Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech (ECE)/SEM-2/MEC-1005/2010

2010

MICROWAVE MEASUREMENT

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.

Answer any *five* questions. 5 × 14 = 70

1. What do you mean by impedance measurement ? How is standing wave occurred in a microwave circuit ? Briefly discuss about a microwave measurement using slotted-line technique. 2 + 2 + 10

2. What are the different types of noise occurred in a microwave circuit ? Derive the expression of Y-factor method to measure noise temperature of a noisy amplifier. An X-band amplifier has a gain of 20 dB and bandwidth of 1 GHz. Its equivalent noise temperature is to be measured by Y-factor method. The following data is obtained :

   T1 = 290K (hot resistor temperature), T1 = 77K (cold resistor temperature), output noise power N1 = – 62 dBm, N2 = – 64·7 dBm (hot & cold resistor noise power). Determine the equivalent noise temperature of the amplifier. 2 + 6 + 6

3. How is frequency measurement occurred in a microwave circuit ? Briefly discuss about a frequency measurement & calibration technique at microwave frequency. 2 + 12

4. What are the problems occurred to measure electrical parameters at microwave frequency ? Why is scattering matrix necessary to measure electrical parameters at microwave frequency ? Draw the signal flow graph of a two-port network & find the reflection & transmission parameters using scattering matrix. 2 + 4 + 8

5. What is intermodulation distortion & why is it occurred ? The following relation is given for a non-linear amplifier :

   $V_o = a_0 + a_1 \cdot V_i + a_2 . V_i . V_i + a_3 . V_i . V_i . V_i$ [V_o = o/p voltage, $V_i = A \sin\omega t$, a_0, a_1, a_2 are constant]. Find the expression of third order intermodulation distortion of this amplifier.

   2 + 2 + 10

6. What are the systematic, random, drift errors occurred in microwave measurement ? What do you mean by load & source mismatch in a microwave circuit ? Briefly explain how load & source mismatch causes errors in a microwave circuit with proper diagram. 2 + 2 + 2 + 2 + 6

7. What are different types of microwave sensors used ? Briefly discuss about the different types of microwave sensors.

2 + 12

8. What are the precautions taken to measure scattering parameters using VNA ? Give an example of a one-port & two-port network. Briefly write the procedure to measure the reflection & transmission parameters of a two-port network using VNA. 2 + 2 + 10