MEERUT INSTITUTE OF ENGINEERING & TECHNOLOGY, MEERUT

Evaluation Scheme

(Effective from 2025-26)

M. Tech

Electronics & Communication Engineering

Affiliated to

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW

Department of Electronics & Communication Engineering

M. Tech ECE Semester-wise Credit Distribution

Semester	I	II	III	IV
Credits for Courses	23	23	16	19
	Total Credit = 81			

MEERUT INSTITUTE OF ENGINEERING & TECHNOLOGY, MEERUT

Department of Electronics & Communication Engineering

M.Tech Ist Semester (Evaluation Scheme)

Sl. No.	Subject code	Subject	Types of Subject	Category	Periods			Mid Semester Examination				End Semester Examination		Total	Credit
					L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	MMEC101	Applied Mathematics	Theory	AS	4	0	0	20	10	30		70	-	100	4
2	MMEC102	Advanced Digital Communication	Theory	Core	4	0	0	20	10	30		70	-	100	4
3	MMEC103	Modern Antenna Theory and Design	Theory	Core	4	0	0	20	10	30		70	-	100	4
4	MMEC104	Advanced Optical Communication	Theory	Core	4	0	0	20	10	30		70	-	100	4
5	MMRM101	Research Methodology	Theory	Mutidisciplinary	3	0	0	20	10	30		70	-	100	3
6	MMEC151	Advanced Optical Communication Lab	Practical	Core	0	0	2	-	-	-	50		50	100	1
7	MMEC152	Advanced Digital Communication Lab	Practical	Core	0	0	2	-	-	-	50		50	100	1
8	MMAE101	Soft Skill (Verbal & PDP)	Skill Enhancement	#SE	2	0	0			50				50	1
9	MMEC153	Antenna Design Lab	Practical	Core	0	0	2	-	-	-	50		50	100	1
				Total	**21**	**0**	**4**					**Total**		**850**	**23**

AS Applied science CT Class Test TE Theory External

SE Skill Enhancement TA Teacher Assessment PS Practical Sessional

No pen paper test TS Theory Sessional PE Practical External

MEERUT INSTITUTE OF ENGINEERING & TECHNOLOGY, MEERUT																
Department of Electronics & Communication Engineering																
M.Tech 2nd Semester (Evaluation Scheme)																
Sl.	**Subject code**	**Subject**	**Types of Subject**	**Category**	**Periods**			**Mid Semester Examination**				**End Semester Examination**		**Total**	**Credit**
No.					**L**	**T**	**P**	**CT**	**TA**	**TOTAL**	**PS**	**TE**	**PE**		
1	MMEC201	Advanced Digital Signal Processing	Theory	Core	4	0	0	20	10	30		70	-	100	4
2	MMEC202	Low Power VLSI Design	Theory	Core	4	0	0	20	10	30		70	-	100	4
3	MMEC203	Internet of Things	Theory	Core	4	0	0	20	10	30		70	-	100	4
4	MMEC204	Advanced Satellite Communication	Theory	Core	4	0	0	20	10	30		70	-	100	4
5	MMEC205	Advanced Wireless Network	Theory	Core	4	0	0	20	10	30		70	-	100	4
6	MMEC251	VLSI Lab	Practical	Core	0	0	2	-	-	-	50		50	100	1
7	MMEC252	Seminar I	Practical	Core	0	0	2	-	-	-	50		-	50	1
8	MMAEA202/ MMAEB202/ MMAEC202/ MMAED202	Launguage Profiency (German/Spanish/Franch/ Russian)	Ability Enhancement Course	#AEC	2	0	0			50				50	1
9	MMNC101/ 201	Envirnomental studies	Non Credit	NC	2	0	0	20	10	30		70		100	0
				Total	**24**	**0**	**4**							**800**	**23**

AEC	Ability Enhancement Course	CT	Class Test	TE	Theory External
SE	Skill Enhancement	TA	Teacher Assessment	PS	Practical Sessional
# No pen paper test		TS	Theory Sessional	PE	Practical External

MEERUT INSTITUTE OF ENGINEERING & TECHNOLOGY, MEERUT

Department of Electronics & Communication Engineering

M.Tech 3rd Semester (Evaluation Scheme)

Sl. No.	Subject code	Subject	Types of Subject	Category	Periods			Mid Semester Examination				End Semester Examination		Total	Credit
					L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	MMEC351	Seminar II	Practical	Core	0	0	2				50			50	1
2	MMEC352	Dissertation	Practical	Core	0	0	28				200		300	500	14
3	MMAE301	Quantitative Ability and Logical Reasoning	Ability Enhancement Course	#AEC	2	0	0			50				50	1
4	MMVA301	Disaster Managment	Value Added	#VA	2	0	0	20	10	30		70		100	0
				Total	**4**	**0**	**30**							**700**	**16**

AEC Ability Enhancement Course
No pen paper test

CT Class Test
TA Teacher Assessment
TS Theory Sessional

TE Theory External
PS Practical Sessional
PE Practical External

MEERUT INSTITUTE OF ENGINEERING & TECHNOLOGY, MEERUT

Department oF Electronics & Communication Engineering

M.Tech 4th Semester (Evaluation Scheme)

