University of Ottawa

Master of Engineering

Electrical and Computer Engineering

Assignment 1

ELG7132D

Topics in Electronics I: Simulation of Radio Frequency Circuits

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Contents

Pg.no

Introduction

The objective is to get familiarized with the HiSPICE- Matlab interface as a tool to used extract the circuit mathematical structures which is done through executing simple commands to access the mathematical constructs describing the circuit.

Circuit Diagram

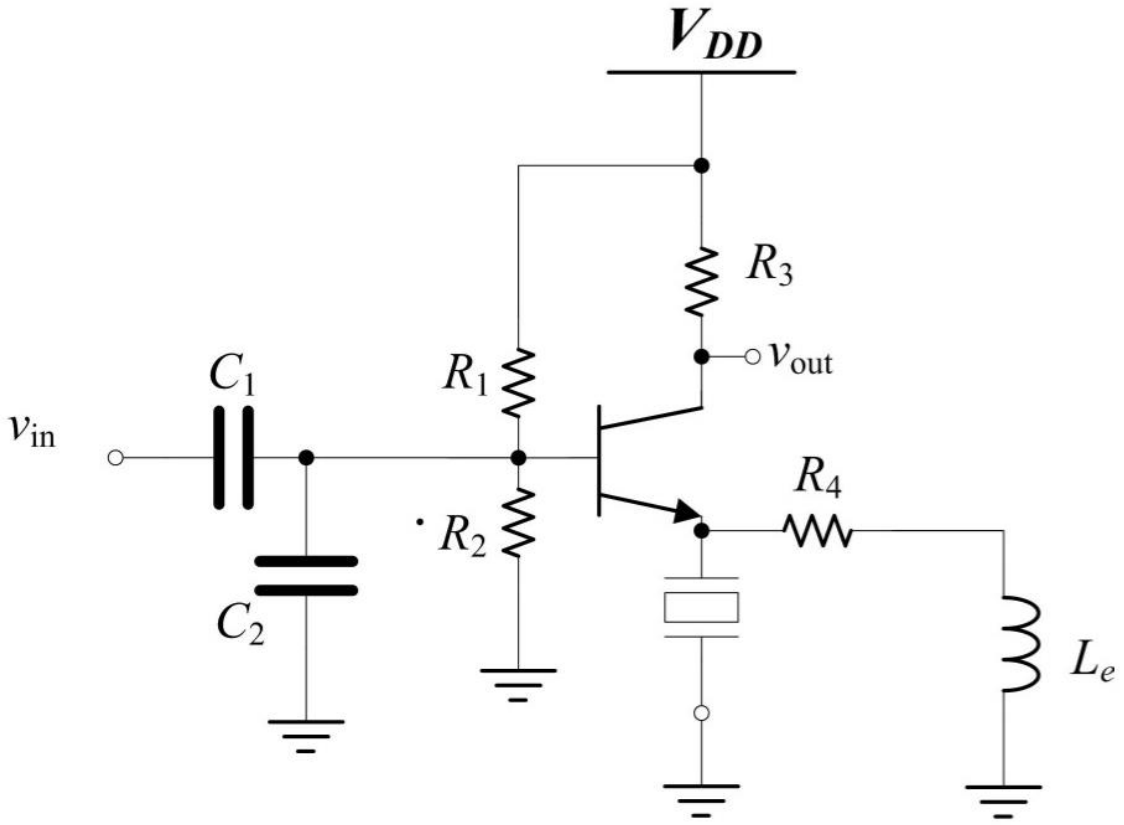

Fig.1 Tuned Amplifier Circuit

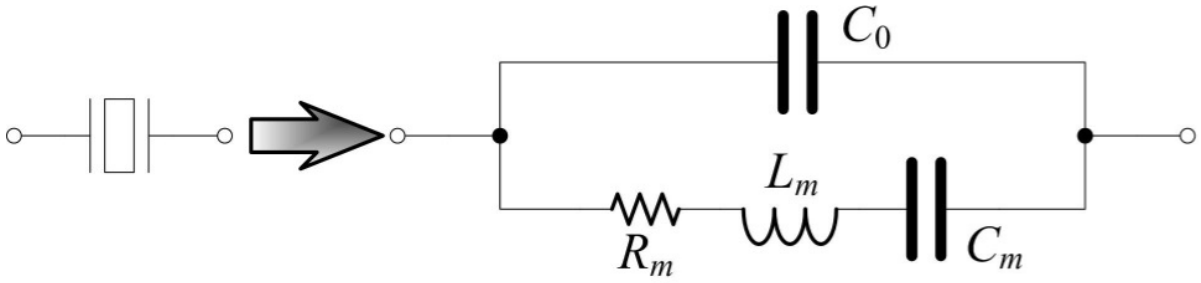

Fig.1.1 Crystal Equivalent model

Equivalent Circuit Model

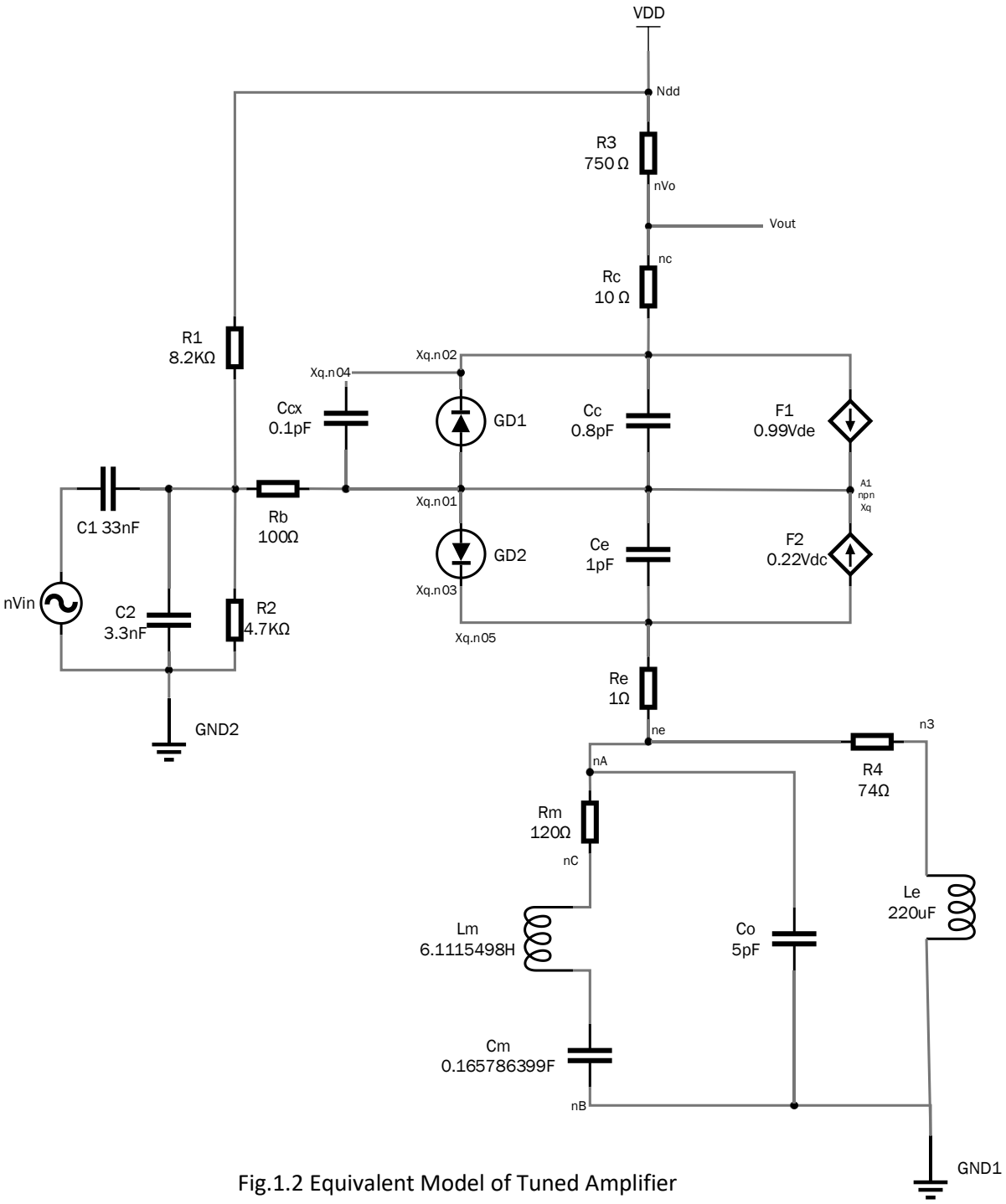

Fig.1.2 Equivalent Model of Tuned Amplifier

G – Matrix

	0	-1/R1	-1/R3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
1/R1+1/R3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
-1/R1	0	-1/R1+1/R2+1/Rb	0	0	0	0	-1/Rb	0	0	0	0	0	0	0	0	0	0	0
-1/R3	0	0	1/R3+1/Rc	0	0	0	0	0	0	-1/Rc	0	0	0	0	0	0	0	0
0	0	0	0	1/Re+1/Rm+1/R4	-1/R4	0	0	0	0	0	-1/Re	1/Rm	0	0	0	0	0	0
0	0	0	0	-1/R4	1/R4	1/Rb	0	0	0	0	0	0	0	0	0	0	0	0
