frame. (2 marks)
(v) Determine the number of bits in a frame. (2 marks)
(vi) Determine the minimum bandwidth that is required for a frame. (2 marks)

**-THE END—**