VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY

(Formerly Uttarakhand Technical University, Dehradun Established by Uttarakhand State Govt. wide Act no. 415 of 2005)

Suddhowala, PO-Chandanwadi, Premnagar, Dehradun, Uttarakhand (Website- www.uktech.ac.in)

SYLLABUS

For

Master of Engineering Programmes

(M.Tech. Electronics & Communication Engineering)

(For admission in 2022-23 and onwards)

Courses Structure and Scheme of Examination for M. Tech.- 2 Year Programme

Electronics and Communication

Semester I											
Sr. No.	**Course Type/Code**	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**			**External Marks**	**Total Marks**
			L	**T**	**P**		**CT**	**TA**	**Total**		
1	ECT-301	Advance Digital Signal Processing	3	1	0	4	30	20	50	100	150
2	ECT-302	Advance Communication System	3	1	0	4	30	20	50	100	150
3	ECT-303	Semiconductor Device Theory and Modeling	3	1	0	4	30	20	50	100	150
4	ECT30X	Professional Elective-I	3	0	0	3	30	20	50	100	150
5	ECT30X	Professional Elective-II	3	0	0	3	30	20	50	100	150
6	ECP301	Lab-I: VLSI Circuit Design lab	0	0	3	1		25	25	25	50
7	ECP302	Lab-II: Signal Processing Lab	0	0	3	1		25	25	25	50
8	AHT302	Research Methodology and IPR	2	0	0	2		50	50	50	100
9	AHT-303	Technical Writing and Presentation Skill	2	0	0	NC		50	50	0	NC
		Total	**22**	**3**	**8**	**22**	**150**	**250**	**400**	**600**	**950**
10	OET30X	Open Elective (Optional)	3	0	0	3	30	20	50	100	150

Professional Elective-I	**Professional Elective-II**	***OpenElective-1(Optional)**
(4) Wireless and Mobile Communication	(7)Advance Analog Filter Design	(1) IoT and its Applications
(5) Digital Image and Video Processing	(8) Embedded System Design	(2) Artificial Intelligence and Machine Learning
(6) Advance Antenna Theory	(9) Nano electronics	(3) Composite Materials
		(4) Industrial Safety
		(5) Non-Conventional Energy Sources

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

Semester III(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	OET30X	Open Elective-2	3	0	0	3	30	20	50	100	150
2	ECP305	Seminar	0	0	4	2		100	100		100
3	ECP306	Project	0	0	10	5		100	100	150	250
4	ECP307	Dissertation-1	0	0	12	6		300	300		300
		Total	**3**	**0**	**22**	**16**		**520**	**550**	**250**	**800**

Semester IV(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	ECP308	Dissertation	0	0	28	14		250	250	450	700
		Total	**0**	**0**	**28**	**14**		**250**	**250**	**450**	**700**

Open Elective-2
(6) NanomaterialsandNanotechnology
(7) GreenEnergy
(8) Industry4.0
(9) OperationsResearch
(10) EntrepreneurshipDevelopmentProgram

Abbreviations:L-No. of Lecture hours per week, T-No. of Tutorial hours per week, P-No. ofPractical hours per week, CT-Class Test Marks, TA-Marks of teacher's assessment including student's class performance and attendance,

1 Hr Lecture	1 Hr Tutorial	2 or 3 Hr Practical
1 Credit	1 Credit	1 Credit

Advanced Digital Signal Processing (ECT-301)

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

COURSE OBJECTIVES:

From this course, students will be able to:

1. Analyze multirate DSP systems.
2. Determine coefficients for perfect reproduction filter banks and wavelets.
3. Choose parameters to take a wavelet transform, and interpret and process the result.

COURSE OUTCOMES:

1. Students will understand theory of different filters and algorithms.
2. Students will understand theory of multirate DSP, solve numerical problems and write algorithms.
3. Students will have knowledge of adaptive filters and their applications.
4. Students will be able to understand the applications of DSP in different fields.
5. Students will be able to solve engineering problems related to DSP.

UNIT 1: Overview of DSP, Characterization in Time and Frequency, FFT Algorithms, Digital Filter Design and Structures: Basic FIR/IIR Filter Design and Structures, Design Techniques of Linear Phase FIR Filters, IIR Filters by Impulse Invariance, Bilinear Transformation, FIR/IIR Cascaded Lattice Structures and Parallel All Pass Realization of IIR. **(8 hours)**

UNIT 2: Multi-rate DSP, Decimators and Interpolators, Sampling Rate Conversion, Multistage Decimator and Interpolator, Poly phase Filters, QMF, Digital Filter Banks, Applications in Sub-band Coding. **(8 hours)**

UNIT 3: Linear Prediction and Optimum Linear Filters, Stationary Random Processes, Forward and Backward Linear Prediction, Solution of the Normal Equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction. **(8 hours)**

UNIT 4: Adaptive Filters, Applications, Direct-Form FIR Filters, Minimum Mean-Square-Error Criterion, LMS Algorithm, Direct-Form Filters – RLS Algorithm, Lattice-Ladder Filters, Recursive Least Square Algorithm. **(8 hours)**

UNIT 5: Estimation of Spectra from Finite-Duration Observations of Signals, Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation. **(8 hours)**

BOOKS:

1. J. G. Proakis and D.G. Manolakis “Digital signal processing: Principles, Algorithm and Applications”, 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, “Multirate Digital Signal Processing: Multirate Systems -Filter Banks Wavelets”, 1st Edition, John Wiley and Sons Ltd, 1999.
3. Bruce W. Suter, “Multirate and Wavelet Signal Processing”, 1st Edition, Academic Press, 1997.
4. M. H. Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley & Sons Inc., 2002.
5. S. Haykin, “Adaptive Filter Theory”, 4th Edition, Prentice Hall, 2001.