Sl. No.	Subject code	Subject	Types of Subject	Category	Periods			Mid Semester Examination				End Semester Examination		Total	Credit
					L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	MMEC451	Dissertation	Practical	Core	0	0	36				200		400	600	18
2	MMAE401	Design Thinking and Innovation	Ability Enhancement Course	#AEC	2	0	0			50				50	1
				Total	**2**	**0**	**36**							**650**	**19**

AEC Ability Enhancement Course

No pen paper test

CT Class Test

TA Teacher Assessment

TS Theory Sessional

TE Theory External

PS Practical Sessional

PE Practical External

Overall Total Marks **3000**

Overall Credit **81**

Subject Code: MMEC101	Subject Name Applied Mathematics	L T P : 4 0 0	Credits: 4

The students will be able to		Blooms Taxonomy
CO-1	Understand the fundamental concepts of vector spaces, subspaces, bases, and dimension.	K2
CO-2	Understand the definition and types of random variables, including discrete and continuous random variables.	K2
CO-3	Apply the concept of two-dimensional random variables and their joint distributions in different problems	K3
CO-4	Make use of numerical methods for solving systems of linear equations, including LU decomposition, and iterative methods.	K3
CO-5	Solve linear programming problems using graphical methods, the Simplex method, and duality theory.	K3

UNIT-1(Linear Algebra) (8)

Vector Spaces, Subspaces, Bases and Dimensions and related theorems. Linear Transforms, Isomorphism, Homomorphism, Matrix representations, Linear Functional, The Double Dual.

UNIT-2(Concept of Random Variables) (8)

Introduction, Distribution and Density function, Specific Random Variables, Conditional Distributions, Asymptotic Approximations for Binomial random variable, The Distributions, Meanand Variance, Moments generating functions.

UNIT-3(Two Dimensional Random Variables) (8)

Bivariate Distributions, One function of two random variables, Two function of two randomvariables, Joint Moments, Joint Characteristic Functions, Conditional Distributions, ConditionalExpected Values, Sequence of Random Variables.

UNIT-4(Numerical Techniques) (8)

Solution of algebraic and transcendental equation using Bisection, Regular-Falsi and Newton-Raphson's method, Numerical solution to linear system, LU factoring decomposition, Cholesky method, GuassSeidal method, Numerical eigen value problem, Jacobi, Givens method.

UNIT-5(Optimization Technique) (8)

Linear and Non Linear Programming, Simplex Algorithm- Two Phase and Big M techniques, Duality theory- Dual Simplex method, Non Linear problems,Lagrange's multiplier method, Kuhn- Tucker conditions and solutions.

Text Books:

1.Sneddon, I.N.,Elements of Partial differential equations, Dover Publications, 2006.

2.Papoulis,A. and Pillai,S.U., Probability Random Variables and Stochastic Processes, TataMcGraw Hill Latest Edition, New Delhi, 1991.

3.Ibe.O.C., Fundamentals of Applied Probability and Random Processes, Elsevier, 2014.

Reference Books:-

1.Joe D. H.,Numerical Methods for Engineers & Scientists, 1992.
2.Peebles. P.Z., Probability Random Variables and Random Signal Principles, Tata Mc GrawHill,Latest Edition, New Delhi, 2017.
3.Rao, S. S.-Optimisation Theory and Application, Wiley Eastern Ltd., New Delhi, 1984.

Subject Code: MMEC102	Advanced Digital Communication	L T P: 4 0 0	Credits: 4

The students will be able to		Blooms Taxonomy
CO-1	Understand and explain the fundamental concepts of the digital communication system.	K2
CO-2	Apply memoryless modulation methods and the spectral characteristics of digitally modulated signals.	K3
CO-3	Apply optimum receiver techniques and signal parameter estimation methods in AWGN channels.	K3
CO-4	Apply detection and equalization techniques in band-limited channels with ISI and AWGN.	K3
CO-5	Analyze OFDM modulation and demodulation techniques and assess IFFT/FFT algorithms in multicarrier communications.	K4

UNIT-1 **(8)**

Introduction to Digital Communication Systems: Basic elements of a digital communication system, mathematical models of communication channels, and channel characteristics (AWGN, fading, and distortion). Representation of bandpass signals, signal space representations, system models for modulation and detection.

UNIT-2 **(8)**

Digital Modulation Techniques: Representation of digitally modulated signals, including Pulse Amplitude Modulation (PAM), Phase Modulation (PM), and Quadrature Amplitude Modulation (QAM). Introduction to multi-dimensional signalling, spectral characteristics of modulation schemes, and their impact on bandwidth and error performance.

UNIT-3 **(8)**

Receiver Design and Channel Estimation: Optimum receiver design for AWGN and multipath channels. Performance analysis of receivers for memoryless modulation and Continuous Phase Modulation (CPM). Signal parameter estimation techniques: carrier phase, symbol timing, and joint estimation, with an emphasis on Maximum Likelihood (ML) estimators and their performance characteristics.

