

EC-703A

RF AND MICROWAVE ENGINEERING

Time Allotted: 3 Hours

Full Marks: 70

The questions are of equal value.

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. Answer any ten questions. 10×1 = 10
- (i) The main advantage of microwave is that
 - (A) highly directive
 - (B) moves at the speed of light
 - (C) greater S/N ratio
 - (D) higher penetration power
 - (ii) Klystron operates on the principle of
 - (A) amplitude modulation
 - (B) frequency modulation
 - (C) pulse modulation
 - (D) velocity modulation
 - (iii) To overcome difficulties with strapping high frequencies, the type of cavity structure desired for magnetron is
 - (A) hole and slot
 - (B) slot
 - (C) vane
 - (D) rising sun
 - (iv) 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

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- (v) Gunn diode cannot be fabricated with which of the following materials?
 - (A) GaAs
 - (B) Si
 - (C) InP
 - (D) CdTe
- (vi) The mode that is absent in a rectangular waveguide is
 - (A) TEM
 - (B) TE
 - (C) TM
 - (D) HE
- (vii) Magic tee is a
 - (A) two port network
 - (B) three port network
 - (C) four port network
 - (D) single port network
- (viii) In a waveguide the maximum and minimum values of voltage standing wave ratio are
 - (A) +1 and -1
 - (B) infinity and 0
 - (C) infinity and one
 - (D) 10 and 1
- (ix) A directional coupler with three or more holes is sometimes used in preference to two hole coupler
 - (A) to increase the bandwidth of the system
 - (B) to reduce spurious mode generation
 - (C) because it is more efficient
 - (D) to increase the coupling of the system
- (x) For matching purpose, waveguide tapers are preferred to transformers because of
 - (A) low cost
 - (B) ease of fabrication
 - (C) durability
 - (D) all of these
- (xi) S_{ii} of a microwave component is -3 dB. The reflection coefficient at port 'i' is
 - (A) 0
 - (B) 3 dB
 - (C) 2
 - (D) -3dB

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(xii) The waveguide passive component that may be used to perform microwave subtraction is

- (A) attenuator (B) hybrid Tee
(C) H plane Tee (D) waveguide twist

GROUP B

(Short Answer Type Questions)

Answer any *three* questions.

3×5 = 15

2. What are cross-field devices? What role does the DC magnetic field play in their normal operation? 2+3
3. What do you mean by cut off frequency of a waveguide? On what factors does the cut off frequency of a waveguide depend? Derive expressions in support of it. 1+2+2
4. What is Tunnel diode? Describe its characteristics 2+3
5. What is an IMPATT diode? Draw an equivalent circuit of an IMPATT diode. How does the negative resistance property arise in it? 1+2+2
6. Why Schottky diodes are suitable for microwave region? 5

GROUP C

(Long Answer Type Questions)

Answer any *three* questions.

3×15 = 45

7. (a) Find out the expressions for the different components of electric and magnetic fields inside a rectangular waveguide for TE mode of propagation. Hence find out the expression for the guide wavelength and propagation constant. 9+3

- (b) When the dominant mode is propagating in an air filled rectangular waveguide, the guide wavelengths for a frequency of 9 GHz is 4 cm. Calculate broad wall dimension of the guide.

8. (a) What is Scattering Parameters? Why is it used in Microwave Network?
(b) Derive the scattering matrix of Magic Tee.
(c) Discuss the operating principle of Faraday's rotation isolator.

9. (a) Describe the operation of an ideal four port 'Directional coupler'. Define 'Coupling' and 'Directivity' in the context of a directional coupler.

- (b) Explain the design of a 2-hole directional coupler in rectangular wave-guide version for a given coupling. Mention the principal shortcoming of such a directional coupler. Discuss how this shortcoming can be overcome.

- (c) Determine the spacing between 2-holes in a 2-hole directional coupler made in rectangular waveguide version with inner dimension of 2.286 cm × 1.00 cm at 9 GHz.

10. (a) Compare and contrast the bunching operation in a two cavity klystron and reflex klystron.

- (b) What is a slow wave structure? Why does the TWT need such a structure? Explain the beam and RF interaction in such a tube.

- (c) What is the function of magnetic field in a traveling wave tube?

11. Write short notes on any *three* of the following:

- (a) Cavity Resonator
(b) Hybrid Rings
(c) Magnetron Oscillator
(d) Microstrip Antenna
(e) Microwave power measurement