ME (ETC) 1st Semester Final Examination 2011
Microwave Devices and Circuits (ET 933)

Time : 3 hrs FM : 70

Answer any three questions from each group. Two marks are reserved in each half for neatness and to the point answer

Group A

1. Describe how velocity modulation of a beam is obtained in Klystron amplifier. How does an amplifier Klystron differ from a reflex Klystron?
   Find out an expression for efficiency and calculate the maximum theoretical efficiency of a reflex klystron.
   Explain the operation of a multi-cavity Klystron amplifier?
   [2+ 1+5+3]

2. Draw different structures of magnetron and make a comparison between them. Why magnetic field requires for the operation of a magnetron is called 'critical' and find out an expression for critical magnetic field required for the operation of magnetron.
   What do you mean by 'mode jumping' in magnetron and how it can be avoided by the method of strapping?
   [2+1+5+3]

3. Explain the quantum tunneling mechanism phenomena of an electron. Write down the necessary conditions for tunneling in a tunnel diode. Draw the equivalent circuit of a tunnel diode and find out expressions for two of its cut-off frequencies. Find out an expression for gain of a tunnel diode amplifier where the load is connected in series.
   [3+2+1+2+3]

4. Make a comparison between SDR and DDR IMPATT diodes in terms of structures, doping profile and electric field profile and also mention in which way a DDR IMPATT is superior over a SDR IMPATT. Draw the equivalent circuit of an IMPATT diode. With a neat schematic explain the operation of a waveguide based IMPATT oscillator. With a neat circuit explain the operation of reflection type IMPATT amplifier.
   [3+2+3+ 3]

5. What is transferred electron effect? How negative differential mobility results in a GUNN diode? Draw the structure and equivalent circuit of a Gunn diode. Also explain the different modes of operation of a Gunn diode.
   [3+4+2+2]

Group B

6. Define *ABCD* parameters of a two-port network. Derive the expression for *ABCD* parameters for a lossy transmission line network in term of characteristic impedance, the complex propagation constant, and length of a transmission line.
Find out the expression of the input impedances, when output port of the transmission line network is short circuited and also open circuited.
A 30 meter long lossless transmission line with Zo = 50 Ω operating at 2 MHz is terminated with a load $Z_L = 60 + j40$ Ω If phase velocity u = 0.6c on the line, find out standing wave ratio and input impedance without using the Smith chart.

[5+3+ 3]

7. How do EM wave propagate through a microstrip line? How the characteristic impedance and effective relative permittivity relates parallel plate and fringing capacitances.
A certain microstrip line has fused quartz (relative permittivity $\varepsilon_r = 3.8$) as a substrate. If the ratio of line width to substrate thickness is $w/h = 4.5$, determine
(a) effective relative permittivity of the substrate
(b) characteristic impedance of the line
(c) wavelength of the line at 10 GHz

Describe the construction and features of a suspended microstrip line

[5+4+ 2]

8. Draw the electrical field distribution of a coupled microstrip lines and describes their parallel plate and fringing capacitances.
What do you under stand 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.
What is edge coupling and broadside coupling-explain with suitable diagram?

[4+4+ 3]

9. Write down the n^{th} order Chebyshev function in term of normalized frequency. Hence drive the Chebyshev lowpass approximate filter function.
What do you understand by Quasi-lump elements of microstrip? How are inductances/capacitances realized by short circuited and open circuited stub?
Describe the design steps of a 5^{th} order microstrip lowpass filter using open circuited stubs and high impedance lines.

[4+4+ 3]

10 Write short notes (any two)
(a) CPW line
(b) Immittance Inverter
(c) Parallel-coupled bandpass filter [51/2 x 2]