K.L.N. COLLEGE OF ENGINEERING

Pottapalayam, Sivagangai District

(An Autonomous Institution Affiliated to Anna University, Chennai)

CURRICULUM & SYLLABUS

CHOICE BASED CREDIT SYSTEM

(REGULATIONS 2024)

I to IV Semester

M.E. Communication Systems

Department of Electronics and Communication Engineering

Dr. V. KEJALAKSHMI
Head of the Department
Dept. of Electronics and Communication Engg.
K.L.N. College of Engineering
Pottapalayam - 630 612
Sivagangai Dist

VISION OF THE INSTITUTION

To become a Centre of Excellence in Technical Education and Research in producing Competent and Ethical professionals to the society.

MISSION OF THE INSTITUTION

To impart Value and Need based curriculum to the students with enriched skill development in the field of Engineering, Technology, Management and Entrepreneurship and to nurture their character with social concern and to pursue their career in the areas of Research and Industry.

VISION OF THE DEPARTMENT

To promote as a center of excellence in educational and research activities related to electronics and communication engineering and its allied areas.

MISSION OF THE DEPARTMENT

To create educational and research environment to meet ever changing and ever demanding needs of electronics and communication industry along with IT and other interdisciplinary fields.

To mould the students to become ethically upright and recognized as responsible engineers.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

- To provide students with strong fundamental concepts and also advanced techniques and tools to build various communication systems.
- To enable graduates to attain successful professional careers by applying their engineering skills in communication system design to meet out the challenges in industries and academia.
- To engage graduates in lifelong learning, adapt emerging technology and pursue research for the development of innovative products.

PROGRAM OUTCOMES (POs):

The Graduate Attributes of PG programmes of the NBA are as following:

1. Critically analyze complex challenges in communication systems and apply engineering principles to support sustainable development goals.
2. Demonstrate the application of systems and processes to address challenges in communication systems, employing modern engineering tools and resources to meet societal needs, with a strong focus on public health, safety and environmental protection.
3. Independently carry out research /investigation and development work to solve practical problems.
4. Write and present a substantial technical report/document.
5. Apply ethical principles, human values adhere to national and International Laws.

PROGRAMME SPECIFIC OBJECTIVES (PSOs):

- To inculcate the ability in graduates to design and analyze the subsystems such as RF, Signal Processing, Modern communication systems and networks.
- To enhance problem solving skills in communication systems design using latest hardware and software tools.
- To apply communication engineering principles and practices for developing products for scientific and business applications.

CATEGORY OF COURSES

1) **Foundation Courses (FC) Courses**

2) **Professional Core (PC) Courses** include the core courses relevant to the chosen programme of study.
3) **Employability Enhancement Courses (EEC)** includes Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.
4) **Professional Elective (PE) Courses** include the elective courses relevant to the chosen programme of study.
5) **Open Elective (OE) Courses**

6) **Audit Courses (AC)** are mandatory courses include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, etc.

Structure of Curriculum

S.NO.	CATEGORY	NUMBER OF CREDITS				
		I SEM	II SEM	III SEM	IV SEM	TOTAL
1.	Foundation Courses (FC)	4				4
2.	Professional Core (PC)	15	16	3		34
3.	Employability Enhancement Course (EEC)	3	1	6	12	22
4.	Professional Electives (PE)		6	7		13
5.	Open Elective (OE)			3		3
6.	Audit Course (AC)	0	0			0
Credits per Semester		22	23	19	12	76
					Total Credits	76

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CURRICULAM AND SYLLABUS

SEMESTER - I

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	24MA102	Linear Algebra, Probability and Queueing Theory	FC	4	4	0	0	4
2.	24CU101	Statistical Signal Processing	PC	3	3	0	0	3
3.	24CU102	Modern Digital Communication Systems	PC	3	3	0	0	3
4.	24CU103	Advanced Wireless Communication	PC	3	3	0	0	3
5.	24CU104	Radiating Systems	PC	3	3	0	0	3
6.	24RM101	Research Methodology and IPR	EEC	3	3	0	0	3
7.		Audit Course – 1* (Optional)	AC	2	2	0	0	0
PRACTICAL								
8.	24CU1L1	Digital Communication Systems Laboratory	PC	3	0	0	3	1.5
9.	24CU1L2	Advanced Digital Signal Processing Laboratory	PC	3	0	0	3	1.5
			TOTAL	**27**	**21**	**0**	**6**	**22**

SEMESTER II

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	24CU201	RF System Design	PC	3	3	0	0	3
2.	24CU202	Microwave Integrated Circuits	PC	5	3	0	2	4
3.	24CU203	Advanced Wireless Networks	PC	3	3	0	0	3
4.	24CU204	Image Processing and Video Analytics	PC	5	3	0	2	4
5.		Professional Elective - I	PE	3	3	0	0	3
6.		Professional Elective - II	PE	3	3	0	0	3
7.		Audit Course – 2* (Optional)	AC	2	2	0	0	0
PRACTICALS								
8.	24CU2L1	Wireless Communication Laboratory	PC	4	0	0	4	2
9.	24CU2L2	Term Paper Writing and seminar	EEC	2	0	0	2	1
			TOTAL	**30**	**20**	**0**	**10**	**23**

SEMESTER III

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	24CU301	Optical Communication and Networking	PC	3	3	0	0	3
2.		Professional Elective - III	PE	3	3	0	0	3
3.		Professional Elective - IV	PE	5	3	0	2	4
4.		Open Elective	OE	3	3	0	0	3
PRACTICAL								
4.	24CU3L1	Project Work Phase - I	EEC	12	0	0	12	6
			TOTAL	**26**	**12**	**0**	**14**	**19**

SEMESTER IV

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1.	24CU4L1	Project Work Phase - II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 76

FOUNDATION COURSE (FC)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24MA102	Linear Algebra, Probability and Queueing Theory	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24CU101	Statistical Signal Processing	PC	3	3	0	0	3
2.	24CU102	Modern Digital Communication Systems	PC	3	3	0	0	3
3.	24CU103	Advanced Wireless Communication	PC	3	3	0	0	3
4.	24CU104	Radiating Systems	PC	3	3	0	0	3
5.	24CU1L1	Digital Communication Systems Laboratory	PC	3	0	0	3	1.5
6.	24CU1L2	Advanced Digital Signal Processing Laboratory	PC	3	0	0	3	1.5
7.	24CU201	RF System Design	PC	3	3	0	0	3
8.	24CU202	Microwave Integrated Circuits	PC	5	3	0	2	4
9.	24CU203	Advanced Wireless Networks	PC	3	3	0	0	3
10.	24CU204	Image Processing and Video Analytics	PC	5	3	0	2	4
11.	24CU2L1	Wireless Communication Laboratory	PC	4	0	0	4	2
12.	24CU301	Optical Communication and Networking	PC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24RM101	Research Methodology and IPR	EEC	3	3	0	0	3
2.	24CU2L2	Term Paper Writing and seminar	EEC	2	0	0	2	1
3.	24CU3L1	Project Work Phase - I	EEC	12	0	0	12	6
4.	24CU4L1	Project Work Phase - II	EEC	24	0	0	24	12

PROFESSIONAL ELECTIVES (PE)

PROFESSIONAL ELECTIVE – 1

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24CU1E1	Electromagnetic Interference and Compatibility	PE	3	3	0	0	3
2.	24CU1E2	Advanced Satellite Communication and Navigation Systems	PE	3	3	0	0	3
3.	24CU1E3	High Speed Switching and Networking	PE	3	3	0	0	3
4.	24CU1E4	Signal Integrity for High Speed Design	PE	3	3	0	0	3
5.	24CU1E5	Wavelets and Subband Coding	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – 2

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24CU2E1	Cryptography and Network Security	PE	3	3	0	0	3
2.	24CU2E2	Satellite Communication and Navigation Systems	PE	3	3	0	0	3
3.	24CU2E3	Speech Processing	PE	3	3	0	0	3
4.	24CU2E4	Millimeter Wave Communication	PE	3	3	0	0	3
5.	24CU2E5	Analog and Mixed Signal VLSI Design	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – 3

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24CU3E1	Ultra Wide Band Communications	PE	3	3	0	0	3
2.	24CU3E2	VLSI for Wireless Communication	PE	3	3	0	0	3
3.	24CU3E3	MEMS and NEMS	PE	3	3	0	0	3
4.	24CU3E4	Advanced Antenna Design	PE	3	3	0	0	3
5.	24CU3E5	Software Defined Radios	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – 4

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24CU4E1	Internet of Things	PE	5	3	0	2	4
2.	24CU4E2	Radar Signal Processing	PE	5	3	0	2	4
3.	24CU4E3	Telecommunication System Modeling and Simulation	PE	5	3	0	2	4
4.	24CU4E4	Signal Detection and Estimation	PE	5	3	0	2	4

OPEN ELECTIVE (OE)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24CUOE1	Satellite Communication Systems	OE	3	3	0	0	3
2.	24CUOE2	Fundamentals of Wireless Communication	OE	3	3	0	0	3
3.	24CUOE3	Multicore Systems	OE	3	3	0	0	3
4.	24CUOE4	Microprocessor and Embedded Systems	OE	3	3	0	0	3

AUDIT COURSE (AC)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24AC101	English for Research Paper Writing	AC	2	2	0	0	0
2.	24AC102	Disaster Management	AC	2	2	0	0	0
3.	24AC103	Sanskrit for Technical Knowledge	AC	2	2	0	0	0
4.	24AC104	Value Education	AC	2	2	0	0	0
5.	24AC105	Constitution of India	AC	2	2	0	0	0
6.	24AC106	Pedagogy Studies	AC	2	2	0	0	0
7.	24AC107	Stress Management by Yoga	AC	2	2	0	0	0
8.	24AC108	Personality Development through Life Enlightenment Skills	AC	2	2	0	0	0
9.	24AC109	Natramizh Ilakiam	AC	2	2	0	0	0

SCHEDULING OF COURSES

Semester	Theory						Laboratory / Project		
I (21)	24MA102 Linear Algebra, Probability and Queueing Theory (4)	24CU101 Statistical Signal Processing (3)	24CU102 Modern Digital Communication Systems (3)	24CU103 Advanced Wireless Communication (3)	24CU104 Radiating Systems (3)	24RM101 Research Methodology and IPR (3)	24CU1L1 Digital Communication Systems Laboratory (1.5)	24CU1L2 Advanced Digital Signal Processing Laboratory (1.5)	Audit Course – 1 (0)
II (23)	24CU201 RF System Design (3)	24CU202 Microwave Integrated Circuits (4)	24CU203 Advanced Wireless Networks (3)	24CU204 Image Processing and Video Analytics (4)	Professional Elective – I (3)	Professional Elective – II (3)	24CU2L1 Wireless Communication Laboratory (2)	24CU2L2 Term Paper Writing and seminar (1)	Audit Course – 2 (0)
III (19)	24CU301 Optical Communication and Networking (3)	Professional Elective – III (3)	Professional Elective – IV (3)	Open Elective (3)	---	---	24CU3L1 Project Work Phase – I (6)	---	---
IV (12)	---	---	---	---	---	---	24CU4L1 Project Work Phase – II (12)	---	---

Total Number of credits to be earned for the award of degree: 76

24MA102 LINEAR ALGEBRA, PROBABILITY AND QUEUEING THEORY

L	T	P	C
4	0	0	4

OBJECTIVES:

- To demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and Logical thinking applicable in Communication system Engineering.

PRE-REQUISITE: NIL

UNIT I LINEAR ALGEBRA 12

Vector spaces – Norms – Inner products – Eigenvalues using QR transformations – QR factorization – Generalized eigenvectors – Jordan Canonical forms – Singular value decomposition and applications – Pseudo inverse – Least square approximations.

UNIT II PROBABILITY AND RANDOM VARIABLES 12

Probability Concepts – Axioms of probability – Conditional probability – Bayes theorem – Random variables – Probability functions – Two-dimensional random variables – Joint distributions – Marginal and conditional distributions – Correlation – Linear Regression.

UNIT III RANDOM PROCESSES 12

Classification – Stationary random process – Markov process – Markov chain – Poisson process – Gaussian process – Auto correlation – Cross correlation.

UNIT IV QUEUEING THEORY 12

Markovian queues – Single and multi-server models – Little's formula – Steady state analysis – Self-service queue.

UNIT V LINEAR PROGRAMMING 12

Formulation – Graphical solution – Simplex method – Big M method – Variants of Simplex method – Transportation problems – Assignment models.

TOTAL: 60 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Apply various methods in linear algebra to solve the system of linear equations. (K3)

CO2 : Calculate the statistical measures for One and Two dimensional random variables. (K3)

CO3 : Determine the stationary and autocorrelation functions using random process. (K3)

CO4 : Classify the simple and multi queuing model and to calculate the statistical measures. (K3)

CO5 : Apply the Simplex method for solving linear programming problems. (K3)

REFERENCES:

1. A.H.Friedberg, A.J.Insel and L.Spence, “Linear Algebra”, Prentice Hall of India, New Delhi, 2004.
2. Richard Bronson, “Matrix Operations”, Schaum’s outline series, McGraw Hill, Second Edition, New York, 2011.
3. D.Gross, J.F.Shortie, J.M.Thompson and C.M.Harris, “Fundamentals of Queueing Theory”, Fourth Edition, Wiley, 2014.
4. Er.Prem Gupta, Dr.D.S.Hira, “Problems in Operations Research”, Fourth Edition, S.Chand &Company Pvt. Ltd., New Delhi, 2015.
5. T.Veerarajan, “Probability, Statistics and Random Process with Queueing Theory and Queueing Network”, Fourth Edition, Tata McGraw Hill, 2017.

24CU101 **STATISTICAL SIGNAL PROCESSING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the basics of random signal processing.
- To learn the concept of estimation and signal modeling.
- To know about optimum filters and adaptive filtering and its applications.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Discrete random processes – Ensemble averages – Wide sense stationary process – Properties - Ergodic process – Sample mean & variance - Auto-correlation and Auto-correlation matrices - Auto covariance and Cross covariance- Properties – White noise process – Wiener Khintchine relation - Power spectral density – Filtering random process – Spectral Factorization Theorem – Special types of Random Processes – AR,MA, ARMA Processes – Yule-Walker equations.

UNIT II PARAMETER ESTIMATION THEORY 9

Principle of estimation and applications - Properties of estimates - unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE) - Cramer Rao bound - Efficient estimators; Criteria of estimation: Methods of maximum likelihood and its properties ; Bayesian estimation : Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation

UNIT III SPECTRUM ESTIMATION 9

Estimation of spectra from finite duration signals, Bias and Consistency of estimators - Non- Parametric methods: Periodogram, Modified Periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric Methods: AR, MA and ARMA spectrum estimation - Detection of Harmonic signals - Performance analysis of estimators. MUSIC and ESPRIT algorithms

UNIT IV SIGNAL MODELING AND OPTIMUM FILTERS 9

Introduction - Least square method – Pade approximation – Prony's method – Levinson Recursion – Lattice filter - FIR Wiener filter – Filtering – Linear Prediction – Non Causal and Causal IIR Wiener Filter -– MSE – State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter, extended Kalman filter.

UNIT V ADAPTIVE FILTERS 9

FIR Adaptive filters - Newton's steepest descent method – Widrow Hoff LMS Adaptive algorithm – Convergence – Normalized LMS – Applications: Noise cancellation, channel equalization, echo canceller, Adaptive Recursive Filters: RLS adaptive algorithm, Exponentially weighted RLS - sliding window RLS. Matrix inversion Lemma, Initialization, tracking of nonstationarity.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Analyze discrete time random processes. (K4)

CO2 : Apply appropriate model for estimation and signal modeling for the given problem. (K3)

CO3 : Analyze non-parametric and parametric methods for spectral estimation. (K4)

CO4 : Design optimum filter for the given problem. (K4)

CO5 : Design adaptive filters for different applications. (K4)

REFERENCES:

1. Monson. H. Hayes, "Statistical Digital Signal Processing and Modelling", John Willey and Sons, 1996 (Reprint 2008).
2. Simon Haykin, "Adaptive Filter Theory", Fifth Edition, Pearson Prentice Hall, 2014.
3. D.G.Manolakis, V.K.Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing", Artech House Publishers, 2005.
4. Steven M. Kay, "Modern Spectral Estimation, Theory and Application", Pearson India, 2009.
5. A.Veloni, N. I.Miridakis and E.Boukouvala, "Digital and Statistical Signal Processing", CRC Press, 2019.
6. S.Nandi and D.Kundu, "Statistical Signal Processing - Frequency Estimation", Second Edition, Springer Nature, Singapore, 2020.
7. M.D.Srinath, P.K.Rajasekaran and R.Viswanathan, "Statistical Signal Processing with Applications", PHI, 1996.

