CRAWFORD UNIVERSITY FAITH CITY IGBESA

COLLEGE OF NATURAL AND APPLIED SCIENCES

DEPARTMENT OF COMPUTER AND MATHEMATICAL SCIENCES

HARMATTAN SEMESTER EXAMINATION

COURSE CODE: ICT 317 COURSE TITLE: TRANSMISSION PROPAGATION AND ANTENNA THEORY

UNITS: 3 **SESSION: 2020/2021**

Instructions:

- **Use your matriculation number as the only means of identification on your answer script.**
- **ANSWER ALL TWENTY (20) QUESTIONS IN THE OBJECTIVE SECTION**
- **ANSWER QUESTION ONE (1) AND ANY OTHER TWO (2) QUESTIONS IN PART B (THEORY SECTION)**
- **PART A: OBJECTIVE SECTION (20 marks)**
- **TIME ALLOWED – $2^1/_2$ HOURS**

PART A: OBJECTIVE SECTION (20 marks)

1. Determine the frequency of a microwave when in active usage for 1 millisecond a) 1KHz b) 10Hz c) 100Hz d) 1Hz
2. If a Half-Wave Dipole operates at 600MHz. What will be the distance between two consecutive maximum points or between two consecutive minimum points? a) 1m b) 0.5m c) 0.25m d) none of these
3. If an antenna draws 12A current and transmits across radiation impedance at 2Ω. What will be the antenna's output voltage? a) 6v b) 12v c) 24v d) 48v
4. A dipole antenna carries current of about 180A across the radiation impedance at 6μΩ. What would be the power radiated by the antenna? a) 0.2341 b) 0.1677 c) 0.1345 d) 0.1944
5. Korede wants to design antenna at 4.5GHz and impedance bandwidth occurs for that antenna from 1.5GHz (f_L) to 5.5GHz (f_H) Help the person out. a) 19.75% b) 20.56% c) 34.50% d) 44.97%
6. Find the radial intensity of the antenna whose radial distance is 64m while the power radiated (Prad) is 2.2kW. a) 1584kW/steradian b) 1782kW/steradian c) 1956kW/Steradian d) 2135kW/steradian
7. A parabolic reflector used for reception with the direct broadcast system is 9m in diameter and operates at 60Hz. The near-field distance for this antenna is
   a) 1.296×10^{-3} m b) 1.296×10^{-2}m c) 8.1×10^{-6}m d) 6.42×10^{-3}m

8. A lossless resonant half-wavelength dipole antenna with 18m in diameter is to be connected to a transmission line that operates at 600Hz. The far-field distance for this antenna is a) 1.296×10^{-2}m b) 8.1×10^{-6}m c) 6.42×10^{-3}m d) 1.296×10^{-3} m
9. The Input power of an antenna is 180kW. If the transmission rate requires 600kW for radiation to occur, find the efficiency of the antenna. a) 33.3% b) 45.3% c) 56.2% d) 67.3%
10. Suppose a lossless antenna with an efficiency of 80% has a directivity of 1.698, find the gain of such an antenna. a) 1.3783dB b) 1.3584dB c) 1.6784dB d) 1.5678dB
11. Determine the HPBW of an antenna that is 50Hz of the wavelength with a diameter of 18m. a) 1.296×10^{-2} m b) 1.296×10^{-3}m c) 8.1×10^{-6}m d) 6.42×10^{-3}m
12. The typical half-power beamwidth of a dipole antenna is 2.15dB, calculate the FNBW of the dipole antenna. a) 4.6dB b) 3.6dB c) 4.3dB d) 2.9dB
13. The formula for HPBW is $=40\lambda/D$ a) True b) False
14. Mathematical Expression for *Percentage bandwidth=absolute bandwidth/centre frequency*=f_H-f_l/f_c a) True b) False
15. Mathematical Expression for far-field region = 140 λ/D a) True b) False
16. The equation of Gain, $G = \eta_e \times D$ a) True b) False
17. The mathematical expression for antenna efficiency, $\eta e=Prad/Pinput$ a) True b) False
18. The mathematical expression for aperture efficiency, $\varepsilon_A=A_{eff}/A_p$ a) True b) False
19. The mathematical expression for Radial Intensity, $U=r^2/Wrad$ a) True b) False
20. The formula for wavelength, $\lambda=c/f$ a) True b) False

