VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY

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

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

SYLLABUS

For

Master of Engineering Programmes

(M.Tech. Wireless Communication)

(For admission in 2022-23 and onwards)

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

Semester I											
Sr. No.	**Course Type/Code**	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**			**External Marks**	**Total Marks**
			L	**T**	**P**		**CT**	**TA**	**Total**		
1	AHT-301	Advanced Mathematics	3	1	0	4	30	20	50	100	150
2	WET-301	Signal Theory	3	1	0	4	30	20	50	100	150
3	WET-302	Digital Communication System	3	1	0	4	30	20	50	100	150
4	WET-3XX	Professional Elective-I	3	0	0	3	30	20	50	100	150
5	WET-3XX	Professional Elective-II	3	0	0	3	30	20	50	100	150
6	WEP-301	Signal Theory Lab	0	0	3	1		25	25	25	50
7	WEP-302	Digital Communication System Lab	0	0	3	1		25	25	25	50
8	AHT-302	Research Methodology and IPR	2	0	0	2		50	50	50	100
9	AHT-303	Technical Writing and Presentation Skill	2	0	0	NC		50	50	0	NC
		Total	**22**	**3**	**8**	**22**	**150**	**250**	**400**	**600**	**950**
10	WET-3XX	Open Elective (Optional)	3	0	0	3	30	20	50	100	150

Semester II (M. Tech.- 2 Year Programme)											
Sr. No.	**Course Type/Code**	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**			**External Marks**	**Total Marks**
			L	**T**	**P**		**CT**	**TA**	**Total**		
1	WET-303	Mobile Communication	3	1	0	4	30	20	50	100	150
2	WET-304	Advanced Wireless	3	1	0	4	30	20	50	100	150

		Communicatio n									
3	WET-3XX	Professional Elective-III	3	1	0	4	30	20	50	100	150
4	WET-3XX	Professional Elective-IV	3	0	0	3	30	20	50	100	150
5	WET-3XX	Open Elective-I	3	0	0	3	30	20	50	100	150
6	WEP-303	Mobile Communicatio n Lab	0	0	3	1		25	25	25	50
7	WEP-304	Advanced Wireless Communicatio n Lab	0	0	3	1		25	25	25	50
		Total	**15**	**3**	**6**	**20**			**300**	**550**	**850**
9	WET-3XX	Open Elective (Optional)	3	0	0	3	30	20	50	100	150

Semester III (M. Tech.- 2 Year Programme)											
Sr. No.	**Course Type/Code**	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**			**External Marks**	**Total Marks**
			L	T	P		**CT**	**TA**	**Total**		
1	WET-3XX	Open Elective	3	0	0	3	30	20	50	100	150
2	WEP-305	Seminar	0	0	4	2		100	100		100
3	WEP-306	Project	0	0	10	5		100	100	150	250
4	WEP-307	Dissertation	0	0	12	6		300	300		300
		Total	**3**	**0**	**22**	**16**		**520**	**550**	**250**	**800**

Semester IV (M. Tech.- 2 Year Programme)											
Sr. No.	**Course Type/Code**	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**			**External Marks**	**Total Marks**
			L	T	P		**CT**	**TA**	**Total**		
1	WEP-308	Dissertation	0	0	28	14		250	250	450	700
		Total	**0**	**0**	**28**	**14**		**250**	**250**	**450**	**700**

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Professionals Electives			
Professional elective-I		**Professional elective-II**	
Course Title	**CourseCode**	**Course Title**	**CourseCode**
Satellite Communication	WET-305	Information Theory & Coding	WET-307
Digital Signal Processing	WET-306	High Frequency Electronics	WET-308
Professional elective-III		**Professional elective-IV**	
Biomedical Electronics	WET-309	Digital Image and Video Processing	WET-311
Antenna Theory and Techniques	WET-310	Micro-Electro-Mechanical-Systems(Mems)	WET-312

Open Electives		
Sr. No.	**Course Code**	**Course Title**
1.	WET-321	Detection and Estimation Theory
2.	WET-322	Optimization Techniques
3.	DET-323	Cloud Computing
4.	WET-324	Telecommunication Switching & Networks
5.	WET-325	Adaptive Signal Processing
6.	DET-326	Artificial Intelligence

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Advanced Mathematics (AHT-301)

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

Course objectives:

- To learn principles of advanced engineering mathematics through linear algebra and calculus of variations.

Learning outcomes:

1. Ability to analyze and solve both linear & non-linear engineering problems whose solutions are not found in the closed form
2. Ability to analyze and solve stochastic engineering & industrial problems
3. Ability to analyze the solution & examine its stability in operator theory
4. Ability to optimize & solve real life problems
5. Ability to solve image processing & signal processing problems

Course content:

Unit I: Numerical Analysis: **(8 hours)**

Use of Interpolation formulae of Stirling, Bessel's, Spline. Solutions of system of linear simultaneous equations using SOR algorithm, Newton's method [up to two variables]

Unit II: Stochastic Process: **(10 hours)**

[Prerequisite: Basic Under graduate course in probability]

Random processes, Random walk, Markov process with special emphasis on Markov chain.