UNIT-4 **(8)**

Detection Systems and Equalization Techniques: Channel characterization for band-limited channels and ISI. Error probability analysis for detection of Pulse Amplitude Modulation (PAM) and modulation codes for spectrum shaping. Design of optimum receivers for ISI and AWGN channels, linear and decision feedback equalization, reduced complexity Maximum Likelihood (ML) detectors, and turbo equalization.

UNIT-5 **(8)**

Multicarrier Modulation and OFDM Systems: Overview of multicarrier communications and Orthogonal Frequency Division Multiplexing (OFDM). Modulation and demodulation techniques, including the IFFT/FFT algorithms for OFDM systems. Challenges of peak-to-average power ratio (PAPR) and techniques to mitigate it.

Text Books:

1. G. PROAKIS, Digital communications, MGH, 2001, 4th edition.
2. Upamanyu Madhow, Fundamentals of Digital Communication, Cambridge University Press, 2008
3. Lathi, B.P. and Ding, Z., "Modern Digital and Analog Communication Systems", Intl. 4th Ed., Oxford University Press.

Reference Books:-

1. Michael Rice, Digital Communications: A Discrete-Time Approach, Prentice Hall, 2008.
2. James L. Melsa and David L. Cohn, Decision and Estimation Theory, McGraw-Hill Inc. Melsa & Cohn

Subject Code:	Subject Name	L T P :	Credits: 4
MMEC103	Modern Antenna Theory and Design	**4 0 0**	

The students will be able to		**Blooms Taxonomy**
CO1	Demonstrate the fundamentals of antenna theory	K2
CO2	Demonstrate the different types of antennas	K2
CO3	Apply the concepts of aperture antennas.	K3
CO4	Apply the concepts of horn, reflector and microstrip antenna.	K3
CO5	Analyze the performance of special applications antennas and antenna arrays.	K4

UNIT-1 Fundamental Concepts: (8 Hours)

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-2 Radiation from Wires and Loops: (8 Hours)

Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

UNIT-3 (8 Hours)

Aperture Antennas: Huygens'principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Fourier transform method in aperture antenna theory.

UNIT-4 (10 Hours)

Horn and Reflector Antennas: Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and Cassegrain antennas.

Microstrip Antennas: Basic characteristics, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

UNIT-5 (8 Hours)

Antenna Arrays: Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, and synthesis of antenna arrays using Schelkunoff polynomial method.

Antenna for Special Applications: Sleeve Antenna, Turnstile Antenna, Antenna design consideration for satellite communication.

Text Books:

1. Antennas and Wave Propagation by John D Kraus [et.al] [TMH]
2. Antenna Theory: Analysis and Design by C.A. Balanis [John Wiley & Sons]
3. Antennas for All Applications by J.D. Kraus [et.al] [McGraw Hill Inc]

Reference Books:-

1. Microstrip Antenna Design Hand Book by R. Garg, Prakash Bhatia, InderBahl [Artech House Publisher]
2. Broadband planner Antennas: Design and Applications by Z.N. Chen & MYW Chia [John Wiley & Sons]
3. Microstrip Patch Antenna by Kai Fong Lee &Kwai Man Luk [Imperial College Press]

Subject Code: MMEC104	Subject Name: Advanced Optical Communication	L T P : 4 0 0	Credits: 4

The students will be able to		Blooms Taxonomy
CO-1	Understand optical fiber types, waveguide theory, and modulation.	K2
CO-2	Illustrate the characteristics of optical fiber communication.	K3
CO-3	Apply WDM, TDM, CDM, and advanced multiplexing techniques.	K3
CO-4	Identify and explain optical components like couplers, transmitters, and detectors.	K3
CO-5	Explore power coupling and modern optical networks like SONET and soliton systems.	K3

UNIT-1 **(8)**

Introduction to optical communication systems. Signal Propagation in Optical Fibre, optical fibre principle, classification of fibres, fibre modes and related definitions, Modulation and demodulation schemes, Optical fibre as a waveguide and different waveguide equations.

UNIT-2 **(8)**

Attenuation and Dispersion: Loss and band width windows, various losses in optical fibres, Various dispersion effects in fiber. Fiber Non-Linear effects, Effective length and area, SBS and SRS effects, self-phase modulation, Semiconductor optical amplifiers: EDFA and Raman amplifiers.

UNIT-3 **(8)**

Multichannel systems: WDM lightwave systems. TDM and code division multiplexing. Advances in wavelength division multiplexing / demultiplexing technologies. Multiple Access Schemes in Optical Communication Systems.

UNIT-4 **(8)**

Optical Components: Couplers, isolators, multiplexers and filters, optical amplifiers, wavelength converters, optical Transmitters and Detectors, LEDs, lasers, Tunable lasers, photo detectors, switch.

UNIT-5 **(8)**

Power Launching and Coupling: Source to fibre power launching, LED coupling to fibres. SONET/SDH, ATM, IP, storage area networks. Wavelength routed networks. Next generation optical Internets. Soliton based High speed communication.

