



Name :

Roll No. :

Invigilator's Signature :

CS/B. Tech (ECE)/SEM-7/EC-701/2011-12

2011

RF AND MICROWAVE ENGINEERING

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

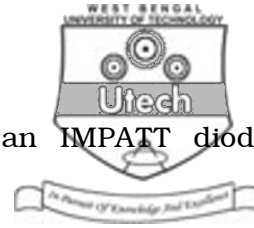
*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the
following : $10 \times 1 = 10$

- i) The intrinsic impedance of free space is given by
 - a) 333Ω
 - b) 377Ω
 - c) 233.5Ω
 - d) 379Ω .
- ii) The range of X-band is
 - a) 12-20 GHz
 - b) 20-27 GHz
 - c) 8-12 GHz
 - d) 2-4 GHz.
- iii) Distance between successive maxima and minima of
standing wave is
 - a) $\lambda/2$
 - b) λ
 - c) $3\lambda/4$
 - d) $\lambda/4$.



- iv) A TRAPATT diode is preferred to an IMPATT diode because of its
- a) lower noise
 - b) larger bandwidth
 - c) higher efficiency
 - d) lesser sensitivity of harmonics.
- v) Any two-port network having a 6 dB loss will give an output power which is of input power.
- a) 0.25
 - b) 0.50
 - c) 0.75
 - d) None of these.
- vi) A cavity is a filter.
- a) Low pass
 - b) High pass
 - c) Band pass
 - d) Band reject.
- vii) Large microwave power can be measured by
- a) Bolometer
 - b) Thermistor
 - c) VSWR meter
 - d) Calorimeter-wattmeter.
- viii) The dominant mode in a waveguide is characterized by
- a) shortest cut-off wavelength
 - b) longest cut-off wavelength
 - c) zero attenuation
 - d) infinite attenuation.



- ix) TWT is sometimes preferred to magnetron for use in RADAR transmitter because it
- a) has broader band
 - b) is less noisy
 - c) is more efficient amplifier
 - d) is capable of larger duty cycle.
- x) Magic- T is a
- a) two-port network
 - b) three-port network
 - c) four-port network
 - d) one-port network.
- xi) Reflex Klystron is a/an
- a) Amplifier
 - b) Oscillator
 - c) Attenuator
 - d) Filter.
- xii) Microwave components are generally characterised by
- a) h -parameter
 - b) z -parameter
 - c) s -parameter
 - d) y -parameter.

GROUP – B

(Short Answer Type Questions)

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

2. What is IMPATT diode ? How does the negative resistance arise in this diode ?
3. a) What do you mean by Doppler frequency shift ?
- b) Compare between Geo-synchronous and Geo-stationary satellites.

2 + 3



4. What is bunching ? Explain with proper diagram. Deduce the expression for the minimum length at which the first bunch will be formed.
5. a) What do you mean by cut-off frequency of a waveguide ?
b) On what factors does the cut-off frequency of a waveguide depend ? Derive expressions in support of your answer.
6. A $200\ \Omega$ load is to be matched to a line with characteristic impedance of $300\ \Omega$. Find the characteristic impedance of a quarter wave transformer to be inserted between them for the purpose of matching. Derive the formula to be used.

2 + 3

GROUP – C

(Long Answer Type Questions)

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

7. a) Define and explain the meaning of the term 'standing wave ratio' (SWR).
b) Explain with a neat sketch, how the SWR in a rectangular waveguide can be measured.

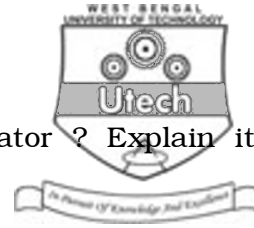


- c) What is Smith chart ? What are its applications ?
- d) The dominant mode (TE_{10}) is propagated in a rectangular waveguide of dimensions $a = 6$ cm, $b = 4$ cm. The distance between two successive minima is 4.47 cm. Determine the signal frequency.

$$3 + 5 + (1 + 1) + 5$$

8. a) Define and explain the terms “coupling factor” and “directivity”.
- b) With neat sketch explain the working principle of a two-hole directional coupler.
- c) A multi-hole directional coupler is fed with signal power of 2.8 mW at 10 GHz. The coupling factor is 3 dB and the directivity is better than 40 dB over X-band range. Find the distribution of power at all other ports.
- d) An air filled rectangular waveguide of inside dimensions $7 \text{ cm} \times 3.5 \text{ cm}$ operates the dominant TE_{10} mode. Find
- the cut-off frequency and
 - determine the guided wavelength at 3.5 GHz.

$$4 + 3 + 4 + 4$$



9. a) What is a rectangular cavity resonator ? Explain its working principle.
- b) Derive the expression of resonant frequency of a rectangular cavity resonator.
- c) Define quality factor Q for a rectangular cavity resonator.
- d) Calculate the resonant frequency of a rectangular cavity resonator with dimensions $a = 25$ mm, $b = 10$ mm and $d = 20$ mm, for TE_{102} mode.
- e) A rectangular waveguide of size $a \times b$ ($a > b$) is to operate in TE_{10} mode alone over a frequency range 10 to 15 GHz. Calculate the ranges of values within which a and b must lie if it is specified that the band centre is at 1.5 times the cut-off and the aspect ratio is 0.45.

3 + 3 + 2 + 2 + 5

10. a) What are strip line and microstrip line ?
- b) What are the advantages and disadvantages of microstrip line ?
- c) Show the electric and magnetic field lines of microstrip line ?
- d) Explain the working principle of a microstrip antenna.

3 + 3 + 4 + 5



11. a) Explain the working principle of a phase shifter.
- b) Explain with experimental set-up the measurement of microwave high power.
- c) Derive the scattering matrix of a Magic TEE.
- d) How can you measure the microwave peak power from average power ? $3 + 5 + 5 + 2$
12. Write short notes on any *three* of the following : 3×5
- a) CW Doppler RADAR
- b) N-port circulator
- c) Gunn diode oscillator
- d) Bethe Hole coupler
- e) Magnetron oscillator.
-