

DECEMBER 2015

Time: 3 Hours

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. The velocity of a transmission line
 - (A) depends on the dielectric strength of the material used
 - (B) increases the velocity along transmission line
 - (C) is governed by the skin effect
 - (D) is higher for a solid dielectric than for air

- b. An air filled rectangular waveguide of inside dimensions 7×3.5 cm operates in the dominant TE_{10} mode. The cut off frequency is
 - (A) 4.28 MHz
 - (B) 4.28 GHz
 - (C) 2.14 GHz
 - (D) 8.56 GHz

- c. Which of the following modes of transmission will not be supported by a rectangular waveguide?
 - (A) TE_{10}
 - (B) TE_{11}
 - (C) TM_{11}
 - (D) TM_{10}

- d. A 3 – port circulator is shown in the figure. Which of the following scattering matrices relates to this Circulator?

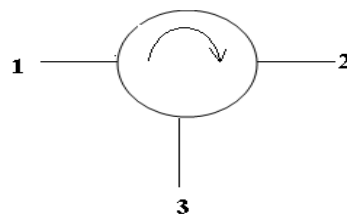


Fig.1

(A)
$$\begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

(B)
$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

(C)
$$\begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 1 \end{bmatrix}$$

(D)
$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

Code: AE72

Subject: MICROWAVE THEORY AND TECHNIQUES

- e. In Cavity Magnetron, strapping is used to
 (A) Prevent mode jumping
 (B) Prevent cathode back heating
 (C) Ensure bunching
 (D) Improve the phase focussing effect
- f. Which one of the following is a transferred electron device?
 (A) BARITT Diode (B) IMPATT Diode
 (C) Gunn Diode (D) Step Recovery Diode
- g. The major advantage of TWT over Klystron is
 (A) Large bandwidth (B) High gain
 (C) High impedance (D) High output
- h. The Cross Field Amplifier (CFA) is a
 (A) Linear Amplifier (B) Parametric Amplifier
 (C) Non linear Amplifier (D) Saturated Amplifier
- i. The modes on micro-strip line are
 (A) TEM (B) Quasi TEM
 (C) TE (D) TM
- j. The process of transferring patterns of geometric shapes on a mask to a thin layer of resist is known as
 (A) Ion implantation (B) Diffusion
 (C) Lithography (D) Epitaxial growth

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

- Q.2** a. Explain (i) Single stub matching and (ii) Double stub matching (8)
- b. A lossless line has a characteristic impedance of 50Ω and is terminated in a load resistance of 75Ω . The line is energised by a generator which has an output impedance of 50Ω and an open-circuit output voltage of 30 V (rms) . The line is assumed to be 2.25 wavelengths long. Determine: (8)
- (i) The input impedance
 (ii) The magnitude of the instantaneous load voltage
 (iii) The instantaneous power delivered to the load
- Q.3** a. An air filled rectangular waveguide has dimensions of $a = 6 \text{ cm}$ and $b = 4 \text{ cm}$. The signal frequency is 3 GHz . Compute the following for the TE_{10} mode; (8)
- (i) Cut off frequency
 (ii) Wavelength in the waveguide
 (iii) Phase velocity
 (iv) Group velocity
- b. A TE_{11} mode is propagating through a circular waveguide. The radius of the guide is 5 cm and the guide contains an air dielectric. (Given that $X'_{11} = 1.841 = k_c a$). (8)
- (i) Determine the cutoff frequency.
 (ii) Determine the wavelength λ_g in the guide for an operating frequency of 3 GHz .
 (iii) Determine the wave impedance Z_g in the guide.

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

- Q.4** a. Explain the working of Microwave Circulator. Explain how a four port Circulator is constructed with two Magic Tees? (10)
- b. What are Directional Couplers? Explain with a neat diagram. Derive S-matrix of Directional Coupler discussed. (6)
- Q.5** a. Explain the physical description of Read Diode. (6)
- b. Explain the principle of operation TRAPATT Diodes. (10)
- Q.6** a. Explain the effect of Lead-inductance and interelectrode capacitance in vacuum tubes at microwave frequencies. (8)
- b. Explain the velocity modulation process in Two cavity Klystron. (8)
- Q.7** a. Explain the power output and efficiency of a Magnetron. (8)
- b. Explain the principle of operation Forward Wave Cross-Field Amplifier. (8)
- Q.8** a. Explain (i) Dielectric Losses (ii) Ohmic Losses in a microstrip line. (8)
- b. Explain (i) Distributed Parameters
(ii) Characteristic Impedance and
(iii) Attenuation Losses in a parallel strip-lines. (8)
- Q.9** a. What is a substrate? What are the characteristics of an ideal substrate material? (6)
- b. What for resistive materials are used and write the properties of a good microwave resistor? (4)
- c. Explain thin film formation. (6)