Text Books:

1. Gerd Keiser, "Optical Fiber Communication", Tata McGraw Hill, 3rd Edition, 2000.
2. G.P.Agrawal, Fiber Optic Communication Systems, Wiley, 3rd Edition
3. R.Ramaswami, K.N. Sivarajan, Optical Networks, Elsevier

Reference Books:-

1. B.P.Pal , Guided Wave Optical Components and Devices, Elsevier
2. John M. Senior, "Optical Communication", PHI
3. G.P.Agrawal, Non linear Fiber Optics, (4/e), Elsevier

Subject Code: MMRM101	Research Methodology	L T P : 3 0 0	Credits: 3

The students will be able to		Blooms Taxonomy
CO-1	Explain the Fundamentals of the different types of Research.	K2
CO-2	Apply a relevant research design technique.	K3
CO-3	Use an appropriate data collection technique.	K3
CO-4	Illustrate Data Analysis and Interpretation	K3
CO-5	Prepare research report and publish ethically.	K3

UNIT-1 Introduction to Research and Problem Definition (8 Hours)

Meaning, Objective,motivation and importance of research, Types of research, steps involve d in research, defining research problem.

UNIT-2 Research Design (8 Hours)

Concept and Importance in Research, Features of a good research design, Exploratory Research Design concept, types and uses, Methods of research design, research process and steps involved, Literature Survey

UNIT-3 Data Collection (8 Hours)

Primary and Secondary Data; Primary and Secondary Data Sources; Data Collection Methods, Data Processing, Classification of Data, Sampling, Sampling techniques, procedure and methods, Ethical considerations in research

UNIT-4 Data Analysis and Interpretation (8 Hours)

Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypoth esis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Inter pretation of results

UNIT-5 Technical Writing and reporting of research (8 Hours)

Types of research report: Dissertation and Thesis, research paper, review article, short comm unication, conference presentation etc., Referencing and referencing styles, Research Journals , Indexing and citation of Journals, Intellectual property, Plagiarism

Text Books:

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques , New Age I nternational publishers, Third Edition.
2. Ranjit Kumar, Research Methodology: A Step-by
Step Guide for Beginners, 2nd Edition, SAGE, 2005
3. Business Research Methods-Donald Cooper & Pamela Schindler, TMGH, 9th edition
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approac hes. Sage publications, 2013.

Subject Code: MMEC151	Advanced Optical Communication Lab	L T P : 0 0 2	Credits: 1

The students will be able to		Blooms Taxonomy
CO1	Solve the concept of optical fiber link establishment.	K3
CO2	Measure losses and optical fiber parameters.	K3
CO3	Illustrate the characteristics of communication channels.	K3

List of Experiments

Minimum Ten experiment of the following:

1 .Measurement of Numerical Aperture

2. Study of setting up an analog link using optical fiber.

3. Study of setting up digital link using optical fiber

4 Measurement of attenuation & bending loss in the optical fiber cable.

5. Measurement of propagation loss in the optical fiber cable

6. Study of Frequency modulation and demodulation using Optical fiber.

7. Study of Pulse width modulation and demodulation technique using Optical fiber

8. Study of I-V Characteristics of Fiber optic LED and Photodetector.

9. Measurement of attenuation & bending loss in the optical fiber cable.

10. Measurement of propagation loss in the optical fiber cable.

11. Study of Conventional Encoder and Decoder

Subject Code: MMEC152	Advanced Digital Communication Lab	L T P : 0 0 2	Credits: 1

The students will be able to		Blooms Taxonomy
CO1	Analysis the concepts of digital communication techniques using MATLAB.	K4
CO2	Modelling and Analysis of Spread Spectrum Technology.	K4
CO3	Investigation and Implementation of various codes using MATLAB	K4

List of Experiments

Minimum Ten experiments of the following:

1. Implementation of sampling theorem using MATLAB.
2. Analysis of Amplitude Shift Keying using MATLAB.
3. Analysis of Frequency Shift Keying using MATLAB.
4. Analysis of Phase Shift Keying using MATLAB.
5. Study and Analysis of Direct Sequence Spread Spectrum System using MATLAB.
6. Study and Analysis of Frequency Hopped Spread Spectrum System using MATLAB.
7. Analysis of Pulse Code Modulation and Demodulation Technique using MATLAB.
8. Implementation of Eye Pattern using MATLAB.
9. Study and Implementation of Linear Block Codes using MATLAB.
10. Study and Implementation of Cyclic Codes using MATLAB.
11. Study and Implementation of Convolution Codes using MATLAB.

Subject Code: MMAE 101	**Subject Name:** Soft Skills (Verbal & PDP)	L T P : 2 0 0	Credits: 1

The students will be able to		Blooms Taxonomy
CO-1	Understand the concept of sentence formation and usefulness of enriched vocabulary.	K2
CO-2	Enhance the listening and comprehending skills.	K2
CO-3	Apply the reading and writing skills to prepare clear and well-structured official and business documents.	K3
CO-4	Build the skills necessary to deliver impactful presentations.	K3
CO-5	Build necessary work-place skills to be a successful professional.	K3

UNIT-1 Applied Grammar and Usage: (5 Hours)
Types of Sentences: Simple, Compound and Complex, Subject-verb agreement, Advanced Vocabulary: Antonyms, Synonyms, Use of jargons.