24CU102 MODERN DIGITAL COMMUNICATION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the coherent and non coherent receivers and their performance under AWGN channel conditions.
- To understand the effect of signalling through bandlimited channels and Equalization techniques used to overcome ISI.
- To understand different channel models, channel capacity and different block coding techniques.
- To understand the principle of convolutional coding and different decoding techniques.
- To understand the basics of OFDM as a multicarrier communication and CDMA as a multiuser communication technique.

UNIT I COHERENT AND NON-COHERENT COMMUNICATION 9

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – QAM modulation and demodulation Noncoherent receivers in random phase channels; MFSK receivers – Rayleigh and Rician channels – Partially coherent receivers – DPSK; M-PSK; M-DPSK - BER Performance Analysis. Carrier Synchronization - Bit synchronization.

UNIT II EQUALIZATION TECHNIQUES 9

Band Limited Channels - ISI – Nyquist Criterion - Controlled ISI - Partial Response signals - Equalization algorithms – Linear equalizer – Decision feedback equalization – Adaptive Equalization algorithms.

UNIT III BLOCK CODED DIGITAL COMMUNICATION 9

Architecture and performance – Binary block codes; – Shannon's channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators – Linear block codes; Hamming; Golay; Cyclic; BCH ; Reed – Solomon codes. Space time block codes.

UNIT IV CONVOLUTIONAL CODED DIGITAL COMMUNICATION 9

Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram - Decoding techniques using Maximum likelihood, Viterbi algorithm, Sequential and Threshold methods – Error probability performance for BPSK and Viterbi algorithm, Turbo Coding.

UNIT V MULTICARRIER AND MULTIUSER COMMUNICATIONS 9

Single Vs multicarrier modulation, orthogonal frequency division multiplexing (OFDM), Modulation and demodulation in an OFDM system, An FFT algorithmic implementation of an OFDM system, Bit and power allocation in multicarrier modulation, Peak-to-average ratio in multicarrier modulation. Introduction to CDMA systems, multiuser detection in CDMA systems – optimum multiuser receiver, suboptimum detectors, successive interference cancellation.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Differentiate coherent and non coherent receivers and analyse their performance under AWGN channel conditions. (K3)

CO2 : Illustrate the effect of signalling through bandlimited channels and Equalization techniques used to overcome ISI. (K3)

CO3 : Determine the channel capacity and design various block coding techniques to combat channel errors. (K3)

CO4 : Construct convolutional coders and analyze the performance of different decoding techniques. (K3)

CO5 : Describe the basics of OFDM as a multicarrier communication and CDMA as a multiuser communication technique. (K3)

REFERENCES:

1. John G. Proakis and Masoud Salehi “Digital Communication”, Fifth Edition, Mc Graw Hill Publication, 2014.
2. Simon Haykin, “Digital communication Systems”, John Wiley and sons, 2014.
3. Bernard Sklar and Pabitra Kumar Ray, “Digital Communications Fundamentals & Applications”, Second Edition, Pearson Education, 2009.
4. B.P.Lathi and Zhi Ding, “Modern Digital and Analog communication Systems”, Oxford University Press, 2011.
5. Richard Van Nee and Ramjee Prasad, “OFDM for Multimedia Communications”, Artech House Publication, 2001.
6. Theodore S. Rappaport, “Wireless Communications”, Second Edition, Pearson Education, 2002.

24CU103 **ADVANCED WIRELESS COMMUNICATION**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the concepts of wireless communication.
- To know about the various propagation methods, Channel models, capacity calculations.
- To know the multiple antennas and multiple user techniques used in the mobile communication.

UNIT I WIRELESS CHANNEL PROPAGATION AND MODEL 9

Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-free space, two ray. Small scale fading - channel classification - channel models – COST -231 Hata model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, 5G Channel model requirements and Measurements, propagation scenarios, METIS channel models, Map-based model, stochastic model.

UNIT II CAPACITY OF WIRELESS CHANNELS 9

Capacity in AWGN, capacity of flat fading channel, capacity of frequency selective fading channels. Capacity of MISO, SIMO systems.

UNIT III DIVERSITY 9

Realization of independent fading paths, Receiver Diversity: Selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, Channel unknown at the transmitter.

UNIT IV MIMO COMMUNICATIONS 9

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain: Beam forming, Diversity-Multiplexing trade-offs, Space time Modulation and coding : STBC,STTC, Spatial Multiplexing and BLAST Architectures.

UNIT V MULTI USER SYSTEMS 9

Introduction to MUD, Linear decorrelator, MMSE MUD, Adaptive MUD, MIMO-MUD Application of convex optimization to wireless design.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 **:** Analyze the wireless channel characteristics and identify appropriate channel models. (K4)

CO2 **:** Derive the mathematics behind the capacity calculation under different channel conditions. (K3)

CO3 **:** Explain the implication of diversity combining methods and the knowledge of channel. (K2)

CO4 **:** Describe the concepts in MIMO Communications. (K3)

CO5 **:** Apply the fundamental concept of MIMO in Spacetime Modulation and coding. (K3)

REFERENCES:

1. David Tse and Pramod Viswanath, “Fundamentals of wireless communications”, First Edition, Cambridge University Press, 2012.
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2007.
3. Harry R. Anderson, “Fixed Broadband Wireless System Design”, John Wiley, India, 2003.
4. Andreas F. Molisch, “Wireless Communications”, John Wiley, India, 2006.
5. Simon Haykin and Michael Moher, “Modern Wireless Communications”, Pearson Education, 2007.
6. T.S.Rappaport, “Wireless communications”, Pearson Education, 2003.
7. Gordon L. Stuber, “Principles of Mobile Communication”, Springer International Ltd., 2001.
8. Upena Dalal, “Wireless Communication”, Oxford Higher Education, 2009.

24CU104 **RADIATING SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the antenna basics.
- To learn about antenna arrays and their characteristics.
- To study about operating antennas.
- To familiarize with modern antennas and measurement techniques.
- To learn about recent trends in antenna design.

UNIT I ANTENNA FUNDAMENTALS & WIRE ANTENNAS 9

Introduction – Types of Antennas – Radiation Mechanism – Current distribution on wire antennas – Maxwell's equations – Antenna fundamental parameters – Radiation integrals – Radiation from surface and line current distributions – dipole, monopole, loop antenna.

UNIT II ANTENNA ARRAYS 9

Linear array – uniform array, end fire and broad side array, gain, beam width, side lobe level; Linear array synthesis techniques – Binomial and Chebyshev distributions; Two dimensional uniform arrays; phased array antennas, smart antennas, switched beam and adaptive arrays, Mutual Coupling in Finite Arrays.

UNIT III APERTURE ANTENNAS 9

Field equivalence principle, Radiation from Rectangular and Circular apertures, Babinets principle, Slot antenna; Horn antenna; Reflector antenna, aperture blockage, and design consideration. Radiation Mechanism and Excitation techniques, Microstrip dipole; Patch, Rectangular patch, Circular patch – Microstrip array and feed network; Lens Antennas.

UNIT IV MODERN ANTENNAS & MEASUREMENT TECHNIQUES 9

Base station antennas, PIFA – Antennas for WBAN – RFID Antennas – Automotive antennas, MIMO Antennas, Diversity techniques – Antenna impedance and radiation pattern measurements.

UNIT V RECENT TRENDS IN ANTENNA DESIGN 9

UWB antenna arrays – Vivaldi antenna arrays – Artificial magnetic conductors/High impedance surfaces – Antennas in medicine – Plasma antennas – Antennas for millimeter wave communication - optimization techniques – Numerical methods.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Describe the fundamentals behind the different techniques in antenna technology. (K3)

CO2 : Explain the challenges associated in designing antennas based on different technologies. (K2)

CO3 : Describe the capability and assess the performance of various antennas. (K3)

CO4 : Identify the antennas specific to the applications, design and characterize. (K2)

CO5 : Explain the need for optimizing in antenna design and the methodologies for the same. (K2)

REFERENCES:

1. A.Balanis, “Antenna Theory Analysis and Design”, Third Edition, John Wiley and Sons, New York, 1982.
2. Frank B. Gross, “Frontiers in Antennas”, Mc Graw Hill, 2011.
3. S.Drabowitch, A.Papiernik, H.D.Griffiths, J.Encinas and B.L.Smith, “Modern Antennas”, Second Edition, Springer Publications, 2007.
4. John D. Krauss, “Antennas”, Second Edition, John Wiley and sons, New York, 1997.
5. I.J.Bahl and P.Bhartia, “Microstrip Antennas”, Artech House Inc.,1980.
6. W.L.Stutzman and G.A.Thiele, “Antenna Theory and Design”, Second Edition, John Wiley & Sons Inc., 1998.
7. Jim R. James and P.S.Hall, “Handbook of Microstrip Antennas”, IEE Electromagnetic wave series 28, Volume 2, 1989.

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24RM101 **RESEARCH METHODOLOGY AND IPR**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To give an overview of the research methodology and explain the technique of defining a research problem.
- To explain the functions of the literature review in research.
- To this course can explain the art of interpretation and the art of writing research reports.
- To explains various forms of the intellectual property its relevance.
- To business impact in the changing global business environment.

UNIT I RESEARCH METHODOLOGY **9**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting are search problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations. Effective literature studies, approaches, analysis, Plagiarism, Research ethics.

UNIT II EFFECTIVE TECHNICAL WRITING **9**

How to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and Assessment by are view committee.

UNIT III INTELLECTUAL PROPERTY AND INTERNATIONAL SCENARIO **9**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International co-operation on Intellectual Property Procedure for grants of patents, Patenting under PCT.

UNIT IV PATENT RIGHTS **9**

Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications.

UNIT V NEW DEVELOPMENTS IN IPR **9**

Administration of Patent System, New developments in IPR, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the scope and objectives of research problem. (K2)
CO2 : Develop effective technical writing for research proposal. (K3)
CO3 : Classify the Intellectual property in IPR. (K3)
CO4 : Illustrate patent rights, indications. (K3)
CO5 : Predict the new development in IPR. (K3)

TEXT BOOKS:

1. Debora J. Halbert, “Resisting Intellectual Property (RIPE Series in Global Political Economy)”, Taylor & Francis Ltd., 2006.
2. W.H.Mayall, “Industrial Design for Engineers”, London Iliffe Books Ltd., 1967.
3. Benjamin W. Niebel, “Product Design and Process Engineering”, McGraw- Hill Inc., US,1974.
4. Morris Asimow, “An Introduction To Design”, Prentice-Hall, Inc. First Edition,1962.
5. Robert P. Merges, Peter S. Menell and Mark A. Lemley, “Intellectual Property in New Technological Age”, Aspen Law & Business, 2012.
6. T.R Amappa, “Intellectual Property Rights Under WTO: Tasks Before India”, AH Wheeler Publishing Co. Ltd., 2002.

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1. S. Melville and W.Goddard, “Research Methodology: An Introduction for Science and Engineering Students”, Juta & Co. Ltd., 1996.
2. Ranjit Kumar, “Research Methodology: A Step-by-Step Guide for Beginners”, Third Edition, SAGE Publications Ltd., 2010.

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24CU1L1 **DIGITAL COMMUNICATION SYSTEMS LABORATORY**

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To study & measure the performance of digital communication systems.
- To provide a comprehensive knowledge of Wireless Communication.
- To learn about the design of digital filter and its adaptive filtering algorithms.

LIST OF EXPERIMENTS

1. OFDM transceiver design using MATLAB /SCILAB/LABVIEW
2. Channel equalizer design using MATLAB (LMS, RLS algorithms)
3. Design and Analysis of Spectrum Estimators (Bartlett, Welch) using MATLAB
4. BER performance Analysis of M-ary digital Modulation Techniques (coherent & non coherent) in AWGN Environment using MATLAB/SCILAB/LABVIEW
5. Design and performance analysis of Lossless Coding Techniques - Huffman and Shanon fano Coding using MATLAB/SCILAB/LABVIEW
6. Design and performance analysis of Lossless Coding Techniques - Lempel Ziv Algorithm using MATLAB/SCILAB/LABVIEW
7. Design and performance analysis of arithmetic coding algorithm using MATLAB/ SCILAB/ LABVIEW
8. Noise / Echo cancellation using MATLAB (LMS / RLS algorithms)
9. Study of synchronization (frame, bit, symbol.)
10. Wireless channel characterization
11. HDL Simulation of PN Sequence Generator
12. HDL Simulation of Low density parity check codes

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Implement the adaptive filtering algorithms. (K3)

CO2 : Generate and detect digital communication signals of various modulation techniques using MATLAB. (K3)

CO3 : Evaluate cellular mobile communication technology and propagation model. (K4)

CO4 : Apply mathematical formulation to analyze spectrum estimation of a signal and bit rate determination of a transmission link. (K3)

CO5 : Analyze the performance of optimization algorithms for equalizing the channel or noise/echo cancellation. (K4)

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24CU1L2 **ADVANCED DIGITAL SIGNAL PROCESSING LABORATORY**

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To enable the student to verify the basic principles of random signal processing, spectral estimation methods and additive white Gaussian noise (AWGN) channel characterization.
- To design and conduct experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts.

LIST OF EXPERIMENTS

1. Generation of Standard discrete time sequences (Unit Impulse, Unit Step, Unit Ramp, Sinusoidal and exponential signals) and carrying out of arithmetic operations and plot the results
2. Generation of random sequences satisfying the given probability distributions such as Uniform, Gaussian, Rayleigh and Rician.
3. Design of FIR filters for the given specification and plot the frequency response of the designed filter
4. Design of IIR filters for the given specification and plot the frequency response of the designed filter
5. Analysis of finite word length effects of FIR filter coefficients
6. Estimation of power spectrum of the given random sequence using Nonparametric methods (Bartlett, Welch and Blackman Tukey)
7. Estimation of power spectrum of the given random sequence using parametric methods (AR, MA and ARMA)
8. Upsampling the discrete time sequence by L times and plot the spectrum of both the given sequence and upsampled sequence
9. Downsampling the discrete time sequence by M times and plot the spectrum of both the given sequence and down sampled sequence
10. Design an adaptive filter to extract a desired signal from the given noisy signal by cancelling the noise using LMS Algorithm
11. Design an adaptive filter to extract a desired signal from the given noisy signal by cancelling the noise using RLS Algorithm
12. Implementation of Digital Filter Banks for the given specifications.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Generate deterministic/Random sequences using simulation tool. (K3)

CO2 : Design and analyze the frequency response of FIR/IIR digital filters for the given specifications. (K4)

CO3 : Estimate power spectrum of the given random sequence using parametric/nonparametric estimation methods. (K3)

CO4 : Implement adaptive filters using LMS/RLS algorithm. (K4)

CO5 : Analyze the discrete time systems at various sampling rates. (K4)

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24CU201 **RF SYSTEM DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- Be familiar with RF transceiver system design for wireless communications.
- Be exposed to design methods of receivers and transmitters used in communication systems.
- Design RF circuits and systems using an advanced design tool.
- Exemplify different synchronization methods circuits and describe their block schematic and design criteria.
- Measure RF circuits and systems with a spectrum analyzer.

UNIT I BASICS OF RADIO FREQUENCY SYSTEM DESIGN 10

Definitions and models of Linear systems and Non-linear system. Specification parameters: Gain, noise figure, SNR, Characteristic impedance, S-parameters, Impedance matching and Decibels. Elements of digital base band signalling: complex envelope of band pass signals, Average value, RMS value, Crest factor, Sampling, jitter, modulation techniques, filters, pulse shaping, EVM, BER, sensitivity, selectivity, dynamic range and, adjacent and alternate channel power leakages.