Unit III: Linear algebra: **(8 hours)**

[Pre-requisite: Basic Under graduate course in abstract algebra]

Vector spaces, Linear transformations, Eigenvalues, Eigenvectors, some applications of Eigen value & Eigen vector problems.

Unit IV: Optimization Technique: **(8 hours)**

Calculus of several variables, Implicit function theorem, Nature of singular points, Necessary and sufficient conditions for optimization, Constrained Optimization, Lagrange multipliers, Gradient method – steepest descent method.

Unit V: Fourier series and Transform: **(8 hours)**

Fourier series, integrals and transforms and their properties. One dimensional Fourier transform, Convolution theorem, Parseval's formula, Introduction to 2-dimensional Fourier transform.

Text Books / References:

1. Kreyzig, 'Advanced EngineeringMathematics'.
2. Sen, M. K. and Malik, D. F.-Fundamental of Abstract Algebra, Mc. GrawHill.
3. Khanna, V. K. and Bhambri, S. K.- Course of Abstract Algebra, VikashPub.
4. Scarborough, J. B.-Numerical Mathematical Analysis, Oxford UniversityPress.
   Rao, S. S.-Optimization Theory and Application, Wiley Eastern Ltd., NewDelhi.

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SIGNAL THEORY(WET-301)

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

Course Objectives:

- To learn principles of advanced engineering mathematics through linear algebra and calculus of variations.
- To understand probability theory and random process that serve as an essential tool for applications of electronics and communication engineering sciences.

Course Outcomes:

CO1: Ability to analyze and solve both linear & non-linear engineering problems whose solutions are not found in the closed form

CO2: Ability to analyze and solve stochastic engineering & industrial problems

CO3: Ability to analyze the solution & examine its stability in operator theory

CO4: Ability to optimize & solve real life problems

CO5: Ability to solve image processing & signal processing problems

Course Contents:

UNIT-I **(8 hours)**

Representation of deterministic signals: Orthogonal representation of signals. Dimensionality of signal spaces. Construction of orthogonal basis functions.

UNIT-II **(8 hours)**

Random Processes: Definition and classification, stochastic integrals, Fourier transforms of random processes, stationary and non-stationary processes, correlation functions. Ergodicity, power spectral density, transformations of random processes by linear systems.

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UNIT-III **(8 hours)**

Representation of random processes (via sampling, K-L expansion and narrow band representations), special random processes: white Gaussian noise, Wiener-Levy process, Poisson process, shot-noise process, Markov process.

UNIT-IV **(8 hours)**

Optimum Filtering: Matched filters for deterministic signals in white and colored Gaussian

noise. Wiener filters for random signals in white and colored Gaussian noise.

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Text Books:

- Principles of Linear Systems and Signals,2e (Intl. Version), Lathi,2nd, Oxford
- Signal & Systems 3e, Chen3rd, Oxford
- Fundamentals of Signals and Systems, M.J. Roberts, W i l e y
- Signals and Systems, P Rao, TMH
- Signals and Systems: A Simplified Approach, Ganesh Rao, Pearson
- Signals and Systems: Continuous and Discrete, Roger E Ziemer,Phi
- Signals and Systems, Ravi Kumar,Phi

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DIGITAL COMMUNICATION SYSTEM(WET-302)

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

Course Objectives:

- Understand and appreciate the need of various modulation and spread spectrum techniques
- Analyze the properties of basic Modulation techniques and apply them to Digital Communication
- Apply different types of coding techniques to design the optimum receiver for channels with ISI and AWGN.

Course Outcomes:

Upon successful completion of the course, the students will be able to

CO1: Explain merits and demerits of different modulation techniques & coding techniques, spread spectrum signals and channel behaviors.

CO2: Analyze various modulation, equalization, diversity and coding techniques for communication systems

CO3: Compare performance of different types of modulation on different wireless application fading channels.

CO4: Design and demonstrate various modulation/coding equalization techniques and measure their performance.

Course Contents:

Unit-I **(8 hours)**

Digital Modulation Techniques: Digital modulation formats, Coherent binary modulation techniques, Coherent quadrature – modulation techniques, Non-coherent binary modulation techniques, Comparison of binary and quaternary modulation techniques, M-ray modulation techniques, Power spectra, Bandwidth efficiency, M-array modulation formats viewed in the light of the channel capacity theorem, Effect of inter symbol interference, Bit verses symbol error probabilities, Synchronization, Applications.

