

University of Eswatini
Faculty of Science and Engineering
Department of Electrical and Electronic Engineering
Main Examination 2021

Title of Paper : **Antenna and Wave Propagation**

Course Number : **EEE544**

Time Allowed : **3 hrs**

Instructions :

1. Answer any four (4) questions
2. Each question carries 25 marks
3. Make sure there are 4 pages including the cover page

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BEEN GIVEN BY THE INVIGILATOR**

QUESTION 1

- (a) (10 pts.) Define the following terms of an antenna:
- (i) Effective area
 - (ii) Directivity
 - (iii) Antenna aperture
 - (iv) Half power beamwidth (HPBW)
 - (v) Antenna efficiency
- (b) (5 pts.) Determine the electric field strength at a distance of 50km due to the power of 100kW radiated from the antenna of 100m effective height.
- (c) (2 pts.) Calculate the radiation efficiency of a short dipole which is $\lambda/8$ m long and it has $R_{loss} = 1.7\Omega$.
- (d) (8 pts.) A transmitting antenna with an effective height of 100m has a current at the base 100A (rms) at the frequency of 300kHz. Determine
- (i) The field strength at a distance of 10km
 - (ii) The power radiated

QUESTION 2

- (a) (10 pts.) A grounded vertical antenna, fed at the bottom with an RF current of 25A at 3MHz, produces a field strength of 9mV/m at a distance of 60km. Determine the effective height of the antenna in meters.
- (b) (10 pts.) Calculate the BWFN and HPBW of a 2.5m paraboloid reflector used at 6GHz. What will be its gain in dB?
- (c) (5 pts.) Determine the electric field strength at 60km distance from a transmitting station of 40kW power.

QUESTION 3

- (a) (8 pts.) Find the FNBW and HPBW in degree for broadside linear array and an end fire linear array consisting of 20 Hertzian dipole with $\lambda/2$ separation and $\lambda/4$ separation, respectively.
- (b) (15 pts.) Discuss the principle of operation of log-periodic antenna? The lower VHF tv channels broadcast from 54 to 88 MHz How many elements and of what length are needed for a log periodic antenna with $k = 0.9$ and $d = 0.08\lambda$. Roughly sketch your design.

QUESTION 4

- (a) (15 pts.) Discuss how Yagi-Uda works. Design a Yagi-Uda antenna of six elements, if the operating frequency is 200 MHz. Take the spacing between the reflector and the driven element to be 0.25λ and other spacing as 0.31λ .
- (b) (10 pts.) If a helical antenna has a spacing between turns 0.05 m, diameter 0.1m, number of turns equal to 20 and operates at 1GHz, find the null-to-null width of the main beam and also half-power beam width and directivity.

QUESTION 5

- (a) (8 pts.) Write short notes on the D, E, and F layers and explain the diurnal and seasonal cycle variations.
- (b) (9 pts.) Explain the following measurements of the antenna
- (i) Gain measurement
 - (ii) Current measurement
 - (iii) Impedance measurements
- (c) (8 pts.) A communication is to be established between two stations using half wavelength antenna for maximum antenna gain of 2.15dB. Transmitter power is 5kW and distance between transmitter and receiver is 120km. What is the maximum power received by the receiver? Frequency of operation is 180MHz.

Useful constants:

$$c = 3 \times \frac{10^8 m}{s}$$

$$1 \text{ radian} = 57.3 \text{ degree}$$

$$\eta = 120\pi \text{ ohms}$$