

AMIETE – ET (OLD SCHEME)

Time: 3 Hours

JUNE 2012

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 microwave junction is supposed to be matched at all ports if in the S matrix
- (A) all the diagonal elements are zero
(B) all the diagonal elements are equal but not zero
(C) all the diagonal elements are complex
(D) is Hermitian
- b. Horizontal polarization is nothing but
- (A) x-polarization (B) y-polarization
(C) circular polarization (D) elliptical polarization
- c. At high frequencies, conventional vacuum tubes have limitations with the presence of
- (A) Transit time effects (B) low bandwidth
(C) high noise (D) vacuum
- d. The maximum electronic efficiency of reflex klystron is
- (A) 40%. (B) 50%.
(C) 22.7% (D) 35%.
- e. Directional coupler is
- (A) non-reciprocal device (B) reciprocal device
(C) an amplifier (D) an oscillator

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- f. In a transmission line $Z_1 \neq Z_0$ and maximum voltage of the standing wave is 5 V & minimum voltage is 3 V then
- (A) VSWR=1.67dB (B) VSWR= 2.34dB
(C) VSWR= 4.44dB (D) VSWR= 8.88dB
- g. The kinetic energy of the beam remains unchanged in the interaction between an electron beam & an RF wave in a
- (A) multi-cavity klystron. (B) crossed-field amplifier.
(C) travelling wave tube (D) gyrotron
- h. The lowest TM mode in a rectangular waveguide of cross section $a \times b$ with $a > b$ will be
- (A) TM_{01} (B) TM_{10}
(C) TM_{12} (D) TM_{11}
- i. The phase shift of a wave whose frequency is 1 GHz in free space
- (A) 21 rad/m (B) 20.93 rad/m
(C) 40.93 rad/m (D) 0.3 rad/m
- j. The maximum unambiguous range in a system depends on
- (A) maximum power of the transmitter (B) pulse repetition frequency
(C) width of the transmitted pulse (D) sensitivity of the radar receiver

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

- Q.2** a. Explain Impedance matching. Describe the various methods of achieving impedance matching with their advantages and disadvantages. (12)
- b. How are waveguides different from normal two wire transmission lines? Discuss the similarities and dissimilarities (4)
- Q.3** a. What are cavity resonators? Derive the expression for resonant frequencies for a rectangular and circular resonator (8)
- b. The TE_{10} mode is propagated in a rectangular waveguide of dimensions $a=6$ cms and $b=4$ cms. By means of a travelling detector, the distance between a maximum and minimum is found to be 4.55 cms. Find the frequency of the wave (8)

- Q.4** a. Obtain the scattering matrix of E-H Plane Tee. (8)
- b. Explain the working of isolator, gyrator and circulator using ferrites. Mention their applications. (8)
- Q.5** a. What are the advantages achieved by adding more cavities in between the input and the output cavities in a klystron tube? With the help of relevant schematic and applegate diagram, briefly describe the bunching phenomenon in a two-cavity klystron. (8)
- b. What are slow wave structures? Explain how a helical TWT achieves amplification. (8)
- Q.6** a. A four cavity klystron VA-628 has the following parameters: beam voltage $V_0=14.5$ kV, beam current=1.4 A, operation frequency $f=10$ GHz, dc electron charge density $\rho_0=10^{-6}$ c/m³, RF charge density $\rho=10^{-8}$ c/ m³, velocity perturbations $V=10^5$ m/sec. Determine (i) dc electron velocity (ii) the dc phase constant (iii) the plasma frequency, (iv) the reduced plasma frequency for $R=0.4$ (v) the dc beam current density, (vi) the instantaneous beam current density. (8)
- b. Explain the different types of losses in Microstrip lines. (8)
- Q.7** a. Describe the method for measurement of impedance at microwave frequencies. (8)
- b. What are the limitations of conventional tubes at microwave frequencies? Explain how these limitations can be overcome (8)
- Q.8** a. What are avalanche transit time devices? Explain the operation, construction and application of the following:
(i) IMPATT
(ii) TRAPTT
(iii) BARITT (12)
- b. Discuss the various factors that affect the satellite communications. (4)
- Q.9** Write short notes on any **TWO** of the following:
(i) Horn antenna and slot antenna
(ii) Tunnel Diode
(iii) Magnetron
(iv) Measurement of dielectric constant (2×8)