UNIT-2 Listening and Speaking Skills (5 Hours)
Listening : Stages and Art of Listening, Traits of a Good Listener, Interpersonal communication skills: Emotional Intelligence, Decision Making, Negotiation and Persuasion.

UNIT-3 Reading and Writing Skills: (5 Hours)
Reading style: Skimming; Scanning; Churning & Assimilation, Effective writing tools; Report writing; CV and Resume-writing.

UNIT-4 Presentation and Interaction Skills (5 Hours)
Oral Presentation, Personal Interaction :Introducing Oneself- one's career goals, Activity: SWOT Analysis, Group Discussion: Non verbal Communication; Interview Skills: Preparation and Performance.

UNIT-5 Work- place skills: (5 Hours)
Leadership qualities; Problem Solving & Conflict Resolution : Case Analysis of a Challenging Scenario Stress Managing Techniques.

Text Books:

1. Bhatnagar Nitin and Mamta Bhatnagar, Communicative English For Engineers And Professionals, 2010, Dorling Kindersley (India) Pvt. Ltd.
2. Butterfield, Jeff., "Soft Skills for Everyone", Cengage Learning, Cengage Learning India
3. John Adair, Decision Making and Problem Solving Strategies,2010, Replika Press, New Delhi.

Reference Books:-

1. Heike, Hering., "How to Write Technical Reports: Understandable Structure, Good Design, Convincing Presentation". Springer Nature, 2nd Edition

2. Jon Kirkman and Christopher Turk, Effective Writing: Improving Scientific, Technical and Business Communication, 2015, Routledge
3. Clifford A Whitcomb & Leslie E Whitcomb, Effective Interpersonal and Team Communication Skills for Engineers, 2013, John Wiley & Sons, Inc., Hoboken: New Jersey.

Subject Code: MMEC153	Antenna Design Lab	L T P : 0 0 2	Credits: 1

The students will be able to		Blooms Taxonomy
CO1	Explain the radiation through the antenna and identify different types of antennas	**K3**
CO2	Design a Feeding technique of antennas	**K3**
CO3	Design and Analysis of Antenna.	**K3**

List of Experiments

Minimum Ten experiment of the following:

1 . To demonstrate the reciprocity theorem for transmitting and receiving radiation patterns of an antenna.

2. Study of variation in the radiation strength at a given distance from the antenna.

3. Plot the radiation pattern of Yagi-UDA 5 Element.

4. Plot the radiation pattern of the Log Periodic antenna

5. Plot the radiation pattern of the Helix Antenna

6. Design and simulate micro strip patch antenna in HFSS simulator.

7. Modelling and simulation of a Dipole antenna (half wave and quarter wave).

8. Design and simulation of Horn antenna.

9. Modelling and simulation of Dielectric Resonator antenna with microstrip feed line.

10. Modelling and simulation of Reconfigurable antenna..

11. Design a rectangular microstrip patch antenna design parameters with probe feeding techniques.

Subject Code: MMEC 201	Subject Name: Advanced Digital Signal Processing	L T P : 4 0 0	Credits: 4

The students will be able to		Blooms Taxonomy
CO-1	Apply multirate DSP for applications and design efficient digital filters & construct multi-channel filter banks.	K3
CO-2	Implement linear filtering techniques to effectively solve engineering problems.	K3
CO-3	Demonstrate adaptive filter generic problems.	K3
CO-4	Implement the various adaptive filter algorithms.	K3
CO-5	Analyse the statistical properties of the conventional spectral estimators.	K4

UNIT-1: Multirate DSP: Review of sampling theory: Sampling rate conversion by integer and rational factors. Efficient realization and applications of sampling rate conversion,Polyphase realization of FIR filter, Subband coding of speech signals, Filter bank realization. Quadrature filter bank. Condition for alias free and perfect reconstruction, Multichannel filter banks**.** **(8 Hours)**

UNIT-2: Filtering: Wiener filtering. Optimum linear prediction,Wiener-Hopf Equations. Levinson- Durbin algorithm. Prediction error filters and its properties.

(8 Hours)

UNIT-3: Adaptive filters: FIR adaptive LMS algorithm, Convergence of adaptive algorithms, Fast algorithms, Steepest Descent algorithm (SDA) & its Applications, Noise canceller, echo canceller and equalizer, Frequency domain analysis of adaptive filters.

(8 Hours)

UNIT-4: Recursive least squares algorithms, Matrix inversion lemma,Convergence analysis of the RLS algorithm, Adaptive beam forming, Kalman filtering. **(8 Hours)**

UNIT-5 Spectrum estimation: Whiner Khintchine Theorem, Ergodicity concept, Estimation of autocorrelation, Properties of estimators, Parametric and Non parametric methods.

