



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.*

Answer any five questions.

5 × 14 = 70

1. a) Explain why an isolator is located after an unknown generator.
- b) Why H , Y or Z are not used to analyze the microwave circuits ?
- c) Why GaAs is used for high frequency and high speed devices ?
- d) What are the limitations of microwave vacuum tubes ?
- e) What is the range of dielectric constant and length of the patch used in microstrip antenna ?

3 + 3 + 3 + 3 + 2



2. a) What are the advantages and disadvantages of microstrip antenna ?
- b) What are the different types of feeding techniques used in microstrip antenna ? Discuss one of them.
- c) Design a rectangular microstrip antenna using a substrate (RT/duroid 5880) with dielectric constant of 2.2, $h = 0.1588$ cm (0.0625 inches) so as to resonate at 10 GHz. 3 + (2 + 3) + 6

3. a) Explain how tunnelling action takes place in a tunnel diode.
- b) Prove that the input impedance of a tunnel diode is given by the expression

$$Z_{in} = R_s + j\omega L_s - [R (j/\omega C) / \{ R + (j / \omega C) \}]$$

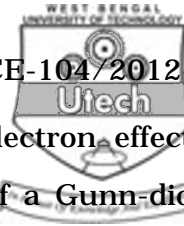
- c) A tunnel diode has the following characteristics :

Negative resistance (R) = 26Ω , Series Resistance (R_s) = 1Ω

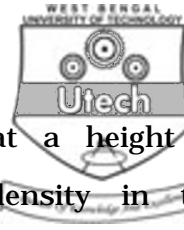
Junction capacitance (C) = $5 pF$

Now calculate the resistive cut-off frequency. 4 + 6 + 4

4. a) Define and prove the properties of S-parameters.
- b) Prove that for a reciprocal three-port network, the ports cannot all be perfectly matched when the network is dissipationless.
- c) Show that how a microwave circulator can be used as a reflection type microwave amplifier. 5 + 5 + 4



5. a) What is the meaning of Transferred electron effect ?
Give the sketch of V-I characteristics of a Gunn diode indicating its threshold point and its implication in operation.
- b) Explain the operation of a Gunn diode oscillator with suitable circuit diagram.
- c) The drift velocity of electron is 2×10^7 cm/sec through the active region of length 10×10^{-4} cm. Calculate the natural frequency of the diode and the critical voltage for GaAs. Critical field for GaAs is 3.2 kV/cm.
- (3 + 3) + 4 + 4
6. a) What is the purpose of using array of antennas ?
- b) Derive an expression of 'array factor' for N numbers of identical antennas. What are the conditions to obtain linear Broad Side array radiation pattern ?
- c) Describe the Hansen and Woodyard's condition to obtain increased directivity.
- 2 + (5 + 3) + 4
7. a) Discuss the theory of reflection of radio waves from the ionosphere layer.
- b) What do you mean by critical frequency of the layer ?
Derive the Secant law related to Maximum Usable Frequency (MUF).



- c) Assume that reflection takes place at a height of 400 km and that the maximum density in the ionosphere corresponds to a 0.9 refractive index at 10 MHz. What will be the range (assume earth is flat) for which the MUF is 10 MHz ? $4 + (2 + 4) + 4$

8. Write short notes on any *two* of the following : $7 + 7$

- a) IMPATT
 - b) Microstrip antenna
 - c) Sky wave propagation
 - d) Duct propagation.
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