Unit-II **(8 hours)**

Coding Techniques: Convolutional encoding, Convolutional encoder representation, Formulation of the convolutional decoding problem, Properties of convolutional codes: Distance property of convolutional codes, Systematic and nonsystematic convolutional codes, Performance Bounds for Convolutional codes, Coding gain, Other convolutional decoding algorithms, Sequential decoding, Feedback decoding, Turbo codes.

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Unit-IV **(8 hours)**

Spread Spectrum Signals for Digital Communication: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, Frequency hopped spread spectrum signals, CDMA, Time hopping SS, Synchronization of SS systems.

Unit-V **(8 hours)**

Digital Communication through Fading Multipath Channels: Characterization of fading multipath channels, the effect of signal characteristics on the choice of a channel model, Frequency nonselective, slowly fading channel, Diversity techniques for fading multipath channels, Digital signals over a frequency selective, slowly fading channel.

Books and References:

Text Books:

1. Simon Haykin, “Digital Communication”, Reprint, Wiley, 2013, ISBN: 0471647357, 9780471647355.
2. Bernard Sklar, “Digital Communications - Fundamentals and Applications”, Pearson Education (Asia) Pvt. Ltd, 2nd Edition, 2014, ISBN: 1292026065, 9781292026060.

References books:

1. John G. Proakis, “Digital Communications”, McGraw Hill, 5th Edition, 2008.
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.

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SIGNAL THEORY LAB (WEP-301)

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

Course Objective:

- The objective of the course is to make familiar with practical implementation of the digital signal
- processing. Students can able to develop DSP algorithms for convolution, correlation, DFT,
- filtering of signals etc**.**
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Course Outcomes:

At the end of this course students will demonstrate the ability to

CO 1: To use computational tools to do basic operations for signal processing.

CO 2: To develop algorithms for designing and implementation of FIR and IIR filters with standardtechniques.

EXPERIMENTS USING TMS320C6XXX DSP KITS

1. FIR Digital FilterDesign
2. IIR Digital FilterDesign
3. FFT of a givensignal
4. Plot PSD/Power Spectrum of asignal
5. Discrete CosineTransform
6. Adaptive Filter Design using Standard LMSAlgorithm
7. Speech analysis usingL.P.C.

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DIGITAL COMMUNICATION SYSTEM LAB (WEP-302)

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

Course Objectives:

- To understand the key modules of digital communication systems with emphasis on digital modulation techniques.
- To get introduced to the concept and basics of information theory and the basics of source and channel coding/decoding.

Course Outcomes:

Students are able to

CO1: Apply the knowledge of statistical theory of communication and explain the conventional digital communication system.

CO2: Apply the knowledge of signals and system and evaluate the performance of digital communication system in the presence of noise.

CO3: Apply the knowledge of digital electronics and describe the error control codes like block code, cyclic code.

CO4: Describe and analyze the digital communication system with spread spectrum modulation.

CO5: Design as well as conduct experiments, analyze and interpret the results to provide valid conclusions for digital modulators and demodulator using hardware components and communication systems using CAD tool.

PART I: PCM AND LINK ANALYSIS

Link establishment, Noise on PCM link, Error detection, BER calculation, Error correction, TDM.

PART II: DIGITAL MODULATION & KEYING

ASK, FSK, PSK, QPSK Modulation and Demodulation.

PART III: CDMA - DSSS

Modulation, Demodulation & BER measurement.

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PART IV: SIMULATION IN MATLAB ENVIRONMENT

BPSK, QPSK, FSK Modulation & Demodulation. BER calculation.

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Research Methodology and IPR (AHT-302)

L:T:P:: 2:0:0 **Credits-2**

Course Objectives: Students will be able to:

1. To understand the fundaments of research in today's world controlled by technology, ideas, concept, and creativity.
2. To understand different methods of research designing and data collections.
3. To understand the methods of report writing and its different methods of interpretations.
4. To understand research ethics and methods of research publications
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and inturn brings about, economic growth and social benefits.

Course Outcomes:

1. To understand research problem formulation.
2. To study research design and method of data collections.
3. To study methods of report writing.
4. To follow research ethics.
5. To enhance student's competence to discover new inventions.

Syllabus Contents:

UNIT I: FUNDAMENTAL OF RESEARCH

Meaning of research; objectives of research; basic steps of research; criteria of good research; Research methods vs. Methodology. Types of research –criteria of good research; Meaning of research problem; selection of research problem; Approaches of investigation of solutions for research problem, Errors in selecting a research problem, Scope and objectives of research problem, Review of related literature- Meaning, necessity and sources.

