Semester II (M. Tech.- 2 Year Programme)										
Sr. No.	**Course Type/Code**	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**			**External Marks**	**Total Marks**
			L	**T**	**P**		**CT**	**TA**	**Total**		
1	ECT310	Advance Microwave Engineering	3	1	0	4	30	20	50	100	150
2	ECT311	AdvanceAnalogSignal Processing	3	1	0	4	30	20	50	100	150
3	ECT31X	Professional Elective-3	3	1	0	4	30	20	50	100	150
4	ECT31X	Professional Elective-4	3	0	0	3	30	20	50	100	150
5	OET30X	Open Elective-1	3	0	0	3	30	20	50	100	150
6	ECP303	Lab-III: FPGA Design Lab	0	0	3	1		25	25	25	50
7	ECP304	Lab-IV: TCAD Lab	0	0	3	1		25	25	25	50
		Total	**15**	**3**	**6**	**20**			**300**	**550**	**850**
8	OET30X	*Open Elective-2 (Optional)	3	0	0	3	30	20	50	100	150

ProfessionalElective-3	**ProfessionalElective-4**	**OpenElective-1**	***OpenElective-2(Optional)**
(2)CMOSAnalogCircuitDesign	(5) Advanced Wireless Communication Networks	(1) IoTanditsApplications	(1) IoTanditsApplications
(3)VLSI Circuit Design	(6)Optical Communication System	(2) ArtificialIntelligenceandMachineLearning	(2) ArtificialIntelligenceandMachineLearning
(4) System for Wireless &Mobile Communication	(7) Smart Antennas	(3) CompositeMaterials	(3) CompositeMaterials
		(4) IndustrialSafety	(4) IndustrialSafety
		(5) Non-ConventionalEnergySources	(5) Non-ConventionalEnergySources

ADVANCED MICROWAVE ENGINEERING (ECT- 310)

L:T:P:: 3:1:0 **Credits-4**

COURSE OBJECTIVES:

From this course, students will be able to:

1. Describe the operation and analyze the performance of basic microwave components
2. Analyze microwave systems and assess the impact of microwave component performances on overall system performance

COURSE OUTCOMES:

1. Students will be able to understand basics of microwave
2. Students will be able to analysis of microwave transmission lines and waveguides.
3. Students will be able to understand various microwave components.
4. Students will be able to understand various Microwave Systems

UNIT 1. BASICS OF MICROWAVE : Microwave Network Analysis Concept of differential signal, coupling and crosstalk, Scattering Parameters: Definition, Meaning, Chain Scattering Matrix, Conversion Between S- and Z-parameters, Signal Flow Chart Modeling.**(8 hours)**

UNIT 2. ANALYSIS OF MICROWAVE TRANSMISSION LINES AND WAVEGUIDES: Transmission line equations & solutions, reflection and transmission coefficient, standing wave and standing wave ratio, line impedance and admittance, impedance matching, using stub line, application of smith chart in solving transmission line problems Introduction to strip lines, Micro strip lines, parallel strip lines, coplanar strip lines, shielded strip lines, Rectangular and circular waveguides-theory and analysis.**(8 hours)**

UNIT3.MICROWAVE COMPONENTS: Microwave Spectrum and Bands, Applications of microwaves. Microwave Cavities - Rectangular and Circular cavity Resonators, Microwave Hybrid Circuits - Waveguide Tees E-plane or Series tee, H-plane or shunt Tee, Magic Tees(Hybrid Tees), Applications of magic Tee, Hybrid Rings (Rat-Race Circuits) Hybrid Rings, Waveguide Corners, Bends and Twists, Directional Couplers, Two-Hole Directional Couplers, Circulators and Isolators.**(8 hours)**

UNIT 4. MICROWAVE SYSTEMS: Wireless Communications system, Radar Systems, Radiometer Systems, Satellite Communication, Remote sensing, Microwave Propagation, Microwave Antennas.**(8 hours)**

UNIT 5. MICROWAVE MEASUREMENTS: Components of Microwave Bench, Detection of Microwaves, Microwave power measurement, Impedance measurements, VSWR measurement, Frequency measurement.**(8 hours)**

BOOKS:

