

S/B.TECH/ECE/ODD SEM/SEM-7/EC-703A/2016-17



**AULANA ABUL KALAM AZAD UNIVERSITY OF
TECHNOLOGY, WEST BENGAL**

Paper Code : EC-703A

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)

- i) Choose the correct alternatives for any ten of the following : $10 \times 1 = 10$
- ii) The wavelength corresponding to microwave frequency range is
- a) 30 GHz to 300 GHz
 - b) 3 GHz to 30 GHz
 - c) 0.3 GHz to 3 GHz
 - d) 300 GHz to 3000 GHz.

CS/B.TECH/ECE/ODD SEM/SEM-7/EC-703A/2016-17

- ii) Reflex Klystron is a/an
- a) Amplifier
 - b) Oscillator
 - c) Attenuator
 - d) Filter.
- iii) Klystron operates on the principle of
- a) Amplitude modulation
 - b) Frequency modulation
 - c) Pulse modulation
 - d) Velocity modulation.
- iv) A travelling wave tube (TWT) is basically
- a) an oscillator
 - b) tuned amplifier
 - c) wideband amplifier
 - d) both amplifier and oscillator.
- v) Microwave semi-conductor devices are basically a
- a) Positive Resistance Device
 - b) Negative Resistance Device
 - c) Zero Resistance Device
 - d) High Resistance Device.

CS/B.TECH/ECE/ODD SEM/SEM 7/EC 703A/2016-17

- vi) GaAs is preferred to Si for use in Gunn diode because it has
- lower noise at high frequencies
 - better frequency stability
 - high ion mobility
 - suitable empty energy band which silicon does not have.
- vii) The transferred electron bulk effect occurs in
- Si
 - Ge
 - GaAs
 - Metal semiconductor junction.
- viii) Waveguide is a
- BPF
 - HPF
 - LPF
 - all pass filter.
- ix) Which wave does not exist in waveguides ?
- TM waves
 - TE waves
 - TEM waves
 - TE and TM waves.

CS/B.TECH/ECE/ODD SEM/SEM 7/EC 703A/2016-17

- x) Magic Tee is a
- two port network
 - three port network
 - four port network
 - one port network.
- xi) A circulator is a
- two port network
 - three port network
 - four port network
 - one port network.
- xii) A tunnel diode is a
- heavily doped p-n junction diode
 - ordinarily doped p-n junction diode
 - one side highly doped and other side lowly diode
 - is a bulk semi-conductor device.
- xiii) Scattering parameters can be measured by a
- CRO
 - Spectrum analyzer
 - Network analyzer
 - Reflectometer.

GROUP - B
(Short Answer Type Questions)

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

2. An airfilled rectangular waveguide of inside dimension $7 \text{ cm} \times 3.5 \text{ cm}$ operates in dominant TE_{10} mode. Find the following :
 - a) Cut-off frequency
 - b) Phase velocity at a frequency 3.5 GHz
 - c) Guide wavelength.
3. Define the following terms in connection with directional coupler :
 - a) Coupling factor
 - b) Directivity
 - c) Insertion Loss.
4. Draw the structure of TRAPATT. Discuss the principle of its operation. $2 + 3$
5. Distinguish between E plane and H plane Tee. How Magic Tee is constructed ? $3 + 2$
6. Why is TE_{10} mode in rectangular waveguide called dominant mode of operation ? How is a rectangular wave-guide treated as a low-pass filter ? $3 + 2$

GROUP - C
(Long Answer Type Questions)

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

7. a) What are the modes of operation of GUNN diode ? Explain.
b) Derive the condition for $-ve$ resistance.
c) A Gunn diode is working in transit time mode at 12 GHz . The domain of charges move at 10^7 cm/sec speed. Calculate (i) the length of the device, (ii) Can the device work at 10 GHz and 14 GHz ? Which is the mode of operation in each case ? $5 + 5 + 5$
8. a) What are the properties of a E -plane Tee ? Draw its equivalent circuit.
b) Establish the input and output equations for E -plane Tee using S matrix analysis. $5 + 10$
9. a) Draw the block diagram of a two cavity Klystron amplifier.
b) Explain the velocity modulation process. Derive the expression for velocity after velocity modulation process.
c) Discuss about the variation of buncher cavity departure angle and catcher cavity arrival angle. $4 + 8 + 3$

CS/B TECH/ECE/ODD SEM/SEM-7/EC-703A/2016-17

10. Write short notes on any *three* of the following : 5 + 5 + 5

- a) Measurement of dielectric constant
- b) Rectangular cavity resonator
- c) IMPATT
- d) Faraday rotation isolator
- e) Magnetron
- f) Micro-strip line.

11. Draw the block diagram of TWT. What are the differences between two cavity Klystron ? Briefly describe the amplification in a Helix TWT. Why is helical structure preferred ? 3 + 3 + 6 + 3