UNIT II RADIO ARCHITECTURES AND DESIGN CONSIDERATIONS 10

Superheterodyne architecture, direct conversion architecture, Low IF architecture, band-pass sampling radio architecture, System Design Considerations for an Analog Frontend Receiver in Cognitive Radio Applications, Interference, Near, In-band & wide-band considerations.

UNIT III AMPLIFIER MODELING AND ANALYSIS 9

Noise: Noise equivalent model for Radio frequency device, amplifier noise model, cascade performance, minimum detectable signal, performance of noisy systems in cascade. Non-Linearity: Amplifier power transfer curve, gain compression, AM-AM, AM-PM, polynomial approximations, Saleh model, Wiener model and Hammerstein model, intermodulation, Single and two tone analyses, second and third order distortions and measurements, SOI and TOI points, cascade performance of nonlinear systems.

UNIT IV MIXER AND OSCILLATOR MODELING AND ANALYSIS 8

Mixers: Frequency translation mechanisms, frequency inversion, image frequencies, spurious calculations, principles of mixer realizations. Oscillators: phase noise and its effects, effects of oscillator spurious components, frequency accuracy, oscillator realizations: Frequency synthesizers, NCO.

UNIT V APPLICATIONS OF SYSTEMS DESIGN 8

Multimode and multiband Superheterodyne transceiver: selection of frequency plan, receiver system and transmitter system design – Direct conversion transceiver: receiver system and transmitter system design.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the radio frequency parameters. (K2)

CO2 : Explain the transceiver architectures and their associated design considerations. (K2)

CO3 : Explain the impact of noise effect during cascade connections. (K2)

CO4 : Explain the non-linearity of amplification modules during cascade connections. (K2)

CO5 : Discuss about the mixer and oscillator realization. (K2)

REFERENCES:

1. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 2004.
2. Qizheng Gu, "RF System Design of Transceivers for Wireless Communications", Springer, 2005.
3. Kevin McClaning, "Wireless Receiver Design for Digital Communications," Yes Dee Publications, 2012.

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24CU202 MICROWAVE INTEGRATED CIRCUITS

L	T	P	C
3	0	2	4

OBJECTIVE:

- To familiarize different transmission lines used at Microwave frequencies
- To design impedance matching networks using lumped and distributed elements
- To design and analyze different microwave components
- To use SMITH chart to analyze the region of stability and instability for designing amplifiers and oscillators
- To simulate and to test the microwave components under laboratory conditions

UNIT - I PLANAR TRANSMISSION LINES AND COMPONENTS **9**

Review of Transmission line theory – S parameters-Transmission line equations – reflection coefficient – VSWR – Microstrip lines: Structure, waves in microstrip, Quasi-TEM approximation, Coupled lines: Even mode and odd mode analysis – Microstrip discontinuities and components – Strip line – Slot line – Coplanar waveguide – Filters – Power dividers and Couplers.

LAB COMPONENT
1. Study of transmission line parameters – Impedance analysis **6**

UNIT - II IMPEDANCE MATCHING NETWORKS **9**

Circuit Representation of two port RF/Microwave Networks: Low Frequency Parameters, High Frequency Parameters, Transmission Matrix, ZY Smith Chart, Design of Matching Circuits using Lumped Elements, Matching Network Design using Distributed Elements.

LAB COMPONENT
2. Design of impedance matching networks
3. Design of low pass and high pass filter **6**

UNIT - III MICROWAVE AMPLIFIER AND OSCILLATOR DESIGN **9**

Characteristics of microwave transistors – Stability considerations in active networks – Gain Consideration in Amplifiers – Noise Consideration in active networks – Broadband Amplifier design – Oscillators: Oscillator versus Amplifier Design – Oscillation conditions – Design and stability considerations of Microwave Transistor Oscillators.

LAB COMPONENT
4. Design of band-pass and band-stop filters
5. Design of branch line couplers **6**

UNIT - IV MIXERS AND CONTROL CIRCUITS **9**

Mixer Types – Conversion Loss – SSB and DSB Mixers – Design of Mixers: Single Ended Mixers – Single Balanced Mixers – Sub Harmonic Diode Mixers, Microwave Diodes, Phase Shifters – PIN Diode Attenuators.

LAB COMPONENT
6. Design of phase shifters
7. Design of Mixers **6**

UNIT - V MICROWAVE IC DESIGN AND MEASUREMENT TECHNIQUES **9**

Microwave Integrated Circuits – MIC Materials- Hybrid versus Monolithic MICs – Multichip Module Technology – Fabrication Techniques, Miniaturization techniques, Introduction to SOC, SOP, Test fixture measurements, probe station measurements, thermal and cryogenic measurements, experimental field probing techniques.

LAB COMPONENT
8. Design of Power dividers **6**

TOTAL: 45 + 30 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the concepts of planar transmission line. (K2)

CO2 : Design impedance matching circuits using LC components and stubs. (K4)

CO3 : Design and analysis the amplifiers at microwave frequencies. (K4)

CO4 : Analysis the stability and design of oscillators at microwave frequencies. (K4)

CO5 : Describe about the mixer and control circuits. (K2)

REFERENCES:

1. Jia Sheng Hong and M.J.Lancaster, “Microstrip Filters for RF/Microwave Applications”, John Wiley & Sons, 2001.
2. David M. Pozar, “Microwave Engineering”, Fourth Edition, John Wiley & Sons, 2012.
3. Reinhold Ludwig and Powel Bretchko, “ RF Circuit Design: Theory and Applications”, First Edition, Pearson Education Asia, 2001.
4. Thomas H. Lee, “Planar Microwave Engineering”, Cambridge University Press, 2004.
5. Matthew M. Radmanesh, “Radio Frequency and Microwave Electronics”, Pearson Education, 2002.

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24CU203 **ADVANCED WIRELESS NETWORKS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study about advanced wireless network, LTE, 4G and Evolutions from LTE to LTE.
- To study about wireless IP architecture, Packet Data Protocol and LTE network architecture.
- To study about adaptive link layer, hybrid ARQ and graphs routing protocol.
- To study about mobility management, cellular network, and micro cellular networks.

UNIT I INTRODUCTION **9**

Introduction to 1G/2G/3G/4G Terminology. Evolution of Public Mobile Services - Motivation for IP Based Wireless Networks - Requirements and Targets for Long Term Evolution (LTE) - Technologies for LTE - 4G Advanced Features and Roadmap Evolutions from LTE to LTE-A - Wireless Standards. Network Model - Network Connectivity - Wireless Network Design with Small World Properties.

UNIT II WIRELESS IP NETWORK ARCHITECTURES **9**

3GPP Packet Data Networks - Network Architecture - Packet Data Protocol (PDP) Context - Configuring PDP Addresses on Mobile Stations - Accessing IP Networks through PS Domain - LTE network Architecture - Roaming Architecture - Protocol Architecture- Bearer Establishment Procedure -Inter-Working with other RATs.

UNIT III ADAPTIVE LINK AND NETWORK LAYER **9**

Link Layer Capacity of Adaptive Air Interfaces - Adaptive Transmission in Ad Hoc Networks - Adaptive Hybrid ARQ Schemes for Wireless Links - Stochastic Learning Link Layer Protocol - Infrared Link Access Protocol - Graphs and Routing Protocols - Graph Theory - Routing with Topology Aggregation - Network and Aggregation Models.

UNIT IV MOBILITY MANAGEMENT **9**

Cellular Networks - Cellular Systems with Prioritized Handoff - Cell Residing Time Distribution - Mobility Prediction in Pico- and Micro-Cellular Networks.

UNIT V QUALITY OF SERVICE **9**

QoS Challenges in Wireless IP Networks - QoS in 3GPP - QoS Architecture, Management and Classes - QoS Attributes - Management of End-to-End IP QoS - EPS Bearers and QoS in LTE networks.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the latest 4G networks and LTE. (K2)

CO2 : Discuss about the wireless IP architecture and LTE network architecture. (K2)

CO3 : Describe the adaptive link layer and network layer graphs and protocol. (K2)

CO4 : Explain the mobility management and cellular network. (K2)

CO5 : Describe the wireless sensor network architecture and its concept. (K2)

REFERENCES:

1. Ayman El-Nashar, Mohamed El-saidny and Mahmoud Sherif, “Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach”, John Wiley & Sons, 2014.
2. Crosspoint Boulevard, “Wireless and Mobile All-IP Networks”, Wiley Publication, 2005.
3. Jyh-Cheng Chen and Tao Zhang, “IP-Based Next-Generation Wireless Networks Systems, Architectures, and Protocols”, John Wiley & Sons, Inc., 2006.
4. Minoru Etoh, “Next Generation Mobile Systems 3G and Beyond”, Wiley Publications, 2005.
5. Savo Glisic, “Advanced Wireless Networks - Technology and Business Models”, Third Edition, John Wiley & Sons, Ltd., 2016.
6. Savo Glisic, “Advanced Wireless Networks - 4G Technologies”, John Wiley & Sons, Ltd., 2006.
7. Stefania Sesia, IssamToufik and Matthew Baker, “LTE – The UMTS Long Term Evolution From Theory to Practice”, Second Edition, John Wiley & Sons, Inc., 2011.

24CU204 IMAGE PROCESSING AND VIDEO ANALYTICS

L	T	P	C
3	0	2	4

OBJECTIVE:

- To comprehend the relation between human visual system and machine perception and processing of digital images.
- To provide a detailed approach towards image processing applications like enhancement, segmentation, and compression.
- To also explore the integration principles of communication system working with different sampling rates.
- To analysis the fundamentals of digital image processing, image and video analysis.
- To present the mathematics and algorithms that underlie image analysis techniques.

UNIT - I INTRODUCTION AND DIGITAL IMAGE FUNDAMENTALS **9**

Introduction: Introduction & Applications, Elements of visual perception, Image sensing and acquisition, simple image formation, Image sampling and Quantization, Representing digital pixels, Image quality, Introduction to colour image – RGB and HSI Models.

Image enhancement in Spatial domain: Introduction to image enhancement, basic grey level transforms, Histogram, Histogram-processing equalization, Matching & colour histogram, Enhancement using arithmetic/logic operations, spatial filtering, Smoothing spatial filtering, Sharpening spatial filtering.

LAB COMPONENT

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization.

6

UNIT - II IMAGE PROCESSING TECHNIQUES **9**

Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation.

LAB COMPONENT

3. Implement segmentation algorithms.
4. Perform video enhancement.

6

UNIT - III VIDEO PROCESSING AND MOTION ESTIMATION **9**

Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations 2-D Motion Estimation: Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

LAB COMPONENT

5. Perform video segmentation.
6. Perform image compression using lossy technique.
7. Perform image compression using lossless technique.

6

UNIT - IV INTRODUCTION: VIDEO ANALYTICS **9**

Computer Vision: Challenges- Spatial Domain Processing – Frequency Domain Processing - Background Modeling - Shadow Detection - Eigen Faces - Object Detection - Local Features - Mean Shift: Clustering, Tracking - Object Tracking using Active Contours - Tracking & Video Analysis - Kalman filters, condensation, particle, Bayesian filters, hidden Markov models, change detection and model based tracking.

LAB COMPONENT	8. Perform image restoration. 9. Convert a colour model into another. 10. Calculate boundary features of an image.	**6**

UNIT - V MOTION UNDERSTANDING **9**

Motion estimation and Compensation-Block Matching Method, Motion Segmentation -Thresholding for Change Detection, Estimation of Model parameters - Optical Flow Segmentation - Modified Hough Transform Method - Segmentation for Layered Video Representation-Bayesian Segmentation - Simultaneous Estimation and Segmentation - Motion Field Model - Action Recognition - Low Level Image Processing for Action Recognition

LAB COMPONENT	11. Calculate regional features of an image. 12. Detect an object in an image/video using template matching/Bayes classifier	**6**

TOTAL: 45 + 30 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the limitations of the computational methods on digital images. (K2)

CO2 : Implement the spatial and frequency domain image transforms on enhancement and restoration of images. (K2)

CO3 : Explain the need for compression and evaluate the basic compression algorithms. (K2)

CO4 : Discuss the techniques to recover the desired signal parameters and information from the signal corrupted by noisy channel. (K2)

CO5 : Explain the algorithms available for performing analysis on video data and address the challenges. (K2)

REFERENCES:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson, 2008.
2. John J. Proakis and Dimitris G. Manolakis, “Digital Signal Processing”, Pearson Education, 2002.
3. Scotte Umbaugh, “Digital Image Processing and Analysis - Human and Computer Vision Application with using CVIP Tools”, Second Edition, CRC Press, 2011.
4. John C. Russ and F. Brent Neal, “The Image Processing Handbook”, Seventh Edition, The Kindle edition, CRC Press,Taylor & Francis Group, 2016.
5. John G. Proakis and Masoud Salehi, “Communication Systems Engineering”, Prentice Hall, 1994.
6. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2011.
7. Yao Wang, JornOstermann and Ya-Qin Zhang, “Video Processing and Communications”, Prentice Hall, 2001.

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24CU2L1 **WIRELESS COMMUNICATION LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVES:

- To enable the student to verify the basic principles of random signal processing, spectral estimation methods, wireless and AWGN channel characterization, application of adaptive filter algorithms for communication system design, coding and modulation design, synchronization aspects and the overall baseband system design.
- To design and conduct experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts.
- To enable the student to appreciate the practical aspects of baseband system design and understand the associated challenges.

LIST OF EXPERIMENTS

1. Spectral Characterization of communication signals (using Spectrum Analyzer).
2. Measurement of gain and radiation pattern of horn antenna.
3. Testing of microwave components using VNA.
4. Simulation of microwave filters.
5. CDMA signal generation and RAKE receiver design using DSP/MATLAB/ SIMULINK.
6. Design and performance analysis of error control encoder and decoder (Block and Convolutional Codes).
7. Wireless Channel equalizer design using DSP (ZF / LMS / RLS).
8. Wireless Channel Estimation and Diversity Combining.
9. Design and simulation of Microstrip patch antenna.
10. Analysis of Antenna Radiation Pattern and measurement.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Design and conduct experiments to demonstrate the trade-offs involved in the design of basic and advanced coding and modulation techniques and the advanced baseband signal conditioning methods. (K4)

CO2 : Applying communication engineering principles and design tools and will be well practiced in design skills. (K3)

CO3 : Comprehensively record and report the measured data, write reports, communicate research ideas and do oral presentations effectively. (K3)

CO4 : Analyzing and interpreting the experimental measurement data and produce meaningful conclusions. (K4)

CO5 : Design and develop RF components using microstrip technology. (K4)

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24CU2L2 **TERM PAPER WRITING AND SEMINAR**

L	T	P	C
0	0	2	1

OBJECTIVES:

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas.

The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (at least 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the author's contributions and critically analyzing each paper.
6. Preparing a working outline.
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the final paper and giving final presentation.

Please keep a file where the work carried out by you is maintained.