6. D.G. Manolakis, V.K. Ingle and S. M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

ADVANCED COMMUNICATION SYSTEMS (ECT-302)

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

COURSE OBJECTIVES:

From this course, students will be able to:
1. Learn Microwave and Radar systems.
2. Study Satellite basics and Satellite communication systems.
3. Understand the concepts of mobile communication and other wireless technologies**.**

COURSE OUTCOMES:
1. Appreciate the importance of microwave communication.
2. Understand the Satellite fundamentals, types and working of satellite.
3. Explain the working of optical communication system.
4. Know the building blocks of network and data link layer protocol.

UNIT 1: MICROWAVE COMMUNICATION: Block Diagram of Terrestrial Communication System, Advantages of Microwave System. Properties of Microwave System, Ground Wave Propagation or Surface Wave Propagation, Sky Wave Propagation/lonospheric Wave Propagation, Space Wave Propagation. Duct Wave Propagation, Fading, Microwave Communication Systems, LOS Microwave Systems. Block Diagram of an Analog Microwave System, Over the Horizon (OTH) Microwave Systems, Digital Microwave System. **(8 hours)**

UNIT 2: SATELLITE COMMUNICATION: Block Diagram of Satellite Communication System, Advantages Disadvantages of Satellite Communication. Applications of Satellites, Frequency Allocation for Satellites, Classification of Satellites. Kepler's Law, Derivation of Time Period of Satellite. Satellite Subsystem, General Link Design Equations, Free Space Path Loss, System Noise Temperature, G/T Ratio, Noise Figure and Noise Temperature, Noise Figure and Noise Temperature for Cascaded Amplifiers. Very Small Aperture Terminal (VSAT), Global Positioning System (GPS). **(8 hours)**

UNIT 3: OPTICAL COMMUNICATION SYSTEMS: Comparison of Satellite and optical Communication, Block Diagram of Optical Communication System. Optical Fibre Link, Refractive Index, Optical Fibre and Fibre Cable, Structural Characteristics. Working Principle of Optical Fibre, Types of rays in Optical Fibre, Classification of Fibres. Normalized Frequency or V-Number of a Fibre, Cut-off Wavelength of a Single Mode Fibre. Degradation mechanisms in optical fibres, Attenuation, Dispersion. Optical Sources and detectors, Optical Link Design, Wavelength Division Multiplexing.**(8 hours)**

UNIT 4: BUILDING BLOCKS OF NETWORK: Network, Switching, Routing Algorithms

OSI AND TCP/IP MODEL: Layered Architecture, Protocols Hierarchies. OSI Model, TCP/IP Reference Model. Transmission Control Protocol (TCP), Introduction to UDP. Addressing, Sub-netting. Internet Protocol Version 4(IPv4), IPv6/IP Next Generation and Transition from IPv4 to IPv6. Address Resolution Protocol, Reverse ARP (RARP), Internet Control Message Protocol (ICMP).**(8 hours)**

UNIT 5: DATA LINK LAYER PROTOCOL: Introduction, Error Detection/Correction Using Data Link Layer. Sliding Window Protocols (SWP), Point-to-Point Protocol (PPP). High Level Data Link Control (HDLC). **(8 hours)**

APPLICATION LAYER PROTOCOL: Introduction, Applications Layer Protocols, Application Layer Protocols and Services Examples.**(8 hours)**

BOOKS:

1. S. Haykins, "Communication Systems" 5th edition, John Wiley, 2008.
2. J. M. Senior, Optical Fiber Communications, PHI, 2010.
3. Behrouz A. Forouzan "Data Communications and Networking"4th Edition.
4. G. Keiser, Optical Fiber Communications, TMH, 2007.
5. Andrew.S.Tanenbaum "Computer Networks".
6. Michel B. G. Maral "Satellite Communications Systems: Systems, Techniques and Technology, 5thEdition by, John Wiley
7. Collin, R.E. "Foundations for Microwave Engineering" TMH 2nd Ed.
8. W. Tomasi, "Advanced Electronic Communication Systems" 4th edition, Pearson Education, 1998.
9. M. K. Simon, S. M. Hinedi and W. C. Lindsey, "Digital Communication Techniques: Signaling and detection" PHI, 1995.
10. M. K. Simon and M. S. Alouini, "Digital Communication over Fading Channels" 2000.

