

**B.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING
FOURTH YEAR SECOND SEMESTER - 2018**

MONOLITHIC MICROWAVE INTEGRATED CIRCUITS

Time: Three hours

Full Marks:100

Section A [Answer all questions]

1. a) What are 'Hybrid MIC' and 'MMIC'? Compare MMIC with Hybrid MIC. [2+2]
- b) "The FET switch is a poor substitute for the PIN diode, and the HEMT millimeter-wave oscillator will have a low power compared with GUNN diode." - explain in the context of MMIC. [2]
- c) Discuss on the design principle of different types of resistors, inductor, capacitors for MMIC? [15]
- d) Discuss on Via-holes and grounding techniques for MMIC. [4]
2. a) Draw the schematic diagram of a switched T attenuator and discuss its working principle. [6]
- b) How will you use PIN diodes to implement different single pole switches in RF circuits? [4]
- c) What is the use of phase shifters? How will you design a loaded line 90 degree phase shifter at 10 GHz? How two-branch coupler can be used to design phase shifters? [12]
- d) Write the differences between analog and digital phase shifters. [3]

Section B [Answer any one question]

3. a) Draw a two-port transistor amplifier network with general source and load impedances and define source, load, input and output reflection coefficients (Γ_s , Γ_L , Γ_{in} and Γ_{out}). Find out G , G_A , G_T and G_{TU} in terms of transistor S-parameters and different reflection coefficients. [10]
- b) A certain transistor has the following S parameters: $S_{11} = 1.2$, $S_{21} = 4.0$, $S_{12} = 0$ and $S_{22} = 0.9$. Determine whether this transistor is unconditionally stable. [5]
- c) Describe the design procedures for a transistor based RF oscillator. [10]

[Turn over

4. a) "Mixers are usually classed as single ended, single balanced, or double balanced" - what are the main differences between these mixers? [6]
- b) Draw schematic diagram of MOSFET double-balanced mixer and discuss its working principle. [4+4]
- c) Discuss the design principle of FET distributed mixer. How can you implement it using microstrip technology? [6+5]

Section C [Answer any one question]

5. Considering $R=1$ Ohm, analyze the performance of the circuit shown in Figure 1, which is designed to match 50 Ohm and 200 Ohm systems at 1 GHz. The circuit uses 13.78 nH series inductor and 1.38 pF parallel capacitor. Plot S_{11} vs. frequency for 0.5-1.5 GHz. [25]

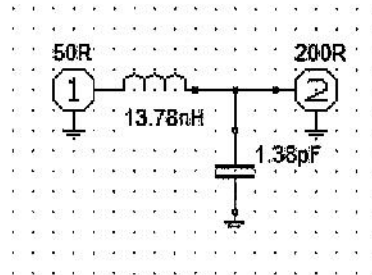


Figure 1

6. Considering $R=1$ Ohm, analyze the performance of the circuit shown in Figure 2 containing two 150.48 Ohm parallel resistors and a 37.35 Ohm series resistor. Plot S-parameter vs. frequency for 0.5-1.5 GHz. What is the purpose of this circuit? [24+1]

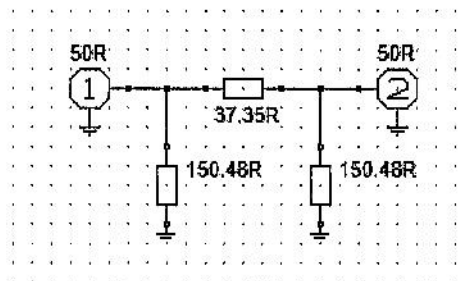


Figure 2