ACTIVITIES			
Activity	**Instructions**	**Submission week**	**Evaluation**
Selection of area of interest and Topic. Stating an Objective	You are requested to select an area of interest, topic and state an objective	2nd week	3 % (Based on clarity of thought, current relevance and clarity in writing)
Collecting Information about your area & topic	➢ List 1 Special Interest Groups or professional society ➢ List 2 journals ➢ List 2 conferences, symposia or workshops ➢ List 1 thesis title ➢ List 3 web presences (mailing lists, forums, news sites) ➢ List 3 authors who publish regularly in your area ➢ Attach a call for papers (CFP) from your area.	3rd week	3% (The selected information must be area specific and of international and national standard)

Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	You have to provide a complete list of references you will be using - Based on your objective - Search various digital libraries and Google Scholar When picking papers to read - try to: ➢ Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them, ➢ Favour papers from well-known journals and conferences, ➢ Favour "first" or "foundational" papers in the field (as indicated in other people"s survey paper), ➢ Favour more recent papers, ➢ Pick a recent survey of the field so you can quickly gain an overview, ➢ Find relationships with respect to each other and to your topic area (classification scheme/categorization) - Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered	4^{th} week	6% (The list of standard papers and reason for selection)
Reading and notes for first 5 papers	Reading Paper Process For each paper form a Table answering the following questions: What is the main topic of the article? What was/were the main issue(s) the author said they want to discuss? Why did the author claim it was important? How does the work build on other's work, in the author's opinion? What simplifying assumptions does the author claim to be making? What did the author do? How did the author claim they were going to evaluate their work and compare it to others? What did the author say were the limitations of their research? What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)	5^{th} week	8% (The table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

Reading and notes for next 5 papers	Repeat Reading Paper Process	6th week	8% (The table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	8% (The table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	8% (This component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	6% (Clarity, purpose and conclusion) 6% (Presentation & Viva Voce)
Introduction Background	Write an introduction and background sections	10th week	5% (Clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	10% (This component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	5% (Conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	10% (Formatting, English, Clarity and linking) 4% (Plagiarism Check Report)

Seminar	A brief 15 slides on your paper	14^{th} & 15^{th} week	10% (Based on presentation and Viva-voce)

TOTAL: 30 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the basics of writing skills. (K2)

CO2 : Illustrate the level of readability. (K2)

CO3 : Discuss about the subsection writing of technical paper. (K2)

CO4 : Summarize the skills needed to form a proper title. (K2)

CO5 : Develop the presentation and discussion skills. (K2)

24CU301 OPTICAL COMMUNICATION AND NETWORKING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enable the student to understand the basic principles of operation of optical system components, the different network architectures and issues associated with network design.
- To enable the student to understand the differences in the design of data plane and the control plane and the routing, switching and the resource allocation methods and the network management and protection methods in vogue.

UNIT I OPTICAL SYSTEM COMPONENTS AND NETWORK DESIGN 9

Optical System Components – MZIM, Multiplexers; filters; switches; wavelength converters; optical amplifiers – EDFA, Raman Amplifiers and hybrid; Transmission system Engineering – System Model, Aimer penalty – transmitter, receiver, cross talk, dispersion compensation, wavelength stabilization, FWM.

UNIT II COHERENT SYSTEMS 9

Basic principles of Coherent detections – Practical constraints – Injection laser line width state of polarization, local oscillator power, fiber limitations; Modulation formats – ASK, FSK, PSK, DPSK and polarization shift keying (POL SK); Demodulation schemes – Homodyne, Heterodyne – Synchronous and Non synchronous detection; Comparison; Carrier recovery in Coherent detection.

UNIT III OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks; First Generation optical networks – SONET / SDH Network, Second Generation (WDM) Optical Networks, Need for Multilayered Architecture - Layers and Sub- layers, Spectrum partitioning, Optical Network Nodes, Network Access Stations, Overlay Processor, Logical network overlays.

UNIT IV NETWORK CONNECTIONS 9

Connection Management and Control; Static Networks, Wavelength Routed Networks; Linear Light wave networks; Logically Routed Networks; Routing and Wavelength Assignment, Traffic Grooming in Optical Networks.

UNIT V OPTICAL NETWORK SURVIVABILITY 9

Protection and Restoration Objectives, Fault Protection and Restoration Techniques in the Logical Layer – Point-to-Point Systems, SONET Self-Healing Rings, Interconnection Techniques, Architectures with Arbitrary Mesh Topologies, Optical-Layer Protection: Point-to-Point and Ring Architectures, Mesh Architectures.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Discuss about the differences and challenges involved in the design of optical systems and networks. (K2)

CO2 : Describe the various coherent modulation schemes in Optical systems. (K2)

CO3 : Describe the various coherent demodulation schemes in Optical systems. (K2)

CO4 : Explain the concepts of optical network architectures. (K2)

CO5 : Explain the network connection and routing management in the different approaches. (K2)

REFERENCES:

1. Max Ming-Kang Liu, “Principles and Applications of Optical Communication”, Tata McGraw Hill Education Pvt. Ltd., New Delhi. 2010.
2. Thomas E. Stern, Georgios Ellinas and Krishna Bala, “Multiwavelength Optical Networks – Architecture, Design and control”, Second Edition, Cambridge University Press, 2009.
3. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks: A Practical Perspective”, Second Edition, Harcourt Asia Pvt. Ltd., 2006.

24CU1E1 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

L	T	P	C
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OBJECTIVES:

- To gain broad conceptual understanding of the various aspects of electromagnetic (EM) interference and compatibility.
- To develop a theoretical understanding of electromagnetic shielding effectiveness.
- To understand ways of mitigating EMI by using shielding, grounding and filtering.
- To understand the need for standards and to appreciate measurement methods.
- To understand how EMI impacts wireless and broadband technologies.

UNIT I INTRODUCTION & SOURCES OF EM INTERFERENCE 9

Introduction - Classification of sources - Natural sources - Man-made sources - Survey of the electromagnetic environment.

UNIT II EM SHIELDING 9

Introduction - Shielding effectiveness - Far-field sources - Near-field sources - Low-frequency, magnetic field shielding - Effects of apertures.

UNIT III INTERFERENCE CONTROL TECHNIQUES 9

Equipment screening - Cable screening - grounding - Power-line filters - Isolation - Balancing - Signal-line filters - Nonlinear protective devices.

UNIT IV EMC STANDARDS, MEASUREMENTS AND TESTING 9

Need for standards - The international framework - Human exposure limits to EM fields - EMC measurement techniques - Measurement tools - Test environments.

UNIT V EMC CONSIDERATIONS IN WIRELESS AND BROADBAND TECHNOLOGIES 9

Efficient use of frequency spectrum - EMC, interoperability and coexistence - Specifications and alliances - Transmission of high-frequency signals over telephone and power networks – EMC and digital subscriber lines - EMC and power line telecommunications.

SUGGESTED ACTIVITIES:

1. Investigate various case studies related to EMIC. Example: Chernobyl Disaster in 1986.
2. Develop some understanding about the design of EM shields in electronic system design and packaging.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Describe the various sources of electromagnetic interference. (K2)

CO2 : Describe about various types of shielding. (K2)

CO3 : Explain the EMI mitigation techniques. (K2)

CO4 : Explain the need for standards and EMC measurement methods. (K2)

CO5 : Discuss the impact of EMC in wireless technologies. (K2)

REFERENCES:

1. C.Christopoulos, “Principles and Techniques of Electromagnetic Compatibility”, Second Edition, CRC Press, 2013.
2. C.R.Paul, “Introduction to Electromagnetic Compatibility”, Second Edition, Wiley India, 2008.
3. V.P.Kodali, “Engineering Electromagnetic Compatibility”, Second Edition, Wiley India, 2010.
4. Henry W. Ott, “Electromagnetic Compatibility Engineering”, John Wiley & Sons Inc, Newyork, 2009.
5. W.Scott Bennett, “Control and Measurement of Unintentional Electromagnetic Radiation”, John Wiley & Sons Inc., 1997.

24CU1E2 ADVANCED SATELLITE COMMUNICATION AND NAVIGATION SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn M2M developments and satellite applications.
- To understand satellite communication in IPv6 environment.

UNIT I OVERVIEW OF SATELLITE COMMUNICATION 9

Overview of satellite communication and orbital mechanics Link budget Parameters, Link budget calculations, Auxiliary Equations, Performance Calculations.

UNIT II M2M DEVELOPMENTS AND SATELLITE APPLICATIONS 9

Overview of the Internet of Things and M2M - M2M Applications Examples and Satellite Support - Satellite Roles Context and Applications - Antennas for Satellite M2M Applications - M2M Market Opportunities for Satellite Operators - Ultra HD Video/TV and Satellite Implications - High Throughput Satellites (HTS) and Ka/Ku Spot Beam Technologies - Aeronautical, Maritime and other Mobility Services.

UNIT III SATELLITE COMMUNICATION IN IPV6 ENVIRONMENT 9

Overview of IPv6 and its benefits for Satellite Networks - Migration and Coexistence - Implementation scenarios and support - Preparations for IPv6 in Satellite communication - Satellite specific Protocol issues in IPv6 - Impact of IPv6 on Satellite Network architecture and services - Detailed transitional plan - IPv6 demonstration over satellites - Key results and recommendations.

UNIT IV SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM 9

Overview of Radio and Satellite Navigation, GPS Principles, Signal model and Codes, Satellite Signal Acquisition, Mathematical model of GPS observables, Methods of processing GPS data, GPS Receiver Operation and Differential GPS. IRNSS, GAGAN, GLONASS and Galileo.

UNIT V DEEP SPACE NETWORKS AND INTER PLANETARY MISSIONS 9

Introduction - Functional description - Design procedure and performance criterion - Mars exploration Rover - Mission and spacecraft summary - Telecommunication subsystem overview - Ground Subsystem-Telecom subsystem and Link performance Telecom subsystem Hardware and software Chandrayaan-1 Mission - Mission and spacecraft summary - Telecommunication subsystem overview - Ground Subsystem - Telecom subsystem and Link performance. Mangalyaan Mission - Mission and spacecraft summary - Telecommunication subsystem overview - Ground Subsystem - Telecom subsystem and Link performance.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Discuss the satellite navigation and global positioning system. (K2)

CO2 : Explain the deep space networks and inter planetary missions. (K2)

CO3 : Describe the different interferences and attenuation mechanisms affecting the satellite link design. (K2)

CO4 : Explain the different communication, sensing and navigational applications of satellite. (K2)

CO5 : Discuss about the implementation aspects of existing satellite based systems. (K2)

REFERENCES:

1. V.Adimurthy, “Concept design and planning of India’s first interplanetary mission”, Current Science, Vol. 109, No. 6, pp. 1054, September 2015.
2. Anil K. Maini and Varsha Agrawal, “Satellite Technology: Principles and Applications”, Third Edition, Wiley, 2014.
3. Daniel Minoli, “Innovations in Satellite Communication and Satellite Technology”, Wiley, 2015.
4. Daniel Minoli, “Satellite Systems Engineering in an IPv6 Environment”, First Edition, CRC Press, 2009.
5. B.Hofmann-Wellenhof, H.Lichtenegger and Elmar Wasle, “Global Navigational Satellite Systems”, Springer-Verlag, 2008.
6. Jim Taylor, “Deep Space Communications”, John Wiley & Sons, 2016.
7. Jr. Louis J. Ippolito, “Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance”, Second Edition, Wiley Inc., 2017.

24CU1E3 HIGH SPEED SWITCHING AND NETWORKING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explore the various space division switches.
- To enable the various network performance analysis.
- To get the clear idea about the various multimedia application.
- To get a clear idea about the traffic and Queuing systems.
- To interpret the basics of security management and the various attacks & its countermeasures.

UNIT I SWITCHING ARCHITECTURES 9

Shared medium switches – Shared memory switches – Space division switches – Cross bar based switching architecture – Input queued, Output queued and Combined input-output queued switches – Non blocking and blocking cross bar switches – Banyan networks – Batcher Banyan networks – Optical switches – Unbuffered and buffered switches – Buffering strategies – Optical packet switches and Optical burst switches – MEMS optical switches.

UNIT II NETWORK PERFORMANCE ANALYSIS 9

Objectives and requirements for Quality of Service (QoS) in high performance networks. Architecture of high performance networks (HPN), design issues, protocols for HPN, VHF backbone networks, virtual interface architectures, virtual interface for networking, High-speed switching and routing - internet and PSTN IP switching techniques, SRP protocols, SRP authentication, and key exchange, comparison of TCP/IP, FTP, TELNET, queuing systems, network modeling as a graph.

UNIT III MULTIMEDIA NETWORKING APPLICATIONS 9

Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism, integrated services, RSVP- differentiated services.

UNIT IV PACKET QUEUES AND DELAY ANALYSIS 9

Littles theorem, Birth and Death process, queueing discipline- Control & stability -, Markovian FIFO queueing system, Non-markovian – Pollaczek Khinchin formula and M/G/1, M/D/1, self-similar models and Batch-arrival model, Networks of Queues – Burkes theorem and Jackson Theorem.

UNIT V NETWORK SECURITY AND MANAGEMENT 9

Principles of cryptography – Elliptic-AES Authentication – integrity – key distribution and certification– Access control and: fire walls – DoS-attacks and counter measures – security in many layers.Infrastructure for network management – The internet standard management framework – SMI, MIB, SNMP, Security and administration – ASN.1.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the fundamental concepts of the switching architecture involved in various switching types. (K2)

CO2 : Interpret the basics of various protocols and QOS in the network performance. (K2)

CO3 : Explain the various types of multimedia networking application. (K2)

CO4 : Recognize the concepts of various analysis method involved in the processing. (K2)

CO5 : Explain the fundamental issues involved in providing the security for various network attacks. (K2)

REFERENCES:

1. Achille Pattavina, “Switching Theory Architectures and performance in Broadband ATM networks”, John wiley & sons Ltd. New York, 2007.
2. Elhanany, Itamar, Hamdi and Mounir, “High Performance Packet Switching Architectures”, Springer 2007.
3. Walrand .J. Varatya, “High Performance Communication Network”, Second Edition, Morgan Kaufmann – Harcourt Asia Pvt. Ltd., 2000.
4. Fred Halsall and Lingana Gouda Kulkarni, “Computer Networking and the Internet”, Fifth Edition, Pearson Education, 2012.
5. Nader F. Mir, “Computer and Communication Networks”, Pearson Education, 2009.

24CU1E4 **SIGNAL INTEGRITY FOR HIGH SPEED DESIGN**

L	T	P	C
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OBJECTIVES:

- To identify sources affecting the speed of digital circuits.
- To introduce methods to improve the signal transmission characteristics.

UNIT I SIGNAL PROPAGATION ON TRANSMISSION LINES 9

Transmission line equations, wave solution, wave *vs.* circuits, initial wave, delay time, Characteristic impedance, wave propagation, reflection, and bounce diagrams Reactive terminations – L,C, static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stackups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for microstrip and stripline Reflection and terminations for logic gates, fan-out, logic switching, input impedance into a transmission-line section, reflection coefficient, skin-effect, dispersion.

UNIT II MULTI-CONDUCTOR TRANSMISSION LINES AND CROSS-TALK 9

Multi-conductor transmission-lines, coupling physics, per unit length parameters, Near and far-end cross-talk, minimizing cross-talk (stripline and microstrip), Differential signalling, termination, balanced circuits, S-parameters, Lossy and Lossless models.

UNIT III NON-IDEAL EFFECTS 9

Non-ideal signal return paths – gaps, BGA fields, via transitions, Parasitic inductance and capacitance, Transmission line losses – Rs, tanδ, routing parasitic, Common-mode current, differential-mode current, Connectors.

UNIT IV POWER CONSIDERATIONS AND SYSTEM DESIGN 9

SSN/SSO, DC power bus design, layer stack up, SMT decoupling, Logic families, power consumption, and system power delivery, Logic families and speed Package types and parasitic, SPICE, IBIS models, Bit streams, PRBS and filtering functions of link-path components, Eye diagrams, jitter, inter-symbol interference Bit-error rate, Timing analysis.

UNIT V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS 9

Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, canceling parasitic capacitance, Clock jitter.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Analyze sources affecting the speed of digital circuits. (K4)
CO2 : Analyze the methods to improve the signal transmission characteristics. (K4)
CO3 : Discuss about the characterize and model multiconductor transmission line. (K2)
CO4 : Analyze nonideal effects of transmission line. (K4)
CO5 : Explain the various power considerations in the high speed signal integrity design. (K2)

REFERENCES:

1. H.W.Johnson and M.Graham, “High-Speed Digital Design: A Handbook of Black Magic”, Prentice Hall, 1993.
2. Douglas Brooks, “ Signal Integrity Issues and Printed Circuit Board Design”, Prentice Hall PTR, 2003.
3. S.Hall, G.Hall and J.McCall, “ High-Speed Digital System Design: A Handboo of Interconnect Theory and Design Practices”, Wiley-Interscience, 2000.
4. Eric Bogatin, “Signal Integrity – Simplified”, Prentice Hall PTR, 2003.

