Roll No. ....

Total Pages : 04

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MICROWAVE ENGINEERING

ECE-497-E

Time : Three Hours]   [Maximum Marks : 100

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

Unit I

1. (a) Derive expressions for unloaded quality factor of rectangualr resonator cavity ?   10

   (b) A rectangular air filled copper wave guide with dimension 0.9 inch × 0.4 inch cross section and 12 inch length is operated at 9.2 GHz with a dominant mode. Find (a) cut-off frequency, (b) guide wavelength, (c) phase velocity, (d) characteristic impedance and the loss ?   5×2

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2. (a) What are the methods of excitation and mechanically tuning a resonator cavity ? Describe with diagrams.   10

   (b) Compare power ratio and RF substitution method for attenuation measurement and give their advantages and disadvantages.   10

Unit II

3. (a) Derive expressions of Beam current density for multicavity Klystron amplifier.   10

   (b) How much power is required to bunch the electron beam in a Two cavity Klystron amplifier, derive necessary expressions ? 10

4. (a) How is the field distributed in a helical slow wave structure in TWT ? Derive necessary expressions using Floquet's Periodicity Theorem ? http://www.kuonline.in

   (b) Explain the following in context to cylindrical magnetron :

   (i) Strapping ?

   (ii) Frequency Pushing

   (iii) Frequency Pulling

   (iv) Condition for sustained oscillations in Magnetron

   (v) Phase Focusing Effect.   2×5=10

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Unit III

5. (a) Prove that a reciprocal network has the same transmission characteristics in either directions.   4

   (b) In a two port matched network give the values of the following losses in terms of S-parameters :   6
      (i) Insertion Loss
      (ii) Tansmission Loss
      (iii) Reflection Loss
      (iv) Return Loss.

   (c) Prove that sum of products of each term of any *one* row or column of S-matrix multiplied by its complex conjugate is unity.   10

6. (a) Explain the operation of a Precision Rotary Attenuator using suitable diagrams of each of its sectional plates and calculate the value of output electric field and its S-matrix.

   (b) In a H-plane tee junction, compute power delivered to the loads of 40Ω and 60Ω connected to arms 1 and 2 when a 10 mW power is delivered to matched port 3.   5

   (c) Explain the operation of circulator with its diagram and S-matrix.   5

Unit IV

7. (a) Explain Two-Valley Model Theory for *n*-type GaAs Gunn Diode with necessary expressions.   10

   (b) A GUNN diode is working in transit time modes at 12 GHz. The domain of charges move at 10^7 cm/sec speed. Calculate :
      (i) Length of Device ?
      (ii) In what modes device can work at 10 GHz and 14 GHz ?   3+3

   (c) Compare characteristics of GUNN Diode with IMPATT Diode.   4

8. (a) Explain negative resistance phenomenon in IMPATT diode with necessary diagram. 10

   (b) Compare characteristics of TRAPATT with BARITT diode.   4

   (c) If a M-Si-M diode having doping concentration of 2.8×10^{21} cm^{-3}, silicon length L = 6 μm and ε_r = 11.8, then determine :   3,3
      (i) Breakdown Voltage
      (ii) Breakdown Electric field.