



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

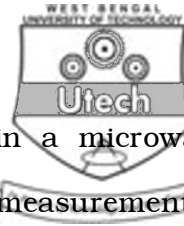
*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

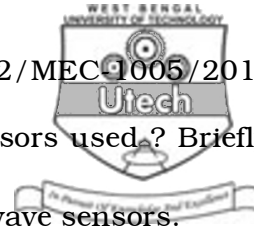
Answer any five questions. 5 × 14 = 70

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 :

T<sub>1</sub> = 290K (hot resistor temperature), T<sub>1</sub> = 77K (cold resistor temperature), output noise power N<sub>1</sub> = - 62 dBm, N<sub>2</sub> = - 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 :
- $$V_o = a_0 + a_1 \cdot V_i + a_2 \cdot V_i \cdot V_i + a_3 \cdot V_i \cdot V_i \cdot V_i$$
- [ $V_o$  = 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

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