24CU1E5 **WAVELETS AND SUBBAND CODING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the fundamentals concepts of wavelet transforms.
- To study system design using Wavelets.
- To learn the different wavelet families & their applications.
- To study signal compression and sub-band coding.

UNIT I INTRODUCTION TO WAVELETS 9

Introduction to Multirate signal processing- Decimation and Interpolation, Quadrature Mirror Filters, Subband coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous Wavelet transform, Time frequency representation, Wavelet System and its characteristics, Orthogonal and Orthonormal functions and function space.

UNIT II MULTIRESOLUTION CONCEPT AND DISCRETE WAVELET TRANSFORM 9

Multiresolution formulation of wavelet systems - signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks - Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

UNIT III WAVELET SYSTEM DESIGN 9

Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

UNIT IV WAVELET FAMILIES 9

Continuous Wavelets- Properties of Mexican hat wavelet, Morlet, Gaussian and Meyer wavelets. Orthogonal wavelets - Properties of Haar wavelets, Daubechies wavelets, Symlets, Coiflets and Discrete Meyer wavelets. Properties of Biorthogonal wavelets, Applications of wavelet families.

UNIT V SIGNAL COMPRESSION AND SUBBAND CODING 9

Compression Systems Based on Linear Transforms - Speech and Audio Compression - Image Compression - Video Compression - Joint Source - Channel Coding.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the fundamental concepts of wavelet transforms. (K2)
CO2 : Discuss the various discrete wavelet transforms. (K2)
CO3 : Describe the multiresolution concepts in wavelet system. (K2)
CO4 : Discuss the system design using wavelets. (K2)
CO5 : Compare different wavelet families. (K2)

REFERENCES:

1. C.Sidney Burrus, Ramesh Gopinath and Haito Guo, “Introduction to wavelets and wavelet transform”, Prentice Hall, 1998.
2. G.Strang and T.Nguyen, “Wavelet and filter banks”, Wesley and Cambridge Press, 1996.
3. Metin Akay, “Time frequency and wavelets in biomedical signal processing”, Wiley-IEEE Press, October 1997.
4. M.Vetterli and J.Kovacevic, “Wavelets and sub band coding”, Prentice Hall, 1995.
5. P.Vaidyanathan, “Multi rate systems and filter banks”, Prentice Hall 1993.
6. Raguveer m Rao and Ajith S. Bopardikar, “Wavelet transforms – Introduction to theory and applications”, Addison Wesley, 1998.
7. S.Mallet, “A Wavelet tour of Signal Processing”, Academic Press, 1998.

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24CU2E1 **CRYPTOGRAPHY AND NETWORK SECURITY**

L	T	P	C
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OBJECTIVES:

- To understand· the importance and goals of communication network and informationsecurity and introduce them to the different types of attacks.
- To expose· different approaches to handling security and the algorithms in use formaintaining data integrity and authenticity.
- To·appreciate the practical aspects of security features design and their implementationin wired and wireless internetworking domains.

UNIT I INTRODUCTION ON SECURITY 9

Security Goals, Cryptographic attacks, Security services and mechanisms Techniques: Cryptography and Steganography, Traditional Symmetric-Key Ciphers: Substitution Ciphers and Transposition Ciphers, Mathematics for Cryptography.

UNIT II SYMMETRIC & ASYMMETRIC KEY ALGORITHMS 9

Introduction to Block Ciphers and Stream Ciphers, Data Encryption Standards (DES), AdvancedEncryption Standard (AES), RC4, Principle of asymmetric key algorithms, RSA Cryptosystem.

UNIT III INTEGRITY, AUTHENTICATION AND KEY MANAGEMENT 9

Message Integrity, Hash functions: SHA 512, Whirlpool, Digital signatures: Digital signature standards. Authentication: Entity Authentication: Biometrics, Key management Techniques.

UNIT IV NETWORK SECURITY, FIREWALLS AND WEB SECURITY 9

Introduction on Firewalls, Types of Firewalls, IP Security, E-mail security: PGP- S/MIME, Websecurity: SSL-TLS, SET.

UNIT V WIRELESS NETWORK SECURITY 9

Security Attack issues specific to Wireless systems: Worm hole, Tunneling, DoS. Security for WLAN, Security for Broadband networks: Security challenges in 4G and 5G deployments,Introduction to side channel attacks and their counter measures.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the basic principles of security algorithms. (K2)
CO2 : Describe the various types of symmetric and asymmetric key algorithms. (K2)
CO3 : Discuss the different types of security algorithms to maintain the data integrity and authenticity. (K2)
CO4 : Explain the practical aspects of security features design and their implementationin wired and wireless internetworking domains. (K2)
CO5 : Discuss about the security attack issues specific to wireless systems. (K2)

REFERENCES:

1. Behrouz A. Forouzan, “Cryptography and Network security”, McGraw- Hill, 2011.
2. William Stallings, "Cryptography and Network security: principles and practice", Second Edition, Prentice Hall of India, New Delhi, 2002.
3. AtulKahate, “Cryptography and Network security”, Second Edition, Tata McGraw-Hill, 2008.
4. R.K.Nichols and P.C.Lekkas, “Wireless Security: Models, threats and Solutions”, McGraw- Hill, 2001.
5. A.Perrig, J.Stankovic and D.Wagner, “Security in Wireless Sensor Networks”, Communications of the ACM, Vol. 47, No. 6, pp. 53-57, 2004.

24CU2E2 SATELLITE COMMUNICATIONS AND NAVIGATION SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enable the student to understand the necessity for satellite based communication, theessential elements involved and the transmission methodologies.
- To enable the student to understand the different interferences and attenuation mechanismsaffecting the satellite link design.
- To expose the student to the advances in satellite based navigation, GPS and the differentapplication scenarios.

UNIT I ELEMENTS OF SATELLITE COMMUNICATION 9

Satellite Systems, Orbital description and Orbital mechanics of LEO, MEO and GSO, Placement of a Satellite in a GSO, Antennas and earth coverage, Altitude and eclipses, Satellite drift and station keeping, Satellite — description of different Communication subsystems, Bandwidth allocation.

UNIT II SATELLITE SPACE SEGMENT AND ACCESS 9

Introduction; attitude and orbit control system; telemetry, tracking and command; power systems, communication subsystems, antenna subsystem, equipment reliability and space qualification, Multiple Access: Demand assigned FDMA - SPADE system - TDMA - satellite switched TDMA — CDMA.

UNIT III SATELLITE LINK DESIGN 9

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design: System noise temperature and G/T ratio, Downlink and uplink design, C/N, Link Design with and without frequency reuse, link margins, Error control for digital satellite link.

UNIT IV SATELLITE BASED BROADBAND COMMUNICATION 9

VSAT Network for Voice and Data – TDM/TDMA, SCPC/DAMA, Elements of VSAT Network, Mobile and Personal Communication Services, Satellite based Internet Systems, Multimedia Broadband Satellite Systems, UAVs.

UNIT V SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM 9

Radio and Satellite Navigation, GPS Position Location Principles of GPS Receivers and Codes, Satellite Signal Acquisition, GPS Receiver Operation and Differential GPS, INS, Indian Remote Sensing and ISRO GPS Systems.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the basic principles of satellite based communication and the essential elements involved and the transmission methodologies. (K2)

CO2 : Discuss about the satellite orbits, placement and control, satellite link design and the communication system components. (K2)

CO3 : Demonstrate an understanding of the different interferences and attenuation mechanisms affecting the satellite link design. (K2)

CO4 : Demonstrate an understanding of the different communication, sensing and navigational applications of satellite. (K2)

CO5 : Discuss the implementation aspects of existing satellite based systems. (K2)

REFERENCES:

1. Wilbur L. Pritchard, Hendri G. Suyderhoud and Robert A. Nelson, “Satellite Communication Systems Engineering”, Prentice Hall/ Pearson, 2007.
2. Timothy Pratt and Charles W.Bostain, “Satellite Communications”, Second Edition, John Wiley and Sons, 2012.
3. D.Roddy, “Satellite Communication”, Fourth Edition, McGraw Hill, 2009.
4. Tri T Ha, “Digital Satellite Communication”, Second Edition, McGraw Hill, 1990.
5. B.N.Agarwal, “Design of Geosynchronous Spacecraft”, Prentice Hall, 1993.
6. Brian Ackroyd, “World Satellite Communication and Earth Station Design”, BSP Professional Books, 1990.

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24CU2E3 **SPEECH PROCESSING**

L	T	P	C
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OBJECTIVES:

- To introduce speech production and related parameters of speech.
- To illustrate the concepts of speech signal representations and coding.
- To understand different speech modeling procedures such Markov and their implementation issues.
- To gain knowledge about text analysis and speech synthesis.

UNIT I FUNDAMENTALS OF SPEECH PROCESSING 9

Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.

UNIT II SPEECH SIGNAL REPRESENTATIONS AND CODING 9

Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder, CELP, Vocoders.

UNIT III SPEECH RECOGNITION 9

Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.

UNIT IV TEXT ANALYSIS 9

Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation.

UNIT V SPEECH SYNTHESIS 9

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Discuss the speech production system. (K2)

CO2 : Discuss the speech signal representations. (K2)

CO3 : Compare the different speech coding techniques. (K2)

CO4 : Design a speech recognition system. (K2)

CO5 : Explain the different text analysis techniques. (K2)

REFERENCES:

1. Ben Gold and Nelson Morgan, “Speech and Audio Signal Processing, Processing and Perception of Speech and Music”, Wiley-India Edition, 2006.
2. Claudio Becchetti and Lucio Prina Ricotti, “Speech Recognition”, John Wiley and Sons, 1999.
3. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education, 2002.
4. Frederick Jelinek, “Statistical Methods of Speech Recognition”, MIT Press, 1997.
5. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.
6. Steven W. Smith, “The Scientist and Engineer‟s Guide to Digital Signal Processing”, California Technical Publishing, 1997.
7. Thomas F. Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education, 2004.

24CU2E4 **mm WAVE COMMUNICATION**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamentals of Millimeter wave devices and circuits.
- To understand the various components of Millimeter wave Communications system.
- To know the antenna design at Millimeter wave frequencies.

UNIT I INTRODUCTION **9**

Millimeter wave characteristics - millimeter wave wireless, implementation challenges, Radio wave propagation for mm wave: Large scale propagation channel effects, small scale channel effects, Outdoor and Indoor channel models, Emerging applications of millimeter wave communications.

UNIT II mm WAVE DEVICES AND CIRCUITS **9**

Millimeter wave generation and amplification: Peniotrons, Ubitrons, Gyrotrons and Free electron lasers. HEMT, models for mm wave Transistors, transistor configurations, Analog mm wave components: Amplifiers, Mixers, VCO, PLL. Metrics for analog mm wave devices, Consumption factor theory, Trends and architectures for mm wave wireless, ADC's and DAC's.

UNIT III mm WAVE COMMUNICATION SYSTEMS **9**

Modulations for millimeter wave communications: OOK, PSK, FSK, QAM, OFDM, Millimeter wave link budget, Transceiver architecture, Transceiver without mixer, Receiver without Oscillator, Millimeter wave calibration, production and manufacture, Millimeter wave design considerations.

UNIT IV mm WAVE MIMO SYSTEMS **9**

Massive MIMO Communications, Spatial diversity of Antenna Arrays, Multiple Antennas, Multiple Transceivers, Noise coupling in MIMO system, Potential benefits for mm wave systems, Spatial, Temporal and Frequency diversity, Dynamic spatial, frequency and modulation allocation.

UNIT V ANTENNAS FOR mm WAVE SYSTEMS **9**

Antenna beamwidth, polarization, advanced beam steering and beam forming, mm wave design consideration, On-chip and In package mm wave antennas, Techniques to improve gain of on-chip antennas, Implementation for mm wave in adaptive antenna arrays, Device to Device communications over 5G systems, Design techniques of 5G mobile.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the Millimeter wave characteristics and implementation challenges faced. (K2)
CO2 : Explain the Millimeter devices and circuits. (K2)
CO3 : Apply the Modulation techniques for millimeter wave communications. (K3)
CO4 : Discuss about the Millimeter wave MIMO systems. (K2)
CO5 : Design antenna for Millimeter wave frequencies. (K3)

REFERENCES:

1. K.C.Huang and Z.Wang, “Millimeter Wave Communication Systems”, Wiley-IEEE Press, March 2011.
2. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport and Murdock, “Millimeter Wave Wireless Communication”, Prentice Hall, 2014.
3. W.Xiang, K.Zheng and X.S.Shen, “5G Mobile Communications”, Springer, 2016.

24CU2E5 **ANALOG AND MIXED SIGNAL VLSI DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the concepts of MOS large signal model and small signal model.
- To understand the concepts of D/A conversion methods and their architectures.
- To learn filters for ADC.
- To study about the switched capacitor circuits.

UNIT I INTRODUCTION AND BASIC MOS DEVICES 9

Challenges in analog design - Mixed signal layout issues - MOSFET structures and characteristics large signal and small signal model of single stage Amplifier - Source follower - Common gate stage – Cascode Stage – large and small signal analysis of differential amplifier with active load, pole-zero estimation, zero value time constant method, frequency response of CS, cascade and Cascode amplifiers.

UNIT II SUBMICRON CIRCUIT DESIGN 9

Submicron CMOS process flow, Capacitors and resistors, Current mirrors, Digital Circuit Design, Delay Elements – Adders - OP Amp parameters and Design.

UNIT III DATA CONVERTERS 9

Static and dynamic errors in DAC and ADC – Architectures & Characteristics of Sample and Hold Digital to Analog Converters – DAC - R-2R, weighted DAC, multiplying DAC, segmented DAC and sigma delta DAC. ADC – Flash ADC, pipelined ADC, successive approximation ADC, sigma delta ADC.

UNIT IV SNR IN DATA CONVERTERS 9

Overview of SNR of Data Converters - Clock Jitters - Improving Using Averaging – Decimating Filters for ADC - Band pass and High Pass Sinc Filters - Interpolating Filters for DAC.

UNIT V SWITCHED CAPACITOR CIRCUITS 9

Resistors, First order low pass Circuit, Switched capacitor Amplifier, Switched Capacitor Integrator – Design of flip around sample and hold circuit – pipelined ADC.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 **:** Explain the basic MOS devices characteristics & analyze their frequency responses. (K2)

CO2 **:** Design the submicron circuit. (K3)

CO3 **:** Discuss the digital to analog conversion techniques. (K2)

CO4 **:** Describe the analog to digital conversion techniques. (K2)

CO5 **:** Analyze the SNR in Data converters. (K4)

REFERENCES:

1. J.Jacob Wikner, Mikael Gustavsson and Nianxiong Tan, “CMOS Data Converters for Communications”, Springer, 2000.
2. Van de Plassche and J.Rudy, “CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters”, Springer, 2003.

24CU3E1 **ULTRA WIDE BAND COMMUNICATIONS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To give fundamental concepts related to Ultra wide band.
- To understand the channel model and signal processing for UWB.
- To acquire knowledge about UWB antennas and regulations.

UNIT I INTRODUCTION TO UWB 9

History, Definition, FCC Mask, UWB features, Benefits and challenges, UWB Interference: IEEE 802.11.a Interference, Signal to Interference ratio calculation, Interference with other wireless services.

UNIT II UWB TECHNOLOGIES AND CHANNEL MODELS 9

Impulse Radio, Pulsed Multiband, Multiband OFDM, features : Complexity, Power Consumption, Security and achievable data rate. MIMO Multiband OFDM, Differential multiband OFDM, Performance characterization, Ultra Wide Band Wireless Channels.

Channel model: Impulse Response Modeling of UWB Wireless Channels, IEEE UWB channel model, Path loss, Delay profiles, Time and frequency modeling.

UNIT III UWB SIGNAL PROCESSING 9

Data Modulation schemes, UWB Multiple Access Modulation, BER, Rake Receiver, Transmit-Reference (T-R) Technique, UWB Range- Data Rate Performance, UWB Channel Capacity, UWB Wireless Locationing: Position Locationing Methods, Time of Arrival Estimation, NLOS Location Error , Locationing with OFDM.