SEMICONDUCTOR DEVICE THEORY AND MODELING (ECT-303)

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

COURSE OBJECTIVES:

From this course, students will be able to:

1. Grasp fundamental knowledge of semiconductor devices for Integrated Circuit design.
2. Understand the operation principle of Diode, BJT and MOSFET.
3. Have a comprehensive understanding of the second- order effects and device modelling through which you can cope with an ever- increasing- speed state- of- the- art design

COURSE OUTCOMES:

1. At the end of this course students will be able to explain the equations, approximations and techniques available for deriving a model with specified properties, for a general device characteristic with known qualitative theory.
2. Students can apply suitable approximations and techniques to derive the model referred to above starting from drift-diffusion transport equations (assuming these equations hold).
3. The students will be able to develop qualitative understanding of the physics of a new device and conversion of this understanding into equation.
4. The students will be able to calculate the charge, electric field, potential and current distributions in the device.
5. The students will be able to explain the I-V characteristics qualitatively in terms of the spatial distributions of charge, electric field, potential and current in the device.

UNIT-1: Intrinsic Semiconductors, Free Electrons, and Holes, Extrinsic Semiconductors, Equilibrium in the Absence of Electric Field, Equilibrium in the Presence of Electric Field, Non-equilibrium; Quasi-Fermi Levels, Relations between Charge Density. Electric Field, and Potential; Conduction: Transit Time, Drift, Diffusion, Total Current, Contact Potentials, The pn Junction, Device Modeling-Basic equations for device analysis, approximation to these equations for deriving analytical expressions.**(8 hours)**

UNIT-2: The Two-Terminal MOS Structure: Introduction, The Flat band Voltage, Potential Balance and Charge Balance, Effect of Gate-Body Voltage on Surface Condition, Flat band Condition, Accumulation, Depletion and Inversion, General Analysis, Accumulation and Depletion, Inversion, General Relations and Regions of Inversion, Strong Inversion, Weak Inversion, Moderate Inversion, Small-Signal Capacitance.**(8 hours)**

UNIT-3 The Three-Terminal MOS Structure: Introduction, Contacting the Inversion Layer, The Body Effect, Regions of Inversion, Approximate Limits, Strong Inversion, Weak Inversion, Moderate Inversion, A "VCB Control" Point of View, Fundamentals, the "Pinch off Voltage", Uses for Three-Terminal MOS Structures.**(8 hours)**

UNIT-4: The Four-Terminal MOS Structure, Small-Dimension Effects: Introduction, Carrier Velocity Saturation, Channel Length Modulation, Charge Sharing: Introduction, Short-Channel Devices, Narrow-

Channel Devices, Limitations of Charge-Sharing Models, Drain-Induced Barrier Lowering, Punch through, Combining Several Small-Dimension Effects into One Model—A Strong-Inversion Example**(8 hours)**

UNIT-5: Hot Carrier Effects; Impact Ionization, Velocity Overshoot and Ballistic Operation, Poly silicon Depletion, Quantum Mechanical Effects, DC Gate Current, Junction Leakage; Band-to-Band Tunneling; GIDL, Leakage Currents—Particular Cases, The Quest for Ever-Smaller Devices: Introduction, Classical Scaling, Modern Scaling. Advanced topics: hot carriers in channel; high-K gate dielectrics.**(8 hours)**

BOOKS:

1. YannisTsividis, Colin McAndrew "Operation and Modeling of the MOS Transistor" (4th ed.) Oxford University Press. 2013

2. Y. Taur and T. H. Ning, Fundamentals of modern VLSI Devices, Cambridge University Press; Second edition, 2013.

3. NarainArora, MOSFET Modeling for VLSI Simulation: Theory and Practice, World Scientific Publishing Co. Re. Ltd. 2007.

4. S.M. Sze, ―Physics of Semiconductor Devices‖, 3rd Edition, Wiley-Interscience, 2006

WIRELESS AND MOBILE COMMUNICATION (ECT-304)

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

COURSE OBJECTIVES:

From this course, students will be able to:

1. Developments in the current and next generation mobile technologies.
2. Details of advanced mobile communication standards and their evolution.
3. Knowledge on mobility support in network layers

COURSE OUTCOMES:

1. Students will be able to design appropriate mobile communication system by applying frequency reuse concept and also analyze the effect of interference and handoff techniques.
2. Students will be able to distinguish various multiple access techniques for mobile communication and their advantages and disadvantages.
3. Students will be able to analyze path loss and interference for wireless telephony and their influences on mobile communication system performance.
4. Students will be able understand the importance of different diversity techniques as well equalizer in wireless communication system.
5. Students will be able to analyze and design CDMA system functioning with knowledge of forward and reverse channel.

UNIT 1:CELLULAR COMMUNICATION FUNDAMENTALS: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment. GSM architecture and interfaces. **(8 hours)**

UNIT 2: MULTIPLE ACCESS TECHNIQUES: Spectral efficiency analysis based on calculations for Multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas.**(8 hours)**

UNIT 3: MOBILE RADIO PROPAGATION: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.**(8 hours)**

UNIT 4: **EQUALIZATION, DIVERSITY:** Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving. **(8 hours)**

UNIT 5:IS 95 SYSTEMS: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA.**(8 hours)**

BOOKS:

1. V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
2. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
3. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI,2002.
4. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
5. Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London,1997

Digital Image and Video Processing (ECT- 305)

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

COURSE OBJECTIVES:

From this course, students will be able to:

1. Learn the elements of current media formats
2. Learn the building blocks of compression systems and select processing modules to enable efficient compression.

COURSE OUTCOMES:

1. Students will be able to understand various transforms used in digital image processing.
2. Students will be able to understand image enhancement techniques and its applications.
3. Students will have knowledge of image restoration and its applications.
4. Students will be able to understand image segmentation and compression and their practical uses.
5. Students will be capable of solving engineering problems related to digital image processing.