0	0	-1/Rb	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.02	-0.99	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	1/Rc	0	0	0	0	0	0	0	0
0	0	0	-1/Rc	0	0	0	0	0	0	0	0	0	0	0	0	-1	0.99	0
0	0	0	0	-1/Re	0	0	0	0	0	0	1/Re	0	0	0	0	0.02	-1	0
0	0	0	0	-1/Rm	0	0	0	0	0	0	0	1/Rm	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	-1	-1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	1	-1	0	0	0	0	0	0

The G-Matrix is formed by considering all the resistors. In a closed network with various linear and nonlinear elements the G matrix represents the presence of resistors between various node.

C- Matrix

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	**C1**	**-C1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	**-C1**	**Ccx+C1+C2**	0	0	0	0	0	0	**-Ccx**	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	**C0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0		0	0	0	**Cc+Ce**	0	0	**-Cc**	**-Ce**	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	**-Ccx**	0	0	0	**-Cc**	0	0	**Ccx+Ce**	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	**-Ce**	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	**Ce**	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	**Cm**	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**Lc**	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Lm

The C-Matrix is formed by considering all the capacitors and the inductors. In a closed network with various linear and nonlinear elements the C-matrix represents the presence of capacitors and the inductors between various node.

Source Vector *b(t)*

b(t) =

0
0
0
0
0
0
0
0
0
0
0
0
0
Vdd
Vin
0
Vdc
Vde
0

The source vector represents the various voltage sources present in a network. It also denotes the node at which the source is present.

Function Vector *f(x(t))*

$$f(x(t)) = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ g(V8-V7) + g(V9-V7) \\ -g(V8-V7) \\ g(V9-V7) \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

Nodes and their indices

Node Label	Index Assigned by Hi-Spice
ndd	1
nVin	2
n1	3
nVo	4
A1	5
n3	6
xQ.n01	7
xQ.n02	8
xQ.n03	9
xP.n04	10
xQ.n05	11
xCrystal.nC	12
xCrystal.C1	13
Vdd	14
Vin	15
Le	16
Vdc	17
Vde	18
Lm	19

Table 1: Nodes in the network and their corresponding indices