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**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
(OTHER SUMMATIVE ASSESSMENTS)  
SEMESTER II  
SESSION 2019/2020**

COURSE NAME : ANTENNA THEORY AND DESIGN  
COURSE CODE : BEB 41003  
PROGRAMME CODE : BEJ  
EXAMINATION DATE : JULY 2020  
DURATION : 2 WEEKS  
INSTRUCTION : PLEASE READ THE INSTRUCTION  
OPEN BOOK EXAMINATION

**THIS QUESTION PAPER CONSISTS OF TWO (2) PAGES**

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**TERBUKA**

As a consultant at Microwave Avenue Consultancy, you have been assigned to design a high performance rectangular microstrip patch antenna in the X-band frequency range. You are given three different sets of dielectric materials for this project. Table 1 shows the specifications of the dielectric substrates:

Name of Substrate Material	Dielectric constant ( $\epsilon_r$ )	Dissipation factor ( $\tan \delta$ )	Thickness (mm)
RA-252	2.2	0.0002	1.5
RG-135	2.1	0.025	2.4
FR-4	4.7	0.002	1.4

Table 1: Specifications of three substrate materials

Based on relevant theories, calculations and CST/HFSS simulations, you are required to design a 4 x 4 microstrip array antenna. In this work, you should include the following design considerations:

- a) Describe important methodology of the 4 x 4 microstrip array design for a specific application. (10 marks)
- b) Apply the transmission line model to correlate the relationship between the loss and bandwidth performance of the 4 x 4 microstrip array constructed on 3 different sets of dielectric materials. (15 marks)
- c) Compare the gain performance between a single rectangular microstrip patch and a 4 x 4 microstrip array. (10 marks)
- d) Explain the chosen feeding technique and impedance matching criteria with the support of calculations and simulations. (7 marks)
- e) Analyze the radiation patterns of the array antenna both in polar and rectangular plots based on the three substrate materials. (8 marks)

A final report with a comprehensive analysis should be submitted by 14<sup>th</sup> June 2020 before a final online presentation session.

**-END OF QUESTIONS-**