UNIT 1: Digital image and video fundamentals and formats, 2-D and 3-D sampling and aliasing, 2-D/ 3-D filtering, image decimation/interpolation, video sampling and interpolation, Basic image processing operations, Image Transforms Need for image transforms, DFT, DCT, Walsh, Hadamard transform, Haar transform, Wavelet transform.**(8 hours)**

UNIT 2: Histogram, Point processing, filtering, image restoration, algorithms for 2-D motion estimation, change detection, motion-compensated filtering, frame rate conversion, de-interlacing, video resolution enhancement, Image and Video restoration (recovery). **(8 hours)**

UNIT 3: Discontinuity based segmentation- Line detection, edge detection, thresholding, Region based segmentation, Scene Change Detection, Spatiotemporal Change Detection, Motion Segmentation, Simultaneous Motion Estimation and Segmentation Semantic Video Object Segmentation, Morphological image processing.**(8 hours)**

UNIT 4: Colour fundamentals, Colour models, Conversion of colour models, Pseudo colour image processing, full colour processing. Lossless image compression including entropy coding, lossy image compression, video compression techniques, and international standards for image and video compression (JPEG, JPEG 2000, MPEG-2/4, H.264, SVC), video quality assessment.**(8 hours)**

UNIT 5: Image Feature representation and description-boundary representation, boundary descriptors, regional descriptors, feature selection techniques, introduction to classification, supervised and unsupervised learning, template matching, Bayes classifier.**(8 hours)**

BOOKS:
1. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 3rd Edition, Prentice Hall, 2008.
2. J. W. Woods, "Multidimensional Signal, Image and Video Processing and Coding", 2nd Edition, Academic Press, 2011.
3. Ed. Al Bovik, "Handbook of Image and Video Processing", 2nd Edition, Academic Press, 2000.
4. A. M. Tekalp, "Digital Video Processing", 2nd Edition, Prentice Hall, 2015.
5. S. Shridhar, "Digital Image Processing", 2nd Edition, Oxford University Press, 2016.

ADVANCED ANTENNA THEORY(ECT – 306)

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

COURSE OBJECTIVES:

From this course, students will be able to:

1. Identify performance parameters and their quantification for antennas
2. Design the following antennas: printed circuit antennas, slots, phased arrays
3. Be able to describe the process of antenna measurements
4. Use antenna numerical analysis principles to analyze antennas

COURSE OUTCOMES:

1. Student will understand the antenna fundamentals.
2. Student will be able to understand the antenna arrays and its design.
3. Student will be able to understand the various broadband antennas and its applications.
4. Student will be able to understand the microstrip antenna and design.
5. Student will be able to understand the different antenna parameters measurement.

UNIT 1: ANTENNA FUNDAMENTALS: Antennas, Radiation concept, Radiation Pattern, Near and far-field regions, Types of Antennas, Antenna parameters, Friis Transmission equation, Antenna Temperature, Radiation integrals, and auxiliary potential functions.**(8 hours)**

UNIT 2: ANTENNA ARRAY: LINEAR, PLANAR AND CIRCULAR: Introduction, Two element array, N element array- uniform and non-uniform amplitude with uniform spacing, Directivity of linear arrays, Pattern multiplication, Planar Array, Circular Array.**(8 hours)**

UNIT 3: TRAVELLING WAVE AND BROADBAND ANTENNAS: Travelling Wave Antennas, Broadband Antennas, Log periodic antennas, Frequency independent antennas, antenna miniaturization, Smart Antennas for mobile communications.**(8 hours)**

UNIT 4: MICROSTRIP ANTENNA AND DESIGN: Overview of Microstrip antennas and applications, feeding methods, Basic principles of operation, Excitation modes, Design Consideration, General characteristics, Rectangular and Circular Patch, Distinct types of circularly polarized printed antennas, singly fed circularly polarized microstrip antennas, dual-orthogonal feed circularly polarized microstrip antennas, Bandwidth Enhancement techniques, Miniaturization, Reducing surface waves and lateral radiation.**(8 hours)**

UNIT 5: ANTENNA MEASUREMENTS: Introduction, Antenna Ranges, Radiation Pattern, Measurement of Gain, Directivity, Radiation Efficiency, Impedance, Current and Polarization.**(8 hours)**

BOOKS:

1. Balanis, C.A., "Antenna Theory and Design", 3rd Ed., John Wiley & 2005 Sons.
2. R. S. Elliot, "Antenna Theory and Design", Revised edition, Wiley-IEEE Press., 2003.
3. Kin Lu Wong, "Compact and Broadband Microstrip Antennas" John Wiley & 2002 Sons.

ADVANCED ANALOG FILTER DESIGN (ECT – 307)

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

COURSE OBJECTIVES:

From this course, students will be able to:

1. Design on classical analog filters and analog oscillators
2. Develop an understanding of small signal amplifier design using linear transistor models
3. Understand the power amplifiers, tuned amplifiers and behaviour of noise in an amplifier.