1. ML Sisodia and V.L.Gupta - Microwave Engineering, 1st Edition, New Age International, 2005.
2. David M. Pozar, Microwave Engineering, Fourth Edition, Wiley.
3. Bryant, G.H., Principles of Microwave Measurements, the Institution of Engineering and Technology.
4. M.L. Sisodia and GS Raghuvanshi - Microwave Circuits and Passive Devices, Wiley Eastern, 1987.
5. Samuel Y Liao - Microwave Devices and Circuits, 3rd Edition, Pearson Education, 2003..
6. I.L. Kosow, Microwave Theory and Measurements, Hewlett Packard, 1st Edition, 1962.
7. Dennis Roddy - Microwave Technology, PHI

ADVANCED ANALOG SIGNAL PROCESSING (ECT- 311)

L:T:P:: 3:1:0 **Credits-4**

COURSE OBJECTIVES:

From this course, students will be able to:

Provide a solid foundation in analog signal processing that will serve as a strong base for further study in digital signal processing, communications, remote sensing, control, and electronics

COURSE OUTCOMES:

1. The students will understand the basics of network analysis and synthesis
2. The students will understand the basics of analog Signal processing
3. The mathematical problem-solving ability of students gets improved.
4. The students will be acquainted with modern actives building blocks and their application in analog signal processing
5. The analog system analyzing and designing skills of students will be improved.

Unit-1 A Review of Network Analysis Techniques: Transformed Impedances, Nodal Analysis, Loop (Mesh) Analysis, Network Functions, One-Port and Two-Port Networks,Admittance Matrix Parameters, Impedance Matrix Parameters, Chain Parameters (Transmission Parameters), Two port interconnections: series-series connection, parallel-parallel connection, Series Input–Parallel Output Connection, Parallel Input–Series Output Connection, Cascade Connection.
(8 hours)

Unit-2 Operational Trans-conductance (OTA) And Its Application: Ideal Operational Trans-Conductance Amplifier, CMOS OTA, Voltage Amplification, Voltage Variable Resistance (VVR), Voltage Summer, Integrator, First Order OTA-C filters, Two Integrator Loop OTA-C filters.**(8 hours)**

Unit-3 Current Feedback Operational Amplifier (CFOA) And Its Application in Design of Analog Circuits: Introduction, Merits and Advantageous Features of the CFOAs, Demerits and Limitations of CFOAs, Unity Gain Voltage and Current Followers , Integrators and Differentiators and Instrumentation Amplifier Using CFOAs, Realization of Gyrator and Grounded Impedances Using CFOAs.**(8 hours)**

Unit-4 Design of Filters Using CFOAs: Introduction, Five Generic Filter Types, Their Frequency Responses and Parameters, Voltage-Mode/Current-Mode Bi-quads Using CFOAs, Dual Function VM Biquads, Single Input Multiple Output (SIMO) VM Bi-quads, Multiple Input Single Output (MISO) Type VM Biquads, MISO-Type Universal Current-Mode (CM) Bi-quads, Dual-Mode Universal Bi-quads Using Single CFOA.**(8 hours)**

Unit-5 Recent Trends in Analog Signal Processing: Realization of Resistors in MOS, CMOS Operational Trans-Resistance Amplifier (OTRA), Realization of OTRA using CFOA, Realization of Current Differencing Buffered Amplifier (CDBA) using CFOA ,**(8 hours)**

BOOKS:

1. R.P. Areny and J.G. Webster, “Analog Signal Processing”, John Wiley & Sons, 2012
2. Robin Raut and M.N.S. Swami, “ Modern Analog Filter Analysis and Design, John Wiley & Sons
3. Raj Senani, D.R. Bhaskar, A.K. Singh and V.K. Singh, “Current Feedback Operational Amplifier (CFOA) And Their Applications, Springer

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ECT-313 VLSI CIRCUIT DESIGN

L:T:P:: 3:1:0 **Credits-4**

COURSE OBJECTIVES:

From this course, students will be able to:

1. Learn digital CMOS logic design.
2. Realize importance of testability in logic circuit design.
3. Overview SoC issues and understand PLD architectures with advanced features

COURSE OUTCOMES:

At the end of the course the student will be able to:

1. To get acquainted with basic theory of MOS transistors and familiar with CMOS fabrication technology
2. To understand the concepts related to implementation of Combinational CMOS logic circuits
3. To understand the concepts related to implementation of sequential CMOS logic circuits
4. To understand the concepts of memories design with efficient architectures to improve access times, power consumption.
5. To understand the process behind testing of CMOS integrated circuits

UNIT 1: REVIEW OF MOSFET OPERATION AND CMOS PROCESS FLOW: MOS Threshold voltage, MOSFET I-V characteristics: Long and short channel, MOSFET capacitances, lumped and distributed RC model for interconnects, SPICE Model, CMOS process flow, Layout and design rules.**(8 hours)**