Unit 2: RESEARCH DESIGN AND DATA COLLECTION

Research design: Types of research design- exploratory, descriptive, diagnostic and experimental;Variables- Meaning and types; Hypothesis- Meaning, function and types of hypothesis; Null/Alternative hypothesis; Sampling- Meaning and types of sampling; Probability and Non-Probability; Tools and techniques of data collection- questionnaire, schedule, interview, observation, case study, survey etc.

Unit 3:REPORT WRITING AND ITS INTERPRETATION

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Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

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Unit 4:RESEARCH ETHICS AND SCHOLARY PUBLISHING

Ethics-ethical issues, ethical committees (human & animal); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism and its concept and importance for scholar.

Unit 5: INTELLECTUAL PROPERTY RIGHT (IPR)

IPR- intellectual property rights and patent law, commercialization, New developments in IPR; copy right, royalty, trade related aspects of intellectual property rights (TRIPS); Process of Patenting and Development; Procedure for grants of patents, Patenting under PCT;Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases.

Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science &engineeringstudents'"
2. WayneGoddardandStuartMelville,"ResearchMethodology:AnIntroduction"
3. RanjitKumar,2ndEdition,"ResearchMethodology:AStepbyStepGuideforbeginners"
4. Halbert,"ResistingIntellectualProperty",Taylor&FrancisLtd,2007.
5. Mayall,"IndustrialDesign",McGrawHill,1992.
6. Niebel,"ProductDesign",McGrawHill,1974.
7. Asimov,"IntroductiontoDesign",PrenticeHall,1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age",2016.
9. T.Ramappa,"IntellectualPropertyRightsUnderWTO",S.Chand,2008

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MOBILE COMMUNICATION(WET-303)

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

Course Objectives:

- Educate students to understand the bandwidth of operation of cellular technology and plan spectrum deployment for cellular systems to provide better customer services as well as earn revenue of service provider
- Utilize the subject knowledge in specifying the technological problems for evolving cellular technology.
- Understand the needs of technological solution for designing and developing next generation cellular technology to fulfill the ever growing service demands of customer
- Apply the mobile and wireless principles for creating solutions for data and voice communication in various Industries like Banking, Marketing and Automobile.

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Course Outcomes:

Upon successful completion of the course, the students will be able to

CO1: Developments in the current and next generation mobile technologies

CO2: Knowledge on mobility support in network layers.

CO3: Details of advanced mobile communication standards and their evolution..

CO4:recognize the various frequency and bandwidth allocations, design concepts of emerging communication systems.

CO5: design a cellular system in a specific radio and geographic environment with specific frequency range

Course Contents:

Unit-I **(8 hours)**

EVOLUTION OF MODERN MOBILE COMMUNICATION: Personal communication systems – Wireless local area networks – Wireless broadband access systems - Wireless wide area networks – Cellular systems and design fundamentals.

Unit-II **(8 hours)**

2G AND 3G CELLULAR SYSTEMS:GSM Architecture – Air interface – Protocols and Signaling - GPRS Architecture – Signaling – Mobility and location management - Interfaces and Protocols – Overview of IS95 – UMTS Architecture – Interfaces and Protocols - Mobility Management - Handover and security procedure

Unit-III **(8 hours)**

ADVANCED MOBILE COMMUNICATION STANDARDS:IEEE 802.11 WLAN standard and its variants – PHY layer technologies – MAC mechanism – Security, Qos and handover Issues – IEEE 802.15 WPAN standard – Bluetooth Architecture and Protocol stack – IEEE 802.16 Wireless broadband access standard – PHY and MAC layer overviews – WiMAX network architecture – Initialization and handover procedures.

UNIT 4 BEYOND 3G **(8 hours)**

HSPA and LTE – Architecture – Radio interface and channels – Resource mapping – Session, mobility and security procedures – LTE Advanced – Heterogeneous Networks – Internetworking – IP based coupling Architecture - Multimode terminals and intersystem handover.

UNIT 5 MOBILE NETWORK, TRANSPORT & APPLICATION LAYERS **(8 hours)**

Mobile IP – Packet delivery process – Routing optimization – Mobile ad-hoc networks and routing protocols – Mobile TCP – Wireless Application Protocols.

Text Books:

1. Theodore S. Rappaport, “wireless communications Principles and Practices”, PHI, 2005
2. Jochen Schiller, “Mobile Communications”, Pearson Education, second edition, 2009.

References books:

1. ItiSahaMisra, “Wireless Communication and Networks – 3G and Beyond”, Mc Graw Hill Education, Second Edition, 2013.

2. Jochen Schiller, “Mobile Communications”, Pearson Education, Second Edition, 2012.

3. Andreas F.Molisch “Wireless Communications”, Wiley, Second Edition, 2014.

4. E.Dahlmanet. al. “3G Evolution: HSPA and LTE for Mobile Broadband”, Elsevier, Second Edition, 2008.

5. G.Sasibhushana Rao, "Mobile Cellular Communication", Pearson, 2013

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ADVANCED WIRELESS COMMUNICATION (WET-304)

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

Course Objectives

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

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Students will be able to design appropriate mobile communication system by applying frequency reuse concept and also analyze the effect of interference and handoff techniques.

