

CS/B.Tech/ECE/Odd/Sem-7th/EC-703A/2015-16



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

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.
All symbols are of usual significance.*

**GROUP A
(Multiple Choice Type Questions)**

1. Answer any *ten* questions. 10×1 = 10

- (i) Distance between successive maxima and minima of standing wave is
 (A) $\lambda/2$ (B) $3\lambda/2$
 (C) λ ~~(D) $\lambda/4$~~
- (ii) Any two-port network having a 6 dB loss will give an output power which is
~~(A) 0.25~~ (B) 0.75
 (C) 0.50 (D) none of these
- (iii) Cavity is a _____ filter
 (A) low pass (B) band pass
~~(C) high pass~~ (D) band reject

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- (iv) 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
- (v) Microwave components are generally characterized by
 (A) h-parameter (B) Z-parameter
~~(C) s-parameter~~ (D) Y-parameter
- (vi) In transmission through a waveguide, the maximum and minimum values of VSWR obtained under loaded conditions are
 (A) one and zero ~~(B) infinity and one~~
 (C) infinity and zero (D) -1 and +1
- (vii) The broad wall dimension of rectangular when the cut-off frequency for dominant mode is 3 GHz is
 (A) 6 cm (B) 4 cm
~~(C) 5 cm~~ (D) none of these
- (viii) In a two hole directional coupler the distance between two holes in terms of guided wavelength λ_g is
 (A) λ_g ~~(B) $\lambda_g/4$~~
 (C) $\lambda_g/2$ (D) $2\lambda_g$
- (ix) To overcome difficulties with strapping high frequencies the type of cavity structure desired for magnetron is
 (A) hole and slot (B) vane
 (C) slot ~~(D) rising sun~~
- (x) In a VSWR measurement a square law detector is used to detect the signal level. The current meter connected to the circuit read 64 mA and 16 mA as maximum and minimum currents respectively, the VSWR is
 (A) 4 (B) 2
~~(C) 0.25~~ (D) zero

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(xi) 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 large duty cycle

(xii) The dominant mode of propagation in circular waveguide is

- (A) TE_{11} (B) TE_{10} (C) TM_{11} (D) TM_{10}

(xiii) Large microwave power can be measured by

- (A) VSWR meter (B) Bolometer
(C) Calorimeter-wattmeter (D) Thermister

GROUP B

(Short Answer Type Questions)

Answer any *three* questions.

3×5 = 15

2. VSWR of a bilateral passive two port microwave component is 2 with the other port matched terminated. If the input power to port 1 is 1 mW then, the output power at port 2 is 0.5 mW. Determine the s-matrix for the component. 5
3. What is the wave impedance of a TE mode in a rectangular waveguide? Express the impedance in terms of the free-space intrinsic impedance and the cut-off wavelength of the mode. Consider a 22.86 mm × 10.16 mm rectangular waveguide. Calculate the wave impedance of the TE_{10} mode at 10 GHz. 4+1
4. Find out the [S] matrix of a H-plane TEE. 5
5. How do you use a three port circulator as two port isolator? Why the isolators are used just after the oscillator? 2.5 + 2.5
6. What do you mean by crystal diode? Why Schottky diodes are suitable for microwave region? 2+3

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GROUP C

(Long Answer Type Questions)

Answer any *three* questions.

3×15 = 45

7. (a) Explain the working principle of a Magnetron. Also derive the expression for cut-off magnetic field B. 8+7
(b) A helix Travelling wave Tube (TWT) has the following characteristics:
Beam voltage $V = 2$ kV, Beam current $I = 4$ mA, frequency $f = 8$ GHz
Circuit Length of interaction $N = 50$ in wavelength, Characteristic impedance $Z = 20$ ohm.
Determine: (i) The gain parameter. (ii) The power gain in dB.
8. (a) Describe the construction of a reflex klystron and explain how it works as an oscillator. 8+7
(b) The input power in a two hole directional coupler is 1 mW. The coupler has a coupling factor of 15 dB and a directivity of 30 dB. Calculate the power in all the ports.
9. (a) Describe the operation of a four-port microwave circulator. 4+3+3+5
(b) What is microwave Isolator?
(c) Describe the operating principle of H-plane tee.
(d) Derive the scattering matrix of Magic tee.
10. (a) Define the term directivity and coupling factor of a directional coupler. 3+4+3+5
(b) The input power in a two hole directional coupler is 1 mW. The coupler has a coupling factor of 15 dB and a directivity of 30 dB. Calculate the power in all the ports.
(c) What is phase shifter? Give its applications.
(d) Explain the principle of operation of VSWR measurement: low, medium and high.
11. Write short notes on any *three* of the following: 3×5
(a) Industrial application of microwave
(b) RF amplifier
(c) Tunnel diode
(d) Magic Tee
(e) VSWR meter

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