(8 Hours)

Text Books:

1. Proakis, John G. *Digital signal processing: principles algorithms and applications*. Pearson Education India, 2001.
2. Oppenheim, Alan V. *Discrete-time signal processing*. Pearson Education India, 1999.
3. Stearns, Samuel D., and Donald R. Hush. *Digital signal processing with examples in MATLAB*. CRC press, 2002.
4. Gopi, E. S. *Algorithm collections for digital signal processing applications using Matlab*. Springer Science & Business Media, 2007.

Reference Books:-

1. Haykin, Simon S. *Adaptive filter theory*. Pearson Education India, 2002.
2. Hayes, Monson H. *Statistical digital signal processing and modeling*. John Wiley & Sons, 1996.
3. ElAli, Taan S. *Discrete systems and digital signal processing with MATLAB*. CRC press, 2016.
4. Ingle, Vinay, Stephen Kogon, and Dimitris Manolakis. *Statistical and adaptive signal processing*. Artech, 2005.
5. Marple Jr, S. Lawrence. *Digital spectral analysis*. Courier Dover Publications, 2019.

Subject Code: MMEC202	Low Power VLSI Design	L T P : 4 0 0	Credits: 4

The students will be able to		Blooms Taxonomy
CO-1	Able to carry out research and development in the area of Low Power VLSI circuits.	K2
CO-2	Apply techniques to improve power consumption of VLSI circuits.	K3
CO-3	Able to analyze and design Low Power VLSI circuits.	K3
CO-4	Apply logic-level, architecture-level and system-level techniques in various designs to optimize power consumption of the VLSI circuits.	K3
CO-5	Analyze practical and state of the art Low Power VLSI designs, suitable for real life and Industry applications.	K4

Unit 1	Introduction: Introduction to Low Power VLSI design, Importance of low power design, Challenges in low power VLSI design, Application of Low Power VLSI circuits, Power analysis of CMOS circuits, Themes of Low Power VLSI design, Supply voltage scaling, Reduction of load capacitances	8 Hours
Unit 2	Low Voltage Process Technology and Device Modelling: CMOS device structure and process fabrication, Innovation on process technology for low power consumption, Multi-threshold process technology, Latch up problem in CMOS technology, MOS Capacitances, CMOS Low voltage analytical model, Threshold voltage definitions, Different Short Channel Effects	8 Hours
Unit 3	Techniques for low power design at Logic Design Level: CMOS logic design style, CMOS Inverter design, Transfer characteristics of CMOS inverter, Delay calculation of CMOS Logic gates, Analysis of various logic design styles for their power consumption (CPL, Domino Logic, NORA CMOS, TSPC Logic, DCVSL, etc.).	8 Hours
Unit 4	Low power design techniques at Architecture and System Level: Importance of parallelism, Introduction to Pipelining, Low power design utilizing redundancy and Data Encoding, Importance of Regularity and Locality, Reduction of complexity to improve power consumption, Low power design techniques at system level	8 Hours
Unit 5	Low Power Random Access Memory Circuits: Introduction to Static RAM Design, Low power Bit-line Conditioning Circuits, Low Power Techniques, Sense Amplifiers, Dynamic RAM Design, Bit line capacitance reduction methodologies, Self-Refresh Techniques, Low Voltage DRAM Operations, and Leakage Power Analysis.	8 Hours

Text Books:

1. A.P.Chandrakasan and R.W.Broderson, Low Power CMOS Design, IEEE Press, 1998.

2. A. Bellaouar and M. I. Elmasry, Low Power Digital VLSI Design Circuits and Systems, Springer

Reference Books:-

1. Jan M. Rabaey, Massoud Pedram, Low Power Design Methodologies, Springer Science+Business Media,LLC
2. Ajit Pal, Low-Power VLSI Circuits and Systems, Springer
3. K. Roy and S. C. Prasad, Low Power CMOS VLSI Circuit Design, John Wiley and Sons, 3 rd Edition, 2009

Subject Code: MMEC203	Subject: Internet of Things	L T P : 4 0 0	Credits: 4

The students will be able to		Blooms Taxonomy
CO-1	Interpret the vision of IoT from a global context.	K2
CO-2	Implement state-of-the-art architecture in IoT.	K3
CO-3	Examine IoT reference layer and various protocols.	K3
CO-4	Implement wireless technologies for IoT and software.	K3
CO-5	Analyze the need for IoT applications.	K4

UNIT-1 Introduction to the Internet of Things (IoT) (8 Hours)

Internet of Things (IoT), IoT and the connected world, Technology drivers, Business drivers, Typical IoT applications, Trends and implications

UNIT-2 IoT Architectures (8 Hours)

Architectures for IoT, Elements of an IoT Architecture, Architectural design Considerations, Opportunities for IoT Relevance of Internet to network of Things, network management, security, mobility and longevity.

UNIT-3 IoT Network protocols (MAC layer) (8 Hours)

Wireless protocols, Connectivity options, Low-power design, range extension techniques, data intensive IoT, MAC and routing aspects, CSMA/CA and slotting, centralized vs. distributed.