CO2: Students will be able to distinguish various multiple access techniques for mobile communication and their advantages and disadvantages.

CO3: Students will be able to analyze path loss and interference for wireless telephony and their influences on mobile communication system performance.

CO4: Students will be able understand the importance of different diversity techniques as well equalizer in wireless communication system.

CO5: Students will be able to analyze and design CDMA system functioning with knowledge of forward and reverse channel.

Course Contents

Unit-I

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

Unit-II

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

Unit-III

MOBILE RADIO PROPAGATION: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response

Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

Unit-IV

EQUALIZATION, DIVERSITY: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

Unit-V

IS 95 SYSTEMS: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA.

Text Books:

1. V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
2. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.

Reference Books:

1. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI,2002.
William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.

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MOBILE COMMUNICATION LAB (WEP-303)

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

Course Objectives This course enables the students to:

- Understand the basic commands to interface GSM module
- Implement all applications of mobile communication.

Course Outcomes At the end of the course, a student should be able to:

CO1: To understand the basic command and applications of AT commands in mobile communication.

CO2: To understand different spread spectrum modulation/demodulation schemes.

CO3: To be able to measure different test point voltages of mobile phones and identify the switch faults.

List of Experiments:

1. Study & use of AT commands.

2. Study of voice call using AT command.

3. Sending message using AT command.

4. Study theory of direct sequence spread spectrum modulation & demodulation.

5. Generation of DSSS modulated signal.

6. Demodulation of DSSS modulated signal.

7. Introduction to parts of mobile phone

8. Measurement of test point voltages of mobile

9. Observe waveforms at different test points of mobile

10. Study of switch faults

11. Video calling

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ADVANCED WIRELESS COMMUNICATION LAB
(WEP-304)

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

Course Type: Core / Elective

Course Objectives This course enables the students to:

- To understand the emerging technologies of wireless and mobile communication.
- To simulate the problems using specific wireless and mobile communication tools.

Course Outcomes At the end of the course, a student should be able to:

CO1: Understand the basic concept of wireless communication i.e. hoc network, Bluetooth & Wi-Fi.

CO2: To develop the Android application.

CO3: To create a program for various problems using Android application.

List of Experiments:

1. Prepare a wireless ad hoc network and show its working.
2. Prepare a Case Study on Wi-Fi tools
3. Study on Bluetooth protocol stack
4. Write installation steps for Android studio
5. Install Genymotion in Android studio.
6. Develop an android app which displays “Hello, welcome to Android Lab” message
7. Implement an Android application that converts Fahrenheit to Celsius and Celsius to Fahrenheit.
8. Write a program for finding factorial of a number.
9. Develop calculator Android Application
10. Write a program to find hamming distance. For example, Hamming distance d (v1, v2) =3 if v1=110011, v2=100111.

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Satellite Communication(WET-305)

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

Course Objectives

- To introduce various aspects in the design of systems for satellite communication and its application.

Course Outcome:

CO1: Analyze the satellite orbits

CO2: Analyze the earth segment and space segment

CO3: Able to understand how analog and digital technologies are used for satellite communication networks

CO4: Able to explain various applications of satellite with the focus on national satellite system

SYLLABUS:

Unit-I **(8 hours)**

Elements of orbital mechanics: 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 **(8 hours)**

Spacecraft Technology: Structure, Elements of communication satellite design. Spacecraft subsystems, Reliability considerations, Spacecraft integration, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems

Unit – III **(8 hours)**

The space link: Introduction, Equivalent isotropic radiated power (EIPR), transmission losses, the link power budget equation, system noise, carrier-to-noise ratio (C/N), the uplink, the downlink, effects of rain, combined uplink and downlink C/N ratio, inter modulation noise, inter satellite links. Interference between satellite circuits.

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Unit – IV **(8 hours)**

Satellite station: Ground station and satellite antenna, radio wave propagation in atmosphere, multiple access techniques. FDMA, TDMA, CDMA. Random Access Techniques. Satellite onboard processing.

Unit - V **(8 hours)**

Remote Sensing Satellites: Classification of remote sensing systems, orbits, Payloads, Types of images: Image Classification, Interpretation, Applications

Weather Forecasting Satellites: Fundamentals, Images, Orbits, Payloads, Applications.

Navigation Satellites: Development of Satellite Navigation Systems, GPS system, Applications.

