INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

RF CIRCUIT DESIGN								
VI Semester : ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AECD33	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite:								

I. COURSE OVERVIEW:

This course provides in-depth knowledge experience on RF and millimeter circuit design. This course covers the topics on how to derive the RF wireless system specifications and how to design the main building blocks of transceiver i.e. low noise amplifier, power amplifier, RF mixers, oscillators, PLL frequency synthesis. An understanding of the technologies behind transmitter and receiver design including small-signal RF amplifiers is obtained.

II. COURSES OBJECTIVES:

The students will try to learn

I. RF systems and circuit design concepts in the existing and future radio technologies.
II. RF circuit devices with active non-linear components and integration of them into systems.
III. Transceiver architecture with matching and biasing networks.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Explain various principles and concepts of research methodology.

CO2 Apply appropriate method of data collection and analyze using statistical methods.

CO3 Analyze research outputs in a structured manner and prepare report as per the technical and ethica standards.

CO4 Formulate research methodology for a given engineering and management problem situation.

CO5 Outline the role of Programmable logic devices for realization of complex boolean functions.

CO6 Examine the test strategies, implementation approach on full custom and semi-custom design fo optimizing speed, cost, reconfiguration and reliability parameters.

IV. COURSE CONTENT:

MODULE - I: INTRODUCTION (10)

Importance of RF Design-Dimensions and Units-Frequency Spectrum-RF Behaviour of Passive Components: High Frequency Resistors, High Frequency Capacitors, High Frequency Inductors. - Chip Components, and Circuit Board Considerations: Chip Resistors, Chip Capacitors, and Surface Mount Inductors. Review of Transmission Lines: Types of Transmission Lines-Equivalent Circuit representation- R, L, C, G parameters of Different Line Configurations-Terminated Lossless Transmission Lines-Special Terminations: Short Circuit, Open Circuit and Quarter Wave Transmission LinesSourced and Loaded.

MODULE –II: SINGLE AND MULTI-PORT NETWORKS (09)

The Smith Chart: Reflection Coefficient, Normalized Impedance-Impedance Transformation: Standing wave Ratio, Special Transformation Conditions-Admittance Transformation-Parallel and Series RL & RC Connections-Basic Definitions of Single and Multi-Port Networks-Interconnecting Networks.

MODULE –III:RF FILTERS AND PASSIVE COMPONENTS (10)R

Fresistors, capacitors and inductors; component parasitics and self-resonance;transmission-line resonators; microstrip and stripline structures; coupledlines; power dividers and directional couplers; Wilkinson power divider; hybridcouplers.

RFfilter specifications; low-pass, high-pass, band-pass and band-stop filters;Butterworth and Chebyshev approximations; lumped-element and distributed RFfilter design.

MODULE –IV: MATCHING AND BIASING NETWORKS (10)

Impedance Matching Using Discrete Components: Two Component Matching Networks, Forbidden Regions, Frequency Response and Quality Factor, T and Pi Matching Networks-Amplifier Classes of Operation and Biasing Networks: Classes of Operation and Efficiency of Amplifiers, Biasing Networks for BJT, Biasing Networks for FET.

MODULE –V: RF TRANSISTOR AMPLIFIER DESIGN (09)

Characteristics of Amplifiers- Amplifier Power Relations: RF Source, Transducer Power Gain, Additional Power Relations Stability Considerations: Stability Circles, Unconditional Stability, And Stabilization Methods-Unilateral and Bilateral Design for Constant Gain- Noise Figure Circles- Constant VSWR Circles. RF Oscillators and Mixers: Basic Oscillator Model: Negative Resistance Oscillator, Feedback Oscillator Design, Design steps, Quartz Oscillators- Fixed Frequency High Frequency Oscillator -Basic Characteristics of Mixers: Concepts, Frequency Domain Considerations, Single Ended Mixer Design, Single, and Double Balanced Mixers.

V. TEXT BOOKS:

1. Reinhold Ludwig, Pavel Bsetchko, “RF Circuit Design – Theory and Applications”, Pearson Education India, 2000.
2. Devendra K. Misra, “Radio Frequency and Microwave Communication Circuits – Analysis and Design”, Wiley Student Edition – John Wiley & Sons, Inc

VI. REFERENCE BOOKS:

1. Matthew M. Radmanesh, “Radio Frequency and Microwave Electronics”, Illustrated by– PEI.
2. Christopher Bowick, Cheryl Aljuni and John Biyler, “RF Circuit Design”, Elsevier Science, 2008.
3. Joseph J.Carr, “Secrets of RF Circuit Design”, McGraw Hill Education, 2000.
4. Peter L.D. Abrif, “Design of RF and Microwave Amplifiers and Oscillators”, Artech House, 2000.
5. Thomas H.Lee, “The Design of CMOS Radio Frequency Integrated Circuits”, Cambridge University Press, 2nd Edition, 2004.

VII. ELECTRONICS RESOURCES:

1. https://www.highfrequencyelectronics.com/index.php?...rf-circuit-design-references..

2. eecs.oregonstate.edu/~karti/ece621/ece621.pdf

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Tech-talk topics
5. Assignments
6. Model question paper - I
7. Model question paper - II
8. Lecture notes
9. Early learning readiness videos (ELRV)
10. Power point presentations