Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH (ECE) (Separate Supple)/SEM-7/EC-701/2011

2011
RF & MICROWAVE 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
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

　　　　　　　　　　　　　　　　　　$10 \times 1 = 10$

　i)　A rectangular cavity resonator having a = width, b = height and d = length for a > b < d, the dominant mode is

　　　a)　TE_{101}　　　　　　b)　TM_{101}

　　　c)　TE_{110}　　　　　　d)　TM_{110}

　ii)　The transmission loss for a 3 GHz. Microwave system for a certain distance is 130 dB. If the frequency is doubled then the transmission loss will be
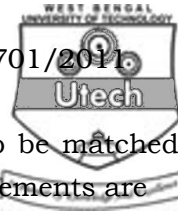
　　　a)　136 dB　　　　　　b)　133 dB

　　　c)　127 dB　　　　　　d)　139 dB.

　iii)　Any two port network having a 6 dB loss will give an output power which is — of input power

　　　a)　$0 \cdot 25$　　　　　　b)　$0 \cdot 50$

　　　c)　$0 \cdot 707$　　　　　　d)　None of these.

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iv) A microwave component is supposed to be matched at all ports if in the S matrix all diagonal elements are

    a)   0

    b)   equal but not 0

    c)   complex

    d)   none of these

v) The guided wave length is measured by short circuiting a waveguide and shifting the tunable probe along the slotted line to locate the voltage minima. If the shorting plate is replaced by matched load, the measurement of guided wavelength will be

    a)   more accurate

    b)   impossible

    c)   less accurate

    d)   none of these.

vi) Microwave components can be characterized by _____ parameters

    a)   y

    b)   z

    c)   s

    d)   h.

vii) The dominant mode in a wave guide is characterized by

    a)   longest cutoff wavelength

    b)   shortest cutoff wavelength

    c)   zero attenuation

    d)   infinite attenuation.

viii) A cavity is a _____ filter

    a)   high pass

    b)   low pass

    c)   band pass

    d)   band reject

ix) When electric field is present only in the direction perpendicular to the direction of propagation, resulting mode is

    a)   transverse electric

    b)   transverse magnetic

    c)   longitudinal

    d)   none of these.

x) Klystron operates on the principle of _____ modulation

    a)   amplitude

    b)   frequency

    c)   pulse

    d)   velocity.

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GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Define Microwave Circulator. Describe the operating principle of a four port circulator.   5

3. a) What do you mean by cut-off frequency of a waveguide ?

   b) On what factors the cut-off frequency of a waveguide depends ? Derive expressions in support of your answer. $1 + 4$

4. A magic TEE is match-terminated at all its ports. A signal of power 1 mW is fed to its H arm from a matched generator. Find the power output from other ports.   5

5. Describe the operation of an Isolator   5

6. Spellout why conventional pentode tube fails to work in GHz. range.   5

7. Define and explain Coupling factor, Directivity, Isolation and Insertion Loss of a Directional Coupler.   5

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

8. a) TE mode is propagating through a rectangular waveguide. Find the expressions for electric field and magnetic field components.   10

   b) Explain Cavity Resonance. Derive expression for resonant frequency of a rectangular cavity resonator.   5

9. a) Define and explain what is meant by scattering matrix of a microwave junction. Illustrate with an example of four port junction.   5

   b) Derive the scattering matrix of a Magic TEE.   5

   c) Explain how a four port circulator can be designed using two Magic TEEs. Give necessary diagrams.   5

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10. a) Define and elucidate what is meant by velocity modulation ? Explain the working principle of reflex klystron with the use of Velocity Modulation. 5

   b) Derive the expressions of its power output and show how it varies with the repeller voltage. 5

   c) A reflex Klystron is to be operated at frequency 10 GHz. with DC beam voltage 300 V, repeller space $0 \cdot 1$ cm for $1\frac{3}{4}$ mode. Calculate P_{RFmax} and corresponding repeller voltage for a beam current 20 mA. 5

11. a) What are the different techniques for measuring Microwave power ? 5

   b) How can you measure the microwave peak power from average power ? 2

   c) Explain clearly the experimental setup to measure the high value of microwave power. 5

   d) Explain the working principle of a Phase-shifter. 3

12. a) What is strip line and microstrip line ? 3

   b) What are the advantages and disadvantages of Microstripline ? 3

   c) Show the Electric and Magnetic Field Lines of Microstripline ? 4

   d) Explain the working principle of a microstrip antenna. 5