ELIZADE UNIVERSITY, ILARA-MOKIN, ONDO STATE

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

FIRST SEMESTER EXAMINATION, 2017/2018 ACADEMIC SESSION

COURSE TITLE: ANTENNA AND WAVES PROPAGATION

COURSE CODE: EEE413

EXAMINATION DATE: 22ND MARCH 2018

COURSE LECTURER: DR. O. AKINSANMI

HOD's SIGNATURE

TIME ALLOWED: 3 HOURS

INSTRUCTIONS:

1. ANSWER FIVE QUESTIONS ONLY
2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM.
3. YOU ARE **NOT** ALLOWED TO BORROW ANY WRITING MATERIALS DURING THE EXAMINATION.

Question 1

(a) (i) Define what is meant by the term ''antenna'' [2 marks]
(ii)List four different types of antennas you know [2 marks]
(b) How is an antenna a reciprocal device? [4 marks]
(c) If the signal power P_t is input into an isotropic antenna, what will be the power density of the radiated field at distance r? [4 marks]

Question 2

(a) What are the applications of the following types of antennas
(i) Wire antennas [1 mark]
(ii) Aperture antennas [1 mark]
(iii) Reflector antennas [1 mark]
(iv) Lens antennas [1 mark]

(b) Why does an antenna radiate an electromagnetic field? [4 marks]

(c) Mention any four electrical properties of an antenna [4 marks]

Question 3

(a) (i) What is an isotropic antenna? [2 marks]
(ii)Which is the most important property of an antenna [2 marks]

(b) Sketch the radiation pattern of an isotropic antenna
(i) in polar co-ordinate system [2 marks]
(ii) in rectangular co-ordinate system [2 marks]
(c) Signal power of P_t is input to an isotropic transmitting antenna. Calculate the power density S, electric field strength E and the magnetic field strength H at distance r for:
(i) $P_t = 10W,\ r = 100m$ [2 marks]
(ii) $P_t = 10W,\ r = 1Km$ [2 marks]

Question 4

(a) (i) Why does the gain of a given antenna not depend on whether the antenna receives or transmits electromagnetic waves? [2 marks]

(ii)What is the output power of an amplifier with the gain of 30dB and the input signal power is 1mW. [2 marks]

(b) (i)What is the difference between the antenna gain and the amplifier gain of an antenna? [1 marks]
(ii)If the gain of a transmitting antenna is 30dB, and a signal power of 1mW is input to the antenna, what is the power radiated from the antenna to the atmosphere? [3 marks]

(c) Derive a mathematical expression for the gain of the antenna. [4 marks]

Question 5

(a) State a difference between the gain and directivity of an antenna. [4 marks]

(b) For a totally lossless antenna, if the gain is 15dBi, what is the directivity? [4 marks]

(c) Calculate the value of the power density S of an antenna for which Electric field strength E and magnetic field strength H and $G = 15dBi, P_t = 10W, r = 100m$ [4 marks]

Question 6

(a) (i) Explain the term ''Capture area'' [2 marks]

(ii)Give the mathematical expression for the capture area A_e of an antenna.[2 marks]

(b) Calculate the power received, P_r (dBm) by an antenna at a frequency f (100MHz) and at a received antenna gain G (8dB) and electric field strength $E(54dB\mu V/m)$. (Assuming FM radio reception) [4 marks]

(c) A 900MHz whip antenna is of the length $\frac{\lambda}{4}$ and of gain 2dBi on the roof of a car. What is the capture area of the antenna? Compare this area to the physical size of the antenna. [4 marks]

Question 7

(a) Derive the link-budget equation in terms of the decibels [4 marks]

(b) A satellite link has a frequency of 12GHz. The satellite antenna reflector size is 1m, the ground station has 2m antenna. The aperture efficiency of each antenna is70%. The power received by the ground station must be -75dBm. What the power of the satellite transmitter (dBm). [4 marks]

(c) If the frequency in (b) above is 24GHz and the aperture efficiency of the antennas is 70%. What is the required power of the transmitter? [4 marks]