COURSE OUTCOMES:

1. The students will understand the basics of analog filter design
2. The mathematical problem-solving ability of students will be improved
3. The students will be acquitted with various approximation theory of filter design
4. The students will be motivated to design of resistor less active filter design
5. The analog system analyzing and designing skills of students will be improved

UNIT-1: REVIEW OF BASIC CONCEPTS: Review of Op-amp circuits, Ideal and real operational amplifiers, Categorization of filters-Low-pass filter, High-pass filter, band-pass filter, band-reject filter, Gain equalizers, and Delay equalizers.**(8 hours)**

UNIT-2: APPROXIMATION THEORY: Butterworth approximation, Chebyshev approximation, Inverse Chebyshev approximation, Pole locations, Filter specifications, Comparison of maximally flat and equal ripple response, Basic of sensitivity, Frequency Transformations: Low pass to High pass, Low pass to band pass, Low pass to band elimination.**(8 hours)**

UNIT-3: BIQUAD FILTERS: Three amplifier Biquad: Basic low pass and band pass circuit, realization of the general Biquadratic Functions, summing of four Amplifier biquad, feed forward three amplifier biquad, Passive Ladder structures, Inductor Substitution using Gyrator, Transformation of elements using the FDNR. **(8 hours)**

UNIT-4: TRANSCONDUCTANCE–C FILTERS: Basic Transconductance Cell, Basic transconductor building blocks- resistors, integrators, amplifiers, summers, gyrator, First and second order filters, higher order filters. **(8 hours)**

UNIT-5 SWITCHED CAPACITOR FILTERS: The MOS switch, The switched capacitor, first order building blocks, second order sections, sampled data operation, Switched capacitor first and second order filters, Bilinear transformation.**(8 hours)**

BOOKS:

1. GobindDaryanani, "Principles of active network synthesis and design", John Wiley and Sons.
2. R. Schaumann, M.E. VanValkenburg, "Design of analog filters", Oxford University Press.

Embedded System Design (VDT-308)

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

COURSE OBJECTIVES:

From this course, students will be able to:

1. Acquire knowledge about the basic functions, structure, concepts and applications of embedded systems
2. Learn the method of designing and program an Embedded Systems for real time applications
3. Acquire knowledge about the development of embedded software using RTOS and implement small programs to solve well-defined problems on an embedded platforms.

COURSE OUTCOMES (COs):

1. To develop basic understanding of embedded systems in general and their applications.
2. To comprehend the architecture and components of embedded systems.
3. To understand the onboard and external communication interfaces.
4. To understand the concepts of multiprocessing, multitasking and shared memory.

COURSE CONTENTs:

Unit I

Formal definition of an Embedded System. Embedded system examples. Compare and contrast embedded system and conventional/generic computer system. Overview of elements of an Embedded system. Processor level implementation using (a) generic devices (b) full custom ASIP and (c) Soft core implementation on FPGA. Key parameters of Embedded System Design (Time to market and cost).

(8 hours)

Unit II

Microcontroller Classification based on memory access, ISA, data bus width. Example microcontroller families (8-bit, 16-bit and 32-bit examples). Memory technologies, Memory interface busses. Desirable microcontroller features. Development, debugging and testing tools. Elements of Microcontroller eCOsystem: Reset, Clock, Power supply and program download options. **(8 hours)**

Unit III

AVR Microcontroller architecture details. Elements of physical interfacing: Input devices, Output, environmental sensors, actuators. Elements of analog signal processing. Inter and Intra-device communication Interfaces. Real Time Clock. Storage devices. Power supply topologies for embedded systems. **(8 hours)**

Unit IV

Elements of Embedded C programming; pointers and memory optimization, bit-wise operations, using and creating device library, Compiler optimization. Interrupt driven programming and Foreground-background programming model. **(8 hours)**

Unit V

Introduction to RTOS. Threads, Processes and Message Passing. Basics of scheduling. Complete system design example. Security in embedded systems. System testing and debugging. **(8 hours)**

Text Books:

1. Embedded System Design: Embedded Systems Foundation of Cyber-Physical Systems and the Internet of Things. 3rd Edition. Peter Marwedel. ISBN 978-3-319-56043-4. Springer.
2. Embedded Hardware: Know It All. Jack Ganssle et al. ISBN: 0750685840. Newnes.
3. Designing Embedded Hardware. 2nd Edition. John Catsoulis. ISBN: 0596007558. O'Reilly
4. Embedded Systems: World Class Designs. Jack Ganssle. ISBN: 0750686251. Newnes.

NANOELECTRONICS (ECT-309)

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

COURSE OBJECTIVES:

From this course, students will be able to:

1. Understanding of fundamentals, fabrication technologies and applications of nanoscale structures.
2. Acquire both theoretical knowledge and practical skills in nano and micro regime design, simulation and fabrication

COURSE OUTCOMES:

1. Students will understand the basics and scale of nanotechnology.
2. Students will have in-depth knowledge in synthesis of Nanomaterials.
3. Students will understand the magnetic and electric properties of material.
4. Students will understand the characterization techniques in nano-electronics
5. Students will understand function of different nano-scale devices.