UNIT-4 Wireless technologies for IoT (Layer 1 & 2): (8 Hours)

WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Threat models, Defensive strategies and examples.

UNIT-5 IoT application programming (8 Hours)

Introduction to IoT device programming, IoT application Development, Data analytics for IoT: A framework for data-driven decision making, Descriptive, Predictive and Prescriptive Analytics.

Text Books:

1. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley 2013.
2. Naveen Balani, Enterprise IoT, CreateSpace Independent Publishing Platform, 2016

Reference Books:-

1. McKinsey Global Institute report : "Unlocking the potential of the Internet of Things".
2. Zhao, Feng, and Leonidas J. Guibas. Wireless sensor networks: an information processing approach. Morgan Kaufmann.
3. Karl, Holger, and Andreas Willig. Protocols and architectures for wireless sensor networks. John Wiley & Sons.

Subject Code: MMEC:204	Subject Name: Advanced Satellite Communication	L T P : 4 0 0	Credits: 4

The students will be able to		Blooms Taxonomy
CO-1	Understand the satellite communication orbital mechanism and satellite positioning.	K2
CO-2	Illustrate satellite link design parameters, transponders, antennas, and noise performance.	K3
CO-3	Illustrate multiple access techniques and their impact on system performance.	K3
CO-4	Analyze TDMA systems, frame design, synchronization, and digital transmission analysis.	K4
CO-5	Illustrate satellite-based services DBS, VSAT, Mobile communication, and GPS.	K3

UNIT-1 **(8)**

Satellite and Orbital Mechanics: A brief History of Satellite Communication, Satellite Frequency bands and Applications. Orbit Equations, Orbit Description, Locating the Satellite in the Orbit and with Respect to Earth, Orbital Elements. Look Angle Determination and Visibility. Orbital Perturbations, Orbit Determination, Launch Vehicles, Orbital Effects in Communication System Performance.

UNIT-2 **(8)**

Satellite and Link Design Equation: Communication Subsystems, Transponders, Antennas, Equipment Reliability. Earth Stations. The Space Link, Satellite Link Design. Basic Transmission Theory. System Noise Temp., G/T Ratio, Noise Figure, Downlink Design, Design of Satellite Links for Specified C/N.

UNIT-3 **(8)**

Multiple Access: FDMA, FDM/FM/FDMA. Calculating the Overall Carrier to Noise Ratio on a FDM/FM/FDMA Link. Backoff. Measuring & Calculating the Effects of Intermodulation Noise. Over deviation and Companding. Companded Single Side Band. Pre-assigned and Demand Assigned FDMA.

UNIT-4 **(8)**

Time Division Multiple Access: Frame Structure and Design. Reference Burst, Preamble, Network Synchronization, Unique Word Detection. TDMA. Channel Capacity, Pre-assigned and Demand Assigned TDMA, Speech Interpolation and Prediction, Downlink Analysis for Digital Transmission.

UNIT-5 **(8)**

Satellite Services: Direct Broadcast by satellite (DBS), VSAT technology and Application, Satellite mobile communication, Global Positioning System (GPS), Radarsat.

Text Books:

1. Satellite Communications: Dennis Roddy, TMH

2. Satellite Communication: D.C. Aggarwal; Khanna Publishers.
3. Satellite Communications- Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003, John Wiley & Sons.

Reference Books:-

1. Digital Satellite Communications-Tri. T. Ha,2nd Ed.,MGH,1990.
2. Fundamental of Satellite Communications- K. N Raja Rao, PHI, 2004
3. Digital Satellite Communications-Tri. T.Ha, 2nd Edition, 1990, Mc. Graw Hill.

Subject Code: MMEC205	Advanced Wireless Network	L T P : 4 0 0	Credits: 4

The students will be able to		Blooms Taxonomy
CO-1	Demonstrate basic architecture of GSM system.	K2
CO-2	Demonstrate the basic concept of wireless standards.	K3
CO-3	Explain the cellular concept and efficient frequency utilization.	K3
CO-4	Analyse the performance of Wi-Max physical layer.	K4
CO-5	Apply the concept of wireless Protocol.	K3

UNIT-1 **(8 Hours)**

GSM services and features – GSM system architecture – GSM radio subsystem – Frame structure for GSM– Signal processing in GSM – GPRS network architecture – GPRS services and features – 3G UMTS network architecture – UMTS services and features.

UNIT-2 **(8 Hours)**

WiMAX Genesis and framework: 802.16 standard, WiMAX forum, Other 802.16 standards, Protocol layer topologies - Layers of WiMAX, CS, MAC CPS, Security layer, Physical layer, Reference model, topology

UNIT-3 **(8 Hours)**

Frequency utilization and system profiles: Cellular concept, Licensed and unlicensed frequencies, Fixed WiMAX system profiles, Mobile WiMAX profiles.

UNIT-4 **(8 Hours)**

WiMAX physical layer: OFDM transmission, SOFDMA, subcarrier permutation, 802.16 transmission chains, Channel coding, Turbo coding, Burst profile, WiMAX MAC and QoS: CS layer.