UNIT IV UWB ANTENNAS 9

Antenna Requirements, Radiation Mechanism of the UWB Antennas, Types of Broad band antennas, Parameters, Analysis of UWB Antennas, Link Budget for UWB System. Design examples of broad band UWB antennas.

UNIT V UWB APPLICATIONS AND REGULATIONS 9

Ultra wideband receiver architecture, Wireless Ad hoc Networking, UWB Wireless Sensor, RFID, Consumer Electronics and Personal, Asset Location, Medical applications, UWB Regulation and standards in various countries, UWB Regulation in ITU, IEEE Standardization.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 **:** Explain the basic concepts of UWB. (K2)

CO2 **:** Describe the basic concepts of UWB technologies. (K2)

CO3 **:** Assess the performance of UWB channels. (K4)

CO4 **:** Apply the UWB signal processing. (K3)

CO5 **:** Design the antenna for UWB applications. (K3)

REFERENCES:

1. Homayoun Nikookar and Ramjee Prasad, “Introduction to Ultra Wideband for Wireless Communications”, First Edition, Springer Science & Business Media, 2010.
2. Thomas Kaiser and Feng Zheng, “Ultra Wideband Systems with MIMO”, First Edition, John Wiley & Sons Ltd., New York, 2010.
3. W.Pam Siriwongpairat and K.J.Ray Liu, “Ultra-Wideband Communications Systems: Multiband OFDM approach”, John Wiley and IEEE press, New York, 2008.
4. Huseyin Arslan, Zhi Ning Chen and Maria-Gabriella Di Benedetto, “Ultra Wideband Wireless communication”, First Edition, Wiley-Interscience, 2006.

24CU3E2 **VLSI FOR WIRELESS COMMUNICATION**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concepts of basic wireless communication concepts.
- To study the parameters in receiver and low noise amplifier design.
- To study the various types of mixers designed for wireless communication.
- To study and design PLL and VCO.
- To understand the concepts of transmitters and power amplifiers in wireless communication.

UNIT I COMMUNICATION CONCEPTS 9

Introduction – Overview of Wireless systems – Standards – Access Methods – Modulation schemes – Classical channel – Wireless channel description – Path loss – Multipath fading –Standard Translation.

UNIT II RECEIVER ARCHITECTURE & LOW NOISE AMPLIFIERS 9

Receiver front end – Filter design – Non-idealities – Design parameters – Noise figure & Input intercept point. LNA Introduction – Wideband LNA design – Narrow band LNA design: Impedance matching & Core amplifier.

UNIT III MIXERS 9

Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion – Noise - A Complete Active Mixer. Switching Mixer – Distortion, Conversion Gain & Noise in Unbalanced Switching Mixer - A Practical Unbalanced Switching Mixer. Sampling Mixer - Conversion Gain, Distortion, Intrinsic & Extrinsic Noise in Single Ended Sampling Mixer.

UNIT IV FREQUENCY SYNTHESIZERS 9

PLL – Phase detector – Dividers – Voltage Controlled Oscillators – LC oscillators – Ring Oscillators – Phase noise – Loop filters & design approaches – A complete synthesizer design example (DECT) – Frequency synthesizer with fractional divider.

UNIT V TRANSMITTER ARCHITECTURES & POWER AMPLIFIERS 9

Transmitter back end design – Quadrature LO generator – Power amplifier design.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the basic wireless communication concepts. (K2)

CO2 : Describe the parameters in receiver and design a low noise amplifier. (K2)

CO3 : Discuss about the design of mixers used in wireless communication. (K2)

CO4 : Explain the PLL and VCO. (K2)

CO5 : Explain the concepts of wireless transmitter architecture in VLSI implementation. (K2)

REFERENCES:

1. Bosco H. Leung, “VLSI for Wireless Communication”, Pearson Education, 2002.
2. B.Razavi, “RF Microelectronics”, Prentice-Hall, 1998.
3. Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw-Hill, 1999.
4. Emad N. Farag and Mohamed I. Elmasry, “Mixed Signal VLSI wireless design – Circuits & Systems”, Kluwer Academic Publishers, 2000.
5. J.Crols and M.Steyaert, “CMOS Wireless Transceiver Design”, Boston, Kluwer Academic Pub., 1997.
6. Thomas H. Lee, “The Design of CMOS Radio – Frequency Integrated Circuits”, Cambridge University Press, 2003.

24CU3E3 **MEMS AND NEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the concepts of Micro Electro Mechanical devices.
- To know the fabrication process of microsystems.
- To know the design concepts of micro sensors and micro actuators.
- To familiarize concepts of Quantum Mechanics and Nano systems.

UNIT I OVERVIEW **9**

New trends in Engineering and Science: Micro and Nanoscale systems, introduction to design of MEMS and NEMS, MEMS and NEMS – applications, devices and structures. Materials for MEMS: Silicon, Silicon compounds, polymers, metals.

UNIT II MEMS FABRICATION TECHNOLOGIES **9**

Microsystem Fabrication Processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin Film Depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching Techniques: Dry and Wet Etching, Electrochemical Etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-Like) Technology; Packaging: Microsystems Packaging, Essential Packaging Technologies, Selection of Packaging Materials.

UNIT III MICRO SENSORS **9**

MEMS Sensors: Design of Acoustic Wave Sensors, Resonant Sensor, Vibratory Gyroscope, Capacitive and Piezo Resistive Pressure Sensors- Engineering Mechanics Behind These Microsensors. Case Study: Piezo-Resistive Pressure Sensor.

UNIT IV MICRO ACTUATORS **9**

Design of Actuators: Actuation Using Thermal Forces, Actuation Using Shape Memory Alloys, Actuation Using Piezoelectric Crystals, Actuation using Electrostatic Forces (Parallel Plate, Torsion Bar, Comb Drive Actuators), Micromechanical Motors and Pumps. Case Study: Comb Drive Actuators.

UNIT V NANOSYSTEMS AND QUANTUM MECHANICS **9**

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave Function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their Quantization, Molecular Wires and Molecular Circuits

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the concepts of MEMS and NEMS. (K2)

CO2 : Describe the MEMS fabrication techniques. (K2)

CO3 : Discuss about the micro sensor applications. (K2)

CO4 : Explain the micro actuator applications. (K2)

CO5 : Analyze the various atomic structures used in nano systems. (K4)

REFERENCES:

1. Chang Liu, “Foundations of MEMS”, Pearson Education India Limited, 2006.
2. Marc Madou, “Fundamentals of Microfabrication”, CRC Press 1997.
3. Stephen D. Senturia, “Micro System Design”, Kluwer Academic Publishers, 2001.
4. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures”, CRC Press, 2002.
5. Tai Ran Hsu, “MEMS and Microsystems Design and Manufacture”, Tata Mcraw Hill, 2002.

24CU3E4 **ADVANCED ANTENNA DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the antenna radiation characteristics and arrays.
- To enhance the student knowledge in the area of various antenna design.
- To enhance the student knowledge in the area of antenna for practical applications.

UNIT I FUNDAMENTAL CONCEPTS 9

Physical concept of radiation, Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

UNIT II THIN LINEAR ANTENNAS AND ARRAYS 9

Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop, N-Element Linear Array, Antenna element spacing without grating lobes, Linear broadside array with non-uniform distributions, Gain of regularly spaced planar arrays with $d = \lambda/2$, Tchebyscheff Array antennas.

UNIT III SECONDARY SOURCES AND APERTURE ANTENNA 9

Magnetic currents, Duality, Images of electric and magnetic currents, electric and magnetic currents as sheet sources, Impressed and induced current sources, Induction and equivalence theorems, Field of a secondary or Huygens source, Radiation from open end of a coaxial line, Radiation through an aperture in conducting screen, slot antenna.

UNIT IV EFFECT OF MUTUAL COUPLING ON ANTENNAS 9

Accounting for mutual effects for dipole array compensation using open-circuit voltages, compensation using the minimum norm formulation, Effect of mutual coupling- constant Jammers, Constant Signal, Compensation of mutual coupling - constant Jammers, Constant Signal, Result of different elevation angle.

UNIT V ADAPTIVE ARRAY CONCEPT 9

Motivation of using Adaptive Arrays, Adaptive Array problem statement, Signal Environment, Array Element Spacing considerations, Array Performance, Concept of optimum Array Processing, Recursive Methods for Adaptive Error Processing.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Discuss about basic antenna parameters. (K2)

CO2 : Explain different types of wire antennas. (K2)

CO3 : Discuss various types of arrays. (K2)

CO4 : Describe the secondary sources and aperture antennas. (K2)

CO5 : Apply the knowledge of mutual coupling on antennas, applications and numerical techniques. (K3)

REFERENCES:

1. C.Balanis, “Antennas”, Third Edition, John Wiley and sons, 2007.
2. Thomas A. Milligan, “Modern Antenna Design”, Second Edition, IEEE press, Wiley Interscience, 2005.
3. David B. Davidson, “Computational Electromagnetics for RF and Microwave Engineering”, Cambridge University Press 2005.
4. Perambur S. Neelakanta and Rajeswari Chatterjee, “Antennas for Information Super Skyways: An Exposition on Outdoor and Indoor Wireless Antennas”, Research Studies Press Ltd., 2004.
5. Godara and Lal Chand, “Smart Antennas”, CRC Press, 2004.
6. Ben A. Munk, “Finite Antenna Arrays and FSS”, John Wiley and Sons, 2003.

24CU3E5 **SOFTWARE DEFINED RADIOS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn various design principles of software defined radio.
- To understand challenges of receiver design.
- To design smart antennas for SDR.

UNIT I INTRODUCTION TO SOFTWARE RADIO CONCEPTS 9

SDR concepts & history, Benefits of SDR, SDR Forum, Ideal SDR architecture, SDR Based End-to-End Communication, Worldwide frequency band plans, Aim and requirements of the SCA. Architecture Overview, Functional View, Networking Overview, Core Framework, Real Time Operating Systems.

UNIT II RADIO FREQUENCY IMPLEMENTATION ISSUES 9

Purpose of RF front – end, Dynamic range, RF receiver front – end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, ADC & DAC distortion, Pre-distortion, Flexible RF systems using micro-electromechanical systems.

UNIT III MULTIRATE SIGNAL PROCESSING IN SDR **9**

Sample rate conversion principles, Polyphase filters, Digital filter banks, Timing recovery in digital receivers using multirate digital filters.

UNIT IV SMART ANTENNAS **9**

Smart antennas, Adaptive techniques, Phased array antennas, Applying SDR principles to antenna systems, Smart antenna architectures, Low Cost SDR Platform, Requirements and system architecture, Convergence between military and commercial systems, The Future For Software Defined Radio.

UNIT V OBJECT ORIENTED REPRESENTATION OF RADIOS AND NETWORK **9**

Networks, Object–oriented programming, Object brokers, Mobile application environments, Joint Tactical radio system. Case Studies in Software Radio Design: SPEAKeasy, JTRS, Wireless Information transfer system, SDR-3000 digital transceiver subsystem, Spectrum Ware, Brief introduction to Cognitive Networking, Processing, Recursive Methods for Adaptive Error Processing.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 **:** Explain the evolving paradigm of Software defined radio and technologies for its implementation. (K2)

CO2 **:** Analyse complex problems critically in the domains of Radio frequency implementation issues. (K4)

CO3 **:** Apply multirate signal processing in SDR. (K3)

CO4 **:** Discuss the smart antenna techniques for better spectrum exploitation for conducting research. (K2)

CO5 **:** Explain the object oriented representations of SDR. (K2)

REFERENCES:

1. Wilbur L. Pritchard, Hendri G. Suyderhoud and Robert A. Nelson, “Satellite Communication Systems Engineering”, Prentice Hall / Pearson, 2007.
2. Timothy Pratt and Charles W.Bostain, “Satellite Communications”, Second Edition, John Wiley and Sons, 2012.
3. D.Roddy, “Satellite Communication”, Fourth Edition, McGraw Hill, 2009.
4. Tri T Ha, “Digital Satellite Communication”, Second Edition, McGraw Hill, 1990.
5. B.N.Agarwal, “Design of Geosynchronous Spacecraft”, Prentice Hall, 1993.
6. Brian Ackroyd, “World Satellite Communication and Earth Station Design”, BSP Professional Books, 1990.

24CU4E1 INTERNET OF THINGS

L	T	P	C
3	0	2	4

OBJECTIVE:

- To understand the architectural overview of IoT.
- To understand the IoT reference architecture and real world design constraints.
- To understand the various IoT levels.
- To understand the basics of cloud architecture.
- To gain experience in Raspberry Pi and experiment simple IoT application on it.

UNIT - I INTRODUCTION **9**

Internet of Things - Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications – Structure of IoT– IoT Map Device - IoT System Management with NETCONF-YANG.

LAB COMPONENT

1. Develop an application for LED Blink and Pattern using arduino or Raspberry Pi. **6**

UNIT - II IoT ARCHITECTURE, GENERATIONS AND PROTOCOLS **9**

IETF architecture for IoT - IoT reference architecture -First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics.

LAB COMPONENT

2. Develop an application for LED Pattern with Push Button Control using arduino or Raspberry Pi. **6**

UNIT - III IoT PROTOCOLS AND TECHNOLOGY **9**

SCADA and RFID Protocols - BACNet Protocol -Zigbee Architecture - 6LowPAN - CoAP -Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module.

LAB COMPONENT

3. Develop an application for LM35 Temperature Sensor to display temperature values usingarduino or Raspberry Pi. **6**

UNIT - IV CLOUD ARCHITECTURE BASICS **9**

The Cloud types; IaaS, PaaS, SaaS.- Development environments for service development; Amazon,Azure, Google Appcloud platform in industry.

LAB COMPONENT

4. Develop an application for Forest fire detection end node using Raspberry Pi device and sensor. **6**

UNIT - V IOT PROJECTS ON RASPBERRY PI **9**

Building IOT with RASPBERRY PI- Creating the sensor project - Preparing Raspberry Pi - Clayster libraries — Hardware Interacting with the hardware - Interfacing the hardware- Internal representationof sensor values - Persisting data - External representation of sensor values - Exporting sensor data.

LAB COMPONENT

5. Develop an application for home intrusion detection web application.
6. Develop an application for Smart parking application using python and Django for webapplication. **6**

TOTAL: 45 + 30 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the various concept of the IoT and their technologies. (K2)

CO2 : Develop the IoT application using different hardware platforms. (K4)

CO3 : Implement the various IoT Protocols. (K3)

CO4 : Describe the power management techniques in IoT. (K2)

CO5 : Analysis the basic principles of cloud computing. (K4)

REFERENCES:

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things: A hands-on approach”, Universities Press, 2015.
2. Dieter Uckelmann, Mark Harrison and Florian Michahelles, “Architecting the Internet of Things”, Springer, 2011.
3. Peter Waher, “Learning Internet of Things”, Packt Publishing, 2015.
4. Ovidiu Vermesan Peter Friess, “Internet of Things – From Research and Innovation to Market Deployment”, River Publishers, 2014.
5. N.Ida, “Sensors, Actuators and Their Interfaces: A Multidisciplinary Introduction”, Second Edition, Scitech Publishers, 2014.

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24CU4E2 RADAR SIGNAL PROCESSING

L	T	P	C
3	0	2	4

OBJECTIVE:

- To understand the Radar Signal acquisition and sampling in multiple domains.
- To provide clear instruction in radar DSP basics.
- To equip the skills needed in both design and analysis of common radar algorithms.
- To understand the basics of synthetic aperture imaging and adaptive array processing.
- To illustrate how theoretical results are derived and applied in practice.

UNIT - I INTRODUCTION TO RADAR SYSTEMS **9**

History and application of radar, basic radar function, elements of pulsed radar,review of signal processing concepts and operations, A preview of basic radar signal processing, radar system components, advanced radar signal processing.

LAB COMPONENT
1. Matched filtering operation.
2. Modeling the Propagation of Radar Signals.

6

UNIT - II SIGNAL MODELS **9**

Components of a radar signal, amplitude models, types of clutters, noise model and signal-to noise ratio, jamming, frequency models: the doppler shift, spatial models, spectral model.

LAB COMPONENT
3. Modeling of radar targets.
4. Density-based algorithm for clustering data.

