Bengal Engineering & Science University, Shibpur

ME 1st Semester (ETC) Final Examination,2013

Microwave Devices & Circuits

ETC-933

Time : 3hrs. **F.M: 70**

Answer any six questions taking three questions from each group
2 marks are reserved for neatness from each group

Group A

1. Explain the principle of velocity modulation using Applegate diagram. How this principle is involved in the operation of a two cavity Klystron amplifier? Prove that theoretical efficiency of Klystron amplifier is 58%.

   [3+2+6]

2. Draw the rising sun structure of magnetron and explain how oscillation builds up in a magnetron.
   An X-band pulsed cylindrical magnetron has the following operating parameters:
   Anode dc voltage = 20kV
   Dc beam current = 25mA
   Radius of anode cylinder = 10cm.
   Radius of the cathode cylinder = 5cm.
   Calculate (i) the cyclotron angular frequency
   (ii) the cut-off magnetic field.

   [2+4+5]

3. Draw the equivalent circuit and symbol of a varactor diode and explain how its junction capacitance varies with voltage? Explain with a neat circuit the operation of parametric amplifier.

   [2+1+2+6]

4. What is transferred electron effect? How negative differential mobility develops in a Gunn diode? Explain different modes of operation of a Gunn diode.

   [1+6+4]

5. How negative resistance develops in an IMPATT diode? Derive an expression for the small signal impedance of an IMPATT diode. Mention some of drawbacks of IMPATT diode.

   [3+6+2]

GroupB

Answer any three questions from this group.

6. (a) Explain various types of planer transmission lines with appropriate diagrams. (b) Define *ABCD* parameters of a two-port network and derive the expression for *ABCD* parameters for a lossy and lossless transmission line network. (c) How do you calculate the distributed capacitance and 'effective dielectric constant' of a microstrip line? (d) Discuss the characteristics of an inverted microstrip line.

[3+3+ 3+2]

7. (a)How does electro-magnetic wave propagate through a microstrip line? Draw the electrical field distribution of a coupled gap microstrip lines and describes their parallel plate and fringing capacitances.
(b)What do you understand by even mode and odd mode propagation? Find out the expression for characteristic impedance and effective dielectric constant for even mode and odd mode excitation. (c) How do you model a microstrip gap?

[4+4+ 3]

8. (a)Write down the n^{th} order Chebyshev function in term of normalized frequency. Hence drive the Chebyshev lowpass approximate filter function. (b) What do you understand by quasi-lump elements of microstrip? How are inductances and capacitances realized by low and high impedance lines? (c)Describe the design steps of a 5^{th} order stepped impedance LC ladder type microstrip lowpass filter.

[4+4+ 3]

9. (a)Write the principle of operation of Switched- delay line phase shifter. Design such a phase shifter using microstrip line with a 30 degree phase shift at 5.6 GHz, on a substrate with a dielectric constant of 3.2 and substrate thickness 0.79 mm. (b) Construct a variable reactance, reflection type phase shifter using hybrid coupler and PIN diode. (c) Write down different applications of phase shifter.

[4+4+ 3]

10. Write short notes (any two)
(a) Schiffman Differential Phase Shifter
(b) Immittance Inverter
(c) Parallel-coupled bandpass filter
(d)Wilkinson's Power divider [51/2 x 2]