Roll No.

Paper Code: MEC-916

M. Tech.
(SEM II) EVEN SEMESTER EXAMINATION, 2015-16
MICROWAVE INTEGRATED CIRCUITS

[Time: 3 hrs.]   **[Max. Marks: 100]**

Note: (1) All Question carry equal marks.
       (2) Attempt all questions.

1. Attempt any FOUR of the following: -   **[5x4=20]**

   (a) What are the different techniques used to fabricate MMICs ?

   (b) Explain the comparison between diffusion and ion implantation.

   (c) What is lithography? Explain the various types of lithography techniques.

   (d) Discuss the salient features Microwave Integrated circuits with suitable example.

   (e) Why is GaAs suitable over Si for microwave integrated devices? Write any three difficulties with MICs.

   (f) A microwave transistor has the following S parameters: : $S_{11} = 0.34 \angle -170^{\circ}$, : $S_{21} = 4.3\angle 80^{\circ}$, : $S_{12} = 0.06 \angle 70^{\circ}$, and : $S_{22} = 0.45 \angle -25^{\circ}$. Determine the stability, and plot the stability circles if the device is potentially unstable.

2. Attempt any TWO of the following: -   **[10x2=20]**

   (a) Discuss any two type of MMIC fabrication Techniques. Find the S parameter of the 3 dB attenuator circuit shown below:
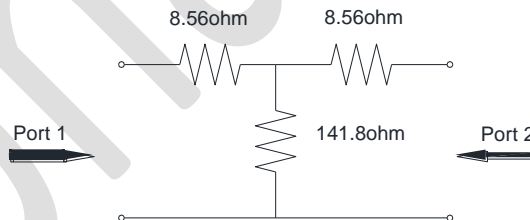

   (b) What is the significance of Scattering Matrix of a lossless junction at microwave frequency Region? Derive the scattering matrix of E plane T if power is fed from port 1.

   (c) What are Reciprocal and loss less networks? Explain them with suitable example and mathematical support.

3. Attempt any TWO of the following: -   **[10x2=20]**

   (a) Define ABCD matrix and find the ABCD parameters of a two port network consisting of series impedance Z between port 1 and port 2.
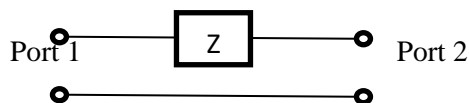
Also calculate the s parameter of the network and prove that $S_{12} = 1 + S_{11}$. Assume characteristic Impedance to be Z_0.

(b) An open circuit tuning stub is to be made from lossy transmission line with attenuation constant α. What is the maximum value of normalized reactance that can be obtained with this stub?What is the maximum value of normalized reactance that can be obtained with a shorted stub of the same type of transmission line? Assume αl is small.

(c) With the help of diagram explain the working of circulator and directional coupler. What are hybrid couplers? Explain how to measure the directivity of the coupler.

4. Attempt any TWO of the following:- **[10x2=20]**

(a) A strip line has a ground-plane spacing of 2 mm, a strip width of 1 mm, and is filled with a dielectric medium with dielectric constant 2.3.Find the characteristic Impedance. Derive an approximate electrostatic solution for micro strip line.

(b) Discuss the salient features of strip transmission lines. A strip line has aground-plane spacing 2H=1 cm and uses a centered copper conducting strip of width W =1 cm and thickness T =0.002 cm. The dielectric filling material has a dielectric constant $\varepsilon_r' =2.2$ and a loss tangent equal to 10^{-3}.Find the characteristic impedance and attenuation at a frequency of 10 GHz.

(c) Explain the procedure for the design of microwave oscillator. An amplifier uses a transistor having the following S parameters ($Z_0 = 50\Omega$) : $S_{11} = 0.61 \angle 170^\circ$, $S_{12} = 0.06 \angle-70^\circ$, $S_{21} = 2.3 \angle80^\circ$, : $S_{11} = 0.72 \angle-25^\circ$. The input of the transistor is connected to a source with $V_s = 2$ V (peak) and $Z_s = 25$ Ω, and the output of the transistor is connected to a load of $Z_L = 100$ Ω. (a) What is the power gain, the available gain, the transducer gain and the unilateral transducer power gain?

5. Attempt any TWO of the following: - **[10x2=20]**

(a) Discuss the properties of constant gain circles .A receiver has a noise figure of 7 dB, a 1 dB compression point of 25dBm (referred to output), a gain of 40 dB, and a third-order intercept point of 35 dBm (referred to output). If the receiver is fed with an antenna having a noise temperature of $T_A = 150$ K, and the desired output SNR is 10 dB, find the linear and spurious free dynamic ranges. Assume a receiver bandwidth of 100 MHz.

(b) Discuss the Importance of Periodic structures. Derive Image Impedance and Transfer functions for the two port networks. Design a composite high pass filter by image parameter method if $R_0 = 75$ Ω, $f_c = 50$ MHz, and $f_\infty =48$ MHz.

(c) Design maximally flat low pass filter prototype. What is the importance of Impedance and frequency scaling in filter transformation. What is Richard's Transformation?