



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech/ECE/SEM-7/EC-701/2012-13**

**2012**

**RF AND 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 any *ten* of the following :  
 $10 \times 1 = 10$

i) Which of the following modes does not exist in a rectangular waveguide ?

- |        |                   |
|--------|-------------------|
| a) TE  | b) TM             |
| c) TEM | d) None of these. |

ii) The cut-off frequency for the dominant mode in an air-filled rectangular waveguide with internal dimension of 4 cm  $\times$  2.5 cm is

- |            |              |
|------------|--------------|
| a) 7.5 GHz | b) 6 GHz     |
| c) 4.5 GHz | d) 3.75 GHz. |



iii) In a rectangular cavity which of the following modes does not exist ?

- a)  $TE_{110}$                                       b)  $TE_{011}$
- c)  $TM_{110}$                                       d)  $TM_{111}$  .

iv) Casagrain feed is used with parabolic reflector to

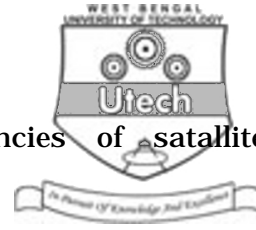
- a) increase the gain of the system
- b) increase the beam width of the system
- c) reduce the size of the main reflector
- d) allow the feed to be placed at a convenient point.

v) A Microstrip line is analogous to a

- a) Co-axial line
- b) Parallel wire line
- c) Rectangular waveguide
- d) Circular waveguide.



- vi) Klystron operates on the principle of
- a) amplitude modulation
  - b) frequency modulation
  - c) pulse modulation
  - d) velocity modulation.
- vii) A magnetic field is used in the cavity magnetron to
- a) prevent anode current in the absence of oscillations
  - b) ensure that the oscillations are pulsed
  - c) help in focussing the electron beam, thus preventing spreading
  - d) ensure that the electrons will orbit around the cathode.
- viii) Gunn diode cannot be fabricated with which of the following materials ?
- a) GaAs
  - b) Si
  - c) InP
  - d) CdTe.
- ix) If the minimum range of radar is to be doubled, the peak power has to be increased by a factor
- a) 2
  - b) 4
  - c) 8
  - d) 16.



x) The uplink and downlink frequencies of satellite communication are

- a) 6 GHz, 4 GHz                      b) 4 GHz, 6 GHz
- c) 6 GHz, 6 GHz                      d) 3 GHz, 5 GHz.

xi) Scattering parameter can be measured with the help of

- a) Spectrum analyzer
- b) Network analyzer
- c) CRO
- d) Bolometer.

xii) The range of microwave frequency is

- a) 1 GHz to 2 GHz
- b) 2 GHz to 4 GHz
- c) 3 GHz to 300 GHz
- d) 300 GHz to 3000 GHz.



**GROUP - B**  
**( Short Answer Type Questions )**

Answer any *three* of the following.

3 × 5 = 15

2. a) Compare the performance of rectangular waveguide and circular waveguide.  
b) Define the term 'dominant mode' and 'degenerate mode' as applied to waveguide.
3. What is an E-plane Tee ? Derive its S-matrix.
4. Explain the working principle of a 4-port circulator consisting of 2-Magic Tees and a non-reciprocal phase shifter.
5. Derive the Radar range equation.
6. Explain how 'velocity modulation' and 'current modulation' are achieved in reflex klystron.

**GROUP - C**  
**( Long Answer Type Questions )**

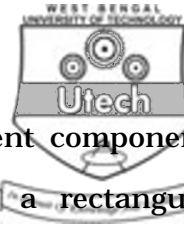
Answer any *three* of the following.

3 × 15 = 45

7. a) What is the difference between 'O-type' and 'M-type' microwave tubes ?  
b) Explain the function of two-cavity klystron amplifier with schematic diagram.  
c) The parameters of a two-cavity klystron amplifier are as follows :

Beam voltage = 1200V, beam current = 28 mA,  
frequency = 8 GHz, gap spacing in either cavity  
 $d = 1$  mm and spacing between two cavities  $L = 4$  cm.  
Find maximum input voltage, gap transit angle, beam  
coupling co-efficient, DC transit angle.

2 + 8 + 5



8. a) Find out the expressions for the different components of electric and magnetic fields inside a rectangular waveguide for TE mode of propagation.

- b) Calculate the ratio of the cross-section of a circular waveguide to that of rectangular one if each is to have the same cut-off wavelength for its dominant mode.

10 + 5

9. a) What is the advantage of heterojunction bipolar transistor ( HBT ) over BJT ? Describe the operational mechanism of HBT.

- b) Derive the expression for the condition for negative differential mobility of 'transferred electron devices'.

- c) What are different modes of operation of Gunn diode ?

( 2 + 4 ) + 5 + 4

10. a) Derive Fris's transmission formula. What do you mean by 'EIRP' and 'path loss' ?

- b) What is G/T ratio of an earth station ? What is its significance ?

- c) State the principle of operation of Moving Target Indication ( MTI ) Radar.

( 5 + 2 ) + ( 2 + 1 ) + 5



11. a) Explain how high value of VSWR can be measured by the double minimum method.
- b) What do you mean by 'directivity' and 'effective aperture' of an antenna ? Derive the relation between directivity and effective apperture of a Horn antenna.

7 + ( 3 + 5 )

12. Write short notes on any *three* of the following : 3 × 5

- a) Excitation modes in rectangular waveguide
- b) TWT
- c) IMPATT diode
- d) Microstrip line
- e) Bolometer.

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