

Time: 3 Hours

JUNE 2014

Max. Marks: 100

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.
- The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.
- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. A transmission line is called a flat line when its Standing Wave Ratio (SWR) is

- (A) 0 (B) 1
(C) infinity (D) minimum

b. The dominant mode in a particular waveguide is mode having

- (A) highest cut off frequency (B) lowest cut off frequency
(C) minimum energy (D) maximum energy

c. In a Magic Tee, if a wave is fed into port 3 (the E arm), it will produce an output of _____ at port 1 and port 2. The o/p at port 4 is zero.

- (A) equal magnitude & opposite phase
(B) equal magnitude & equal (same) phase
(C) magnitude halved and same phase
(D) equal magnitude & same phase

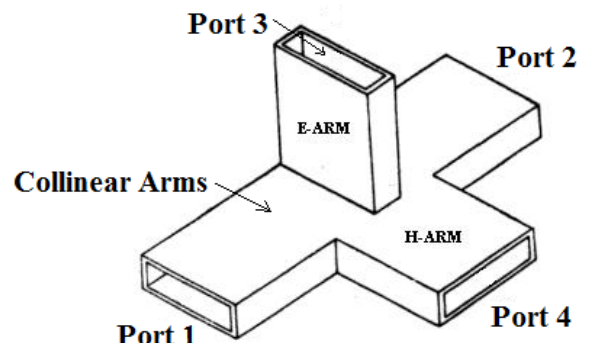


Fig.1

d. The abbreviation LSA in LSA diodes stands for

- (A) Laser Stimulated Accumulation
(B) Limited Space Charge Accumulation
(C) Liquid Space Charge Argon
(D) Limited Space Charge Assimilator

e. The efficiency of a two cavity klystron is about

- (A) 40% (B) 10%
(C) 80% (D) 60%

- f. Crossed field tubes derive their name from the fact that
- (A) DC electric field & DC magnetic field are parallel to each other
 - (B) DC electric field & DC magnetic field are perpendicular to each other
 - (C) AC electric field & AC magnetic field are parallel to each other
 - (D) AC electric field & AC magnetic field are perpendicular to each other
- g. Modes on microstrip lines are only
- (A) TE modes
 - (B) TM modes
 - (C) Can be either TE or TM
 - (D) TEM modes
- h. Following are types of Lithography technology: One of these which is not a type of Lithography
- (A) Electron beam Lithography
 - (B) Conducting beam Lithography
 - (C) Ion beam Lithography
 - (D) X-ray Lithography
- i. Both microwave circulators and isolators are _____ transmission devices, that use the property of _____.
- (A) Non Reciprocal, Faraday Rotation
 - (B) Reciprocal, Faraday Rotation
 - (C) Random, Faraday Rotation
 - (D) Reversible, Finite element theory
- j. Quality factor Q is a measure of frequency selectivity of a resonant or antiresonant circuit and is defined as
- (A) $Q = 2\pi \frac{\text{Energy dissipated per cycle}}{\text{Max. Energy stored}}$
 - (B) $Q = \pi \frac{\text{Energy dissipated per cycle}}{\text{Max. Energy stored}}$
 - (C) $Q = \pi \frac{\text{Energy dissipated per cycle}}{\text{Max. Energy dissipated}}$
 - (D) $Q = 2\pi \frac{\text{Maximum Energy stored}}{\text{Energy dissipated per cycle}}$

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

- Q.2** a. Compare waveguides with 2 wire transmission lines. Give any four similarities & four dissimilarities. (8)
- b. A transmission line has a characteristic impedance of $50 + j 0.01\Omega$ and is terminated in a load impedance of $73 - j 42.5 \Omega$ calculate (i) the reflection coefficient (8)
(ii) the standing wave ratio
- Q.3** a. Derive the TM_{mn} mode field equation in rectangular waveguides and show that TM_{01} and TM_{10} modes do not exist. (10)
- b. A TE_{11} mode is propagating through a circular waveguide. The radius of the guide is 5 cm and guide contains an air dielectric. Find the cut off frequency. Given, for TE_{11} mode, $n = 1$, $p = 1$ and $X_{11} = 1.841 = K_c \cdot a$ where a is the radius. (6)
- Q.4** a. What is a tee junction? Explain a magic tee. What are its applications? (8)
- b. Determine the scattering parameters ($S_{14}, S_{41}, S_{31}, S_{13}, S_{11}, S_{22}, S_{33}, S_{44}$) only for a 10 dB directional coupler with given data:
Directivity $D = 30$ dB
Assume it is lossless.
VSWR at each port = 1.0 under matched condition. Designate ports in the main guide as 1 & 2 and in auxiliary guide as 3 and 4. (8)
- Q.5** a. Explain the principle of operation of a tunnel diode. Draw its I-V characteristics. (10)
- b. Explain two valley model theory of Gunn diodes. (6)
- Q.6** a. Draw a neat diagram of a two cavity Klystron amplifier. Explain the process of Bunching. (8)
- b. A four cavity Klystron VA-828 has the following parameters: (8)
Beam voltage $V_0 = 14.5$ kV
Beam current $I_0 = 1.4$ A
Operating frequency $f = 10$ GHz
dc electron charge density $\rho_0 = 10^{-6}$ C/m³
RF charge density $\rho = 10^{-8}$ C/m³
Velocity per turbation $v = 10^5$ m/s
- Compute: (i) dc electron velocity
(ii) dc phase constant
(iii) Plasma frequency
(iv) dc beam current density

Code: AE72**Subject: MICROWAVE THEORY AND TECHNIQUES**

- Q.7** a. What is a magnetron Oscillator? What are its various types? (6)
- b. An X band pulsed magnetron has the following operating parameters.
Anode voltage $V_0 = 26$ kV
Beam current $I_0 = 27$ A
Magnetic flux density $B_0 = 0.336$ Wb/m²
Radius of cathode cylinder $a = 5$ cm
Radius of vane edge to center $b = 10$ cm
Compute: (i) Cyclotron Angular frequency
(ii) Cut off voltage for a fixed B_0
(iii) Cut off magnetic flux density for a fixed V_0 (10)
- Q.8** a. Explain characteristic impedance of microstrip lines. (4)
- b. Explain quality factor of microstrip lines. (4)
- c. Explain various losses in microstrip lines. (8)
- Q.9** a. List the various techniques by which monolithic microwave integrated circuits can be fabricated. Explain lithography. (10)
- b. A planar resistor has the following parameters:
Resistive film thickness: $t = 0.1$ μ m
Resistive film length: $\ell = 15$ mm
Resistive film width $w = 15$ mm
Sheet Resistivity of gold film $\rho_s = 2.44 \times 10^{-8}$ Ω -m
Calculate the planar Resistance. (6)