



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/M.Tech (ECE-VLSI)/SEM-2/MVLSI-205 A/2013**

**2013**

**RF CIRCUITS & SYSTEMS**

*Time Allotted : 3 Hours*

*Full Marks : 70*

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

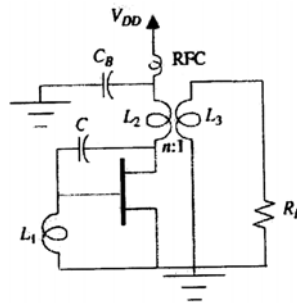
Question No. 1 is compulsory and attempts any 4 from the rest.

1. Answer the following question :  $7 \times 2 = 14$

- a) What is Heterostructure ? Is this structure superior to homostructure ? Explain.
- b) Write down the characteristics of high frequency BJT used in RF range.
- c) Explain resonant tunneling phenomenon ?
- d) Differentiate active and passive RF components
- e) Why T parameters are necessary for the analysis of RF networks.
- f) What are the basic use of Smith chart in the RF application field.
- g) What is the use of PLL circuit.



2. Explain the principle of operation of a microwave tunnel diode. Show the V-I characteristic of a tunnel diode. A microwave tunnel diode has a negative resistance  $R_n$  and the resonant circuit has a circuit resistance  $R_l$ . Derive equation for the gain of a microwave tunnel diode amplifier. 3 + 4 + 7
  
3. What are the basic elements of Phase Locked Loop circuit ? What is Phase Noise in PLL circuit & describe the effect of it ? Explain the operation of VCO tuning. Describe the operation of PLL frequency synthesizer. 3 + 4 + 3 + 4
  
4. What is Barkhausen criterion ? Describe the operation of crystal oscillator. Explain the electronic tuning of oscillator. The Hartley circuit shown in Figure below is oscillating at 150 MHz. If the transconductance  $gm$  of the FET is 4.5mS, the load resistance  $R_L$  is  $50\Omega$ , and there is no coupling between  $L_1$  and  $L_2$  whereas  $L_2$  and  $L_3$  are tightly coupled, find the values of the circuit components. Consider  $L_1 = L_2 = 1\text{ nH}$ . 2 + 5 + 3 + 4





5. Write short note any *four* :

- a) Frequency divider
- b) Microwave detector
- c) Microwave mixer
- d) Stability of active network
- e) T parameter
- f) RF integrated device

6. Explain the working principle of directional coupler. What are RF power combiners and splitters ? Write down the characteristics of splitter/combiner circuits. Explain 90 degree splitter/combiner.

4 + 3 + 3 + 4

7. What are reciprocal network and symmetrical network ? Why scattering parameters are used for the analysis of a network ? Show the scattering matrix. Obtain expressions for scattering parameters.

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