UNIT-1: Classical Particles, Classical Waves, Quantum Particles, Quantum Mechanics of Electrons, Free and Confined electrons: Introduction to nanoelectronics, Origins of Quantum Mechanics, Light as Wave, Light as a Particle, Electrons as Particles, Electrons as Waves, Wave packets and Uncertainty, General Postulates of Quantum Mechanics, Time-Independent Schrodinger's Equation, Free Electrons, Free Electron Gas theory of Metals, Electrons Confined to a Bounded Region of Space and Quantum Numbers, wave Equations and Energy calculation for Quantum Dots, Wires and Wells.**(8 hours)**

UNIT-2: Electrons Subject to a Periodic Potential – Band Theory of Solids: Crystalline Materials, Electrons in a Periodic Potential, Kronig-Penney Model of Band Structure, Band theory of Solids, Graphene and Carbon Nanotubes, Tunneling Through a potential Barrier, Potential Energy Profiles for Material Interfaces, Applications ofTunnelling, Harmonic Oscillator**(8 hours)**

UNIT 3: Coulomb Blockade and the Single-Electron Transistor: Coulomb Blockade, The Single-Electron Transistor, Single Electron Transistor logic; Other SET and FET Structures: Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs, Molecular SETs and Molecular Electronics; Density of States, Classical and Quantum Statistics**(8 hours)**

UNIT 4: Nanowires, Ballistic Transport and Spin Transport: Classical and Semiclassical Transport, Landauer theory, Ballistic Transport, Transport of Spin, and Spintronics: The Transport of Spin, Spintronic Devices and Applications.**(8 hours)**

UNIT 5: Nanoelectronic Devices: Overview of MOS and MOSFET; CMOS Scaling and shrink down approaches; FINFET; Tunnel FET; Junctionless Transistor; Nanowire MOSFET, GAA FET; Carbon Nanotubes.**(8 hours)**

BOOKS:

1. C.P. Polle and F.J. Owens, Introduction to Nanotechnology, Willey India Pvt. Ltd, Edition 2011.
2. Daniel Minoli, Nanotechnology Applications to Telecommunications and Networking, Willey India Pvt. Ltd, Edition 2011.
3. Callister/Balasubramaniam – Callister‟s Material Science & Engineering Wiley India, 2009.
4. Van Vlack - Elements of Material Science & Engineering John Wiley & Sons, 2010.
5. V. Raghvan - Material Science, Prentice Hall

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
4. T. L. Deliyannis, Y. Sun and J. Kel Fiedler, "*Continuous-Time Active Filter Design",* Boca Raton: CRC Press LLC,1999

CMOS ANALOG CIRCUIT DESIGN (ECT-312)

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

COURSE OBJECTIVES:

From this course, students will be able to:

1. Understand a broad perspective of analog IC design
2. Understand the requirements for an analog IC designer
3. Top-level understanding of sources, amplifiers, op amps, comparators, and DA and AD converters

COURSE OUTCOMES (COs):

1. Understanding of advantages and limitations of CMOS analog circuits
2. Appreciation of relative merits and demerits of various MOS current mirrors
3. Develop an understanding of the design considerations of CMOS op-amps and OTAs
4. Capability of analyzing CMOS translinear and square domain circuits
5. Ability to design some CMOS analog circuits employing modern circuit concepts

COURSE CONTENT:

Unit-I

Importance, advantages and limitations of CMOS analog circuits; common source amplifier and source follower; differential amplifier; offset voltage determination; Frequency response; noise analysis; voltage follower, Flipped voltage follower **(8 hours)**

Unit-II

IC biasing-current sources, current mirrors and current-steering circuits, Wilson current mirror, Cascode and modified Wilson Current Mirrors; Comparative analysis of various Current mirrors and their features .**(8 hours)**

Unit-III

CMOS op-amps: typical architectures, compensation techniques; stability considerations; analysis and design; CMOS OTAs and CMOS single-ended transconductors**(8 hours)**

Unit-IV

Translinear principle, TL circuits, MOS TL circuits, Square root domain circuits, Typical examples of MOS

translinear circuits; Current Conveyors, CFOAs and other modern building blocks **(8 hours)**

Unit-V

General Techniques of non-linearity cancellation in MOS analog circuits and their applications; Linearized transconductors, CMOS VCR realisation; CMOS multipliers/dividers; squarers and square-rooters. **(8 hours)**

1. Philip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, Oxford University Press.
2. BehzadRazavi, Design of Analog CMOS Integrated Circuits, Tata-McGraw Hill.
References:
3. Gray R., Paul, Hurst, J. Paul, Lewis H. Stephen and Meyer G. Robert, Analysis and Design of Analog Integrated Circuits, John Wiley and Sons.

`

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"
5. Ajit Pal, ―Low-Power VLSI Circuits and Systems‖, Springer, 2015.
6. K. Roy and S. C. Prasad, ―Low-Power CMOS VLSI Circuit Design‖, Wiley, 2000.

Embedded System for Wireless & Mobile Communication (ECT-314)

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

COURSE OBJECTIVES:

From this course, students will be able to:

1. The evolution of Mobile communication and cell concept to improve capacity of the system.
2. Role of equalization in Mobile communication and to study different types of Equalizers and Diversity techniques.
3. Know the types of channel coding techniques, data transmission modes and services of GSM & CDMA

COURSE OUTCOMES:

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

1. Demonstrate the cellular concepts like frequency reuse, fading, equalization, GSM ,CDMA
2. Exposure with different Wireless and Mobile Communication Technologies.
3. Compare different multiple access techniques in mobile communication.
4. Familiarization with usage of different Wireless and Mobile communication Modules/ kits such as WiFi (WLAN), GSM/GPRS, Bluetooth, ZigBee, GPS etc.
5. Exposure to Embedded & Wireless applications.

