Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech (ECE)/SEM-1/MCE-104/2012-13

2012

ADVANCED MICROWAVE COMMUNICATION ENGINEERING

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

Answer *all* the questions. 14

1. Derive the Friss transmission formula with the help of proper diagram. 5
2. Draw the equivalent circuit of an antenna both as a transmitter and a receiver. 3
3. What are different types of impedance matching network used in microwave circuits ? Explain any one with example. 3
4. What are the high frequency limitations of conventional measuring techniques ? 3

GROUP – B

Answer any *four* of the following. 4 × 14 = 56

5. Derive the expression for electric field for a Hertzian dipole antenna in the far field region with suitable diagram.

6. a) Draw and describe the different types of feed used in microstrip antennas. What are the major drawbacks of microstrip antennas ?

   b) Design a rectangular microstrip antenna using a substrate (RT/duroid) (5880) with $\varepsilon_r = 2 \cdot 2$ and $h = 0 \cdot 1588$ cm so as to resonate at 10 GHz. 5 + 2 + 7

7. a) A uniform plane wave is incident upon a very short lossless dipole ($1 << \lambda$). Find maximum effective area assuming the radiation resistance of the dipole is 80 ($\pi l/\lambda)^2$ and the incident field is linearly polarized along the axis of the dipole. 5

   b) Mention the advantages of horn antenna. Describe with reasons why normal mode of operations is seldom used in helical antenna. 5 + 4

8. Define the S-parameters and its properties. What are the different parameters associated with a two port network ? Show how to measure return loss using Vector Network Analyzer for a two-port device. Derive the S-matrix for a directional coupler and explain its relevant parameters. 3 + 2 + 5 + 4

9. a) A rectangular waveguide cavity is made of copper WR-180 band waveguide with a = 4·755 cm and b = 2·215 cm. The cavity is filled with polyethylene (ε_r = 2·25, tanδ = 0·0004). If resonant frequency is 5 GHz, find the required length d and resulting Q for the 1 = 1 and 1 = 2 resonant modes. 8

b) Explain the operating principle of Isolator and Circulator. 6

10. What are the limitations of vacuum tube devices ? Explain the operating principle of Magnetron. The parameters of two cavity amplifier klystron are : V_0 =1200 V, I_0 = 28 mA and f = 8 GHz. Gap spacing in either cavity : d = 1 mm, spacing between two cavities : L = 4 cm and effective shunt resistance : R_{sh} = 40kΩ (excluding beam loading).

a) Find the input microwave voltage V_1 in order to generate maximum output voltage.

b) Determine the voltage gain.

c) Calculate the efficiency of the amplifier neglecting beam loading.

d) Compute the beam loading conductance and show that one may neglect it in preceding calculations. 3 + 5 + 6

11. Why are semiconductors preferred over vacuum tubes in most applications ? Where are tubes still required ? What is the principle of operation of TRAPATT diode ? Explain velocity modulation using relevant mathematical expressions. 3 + 2 + 5 + 4