6

UNIT - III SAMPLING AND QUANTIZATION OF PULSED RADAR SIGNALS **9**

Domains and criteria for sampling radar signals, Sampling in the fast time dimension,Sampling in slow time: selecting the pulse repetition interval, sampling the doppler spectrum, Sampling in the spatial and angle dimension, Quantization, I/Q Imbalance and Digital I/Q.

LAB COMPONENT
5. MTI radar design, target detection in noise.
6. Estimation of bearing angle in noise, clutter modelling.

6

UNIT - IV RADAR WAVEFORMS **9**

Introduction, The waveform matched filter, Matched filtering of moving targets, The ambiguity function, The pulse burst waveform, frequency-modulated pulse compression waveforms, Range sidelobe control for FM waveforms, the stepped frequency waveform, Phase-modulated pulse compression waveforms, COSTAS Frequency Codes.

LAB COMPONENT
7. Frequency modulated radar signal generation.
8. Doppler shift Signal strength.

6

UNIT - V DOPPLER PROCESSING **9**

Alternate forms of the Doppler spectrum, Moving target indication (MTI), Pulse Doppler processing, dwell-to-dwell stagger, Pulse pair processing, additional Doppler processing issues, clutter mapping and the moving target detector, MTI for moving platforms: adaptive displaced phase center antenna processing.

LAB COMPONENT
9. SNR loss measurement in pulse compression.
10. Detection and performance of a radar system.

6

TOTAL: 45 + 30 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the radar signal processing concepts. (K2)

CO2 : Develop the signal models for radars. (K4)

CO3 : Describe the sampling and quantization concepts of pulsed radar signals. (K2)

CO4 : Discuss about the frequency and phase modulated radar waveforms. (K2)

CO5 : Discuss about doppler processing. (K2)

REFERENCES:

1. Michael O. Kolawole, “Radar systems, Peak Detection and Tracking”, Elsevier, 2003.
2. Skolnik, “Introduction to Radar Systems”, Third Edition, McGraw Hill, 2017.
3. Peyton Z. Peebles, “Radar Principles”, Wiley India, 2009.
4. Marvin N. Cohen and Fred E. Nathanson, “Radar Design Principles - Signal Processing and the environment”, Second Edition, PHI, 2006.

24CU4E3	TELECOMMUNICATION SYSTEM MODELING AND SIMULATION	L	T	P	C
		3	0	2	4

OBJECTIVE:

- To enable the student to understand the various aspects of simulation methodology and performance.
- To appreciate the significance of selecting sampling frequency and modeling different types of signals and processing them.
- To expose the student to the different simulation techniques, their pros and cons and enable him to understand and interpret results using case studies.

UNIT - I **SIMULATION METHODOLOGY** **9**

Introduction, Aspects of methodology, Performance Estimation, Simulation sampling frequency, Low pass equivalent simulation models for bandpass signals, Multicarrier signals, Non-linear and time-varying systems, Post processing – Basic graphical techniques and estimations.

LAB COMPONENT

1. Study the spectrum of response of linear and non-linear systems for single tone input.
2. Generation of OFDM (multicarrier) signal and plot the spectrum (RF and Low pass equivalent). **6**

UNIT - II **RANDOM SIGNAL GENERATION & PROCESSING** **9**

Uniform random number generation, Mapping uniform random variables to an arbitrary pdf, Correlated and Uncorrelated Gaussian random number generation, PN sequence generation, Random signal processing, Testing of random number generators.

LAB COMPONENT

3. Generation of uniform / Gaussian random numbers and verification of their probability distribution, autocorrelation and spectrum.
4. Generation of uncorrelated and correlated random processes and verification of cross-correlations. **6**

UNIT - III **MONTE CARLO SIMULATION** **9**

Fundamental concepts, Application to communication systems, Monte Carlo integration, Semi - analytic techniques, Case study: Performance estimation of a wireless system.

LAB COMPONENT

5. Generation of PN sequence and verification of properties and spectrum.
6. Application of Monte Carlo simulation for estimation of BER of a wireless communication link. **6**

UNIT - IV **ADVANCED MODELS & SIMULATION TECHNIQUES** **9**

Modeling and simulation of non-linearities : Types, Memoryless non-linearities, Non-linearities with memory, Modeling and simulation of Time varying systems : Random process models, Tapped delay line model, Modeling and simulation of waveform channels, Discrete memoryless channel models, Markov model for discrete channels with memory.

LAB COMPONENT	7. Study the impact of non-linearity of amplifier on transmitter symbol constellation with the help of Saleh model. 8. Studying the effect of time invariant (slow fading) frequency selecting channel with the help of symbol constellation.	**6**

UNIT - V EFFICIENT SIMULATION TECHNIQUES **9**

Tail extrapolation, pdf estimators, Importance Sampling methods, Case study: Simulation of a Cellular Radio System.

LAB COMPONENT	9. Studying the effect of time variant flat fading (memoryless) channel with the help of symbol constellation.	**6**

TOTAL: 45 + 30 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the different signal generation and processing methods. (K2)

CO2 : Describe the random signal generation. (K2)

CO3 : Discuss about monte Carlo simulation in wireless systems. (K2)

CO4 : Apply the different simulation techniques for designing a communication system and channel. (K3)

CO5 : Analyze the simulation of a cellular radio system. (K4)

REFERENCES:

1. William H. Tranter, K.Sam Shanmugam, Theodore S. Rappaport and Kurt L. Kosbar, “Principles of Communication Systems Simulation”, Pearson Education (Singapore) Pvt. Ltd., 2004.
2. M.C.Jeruchim, P.Balaban and K.Sam Shanmugam, “Simulation of Communication Systems: Modeling, Methodology and Techniques”, Plenum Press, New York, 2001.
3. Averill M. Law and W.David Kelton, “Simulation Modeling and Analysis”, McGraw Hill Inc., 2000.
4. Geoffrey Gorden, “System Simulation”, Second Edition, Prentice Hall of India, 1992.
5. Jerry Banks and John S. Carson, “Discrete Event System Simulation”, Prentice Hall of India, 1984.

24CU4E4 SIGNAL DETECTION AND ESTIMATION

L	T	P	C
3	0	2	4

OBJECTIVE:

- To understand the concepts of detection and estimation.
- To learn the basics of multi-user detection theory
- To understand the theory behind various estimation techniques.
- To understand Wiener filter and Kalman filter in detail.

UNIT - I REVIEW OF PROBABILITY AND STOCHASTIC PROCESS **9**

Conditional Probability, Bayes' Theorem, Random Variables, Conditional Distributions and Densities, moments and distribution of random variables., Stationary Processes Cyclostationary Processes Averages and Ergodicity Autocorrelation Function Power Spectral Density Discrete Time Stochastic Processes, Spatial Stochastic Processes, Random Signals, Relationship of Power Spectral Density and Autocorrelation Function.

LAB COMPONENT 1. Power Spectrum Estimation of a Random Signal. **6**

UNIT - II SINGLE AND MULTIPLE SAMPLE DETECTION **9**

Hypothesis Testing and the MAP Criterion, Bayes Criterion, Minimax Criterion, Neyman-Pearson Criterion, Sequential Detection, The Optimum Digital Detector in Additive Gaussian Noise , Performance of Binary Receivers in AWGN.

LAB COMPONENT 2. Maximum Likelihood Estimation. **6**

UNIT - III FUNDAMENTALS OF ESTIMATION THEORY **9**

Formulation of the General Parameter Estimation Problem, Relationship between Detection and Estimation Theory, Types of Estimation Problems, Properties of Estimators, Bayes estimation, Minimax Estimation, Maximum-Likelihood Estimation, Comparison of Estimators of Parameters.

LAB COMPONENT 3. Design of optimum receiver in AWGN channel. **6**

UNIT - IV WIENER AND KALMAN FILTERS **9**

Orthogonality Principle, Autoregressive Techniques, Discrete Wiener Filter, Continuous Wiener Filter, Generalization of Discrete and Continuous Filter Representations , Linear Least-Squares Methods, Minimum-Variance Weighted Least-Squares Methods, Minimum-Variance, Least Squares, Kalman Algorithm - Computational Considerations, Signal Estimation, Continuous Kalman Filter, Extended Kalman Filter.

LAB COMPONENT 4. Wiener Filter Design **6**

UNIT - V APPLICATIONS **9**

Detector Structures in Non-Gaussian Noise , Examples of Noise Models, Receiver Structures, and Error-Rate Performance, Estimation of Non-Gaussian Noise Parameters Fading Multipath Channel Models, Receiver Structures with Known Channel Parameters, Receiver Structures without Knowledge of Phase, Receiver Structures without Knowledge of Amplitude or Phase, Receiver Structures and Performance with No Channel Knowledge.

LAB COMPONENT 5. Adaptive Filter Design using LMS algorithm.
6. Minimum Variance Estimation. **6**

TOTAL: 45 + 30 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain the importance of probability and stochastic process concepts in detection and estimation. (K2)

CO2 : Design optimum detector and estimator for AWGN channel. (K4)

CO3 : Develop and analyze the various estimators. (K4)

CO4 : Develop and design Wiener and Kalman filters to solve linear estimation problems. (K4)

CO5 : Develop and design novel receiver structures suitable for modern technology. (K4)

REFERENCES:

1. Harry L. Van Trees, “Detection, Estimation and Modulation Theory”, John Wiley and Sons, New York, 2004.
2. Lonnie C. Ludeman, “Random processes: filtering, estimation, and detection”, John Wiley & Sons Inc., 2003.
3. Sergio Verdu “Multi User Detection”, Cambridge University Press, 1998.
4. Steven M. Kay, “Fundamentals of Statistical Processing, Volume I: Estimation Theory”, Prentice Hall Signal Processing Series, Prentice Hall, PTR, NewJersy, 1993.
5. Thomas Schonhoff, “Detection and Estimation Theory”, Prentice Hall, NewJersy, 2007.

24CUOE1 **SATELLITE COMMUNICATION SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of satellite orbits.
- To analyze the geo stationary and non geo stationary orbits.
- To acquire the knowledge about launching procedures.
- To study the satellite system engineering, orbital mechanism and effects.
- To study and analysis of multiplexing and multiple access techniques.
- To study and analysis of earth station antenna and equipment.

UNIT I SATELLITE ORBITS **9**

Kepler's Laws - Newton's law - orbital parameters - orbital perturbations - station keeping - geo-stationary and non geo-stationary orbits - Look Angle Determination - Limits of visibility – eclipse - Sub satellite point - Sun transit outage - Launching Procedures - launch vehicles and propulsion.

UNIT II SPACE SEGMENT **9**

Spacecraft Technology: Structure, Primary power, Attitude and Orbit control - Thermal control and Propulsion - communication Payload and supporting subsystems - Telemetry - Tracking and command - Transponders - The Antenna Subsystem.

UNIT III SATELLITE LINK DESIGN **9**

Basic link analysis - Link budget calculations - Uplink and Downlink of a satellite link - Atmospheric Losses Interference analysis - Rain induced attenuation and interference - Ionospheric characteristics - Effects - Link Design with and without frequency reuse.

UNIT IV SATELLITE ACCESS AND CODING METHODS **9**

Modulation and Multiplexing: Voice, Data, Video - Analog and digital transmission system - Digital video Broadcast - Multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods - compression - encryption.

UNIT V SATELLITE APPLICATIONS **9**

INTELSAT Series: INSAT, VSAT. - Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles - Direct Broadcast satellites (DBS/DTH) - Indian Regional Navigation Satellite System (IRNSS).

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Elaborate the Extended and reusable satellite launching vehicles and launching procedures of satellite systems. (K4)

CO2 : Describe about the satellite space segment with various satellite subsystems. (K2)

CO3 : Illustrate the satellite Link design with uplink, downlink, rain effects and Ionospheric characteristics. (K2)

CO4 : Apply accessing schemes such as TDMA, FDMA and CDMA for satellite communication. (K3)

CO5 : Discuss the LEO, MEO and GEO orbits of satellite and orbital parameters. (K2)

TEXT BOOKS:

1. Dennis Roddy, “Satellite Communication”, Mc Graw Hill International, Fourth Edition, 2006.
2. Timothy Pratt, Charles W. Bostain and Jeremy E. Allnutt, “Satellite Communication”, John Wiley & Sons, Second Edition, 2003.

REFERENCES:

1. Wilbur L. Pritchard, Hendri G. Suyderhoud and Robert A. Nelson, “Satellite Communication Systems Engineering”, Prentice Hall/Pearson, 2007.
2. N.Agarwal, “Design of Geosynchronous Space Craft”, Prentice Hall, 1986.
3. Bruce R. Elbert, “The Satellite Communication Applications”, Hand Book, Artech House Bostan, London, 1997.
4. Tri T. Ha, “Digital Satellite Communication”, McGraw-Hill Communications Series, Second Edition, 1990.
5. M.Richharia, “Satellite Communication Systems: Design Principles”, Mac Millan, 2003.

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24CUOE2 FUNDAMENTALS OF WIRELESS COMMUNICATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the various wireless communication system.
- To understand the design of a cellular system.
- To study the various digital signaling techniques.
- To study the various multipath mitigation techniques.
- To understand the concepts of multiple antenna techniques.

UNIT I WIRELESS CHANNELS 9

Evolution of mobile Radio communication networks – Examples of wireless communication systems - Cellular network components - Setting up a call process - Trends in cellular communications: Second Generation networks – Third Generation networks - fourth generation.

UNIT II CELLULAR CONCEPTS 9

Cellular concept - Frequency reuse - channel assignment – hand off Strategies-practical handoff considerations - interference – co channel interference - adjust channel interference - system capacity - Coverage and capacity improvement.

UNIT III DIGITAL SIGNALLING FOR FADING CHANNELS 9

Linear modulation techniques: binary PSK, DPSK, QPSK - Transmission, detection - Principles of Offset QPSK- π/4 QPSK - Constant Envelop Modulation - Minimum Shift Keying - Gaussian Minimum Shift Keying.

UNIT IV MULTIPATH MITIGATION TECHNIQUES 9

Equalization - Linear and Non-Linear equalization - Adaptive equalization - Zero forcing and LMS Algorithms. Diversity - Micro and Macro diversity - Diversity combining techniques - Rake receiver.

UNIT V MULTIPLE ANTENNA TECHNIQUES 9

MIMO systems - spatial multiplexing - System model - Transmitter Precoding - Beam forming - transmitter diversity - receiver diversity.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Explain cellular network evolutions. (K2)
CO2 : Explain cellular system based concepts. (K2)
CO3 : Identify suitable modulation signaling. (K2)
CO4 : Describe the various diversity techniques to mitigate multipath effect in the wireless channel. (K2)
CO5 : Explain the multiple antenna techniques. (K2)

TEXT BOOKS:

1. T.S.Rappaport, “Wireless communications”, Pearson Education, Second Edition, 2010.
2. Andreas.F. Molisch, “Wireless Communications”, John Wiley India, 2006.

REFERENCES:

1. Andrea Goldsmith, “Wireless Communication”, Cambridge University Press, 2011.
2. R.Van Nee and Ramji Prasad, “OFDM for wireless multimedia communications”, Artech House, 2000.
3. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
4. Upena Dalal, “Wireless Communication”, Oxford University Press, 2009.

24CUOE3 **MULTICORE SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To identify the limitations of ILP and the need for multicore architectures.
- To define fundamental concepts of parallel programming and its design issues.
- To solve the issues related to multiprocessing and suggest solutions.
- To demonstrate the role of OpenMP and programming concept.

UNIT I INTRODUCTION TO MULTI-CORE ARCHITECTURE 9

Introduction to Multi-core Architecture - Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi-core Architectures from Hyper-Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms: Understanding Performance, Amdahl's Law, Growing Returns: Gustafson's Law. System Overview of Threading: Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization.

UNIT II FUNDAMENTAL CONCEPTS OF PARALLEL PROGRAMMING 9

Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Challenges, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion, Other Alternatives. Threading and Parallel Programming Constructs: Synchronization, Critical Sections, Deadlock, Synchronization Primitives, Semaphores, Locks, Condition Variables, Messages, Flow Control-based Concepts, Fence, Barrier, Implementation-dependent Threading Features.