UNIT 1: Introduction to wireless technologies: WAP services, Serial and Parallel Communication,
Asynchronous and synchronous Communication, FDM, TDM, TFM, Spread spectrum technology.**(8 hours)**

UNIT 2 : Introduction to Bluetooth: Specification, Core protocols, Cable replacement protocol Bluetooth Radio: Type of Antenna, Antenna Parameters, Frequency hoping
Bluetooth Networking: Wireless networking, wireless network types, devices roles and states, adhoc network, scatter net Connection establishment procedure, notable aspects of connection establishment, Mode of connection, Bluetooth security, Security architecture, Security level of services, **(8 hours)**

UN**IT 3** Profile and usage model: Generic access profile (GAP), SDA, Serial port profile, Secondary bluetooth profile Hardware: Bluetooth Implementation, Baseband overview, packet format, Transmission buffers,**(8 hours)**

`

UNIT 4 Protocol Implementation: Link Manager Protocol, Logical Link Control Adaptation Protocol, Host control Interface, Protocol Interaction with layers.**(8 hours)**

UNIT 5 Programming with Java: Java Programming, J2ME architecture, Javax. bluetooth package Interface, classes, exceptions, Javax. obex Package: interfaces, classes
Bluetooth services registration and search application, bluetooth client and server application. Overview of IrDA, HomeRF, Wireless LANs, JINI.**(8 hours)**

Reference Books:

1. C.S.R. Prabhu and A.P. Reddi,“ Bluetooth Technology”, PHI Publication.
2. U. Dalal& M. Shukla, "Wireless & Mobile Communication", Oxford University Press.
3. C. Y. William, Lee, "Mobile communication engineering theory and applications", TMH, Publication.
4. S .Haykins, “Communication Systems”, John Wiley and Sons.

`

ADVANCED WIRELESS COMMUNICATION NETWORKS (ECT-315)

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

COURSE OBJECTIVES:

From this course, students will be able to:

1. The foundation of understanding and working for future generation of wireless systems
2. The fundamentals of mobile wireless channels, and the limitations of mobile channels imposed on communication systems
3. The architectures of mobile communications, and recent standard mobile systems, such as the fifth generation (5G) system

COURSE OUTCOMES:

1. Students will be able to analyze radio propagation mechanisms in wireless communication along with their applications.

2. Students will be able to understand various fundamental concepts related to statistical modeling of wireless multipath channel.

3. Students will be able to solve various engineering problems related to capacity of wireless channel.

4. Students will be able to understand various advanced transceiver schemes used in wireless communication such as OFDM.

5.Students will be able to demonstrate the ability to evaluate design challenges, constraints and security issues associated with wireless networks.

UNIT 1: FUNDAMENTALS OF WIRELESS COMMUNICATION: Radio Wave Propagation, Free-Space Path Loss, Ray Tracing, Ten-Ray Model (Dielectric Canyon), General Ray Tracing, Empirical Path Loss Models, Okumura Model, Hata Model, COST231 Piecewise Linear Model, Indoor Attenuation, Combined Path Loss and Shadowing, Outage Probability, Cell Coverage Area.**(8 hours)**

UNIT 2: STATISTICAL MULTIPATH CHANNEL MODEL: Time-Varying Channel Impulse Response, Autocorrelation, Cross Correlation, and Power Spectral Density, Level Crossing Rate and Average Fade Duration, Finite State Markov Channels, Wide band Fading Models, Power Delay Profile, Coherence Bandwidth, Doppler and Channel Coherence Time,

Transforms for Autocorrelation and Scattering Functions, Discrete-Time Model, Space-Time Channel Models. **(8 hours)**

UNIT 3: CAPACITY OF WIRELESS CHANNELS: Capacity in AWGN, Capacity of Flat-Fading Channels, Channel and System Model, Channel Distribution Information (CDI) Known, Channel Side Information at Receiver, Channel Side Information at Transmitter and Receiver, Capacity with Receiver Diversity, Capacity Comparisons, Capacity of Frequency-Selective Fading Channels. **(8 hours)**

UNIT 4: ADVANCED TRANSCEIVER SCHEMES: Data Transmission using Multiple Carriers, Overlapping Sub channels, Mitigation of Sub Carrier Fading, Discrete Implementation of Multi-carrier, Cyclic Prefix, OFDM, Matrix Representation of OFDM, Vector Coding, PAPR, Frequency and Timing Offset, Multi-user Channels, Multiple Access, Downlink Channel Capacity, Uplink Channel Capacity, Capacity in AWGN, Fading with Multiple Antennas**.**

(8 hours)

UNIT 5: WIRELESS NETWORKS: Introduction and Development of Wireless Networks, Traffic Routing in Wireless Networks, Wireless Data Services, Common Channel Signaling, Protocols for Network Access, Ad Hoc Wireless Networks Applications, Design Principles and Challenges.**(8 hours)**

BOOKS:

1. Andrea, Wireless Communications, Cambridge University Press, 2005.
2. Rappaport, Wireless Communications, Pearson Education, 2002.
3. Garg, Wireless Communications and Networking, Elsevier.
4. Paulraj, Arogyaswami, Gore, Dhananjay and Nabar, Rohit, Introduction to Space-Time Wireless Communications, Cambridge University Press, 2003.

