Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	ANTENNA THEORY AND DESIGN
COURSE CODE	:	BEB 41003
PROGRAMME	:	4 BEJ
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL FOUR (4)** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) An efficient antenna system depends on the antenna design considerations which affect the antenna performance.

(i) Explain FIVE (5) important design considerations of an antenna system.

(5 marks)

(ii) Describe THREE (3) factors which limit the performance of an antenna and suggest practical ways to optimize the efficiency of an antenna.

(5 marks)

(b) A high gain antenna is required to be installed at a base station located in Kajang, Selangor to replace a degraded antenna system.

(i) With the aid of relevant mathematical equations and diagrams, explain key important factors in order to achieve a high gain antenna performance at the base station.

(5 marks)

(ii) The power gain of the transmit antenna is now fixed at 25 and the input power is specified to be generated at 250W. Determine the Effective Isotropic Radiated Power (EIRP) in Watts and dBW.

(5 marks)

(iii) Based on the calculations obtained in **Q1(b)(ii)**, propose an antenna design which takes into account the average power at a distance of 35.75 km away from the transmit antenna.

(5 marks)

Q2 (a) Explain the term *Maximum Power Transfer* (MPT) in guided mediums. Construct a basic formulation condition that is required in order to achieve MPT.

(3 marks)

(b) A basic equivalent circuit can be used to represent a transmission line of length y cm with characteristic impedance, Z_o given by $a \leq Z_o \leq b$.

(i) Formulate the radiation resistance of the transmission line by taking into consideration dissipated power and radiated power of the line.

(2 marks)

(ii) If a half-wave dipole antenna is designed at 2 GHz with slots embedded in the dipole element, illustrate the radiation pattern of the antenna considering the important values of a and b.

(2 marks)

(iii) Discuss the impact caused by the introduction of slots on surface currents.

(2 marks)

(c) Consider an ideal transmit antenna, where the values of the radiation resistance R_{rad} = 78.5 Ω, the effective antenna resistance, R_e = 18 Ω, the directive gain, G_d = 15 and an input power P_{in}=100W;

(i) Calculate the radiation/antenna efficiency.

(4 marks)

(ii) Determine the antenna gain, G_p (absolute and dB).

(4 marks)

(iii) Calculate the radiated power and the Effective Isotropic Power (EIRP) in Watts, dBm and dBW.

(4 marks)

(iv) Based on the results obtained in **Q2(c)(i)-(iii)**, evaluate the performance of the antenna.

(4 marks)

Q3 (a) The disappearance of MH370 has left the aviation experts at a loss of what actually had happened.

(i) Based on the fundamental of radio wave propagation, explain **TWO (2)** main functions of a control tower at Kuala Lumpur International Airport (KLIA).

(5 marks)

(ii) With the aid of relevant diagrams, explain possible reasons of the missing plane and suggest practical strategies to resolve the problem.

(5 marks)

(b) A 2m diameter parabolic reflector is required to be designed at the Control Tower of KLIA with 10W of power radiated by the fed mechanism operating at 6GHz. Given the transmit antenna efficiency is 55%, determine

(i) Beamwidth (4 marks)

(ii) Transmit power gain and Receive power gain (dB) (4 marks)

(iii) EIRP (4 marks)

(c) Predict the performance of the parabolic antenna in **Q3(b)** if the transmit efficiency is increased to 65%.

(3 marks)

Q4 Figure Q4 shows the effect of the variation in dielectric constant and dimensions of resonant microstrip elements printed above grounded dielectric substrates.

(a) With the aid of relevant equations and diagrams, explain sources of loss of microstrip patch elements.

(5 marks)

(b) Design a microstrip patch line considering the width and the length of a microstrip line for a 50Ω characteristic impedance and a 45° phase shift at 2.5 GHz. The substrate thickness is d=0.127cm, with ε_r=2.20.

(8 marks)

(c) As a communications engineer, you have been assigned to design a microstrip line for multi-band systems which can be mounted onto a mobile station in Batu Pahat. It composes of zero thickness copper conductors on a substrate having εr = 8.4 tan δ =0.0005 and thickness 2.4 mm. If the line width is 1 mm, and operated at 10 GHz, design a multi-band microstrip antenna with these specifications which takes into account the characteristics impedance and the attenuation due to the conductor loss and dielectric loss.

(12 marks)

- END OF QUESTION -

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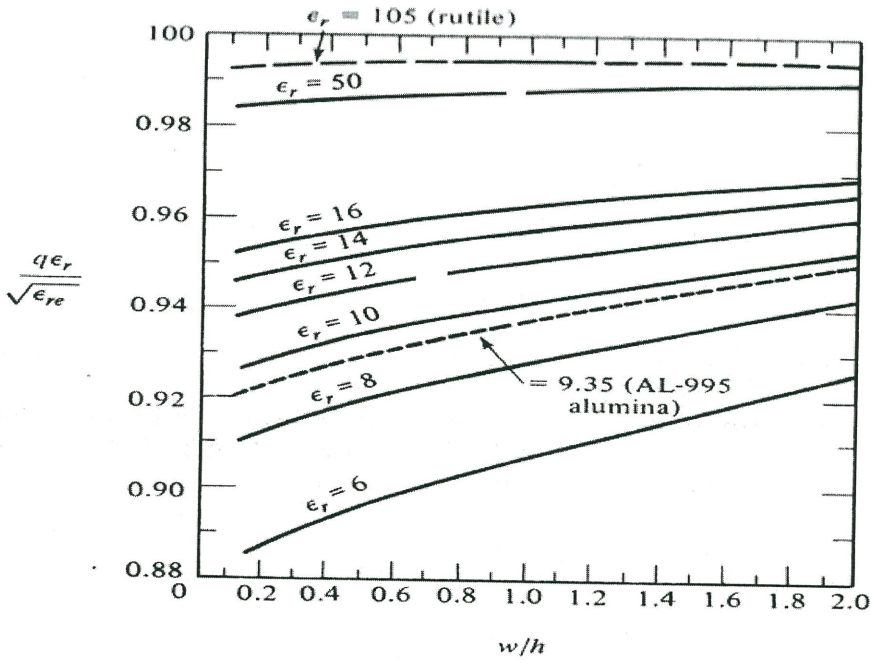

FIGURE Q4