UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	APPLIED ELECTROMAGNETICS
COURSE CODE	:	BEB 30603
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	DECEMBER 2018/JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) Define lossless transmission lines together with the line parameters.

(2 marks)

(b) Explain the concept of skin depth with the help of a proper figure.

(2 marks)

(c) Illustrate the concept of matching network in a transmission line system. Relate the matching network with impedance matching techniques.

(3 marks)

(d) A lossless transmission line of length 0.434λ and characteristic impedance $100\ \Omega$ is terminated in an impedance $260 + j180\ \Omega$. Use the Smith Chart to determine:

(i) voltage reflection coefficient,

(ii) standing wave ratio,

(iii) input impedance, and

(iv) the location of a voltage maximum closest to the load.

(12 marks)

(e) The standing wave ratio on the line is now reduced to 2 by changing the terminating impedance to a resistive load, R_L. Determine:

(i) resistive load R_L, and

(ii) input impedance.

(6 marks)

Q2 (a) Explain THREE (3) main roles of a metallic cavity in microwave engineering.

(4 marks)

(b) Briefly describe the quality factor, Q of the cavity. Evaluate Q if the cavity is lossless.

(4 marks)

(c) A rectangular air-filled copper waveguide with dimension 0.9 inch x 0.4 inch cross section and 12 inch length operates at 9.2 GHz with a dominant mode. Design a rectangular waveguide in a dominant mode of microwave operation

by calculating cut-off frequency, guide wavelength, phase velocity, characteristic impedance and loss factor. (12 marks)

(d) Differentiate the field distribution of the waveguide for TE_{10} and TE_{20}. With the help of relevant diagrams, explain important steps in order to avoid multi-mode operation in the waveguide. (5 marks)

Q3 (a) With the aid of relevant equations or diagrams, briefly explain the following terms:

(i) gain, G_R for a receive antenna,

(ii) radiation efficiency, η_r,

(iii) polarisation, and

(iv) half-power beam width.

(2 marks)

(b) A dipole antenna of length 0.35λ operating at 3 GHz is constructed by using copper with 2.5 mm in diameter.

(i) Determine the radiation efficiency, η_r of the antenna.

(2 marks)

(ii) Calculate the directivity, D of the antenna if maximum radiation intensity, U_{max} of 0.75 W/sr and input power, P_{in} of 0.25 W are employed respectively.

(8 marks)

(iii) Four half-wave dipoles are arranged in a square lattice, spaced in a straight line by a distance of one half wavelength along a line. Illustrate the element pattern in both E and H planes and predict the boresight gain in case that all elements are fed with equal amplitudes which are in phase.

(5 marks)

(c) Given transmit antenna efficiency, η_r is 65%, design a parabolic reflector operating at 8.52 GHz with 15 W of power radiated by the systems. In your consideration, plan the design of the reflector by taking into account the beam width, θ; transmit power, P_T; receive power, P_R; and Effective Isotropic Radiated Power, EIRP. (8 marks)

Q4 (a) Differentiate between Electromagnetic Compatibility (EMC) and Electromagnetic Interference (EMI)

(2 marks)

(b) Describe the condition(s) when a system is considered as *Electromagnetically Compatible*.

(2 marks)

(c) **Figure Q4(c)** shows an electrical system that fails some EMC tests due to some EMI issues.

(i) Relate to the EMC tests involved

(ii) Propose and elaborate some methods that you can used to minimise the emissions as shown in the **Figure Q4(c).**

(10 marks)

(d) In EMC measurement setups, many environments such as listed below are involved:

- Open Area Test Site (OATS)
- Screened Room (SR)
- GigaHertz Transverse Electromagnetic Cell (GTEM)
- Semi Anechoic Room (SAR)
- Reverberation Chamber (RC)

(i) Explain the term environment in the aspect of EMC testing. (2 marks)

(ii) From the environments listed above, compare these environments in terms of their advantages and disadvantages.

(9 marks)

- END OF QUESTIONS -

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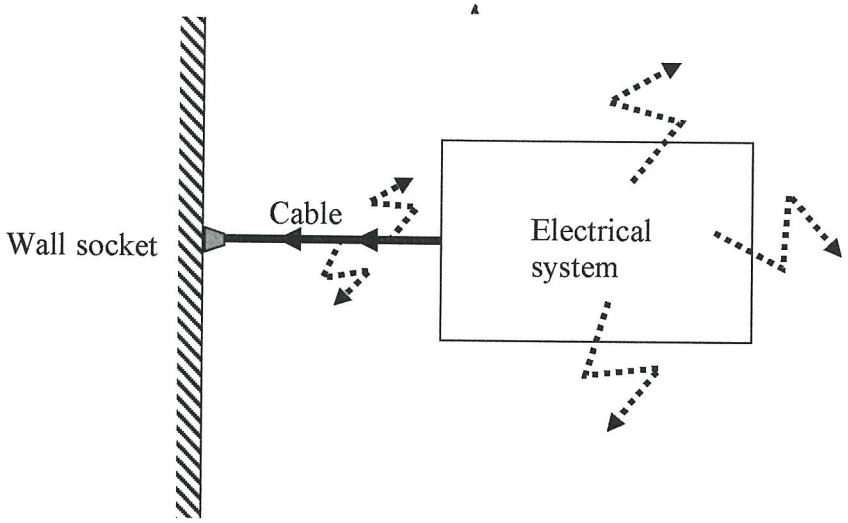

FIGURE Q4(c)