GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY
Faculty of Engineering
Department of Electrical, Electronic and Telecommunication Engineering

BSc Engineering Degree
Semester 5 Examination – May/June 2018
(Intake 33 - ET)

ET 3112 – ANTENNAS AND PROPAGATION

Time allowed: 2 hours

31 May , 2018

INSTRUCTIONS TO CANDIDATES

This paper contains 4 questions on 4 pages

Answer all 4 questions

This is an open for limited content examination. You are authorized to bring 1 (one) A4 page (both side) to the examination and refer to it during the examination if required

This examination accounts for 80% of the module assessment. A total maximum mark obtainable is 100. The marks assigned for each question and parts thereof are indicated in square brackets

If you have any doubt as to the interpretation of the wordings of a question, make your own decision, but clearly state it on the script

Assume reasonable values for any data not given in or provided with the question paper, clearly make such assumptions made in the script

All examinations are conducted under the rules and regulations of the KDU

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Q1. a) Draw a rough sketch to show the three vectors **E**, **H** and **P** for an electromagnetic wave propagating in free space. (2 marks)

b) Give Poynting Theorem for electromagnetic wave propagation. (3 marks)

c) The strength of the signal received at a distant location P, 200 km away from a TV transmitter is 0.1 V/m, for a signal of frequency 475 MHz.

i What is the power density of the signal at P? (5 marks)

ii The safety standard specified by FCC for human absorption of electromagnetic radiation for the UHF region is f/4500 mW/cm^2 where 'f' is in MHz. Is the radiation from the TV transmitter safe for the public living around location P? (10 marks)

iii Would it be safe for the public living 10 km away from the transmitter? (5 marks)

Q2. a) The far field electric field components E_r, E_θ and E_ϕ for a thin Half Wave vertical dipole are,

$$E_r = 0;\ E_\theta = E_0 [\ \mathrm{Cos}[(\pi/2)(\cos(\theta)]\ /\ \sin(\theta);\ \ E_\phi = 0,$$

in the spherical coordinate system as shown in Fig:Q1.

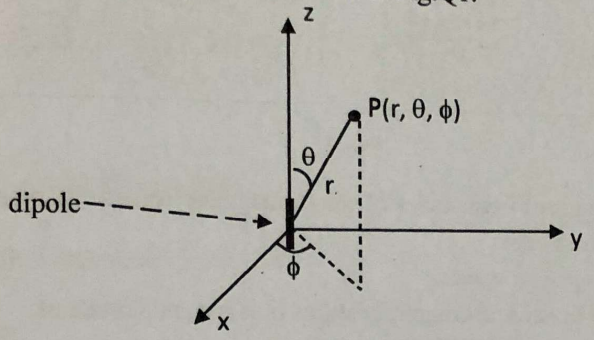

Fig: Q1.

i Draw the radiation pattern for a this vertical HW dipole in the vertical and horizontal planes. (8 marks)

ii Obtain the half power beam width for the vertical HW dipole in the horizontal and vertical planes. (6 marks)

iii Estimate an approximate value for the directivity of the HW dipole. Express your answer in dB. (5 marks)

b) For the vertical HW dipole, give the following:-

i Input impedance (2 marks)

ii Radiation Resistance (2 marks)

iii Polarization. (2 marks)

Q3. A parabolic reflector antenna operating at 3 GHz has a square aperture of size 5 m x 5 m.

a) Draw the far field radiation pattern and obtain the beam width between first nulls. You may assume the far field due to an aperture of size L as, (12 marks)

$$E(\theta) = E_0 \frac{Sin(\varphi/2)}{(\varphi/2)}$$

The letters have their usual meanings. (8 marks)

b) Estimate the antenna gain in dBd, assuming an antenna aperture efficiency of 60%. (5 marks)

c) Fig;Q2 shows different feeding mechanisms of a parabolic dish antenna. Describe the best method out of A, B, C and D, giving its good features and limitations.

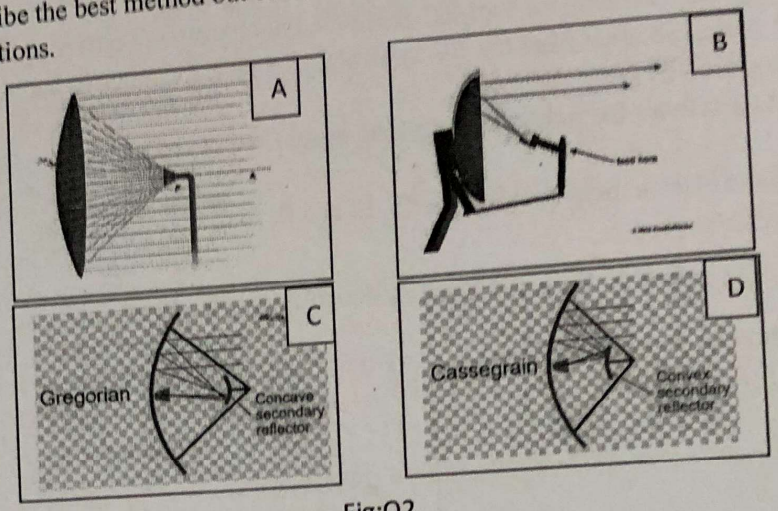

Fig:Q2

Q4. a) i What are the ranges of frequencies of electromagnetic waves that propagate in the ground waves mode? (3 marks)

ii Briefly describe ground waves. (2 marks)

iii Mention one application in communications that uses this mode of electromagnetic wave propagation. (2 marks)

b) i Using a diagram, mention one antenna that is used for communication in the HF region. (3 marks)

ii Name the mode of wave propagation in the HF region? (4 marks)

c) i What is space wave mode of propagation? (4 marks)

ii Give the range of frequencies that propagate in this mode? (3 marks)

iii Describe using a diagram showing the antennas used for a LOS terrestrial link that uses space wave propagation. (4 marks)

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