PART B (THEORY SECTION)

QUESTION ONE (20 MARKS)

a) Give a comprehensive report/analysis on the Excursion report to Airtel Site. **(4 Mks)**

b) Plot five (5) graphs from the following three tables of Angular velocity against Antenna Gain(dB) with their slopes accordingly. **(10 Mks)**

(i)

Angular velocity	0°	20°	25°	60°	75°	100°	120°
Antenna Gain (dB)	-3	-2	-1	0	1	2	3

(ii)

Angular velocity	0°	15°	25°	35°	45°	60°	75°	80°	85°	95°
Antenna Gain (dB)	-9	-8	-7	-6	-5	-4	-3	-2	-1	0

(iii)

Angular velocity	0°	30°	60°	90°	120°	150°	180°	210°	240°
Antenna Gain (dB)	-12	-9	-6	-3	0	3	6	9	12

(iv)

Angular velocity	0°	50°	100°	150°	200°	250°	300°	350°	400°
Antenna Gain (dB)	-15	-12	-9	-6	0	6	9	12	15

(v)

Angular velocity	0°	120°	160°	200°	240°	280°	320°	360°	400°
Antenna Gain (dB)	0	3	6	9	12	15	18	21	24

1e. State the main reason for the increase of the values of the Antenna gain by 3. **(3 Mks)**

1f. State the Mathematical expression of the Antenna gain. **(3 Mks)**

QUESTION TWO (10 MARKS)

a. List and explain the four (4) types of Antenna polarization. **(4 Mks)**

b. Briefly discuss the following terms: 1) Waveguide (with diagram) 2) Frequency (with its mathematical expression) 3) Wavelength (with its mathematical expression) 4) VSWR & Reflected power 5) Bandwidth 6) Radiation intensity (with its mathematical expression). **(6 Mks)**

QUESTION THREE (10 MARKS)

a. (i) Distinguish between the near field and the far field in terms of its effect and mathematical expression. **(4 Mks)**

(ii) Draw the diagram that illustrates the Near and Far field regions. **(2 Mks)**

b. Explain the following terms briefly: 1) Radiation 2) Radiation pattern in 2D 3) Main Lobe 4) Fan-beam Pattern. **(4 Mks)**

QUESTION FOUR (10 MARKS)

a. (i) List and briefly state the application areas of the following frequency bands: 1) ELF 2) SLF 3) VLF 4) LF 5) MF 6) HF 7) VHF 8) UHF 9) SHF 10) EHF. **(5 Mks)**

(ii) Highlight the Wavelengths (in metres) of a (i) above. **(2.5 Mks)**

(iii) State the frequency ranges of a(i) above. **(2.5 Mks)**

QUESTION FIVE (10 MARKS)

a. Someone wants to design antenna at 2.5GHz and impedance BW occurs for that antenna from 2GHz (f_L) to 4GHz (f_H). Help the person out. **(4 Mks)**

b. A parabolic reflector used for reception with the direct broadcast system is 18m in diameter and operates at 300Hz. What is the far-field distance for this antenna? **(6 Mks)**

QUESTION SIX (10 MARKS)

a. (i) Identify and briefly discuss the three (3) categories for propagation mode of electromagnetic waves in the atmosphere and in free space. **(3 Mks)**

(ii) Identify any two (2) applications of Radio wave Propagation. **(2 Mks)**

b. State the constituents of the ionosphere and its mode of operation. **(2 Mks)**

c. State two (2) applications of sky waves. **(2 Mks)**

d. (i) Highlight one (1) application of radio waves. **(1 Mk)**