GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering
Level: PG
Branch: Electronics And Communication (VLSI Design)
Subject Code: ME02096061
Subject Name: RF Microelectronics

WEF Academic Year	2025-26
Semester	02
Category of the Course	PEC-05

Prerequisite:	Analog CMOS circuits, physics of MOS transistors
Rationale:	For system-on-chip (SOC) solutions, it is required to integrate high-frequency circuits with low-power dissipation and low-noise circuits. So, it is most significant for the students to study behaviors of VLSI circuits in high-frequency scenarios as well as low-power dissipation and low-noise circuits' scenarios. This course covers various modules related to RF microelectronics.

Course Outcome: After completion of the Course, Students will be able to:

No	Course Outcomes	RBT Level*
01	Understand various RF circuit performance parameters.	UN
02	Analyze passive RLC network.	AN
03	Calculate noise performance of RF circuits.	AP
04	Analyze LNA CMOS Circuits.	AN
05	Evaluate performance of RF Mixer circuits.	EL

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
03	00	02	04	70	30	30	20	150

Course Content:

U. No	Course Content	No of Hours	% weightage
1	**Basic Concepts in RF Design**: General Considerations, effects of nonlinearity, noise, sensitivity and dynamic range, passive impedance transformation, scattering parameters, analysis of nonlinear dynamic systems, Volterra series.	8	20

2	**Passive RLC Network**: Introduction, parallel RLC tank, series RLC networks, other resonant RLC networks, RLD networks as impedance transformers	4	10
3	**Noise:** Introduction, thermal noise, shot noise, flicker noise, popcorn noise, classical two-port noise theory, examples of noise calculations, a handy rule of thumb, typical noise performance.	6	15
4	**LNA Design**: Introduction, derivation of intrinsic MOSFET two-port noise parameters, LNA topologies – power match Vs noise match, power-constrained noise optimization, design examples, linearity and large-signal performance, spurious-free dynamic range.	8	20
5	**Mixer:** Introduction, mixer fundamentals, nonlinear systems as liner mixers, multiplier-based mixers, subsampling mixers, diode-ring mixers.	8	15
6	**Feedback Systems:** Introduction, a brief history of modern feedback, a puzzle, desensitivity of negative feedback systems, stability of feedback systems, gain and phase margin Vs stability measures, root-locus techniques, summary of stability criteria, modelling feedback systems, errors in feedback systems, frequency- and time-domain characteristics of 1^{st} – and 2^{nd} – order systems, useful rules of thumb, root-locus examples and compensation, summary of root-locus techniques	8	20
		42	100

Reference Book:

- Thomas H. Lee, The Design of CMOS RF Integrated Circuits, 2^{nd} Edition, Cambridge University Press, 2003.
- B. Razavi, RF Microelectronics, PHI, 1998.
- Robert Caverly, CMOS RFIC Design Principles, Artech House, 2007

Suggested Course Practical List:

- The practical work will be carried out based on the content covered during the academic session.

List of Laboratory/Learning Resources Required:

- List of Hardware: FPGA/CPLD programming tool,
- List of Software: EDA Tools – Cadence, Synopsis, Siemens
- List of Useful websites MOOCs:---
  - NPTEL Course on Analog Electronic Circuit, IIT Delhi, Prof. Shouribrata Chatterjee - https://nptel.ac.in/courses/108102112
  - Course-related online MOOCs on NPTEL/SWAYAM platform
  - Recent publications in reputed journal/conferences

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