`

OPTICAL COMMUNICATION SYSTEM (ECT-316)

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

COURSE OBJECTIVES:

From this course, students will be able to:

1. Learn the basic elements of optical fiber transmission link, fiber modes configurations and structures
2. Understand the different kind of losses, signal distortion, SM fibers, optical sources, materials and fiber splicing
3. Learn link budget, WDM, solitons and SONET/SDH network

COURSE OUTCOMES:

1. Students will be able to understand the structures, types and mode of optical fiber communication.
2. Students will have knowledge of transmission principles of optical signal through optical fibers.
3. Students will be able to understand the working principles of optical sources and detectors and their applications.
4. Students will be able to design and analyze the optical receiver circuits
5. Students will be able to solve engineering problems related to optical communication.
6.

UNIT 1: INTRODUCTION: Demand of information age, block diagram of optical fiber communication system, technology used in OFC system, structure and types of fiber, modes and configuration**,** mode theory for circular guide modal equation, modes in optical fiber, linearly polarized modes, Single mode fibers, mode field diameter.**(8 hours)**

UNIT 2: TRANSMISSION CHARACTERISTICS:

Attenuation: Material absorption losses, scattering losses, bending losses.

Dispersion: Intra-modal dispersion (material, waveguide), Intermodal dispersion (multimode step index fiber, multimode graded index fiber), modal noise, Overall fiber dispersion

(multimode fiber, single mode fiber), Dispersion modified single mode fibers (dispersion shifted fibers, dispersion flattened fibers).
Polarization: Modal birefringence, polarization-maintaining fibers.**(8 hours)**

UNIT 3: OPTICAL SOURCES:
LED: Visible LED, infrared LED, LED structure and configuration, loss mechanism, application of LED, operating characteristics of materials for visible LED.
LASER: Principle of LASER action, efficiency of LASER diode, principles and structures, index guided and gains guided lasers, mode separation, quantum well laser, laser modulation.
(8 hours)
UNIT 4: OPTICAL DETECTORS: Optical absorption in semiconductors, types of photo diodes, Principle of photo detection, working and structures of p-i-n and APD photo detectors, noises in photo detectors, SNR, detector response time effects, comparison of various photo detectors.**(8 hours)**
UNIT 5: ANALYSIS AND PERFORMANCE OF OPTICAL RECEIVER: Receiver sensitivity, photodiode for optical receiver, optical receiver design, recent receiver circuits, system configuration and power budget.**(8 hours)**
OPTICAL NETWORKS: WDM concepts and principles, passive components, SONET/SDH networks, performance of WDM.**(8 hours)**

BOOKS:

1. Senior, Optical Fiber Communications, PHI, 2010.
2. Keiser, Optical Fiber Communications, TMH, 2007.
3. Agarwal, Fiber Optic Communication Systems, John Wiley, 2007.
4. Mynbaev, Gupta, Scheiner, Fiber Optic Communications Pearson, 2010.
5. Palais, Fiber Optic Communications Pearson, 2015.

`

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
4. Balanis, C.A., “Antenna Theory and Design”, 4th Ed., John Wiley & Sons, 2016.
5. Hueber, Nicknejad, "Millimeter Wave Circuits for 5G and Radar”, Cambridge University Press, 2019.

`

Technical Writing and Presentation Skills (AHT-303)

L:T:P::2:0:0 **Non-credits**

Course Objectives:

- To develop effective writing and presentation skills in students.
- To develop textual, linguistic and presentation competencies instudents appropriate for their professional careers.

Course Outcomes:

After the successful completion of course, the students will be able to:

CO1: Write clearly and fluently to produce effective technical documents.

CO2: Demonstrate an appropriate communication style to different types of audiences both orally and written as per demand of their professional careers.

CO3: Communicate in an ethically responsible manner.

Course Contents:

WRITING SKILLS

Unit-I **(4 hours)**

Technical Writing-Basic Principles: Words-Phrases-Sentences, Construction of Cohesive Paragraphs, Elements of Style.

Unit-II **(4 hours)**

Principles of Summarizing: Abstract, Summary, Synopsis

`

Unit-III **(6 hours)**

Technical Reports: Salient Features, Types of Reports, Structure of Reports, Data Collection, Use of Graphic Aids, Drafting and Writing

PRESENTATION SKILLS

Unit-IV **(6 hours)**

Speaking Skills: Accuracy vs. Fluency, The Audience, Pronunciation Guidelines, Voice Control.

Unit-V **(8 hours)**

Professional Presentations: Planning, Preparing, Presentation Strategies, Overcoming, Communication Barriers, Using Technology, Effective Presentations.

References:

1. Kumar, Sanjay &PushpLata, "Communication Skills", Oxford UniversityPress,2011.
2. Quirk & Randolph, "A University Grammar of English", Pearson,2006.
3. Rutherford, Andrea J., "Basic Communication Skills for Technology", Pearson 2007.
4. Rizvi, M Ashraf, "Effective Technical Communication", McGraw Hill,2009.
5. Leigh, Andrew & Maynard, Michael, "The Perfect Presentation", Random House.
6. Barker, Larry L., "Communication", Prentice-Hall.
7. Lesikar&Flatley, "Basic Business Communication-Skills for Empowering the Internet Generation", Tata McGraw-Hill.