



KENYATTA UNIVERSITY
UNIVERSITY EXAMINATIONS 2011/2012
FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELLOR OF
SCIENCE

SPH 408: ANTENNAS AND WAVE PROPAGATION

DATE: Friday 2nd December 2011

TIME: 11.00a.m – 1.00p.m

Answer Question one and two other questions.

Question 1

40 marks.

An antenna with a complex wave impedance

$Z_A = 50 + j20$ Ohms is connected to a transmission line of impedance $Z_L = 45 + j30$ Ohms and a transmitter of 100 Watts power output with negligible .

The Antenna has a gain of 15 dB.

Evaluate the following:

- (a) Complex reflection factor Γ
- (b) VSWR
- (c) Return power loss in dB
- (d) Matching factor
- (e) Power absorbed at the Antenna in dB
- (f) EIRP
- (g) Antenna efficiency
- (h) Comment on the Antenna system setup.

Question 2.

30 marks

An Antenna Array has an input power of 100 milli Watts. The electric field strength the Antenna is given by the following function:

$$E(\varphi) = 10 \sin\left(\frac{n\pi a}{\gamma} \cos \varphi\right) \text{ dB}, \quad 0 \leq \varphi \leq 2\pi \text{ Radians, where: } n = 6, a/\gamma = \frac{1}{4}$$

- (a) Sketch horizontal radiation pattern for this Antenna
- (b) What is the EIRP of the Antenna in dB
- (c) What is HPBW and NPBW
- (d) Calculate F/B ratio in dB
- (e) What is the gain of this Antenna
- (f) What type of Antenna is this
- (g) What are possible uses

Question 3

30 marks

Given below is a radio link overland with the following technical specifications.

Transmitter power 100 Watts, Frequency – 7 GHz, Gain of transmit Antenna 15 dB, Gain of receive Antenna 20 dB, Distance between transmitter and receiver 40 kilometers, Transmit Antenna height 40 meters, receive antenna height 35 meter, transmission losses 2.5 dB, Receiver sensitivity -85 dB. Assume atmospheric losses to be 2 dB.

Evaluate the following:

- (a) Transmitter EIRP
- (b) Free Space losses
- (c) h_{Tx} and h_{Rx}
- (d) Received power
- (e) System/Link Margin
- (f) Will the system work? If so explain
- (g) If not make necessary design adjustments to make it work.

Question 4.

30 Marks

Given a 60 meter long vertical Antenna with mean wave impedance Z_L is 300 Ohms and operating current of 20 Amps. The operating frequency is 1.2 MHz. Assume clear Line of Sight conditions.

Evaluate the following:

- (a) Input Impedance of the Antenna Z_A
- (b) Maximum voltage
- (c) Antenna output power
- (d) Lost power if loss resistance is 1.5 Ohms
- (e) Efficiency of the system

Question 5:

30 marks

Given a parabolic Microwave Antenna at both Tx and Rx ends of a radio link:

Diameter = 2 meters, Apperture efficiency = 0.7, Separation between Tx and Rx = 40 Km, Transmitter Power = 10 watts, System Temperature = 40 degrees Celsius.

Evaluate the following:

- (a) Effective Surface Area A_e
- (b) Operating frequency f_c
- (c) Gain in DB
- (d) Bandwidth
- (e) Free space loss in dB
- (f) Power at the receiver end in dB
- (g) System margin
- (h) Noise power in dB
- (i) S/N ratio at the Receiver in dB