TEXTBOOKS:

1. Timothy,Pratt,Charles,W.Bostain,JeremyE.Allnutt,"SatelliteCommunication‖,2nd Edition, Wiley Publications,2002
2. Dennis Roddy, ―Satellite Communication‖, 4th Edition, Mc Graw Hill International, 2006.
3. Anil K. Maini, Varsha Agrawal, Satellite Communications, Wiley India Pvt. Ltd., 2015, ISBN: 978-81-265-2071-8.

REFERENCEBOOKS:

1. Bruce R. Elbert, ―The Satellite Communication Applications‖, Hand Book, Artech House Bostan London, 1997
2. B.N. Agrawal, Design of Geosynchrons Spacecraft, Prentice- Hall,1986.

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DIGITAL SIGNAL PROCESSING (WET-306)

L: T: P: 4: 0: 4 **Credits-5**

Course Objectives:

- Understand the techniques for design and realization of digital Filters for various electronic communication applications.
- Understand how to choose the sampling rate conversion and apply to Multirate signal processing techniques.
- Design of Adaptive filters, linear prediction and optimum linear filters.

Course Outcomes:

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

CO1 Evaluate various Digital filters, linear filters and adaptive filters for multirate signal processing and power spectrum estimation..

CO2: Apply different design techniques for FIR and IIR filters

CO3: Design and demonstrate various Digital Signal Processing systems using modern software and hardware

Course Contents:

Unit-I **(10 hours)**

Design of Digital Filters: General Considerations, Design of FIR filters, Design of IIR filters from analog Filters, Frequency Transformation.

Unit-II **(10 hours)**

Multirate Digital Signal Processing: Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a Rational Factor I/D. Implementation of sampling Rate Conversion, Multistage implementation of sampling rate conversion, Sampling rate conversion by an Arbitrary Factor, Applications of Multirate Signal Processing, Digital Filter Banks, Two-Channel Quadrature Mirror Filter Bank, M-channel QMF Bank.

Unit-III **(10 hours)**

Linear Prediction and Optimum Linear Filters: Random Signals, Correlation Functions, and Power spectra, innovations representation of a stationary random process, Forward and backward Linear Prediction, Levinson – Durdin algorithm, properties of the Linear Prediction-Error Filters, Wiener Filters for filters for filtering and prediction.

Unit-IV **(10 hours)**

Adaptive Filters: Applications of Adaptive filers, Adaptive Direct-Form FIR Filters- The LMS algorithm, Adaptive Direct Form Filters- RLS algorithm.

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Unit-V **(10 hours)**

Power Spectrum Estimation:

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

References:

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

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Information Theory & Coding(WET-307)

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

Course Objectives:

- Calculate the information content of a random variable from its probability distribution
- Relate the joint, conditional, and marginal entropies of variables in terms of their coupled probabilities
- Define channel capacities and properties using Shannon's Theorems
- Construct efficient codes for data on imperfect communication channels

Course Outcome:

CO 1: Understand the information content of a random variable

CO 2: Understand the variables in terms of their coupled probabilities

CO 3: Understand the basic concepts of cryptography

CO 4: Explore the properties using Shannon's Theorems

SYLLABUS:

Unit – I **(10 hours)**

Elements of information theory: Measurement of information and the Entropy Function, Entropies defined, and why they are measures of information, marginal entropy, joint entropy, Conditional entropy and the Chain Rule for Entropy. Sources with and without Memory: Sources coding theorem, Prefix, Variable and Fixed- length Codes. Error Correcting Codes

Unit – II **(08 hours)**

Channel Types, Properties, Noise and Channel Capacity: Perfect communication through a noisy channel. The binary symmetric channel, their classification and capacity of a noiseless discrete channel. The Hartley and Shannon laws for channel capacity.

Unit – III: **(08 hours)**

Continuous Information; Density; Noisy Channel Coding Theorem: Extensions of the discrete entropies and measures to the continuous case. Signal-to-noise ratio; power spectral density,

Gaussian channels, Relative significance of bandwidth and noise limitations. The Shannon rate limit and efficiency for noisy continuous channels.

Unit – IV **(08 hours)**

Error Control Coding: Linear blocks codes and their properties, hard-decision decoding, cyclic codes, Convolution codes, Soft decision decoding, Viterbi decoding algorithm.

Unit – V **(08 hours)**

Advanced Coding Techniques and Cryptography: BCH codes, Trellis coded modulation, introduction to cryptography, overview of encryption techniques, symmetric cryptography, DES, IDEA, asymmetric algorithms, RSA algorithm.

