Code: AE72/AE120   Subject: MICROWAVE THEORY AND TECHNIQUES

AMIETE – ET (Current & New Scheme)

Time: 3 Hours   **DECEMBER 2018**   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. Reflection coefficient is the ratio of
       (A) reflected current to the incident current
       (B) incident voltage to the reflected voltage
       (C) incident current to the reflected current
       (D) reflected voltage to the voltage drop

   b. A rectangular waveguide behaves like a
       (A) band pass filter   **(B)** high pass filter
       (C) low pass filter   **(D)** all pass filter

   c. The main advantage of the two-hole directional coupler is
       (A) low directional coupling   **(B)** poor directivity
       (C) high SWR   **(D)** narrow bandwidth

   d. Major drawback of IMPATT diode is
       (A) high noise   **(B)** narrow bandwidth
       (C) low efficiency   **(D)** All of these

   e. A travelling wave tube is sometimes preferred over the multi-cavity klystron amplifier, because the former
       (A) gives higher output
       (B) has a higher number of modes
       (C) is more efficient
       (D) has a greater bandwidth

   f. In a cavity magnetron strapping is used to
       (A) ensure bunching
       (B) prevent mode jumping
       (C) prevent cathode back-heating
       (D) improve the phase-focusing effect

g. The advantage of strip line over waveguide is
    (A) its higher power handling capacity
    (B) smaller bulk
    (C) lower bandwidth
    (D) All of these

h. In waveguides, for matching purposes, tapers are preferred to transformers
    due to
    (A) low cost   **(B)** durability
    (C) ease of fabrication   **(D)** All of these

i. Klystron amplifiers may use intermediate cavities to
    (A) reduce the power gain
    (B) reduce the bandwidth of the device
    (C) increase the efficiency of the klystron
    (D) prevent the oscillations that occur in two-cavity klystron

j. For standard rectangular waveguide, the aspect ratio is
    (A) 5 : 3   **(B)** 4 : 3
    (C) 3 : 2   **(D)** 2 : 1

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

Q.2 a. A transmission line has the following parameters:
         $R = 2\ \Omega$/m, G = 0.5 mmho/m, L = 8 nH/m, C= 0.23 pF, f = 1 GHz
         Calculate: (i) the characteristic impedance; (ii) the propagation constant.   **(8)**

         b. Explain Smith Chart. Explain how reflection coefficient can be obtained from
         it? Give example.   **(8)**

Q.3 a. Explain about TE modes in rectangular waveguides.   **(8)**

         b. Explain about TM modes in circular waveguides.   **(8)**

Q.4 a. Derive the S-matrix of E-plane Tee.   **(8)**

         b. Explain the construction of four-port circulator using two Magic Tees and one
         Phase Shifter.   **(8)**

Q.5 a. Describe the Ridley-Watkins-Hilsum theory.   **(8)**

         b. A TRAPATT diode has the following parameters:

         Doping Concentration: $N_A = 2 \times 10^{15}$ cm^{-3}
         Current density: J = 20 kA/cm^2
         Calculate the avalanche-zone velocity.   **(8)**

Q.6 a. Explain the working of two-cavity Klystron Amplifier with neat Schematic.   **(8)**

         b. Explain the working of TWT with neat Schematic.   **(8)**

Q.7 a.   An X-band pulsed cylindrical magnetron has the following operating
          parameters.
          Anode voltage: $V_o = 26$ kV
          Beam current: $I_o = 27$ A
          Magnetic flux density: $B_o = 0.336$ Wb/m^2
          Radius of cathode cylinder: a = 5 cm
          Radius of vane edge to center: b = 10 cm
          Compute:
          (i) The cyclotron angular frequency
          (ii) The cutoff voltage for a fixed B_o
          (iii) The cutoff magnetic flux density for a fixed V_o.   **(8)**

      b. Explain the working of Amplitron with neat Schematic.   **(8)**

Q.8 a. Write a short note on Quality Factor Q of Microstrip lines.   **(8)**

      b. A certain microstrip line has the following parameters.
          $\varepsilon r = 5.23$
          h = 7 mils
          t = 2.8 mils
          w = 10 mils
          Calculate the characteristic impedance Z_o of the line.   **(3)**

      c. Compare strip lines and microstrip lines in any 5 aspects.   **(5)**

Q.9 a. List the basic properties provided by ideal conductor, dielectric, and resistive
          material used in MMICS.   **(8)**

      b. A circular spiral inductor has the following parameters: **(8)**
          Number of turns : $\eta = 5$
          Separation : s = 100 mils
          Film width: w = 50 mils
          Compute the inductance.