UNIT-5 **(8 Hours)**

Wireless Protocol: MAC Protocols, The Mediation Device Protocol, Contention based protocols - PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Challenges and Issues in Transport layer protocol.

Text Books:

1. Loutfi Nuyami, "WiMAX - Technology for broadband access", John Wiley, 2007.
2. Yan Zhang, Hsia-Hwa Chen, "Mobile WiMAX", Aurobech Publications, 2008

Reference Books:-

1. Stallings, William. *Wireless communications & networks*, Pearson Education India, 2009
2. Siegmund M. Redl, Mathias K. Weber, Malcolm W. Oliphant, “An Introduction to GSM”, ArtechHouse Publishers, 1995.

Subject Code: MMEC251	VLSI Lab	L T P : 0 0 2	Credits: 1

The students will be able to		Blooms Taxonomy
CO1	Understand the features of CAD tool in VLSI design.	**K2**
CO2	Design of combinational and sequential circuits using Verilog HDL.	**K3**
CO3	Design and verify the behavior of digital and analog circuits using full custom design flow.	**K3**

List of Experiments

Minimum Ten experiment of the following

1. HDL code to realize all the logic gates.

2. Design of Full adder using 3 modelling styles.

3. Design of 2-To-4 Decoder.

4. Design of Flip Flops: SR, D, T, JK

5. Design of ALU to Perform – ADD, SUB, AND-OR, 1's and 2's Compliment, Multiplication, and Division.

6. Design and Simulation of CMOS Inverter to study the transfer Characteristics by varying the design constraints using EDA Tools

7. Design and Simulation of NAND Gate, NOR Gate and XOR Gate using full custom design.

8. Design and Simulation of CMOS 1-Bit Full Adder.

9 . Design and Simulation of Common Source Amplifier.

10. Design and Simulation of Differential Amplifier.

Subject Code: MMNC101/201	Subject Name: ENVIRONMENTAL STUDIES	L T P : 2 0 0	Credits: NC

The students will be able to		Blooms Taxonomy
CO-1	Understand the basic concepts of environment and ecosystem emphasizing on structural and functional aspects.	K2
CO-2	Understand the important concepts of biodiversity, its significance and conservation.	K2
CO-3	Understand the concept and classification of Natural Resources emphasizing on associated problems and conservation strategies.	K2
CO-4	Understand the causes and effects of environmental pollution and contribute to the preventive measures in the immediate society.	K2
CO-5	Understand the role of Government and legal aspects related to protection of environment and control of environmental pollution.	K2

UNIT-1: ENVIRONMENT & ECOSYSTEM [07]

The Multidisciplinary nature of environmental studies: Definition, scope and importance of environment, need for public awareness and environmental education, Concept of an ecosystem: Structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow and nutrient cycling (carbon, nitrogen and sulphur) in the ecosystem, food chains, food webs and ecological pyramids, Types of ecosystems: Introduction, types and characteristic features of desert, grassland, forest and pond ecosystems.

UNIT-2: BIODIVERSITY AND ITS CONSERVATION [05]

Introduction to biodiversity definition: genetic, species and ecosystem diversity, bio geographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local levels, India as a mega-diversity nation, hot-spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, endangered and endemic species of India, Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity and conservation through legal aspects.

UNIT-3: NATURAL RESOURCES [06]

Natural Resources: Classification, causes of depletion, Forest resources: Use and over-exploitation, deforestation, practices for conservation, Water resources: Use and overutilization of surface and ground water, floods, drought, conservation strategies, water related diseases, Mineral resources: Use and exploitation, environmental effects of mineral extraction (mining), Food resources: World food problems, Ill effects of Modern agriculture on environment, sustainable agriculture, Energy Resources: Growing energy needs, renewable and non-renewable energy sources, use of alternative energy sources.

UNIT-4: ENVIRONMENTAL POLLUTION & GLOBAL ENVIRONMENTAL ISSUES [07]

Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and radiation pollution, Solid waste Management: causes, effects and control measures of urban and industrial waste; E-Waste management, Human population and environment: Characteristics, population growth; causes, impacts and control measures of population explosion in India, role of individual in prevention of pollution, Global Environmental issues: Climate change, global warming, acid rain, ozone layer depletion, chemical and nuclear accidents.

UNIT-5: ENVIRONMENTAL POLICY, LEGISLATION & EIA [05]

Role of Government in environmental protection, Environmental Protection Act-1986, Air (prevention and control of pollution) Act- 1981, Water (prevention and control of pollution) Act-1974, Forest Conservation Act-1980, Wild life Protection Act-1972, EIA: Objective and process; EIA in India, Towards Sustainable Future: Concept of Sustainable Development.

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Recommended Text Book:

1. A Text Book of Environmental Studies for Undergraduate Courses, Third Edition (2021), by Erach Bharucha, University Press (India) Private Limited.
2. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers (2018).
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 3rd edition, Pearson Education (2015).
4. Environmental Chemistry (Ninth Multicolour Edition, 2018) by Anil K DE, New Age International Publishers

Reference Books:-

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007