TEXT BOOKS

1. Ranjan Bose, Information Theory, Coding and Cryptography, Tata McGraw Hill

2. Richard B. Wells, Applied Coding and Information Theory for Engineers, Pearson

3. R.W.Hamming , Coding and Information Theory, 2nd edition, Prentice Hall

4. R.G.Gallager, Information Theory and Reliable Communication, Wiley

REFERENCES

1. R.J. McEliece, The Theory of Information and Coding. Addison –Wesley

2. M.Mansuripur, Introduction to information Theory: Prentice Hall,1987

3. Taub & Schilling, Principles of communication, McGraw Hill

4. Thomas Cover & Joy Thomas, Elements of Information Theory, John Wiley &Sons

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HIGH FREQUENCY ELECTRONICS (WET-308)

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

Course Objectives:

- Analyze high-frequency propagation, standing wave ratios, distributed impedance and reflections by applying transmission line theory and Smith charts.
- Analyze electrical structures where active components require high-frequency modelling, and propagation delays are not insignificant
- Design high frequency multiport circuits using S and Z parameters, as well as signal flow graphs.
- Design high-frequency multistage amplifiers, including the case where the amplifiers require impedance matching networks.

Course Outcome:

CO1: Understand and identify the fundamental concepts and various components of analog communication systems.

CO2: Explain signal to noise ratio, noise figure and noise temperature for single and cascaded stages in a communication system.

CO3: Describe analog pulse modulation techniques and digital modulation technique.

CO4: Develop the ability to compare and contrast the strengths and weaknesses of various communication systems.

Syllabus:

UNIT-I **(2 hours)**

Introduction: Overview of wireless communication system, Signal, spectrum and modulation, Features of this course.

UNIT-II **(10 hours)**

Multirate Digital Signal Processing: Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a Rational Factor I/D. Implementation of sampling Rate Conversion, Multistage implementation of sampling rate conversion, Sampling rate conversion by an Arbitrary Factor, Applications of Multirate Signal Processing, Digital Filter Banks, Two-Channel Quadrature Mirror Filter Bank, M-channel QMF Bank.

UNIT-III **(10 hours)**

Linear Prediction and Optimum Linear Filters: Random Signals, Correlation Functions, and Power spectra, innovations representation of a stationary random process, Forward and backward Linear Prediction, Levinson – Durdin algorithm, properties of the Linear Prediction-Error Filters, Wiener Filters for filters for filtering and prediction.

UNIT-IV **(10 hours)**

Adaptive Filters: Applications of Adaptive filers, Adaptive Direct-Form FIR Filters- The LMS algorithm, Adaptive Direct Form Filters- RLS algorithm

UNIT-V **(10hours)**

Power Spectrum Estimation: Estimation of spectra from Finite-Duration Observations of Signals, Nonparametric methods for power spectrum estimation, Parametric methods for power spectrum estimation, Eigen analysis algorithms for spectrum estimation- Eigen decomposition of the Autocorrelation Matrix for sinusoids in White Noise, MUSIC algorithm, ESPRIT algorithm.

Text Books:

1. John G. Proakis and Manolakis, “Digital Signal Processing”, Prentice Hall, 4th Edition, 2007.
2. E C Ifeachor and B W Jarvis, “Digital Signal Processing: A Practitioner’s approach”, Pearson Education, India, 2nd Edition, 2002, Reprint.

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References books:

1. Robert O Cristi, "Modern Digital Signal Processing", Cengage publishers India, 2003
2. S K Mitra, "Digital Signal Processing: A computer based Approach" Tata Mcgraw Hill, India, 3rd Edition, 2007

BIOMEDICAL ELECTRONICS(WET-309)

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

Course Objectives:

- To study the working of different medical equipment's.
- To understand the applications and able to measure different physiological parameters of human body.

Course Outcome:

CO1: To understand the electronic devices and theory of operation in the medical area.

CO2: To apply the knowledge of engineering and science to understand biomedical electronic circuits.

CO3: To understand the advanced technologies of healthcare treatment.

CO4: To study various ECG compression techniques.

Syllabus:

Unit I **(8 hours)**

Intoduction : Brief introduction to human physiology. Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases.

Unit II **(8 hours)**

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Biomedical equipments& measurements: Bioelectrodes and biopotential amplifiers for ECG, EMG, EEG, etc. Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrsonic and nuclear imaging. Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped. Safety aspects.

Unit III **(8 hours)**

Telemetry: Transmission of the original through wire & wireless. Imaging techniques – Ultrasound, CAT, X-Rays, PET, NMR, Nuclear. Physiological effect of electric current, safety.

Unit IV **(8 hours)**

Cardiological Signal Processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG parameters & their estimation, the use of multi scale analysis for parameters estimation of ECG waveforms, Arrhythmia analysis, monitoring, long form continuous ECG recording.

Unit V **(8 hours)**

ECG data compression: reduction technique, Direct data compression techniques, Direct ECG data compression techniques. Transformation compression techniques. Other data compression techniques. Data compression techniques, comparison.