UNIT III DIGITAL SIGNALLING FOR FADING CHANNELS 9

Threading APIs for Microsoft Windows, Win32/MFC Thread APIs, Threading APIs for Microsoft. NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads, Thread Synchronization, Signaling, Compilation and Linking.

UNIT IV OPENMP 9

A Portable Solution for Threading : Challenges in Threading a Loop, Loop-carried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No wait, Interleaving Single-thread and Multi-thread Execution, Data Copy-in and Copy-out, Protecting Updates of Shared Variables, Intel Task queuing Extension to OpenMP, OpenMP Library Functions, OpenMP Environment Variables, Compilation, Debugging, performance.

UNIT V SOLUTIONS TO COMMON PARALLEL PROGRAMMING PROBLEMS 9

Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture, High-level Languages, Avoiding Pipeline Stalls on IA32,Data Organization for High Performance.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Describe multi core architectures and identify their characteristics and performance issues. (K2)
CO2 : Identify the issues in programming Parallel Processors. (K2)
CO3 : Illustrate distributed memory programs using MPI. (K2)
CO4 : Illustrate shared memory programs using OpenMP. (K2)
CO5 : Analyze the parallel program implementation of nBody solvers using OpenMP and MPI programs. (K4)

TEXT BOOKS:

1. Patrick Stakem, “Multicore Computer Architectures”, 4th Edition, PRRB Publishing, 2014.
2. Gerassimos Barlas, "Multicore and GPU Programming: An Integrated Approach Paperback", 1st Edition, Morgan Kaufmann, 2014.

REFERENCES:

1. M.Shyamala Devi, “Multi-Core Architectures and Programming”, Vijay Nicole Imprints, 2018.
2. Peter S. Pacheco, “An Introduction to Parallel Programming”, Morgan-Kauffman / Elsevier, 2011.
3. Darryl Gove, “Multicore Application Programming for Windows, Linux, and Oracle Solaris”, Pearson, 2011.
4. Michael J. Quinn, “Parallel programming in C with MPI and OpenMP, Tata McGraw Hill, 2003.
5. Yan Solihin, "Fundamentals of Parallel Multicore Architecture", 1st Edition, CRC Press/Taylor and Francis, 2015.

24CUOE4 MICROPROCESSOR AND EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide fundamental operating concepts of microprocessors and microcontrollers.
- This course aims to provide students with a solid theoretical basis as well as comprehensive professional understanding of Arduino and Raspberry Pi.

UNIT I MICROPROCESSORS 9

8085-architecture, operation, pin configuration and functions, bus organization, control signal generation for external operations- fetch, IO/M, read/write, machine cycles and bus timings. Addressing mode, instruction set.

UNIT II MICROCONTROLLERS 9

8051-architecture, operation, pin configuration and functions, memory organization, register, I/O ports, addressing modes, instruction sets, instruction classification. Assembly language programming, Interrupts in 8051. Timer/Counter programming for time delay generation and waveform generation.

UNIT III ARDUINO 9

Introduction to the Arduino, creating an Arduino programming Environment, Arduino IDE, creating an Arduino program, Arduino Libraries, Analog and Digital Interfacing, Adding Interrupts, communicating with devices and sensors.

UNIT IV RASPBERRY PI 9

Introduction to the Raspberry Pi, basic functionality of the Raspberry Pi board and its processor, setting and configuring the board, programming on Raspberry Pi, python programming environment, python expressions, general purpose IO pins, Protocol pins, RPi, GPIO library, communicating with devices and sensors.

UNIT V IOT APPLICATION USING ARDUINO AND RASPBERRY PI 9

Arduino - Playing tones and a melody, alphanumeric LCD display, speed and direction control, temperature and humidity sensor interfacing. Raspberry Pi - controlling LED, interfacing an LED and Switch, Interfacing a Light Sensor (LDR), camera interfacing etc.

TOTAL: 45 PERIODS

Course Outcomes (COs):

After completing this course, students should demonstrate competency in the following skills:

CO1 : Distinguish various types of processor architectures. (K2)

CO2 : Describe architecture, memory organization of 8085 and 8051. (K2)

CO3 : Create sketches, libraries and Arduino development environment. (K2)

CO4 : Design Raspberry Pi hardware and implement program. (K2)

CO5 : Develop interfacing between different sensors and Arduino / Raspberry Pi. (K4)

TEXT BOOKS:

1. Ramesh Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, Sixth Edition, Penram International Publishing, 2013.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi and Rolin Mc Kinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson Education, 2011.

REFERENCES:

1. Michael Margolis, “Arduino Cookbook”, O’Reilly Media Inc., 2011.
2. John Baichtal, “Arduino for Beginners: Essential Skills Every Maker Needs”, Person Education Inc., 2013.
3. Eben Upton and Gareth Halfacree, “Raspberry Pi User Guide”, 4th Edition, John Wiley & Sons, 2016.
4. Simon Monk, “Programming with Raspberry Pi: Getting Started with Python”, McGraw Hill Professional, 2012.

24AC101 **ENGLISH FOR RESEARCH PAPER WRITING**

L	T	P	C
2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title
- Ensure the good quality of paper at very first-time submission

UNIT I	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.	**4**
UNIT II	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts and Introduction.	**4**
UNIT III	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	**4**
UNIT IV	Key skills are needed when writing a Title, Key skills are needed when writing an Abstract, Key skills are needed when writing an Introduction, Skills needed when writing a Review of the Literature.	**4**
UNIT V	Skills are needed when writing the Methods, Skills needed when writing the Results, Skills are needed when writing the Discussion, Skills are needed when writing the Conclusions.	**4**
UNIT VI	Useful phrases, How to ensure paper is as good as it could possibly be the first-time submission.	**4**

TOTAL: 24 PERIODS

REFERENCES:

1. Robert Goldbort, “Writing for Science”, Yale University Press, 2006.
2. Robert A Day and Barbara Gastel, “How to Write and Publish a Scientific Paper”, Seventh Edition, Greenwood Press, 2011.
3. Nicholas J Higham, “Handbook of Writing for the Mathematical Sciences”, Society for Industrial and Applied Mathematics, 1998.
4. Adrian Wallwork, “English for Writing Research Papers”, Springer, 2011.

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24AC102 **DISASTER MANAGEMENT**

L	T	P	C
2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

UNIT I	**Disaster:** Definition, Factors and Significance, Difference between Hazard and Disaster. **Natural and Manmade Disasters:** Difference, Nature, Types and Magnitude.	**4**
UNIT II	**Repercussions of Disasters and Hazards:** Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. **Natural Disasters:** Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches. **Man-made Disaster:** Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.	**4**
UNIT III	**Disaster Prone areas in India:** Study of Seismic Zones, Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.	**4**
UNIT IV	**Disaster Preparedness and Management Preparedness:** Monitoring of Phenomena Triggering a Disaster or Hazard. **Evaluation of Risk:** Application of Remote Sensing, Data from Meteorological and other Agencies. **Media Reports:** Governmental and Community Preparedness.	**4**
UNIT V	**Risk Assessment Disaster Risk:** Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.	**4**
UNIT VI	Disaster Mitigation Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.	**4**

TOTAL: 24 PERIODS

REFERENCES:

1. Nishith Rai and A.K.Singh, “Disaster Management in India: Perspectives, Issues and Strategies”, New Royal Book Company, 2007.
2. Pardeep Sahni, Alka Dhameja and Uma Medury, “Disaster Mitigation: Experiences and Reflections”, Prentice Hall India Learning Private Limited, 2001.
3. S.L.Goel, “Disaster Administration and Management: Text and Case Studies”, Deep & Deep Publication Pvt. Ltd., 2007.

24AC103 **SANSKRIT FOR TECHNICAL KNOWLEDGE**

L	T	P	C
2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Get a working knowledge in illustrious Sanskrit, the scientific language in the world.
- Learning of Sanskrit to improve brain functioning.
- Learning of Sanskrit to develop the logic in mathematics, science and other subjects enhancing the memory power.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

UNIT I	➢ Alphabets in Sanskrit ➢ Past/Present/Future Tense ➢ Simple Sentences	**8**
UNIT II	➢ Order ➢ Introduction of roots ➢ Technical information about Sanskrit Literature	**8**
UNIT III	Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	**8**

TOTAL: 24 PERIODS

REFERENCES:

1. H.R.Vishwas and Samskrita Bharati, “Abhyâsapustakam”, Samskrita-Bharti Publication, New Delhi.
2. Vempati Kutumba Shastri, “Teach Yourself Sanskrit: Prathama Diksha (Sanskrit)”, Rashtriya Sanskrit Samsthana, Delhi, 2012.
3. Suresh Soni, “Indias Glorious Scientific Tradition”, Prabhat Prakashan, 2006.

24AC104 **VALUE EDUCATION**

L	T	P	C
2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Understand the value of education and self-development.
- Imbibe good values in students.
- Know about the importance of character.
- Learn the importance of Human values.
- Developing the overall personality.

UNIT I **6**

- Values and self-development – Social values and individual attitudes.
- Work ethics, Indian vision of humanism.
- Moral and non-moral Valuation.
- Standards and Principles.
- Value judgements.

UNIT II **6**

- Importance of cultivation of values.
- Sense of duty.
- Devotion, Self-reliance.
- Confidence, Concentration.
- Truthfulness, Cleanliness.
- Honesty, Humanity.
- Power of faith, National Unity.
- Patriotism.
- Love for nature, Discipline.

UNIT III **6**

- Personality and Behaviour Development - Soul and Scientific attitude.
- Positive Thinking.
- Integrity and Discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of Labour.
- Universal brotherhood and religious tolerance.
- True Friendship.
- Happiness vs. Suffering, Love for Truth.
- Aware of Self-Destructive habits.
- Association and Cooperation.
- Doing best for saving nature.

UNIT IV	➢ Character and Competence – Holy books vs. Blind faith. ➢ Self-Management and Good health. ➢ Science of reincarnation. ➢ Equality, Non-violence, Humility, Role of Women. ➢ All religions and same message. ➢ Mind your Mind, Self-control. ➢ Honesty, Studying effectively.	**6**

TOTAL: 24 PERIODS

REFERENCES:

1. S.K.Chakraborty, “Values of Ethics for Organization: Theory and Practice”, Oxford University Press, 1999.

24AC105 **CONSTITUTION OF INDIA**

L	T	P	C
2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- Address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I **History of Making of the Indian Constitution:** History, Drafting Committee (Composition and Working) **4**

UNIT II **Philosophy of the Indian Constitution:** Preamble, Salient Features **4**

UNIT III **Contours of Constitutional Rights and Duties:** **4**

- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties

UNIT IV **Organs of Governance:** **4**

- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

UNIT V Local Administration: **4**

- District's Administration head: Role and Importance
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation
- Pachayati raj: Introduction
- PRI: Zila Pachayat
- Elected officials and their roles
- CEO Zila Pachayat: Position and role
- Block level: Organizational Hierarchy (Different departments)
- Village level: Role of Elected and Appointed officials
- Importance of grass root democracy

UNIT VI Election Commission: **4**

- Election Commission: Role and Functioning
- Chief Election Commissioner and Election Commissioners
- State Election Commission: Role and Functioning
- Institute and Bodies for the welfare of SC/ST/OBC and women

TOTAL: 24 PERIODS

REFERENCES:

1. The Constitution of India, January 1950 (Bare Act), Gazette of **India**.
2. S.N.Busi, "Dr. B.R. Ambedkar Framing of Indian Constitution", Vol. 1 to 6, First Edition, 2016.
3. M.P.Jain, Justice Jasti Chelameswar and Justice Dama Seshadri Naidu, "Indian Constitution Law", Lexis Nexis, 2018.
4. D.D.Basu, "Introduction to the Constitution of India", Lexis Nexis, 2011.

24AC106 **PEDAGOGY STUDIES**

L	T	P	C
2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the Department for International Development (DFID), other agencies and researchers.
- Identify critical evidence gaps to guide the development.
- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT I **Introduction and Methodology:** **5**

- Aims and rationale, Policy background, Conceptual framework and terminology.
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions.
- Overview of methodology and Searching.

UNIT II **Thematic Overview:** **4**

- Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

UNIT III **Evidence on the effectiveness of pedagogical practices:** **5**

- Methodology for the in depth stage: Quality assessment of included studies.
- How can teacher education (Curriculum and Practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV **Professional Development:** **5**

- Alignment with classroom practices and follow-up support.
- Peer support.
- Support from the head teacher and the community.
- Curriculum and Assessment.
- Barriers to learning: Limited resources and large class sizes.

UNIT V **Research gaps and future directions:** **5**

- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact

TOTAL: 24 PERIODS

REFERENCES:

1. Jim Ackers and Frank Hardman, “Classroom Interaction in Kenyan Primary Schools”, Compare, Vol. 31, No. 2, 2001. pp. 245-261.
2. Mamta Agrawal, “Curricular reform in schools: The importance of evaluation”, Journal of Curriculum Studies, Vol. 36, No. 3, 2004. pp. 361-379.
3. Kwame Akyeampong, “Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER), Country Report One, London, DFID, March 2003.
4. Kwame Akyeampong, Kattie Lussier, John Pryor and Jo Westbrook, “Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?”, International Journal of Educational Development, Vol. 33, No. 3, 2013. pp. 272‑282.
5. Robin J Alexander, “Culture and Pedagogy: International Comparisons in Primary Education”, Wiley-Blackwell, 2001.
6. www.pratham.org/images/resource%20working%20paper%202.pdf.

24AC107 **STRESS MANAGEMENT BY YOGA**

L	T	P	C
2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Achieve overall health of body and mind
- Overcome stress
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT I **Ashtanga:** **8**

Definitions of Eight parts of yoga.

UNIT II **Yam and Niyam:** Do and Not Do in life **8**

- Ahinsa, Satya, Astheya, Bramhacharya and Aparigraha
- Shaucha, Santosh, Tapa, Swadhyay, Ishwarpranidhan

UNIT III **Asan and Pranayam:** **8**

- Various yoga poses and their benefits for mind and body
- Regularization of breathing techniques and its effects - Types of Pranayam

TOTAL: 24 PERIODS

REFERENCES:

1. "Yogic Asanas for Group Training - Part-I", Janardan Swami Yogabhyasi Mandal, Nagpur.
2. Swami Vivekananda, "Raja-Yoga or Conquering the Internal Nature", Vedanta Press, 1998.

24AC108 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L	T	P	C
2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Learn to achieve the highest goal happily
- Become a person with stable mind, pleasing personality and determination
- Awaken wisdom in students
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students.

UNIT I Neetisatakam - Holistic development of personality: 8

- Verses - 19, 20, 21, 22 (Wisdom)
- Verses - 29, 31, 32 (Pride and Heroism)
- Verses - 26, 28, 63, 65 (Virtue)
- Verses - 52, 53, 59 (Dont's)
- Verses - 71, 73, 75, 78 (Do's)

UNIT II Approach to day-to-day work and duties: Shrimad Bhagwad Geeta 8

- Chapter 2 - Verses - 41, 47, 48
- Chapter 3 - Verses - 13, 21, 27, 35
- Chapter 6 - Verses - 5, 13, 17, 23, 35
- Chapter 18 – Verses - 45, 46, 48

UNIT III Statements of basic knowledge: Shrimad Bhagwad Geeta 8

- Chapter 2 - Verses - 56, 62, 68
- Chapter 12 - Verses - 13, 14, 15, 16, 17, 18

Personality of role model: Shrimad Bhagwad Geeta

- Chapter 2 - Verses – 17
- Chapter 3 - Verses - 36, 37, 42
- Chapter 4 - Verses - 18, 38, 39
- Chapter 18 - Verses - 37, 38, 63

TOTAL: 24 PERIODS

REFERENCES:

1. Swami Swarupananda, "Srimad Bhagavad Gita", by Advaita Ashram, Kolkata.
2. Pt. Gopinath, "Three Satakam of Bharatrhari (Niti, Srngara, Vairagya)", Rashtriya Sanskrit Sansthan, 2010.

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