UNIT 2: CMOS INVERTER ANDCOMBINATIONAL LOGIC: The CMOS Inverter, CMOS Logic Gates: NAND Gate, NOR Gate, Compound Gates, Pass Transistors and Transmission Gates, Tristates, Multiplexers, adders, Complex logic circuit.**(8 hours)**

UNIT 3: SEQUENTIAL LOGIC: Behaviour of Bistable element, monostable and a stable circuits, Static latches and flip-flops (FFs), dynamic latches and FFs, Voltage Bootstrapping, Synchronous dynamic high Performance dynamic CMOS circuits.**(8 hours)**

UNIT 4: MEMORIES AND ARRAY STRUCTURES: MOS-ROM, SRAM cell, memory peripheral circuits, signal to noise ratio, power dissipation.**(8 hours)**

UNIT 5: **Testing, Debugging, and Verification:** Test vectors, Fault Models, Observability, Controllability, Repeatability, Survivability, Fault Coverage, Automatic Test Pattern Generation (ATPG),Delay Fault Testing, Ad Hoc Testing, Scan Design, Built-In Self-Test (BIST), IDDQ Testing, Design for Manufacturability, Boundary Scan etc.**(8 hours)**

BOOKS :

1. Rabaey, Chandrakasan and Nikolic, “Digital Integrated Circuit: A Design Perspective”, PHI; Latest Edition.
2. Sung-Mo Kang, Yusuf Liblebici, “CMOS Digital Integrated Circuits,” Tata McGraw Hill.
3. Weste and Eshraghian, “Principles of CMOS VLSI Design” Addison Wesley, Latest Edition
4. Weste and Harris, “CMOS VLSI Design”

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SMART ANTENNAS (ECT-317)

L:T:P:: 3:1:0 **Credits-3**

COURSE OBJECTIVES:

From this course, students will be able to:

1. Provide the basic knowledge of smart antennas and their radiation characteristics.
2. Provide the knowledge of broad band antennas and their applications
3. Develop the students understanding of various Microstrip antenna for smart antenna applications

COURSE OUTCOMES

1. Students will able to understand the MIMO antennas.
2. Students will able to understand the different types of RFID antennas and its applications.
3. Students will able to understand the different tuning characteristics of antenna using reconfigurable antenna.
4. Students will able to understand the UWB antennas.
5. Students will able to understand the technology of 5G and Millimeter wave technology

UNIT 1: MIMO ANTENNAS: Theory and applications of MIMO, MIMO antenna performance criterion, 5G massive MIMO technology, Single band MIMO Antenna, Multi Band MIMO Antenna, CP-MIMO Antenna for WLAN applications.**(8 hours)**

UNIT 2: RFID ANTENNAS: Introduction to RFID systems, RFID reader systems, Physical Layer Developments of Smart Antennas for RFID Systems, Multi Antenna RFID, MIMO Antenna RFID .**(8 hours)**

UNIT 3: RECONFIGURABLE ANTENNAS AND METAMATERIALS: Introduction to Reconfigurable Antennas, Overview of RF/Microwave Switches; Basic Antenna Configurations; Frequency and Polarization Reconfiguration; Pattern Reconfiguration, Basic Scanning Antenna Array Design, Switch Biasing and other Considerations, Modeling of Reconfigurable Antennas, MIMO Reconfigurable Antennas, Introduction to meta-materials in antenna designs.**(8 hours)**

UNIT 4: ULTRAWIDEBAND ANTENNAS: Introduction to UWB Systems and Applications, Design and Developments of UWB Antennas, UWB Arrays, UWB Beam forming, UWB Spatial Channel Characteristics, UWB Reflector Antennas, UWB feed designs.**(8 hours)**

UNIT 5: 5G AND MILLIMETER WAVE TECHNOLOGY: Introduction to 5G, A circuit's designer perspective, High frequency limitation of Microstrip Antennas, RF and millimeter wave full duplex wireless for 5G and beyond, Scalable RF and millimeter wave multi beam approaches, Phased arrays for 5G millimeter wave communications, Orthogonal phase and gain array control**(8 hours)**

BOOKS:

1. Malviya, Panigrahi, "MIMO Antennas for Wireless Communication Theory and Design", 2021 CRC Press
2. Nemai Chandra Karmakar, “Handbook of Smart Antennas for RFID applications”,
3. Allen, Dohler, “Ultra-Wideband Antennas and Propagation for Communications, Radar and Imaging