BOOKS

- Medical Instrumentation: Application and Design, 3ed-, Webster, Wiley
- Biomedical Signal Processing, D Reddy, TMH
- Electronics in Medicine and Biomedical Instrumentation, Phi
- Biomedical Signal Processing, D.Reddy,TMH
- Medical Instrumentation Application And Design,John G.Webster,Oxford
- Advanced Methods Of Biomedical Signal Processing,SergioCerutti,Oxford

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ANTENNA THEORY AND TECHNIQUES (WET-310)

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

Course Objectives:

- To provide comprehensive knowledge of different design and performance parameters of antenna.
- To provide the overall idea about various existing antennas and different advance antennas presently in practice.
- To provide principle of operation, analysis and application of different antennas such as micro-strip antenna, smart antenna, etc.

Course Outcomes:

CO1: It provides career path to get into different antenna manufacturing industry such as Linx technology, Wavelin Inc. etc.

CO2: It provides an active participation in the electronics industry where antennas are essential equipment such as Samsung, Apple etc.

CO3: It provides an opportunity to serve as a faculty in RF & Microwave Engineering.

Unit I **12hours**

Fundamental Concepts: 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.

Radiation from Wires and Loops: Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

Unit II **08hours**

Biconical antenna, discone& conical skirt monopole, equiangular spiral antenna, fractal antenna concept & technology, corrugated horn antenna, multimode horn antenna, smart antenna- benefit, drawbacks & design, adaptive beamforming, MANET, array theory, Electrically small & big antenna

Unit III **08hours**

Artificial dielectric lens antenna, Luneburg & Einstein lenses, electrically & physically small antenna, ground plane antenna, sleeve antenna, turnstile antenna, submerged antenna, surface wave & leaky wave antenna, weather-vane antenna, flagpote antenna, chimney antenna, ILS antenna, sugar-scoop antenna, asteroid detection antenna, embedded antenna, plasma antenna

Unit IV **10hours**

Microstrip and other planar antennas, Various types of feeding methods for microstrip antenna (Co-axial, Inset, Aperture/Slot Coupled, Proximity coupled and Corporate feeding for Arrays); Analysis of rectangular Patch Antenna, Cavity/ Modal Expansion Technique, microstrip antenna array

Unit V **10hours**

Conventional Scanning Techniques, Feed Networks for phased Arrays, Frequency Scanned Array Design, Search Patterns

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Text Books:

1. C.A.Balanis,"Antenna Theory and Design", 3 rd Ed., John Wiley &Sons., 2005

2. W. L.Stutzman, and G.A. Thiele,"Antenna Theory and Design", 2 nd Ed., John Wiley &Sons., 1998

3. R.S.Elliot,"Antenna Theory and Design", Revised edition, Wiley-IEEE Press., 2003.

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DIGITAL IMAGE AND VIDEO PROCESSING (WET-311)

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

Course Objectives:

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

Course Outcomes:

CO1: Students will be able to understand various transforms used in digital image processing.
CO2: Students will be able to understand image enhancement techniques and its applications.
CO3: Students will have knowledge of image restoration and its applications.
CO4: Students will be able to understand image segmentation and compression and their practical uses.
CO5: Students will be capable of solving engineering problems related to digital image processing.

Syllabus:

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

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

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

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

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

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 3rd Edition, Prentice Hall, 2008.
2. J. W. Woods, "Multidimensional Signal, Image and Video Processing and Coding", 2nd Edition, Academic Press, 2011.

Reference Books:

1. Ed. Al Bovik, "Handbook of Image and Video Processing", 2nd Edition, Academic Press, 2000.
2. A. M. Tekalp, "Digital Video Processing", 2nd Edition, Prentice Hall, 2015.
3. S. Shridhar, "Digital Image Processing", 2nd Edition, Oxford University Press, 2016.

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MICRO-ELECTRO-MECHANICAL-SYSTEMS (WET-312)

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

Course Objectives:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

Course Outcomes:

CO1: Ability to understand the operation of micro devices, micro systems and their applications.

CO2: Ability to design the micro devices, micro systems using the MEMS fabrication process.

Syllabus:

UNIT 1 INTRODUCTION **(8 hours)**

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT 2 SENSORS AND ACTUATORS-I **(8 hours)**

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.

UNIT 3 SENSORS AND ACTUATORS-II **(8 hours)**

Piezo resistive sensors – Piezo resistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT 4MICROMACHINING **(8 hours)**

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT 5POLYMER AND OPTICAL MEMS (8 hours)

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

Text Books:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

References books:

1. NadimMaluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2001.
3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

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DETECTION AND ESTIMATION THEORY (WET-321)

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

Course Objectives:

- To provide knowledge about various estimation techniques like parametric and non-parametric estimation techniques.
- To provide knowledge for finding good estimators.
- To provide enough knowledge for detection of signal in noise and estimate the signals in the presence of noise.

Course Outcomes:

CO1: The students will be able to apply various methods of signal estimation knowing the significance of each method.
CO2: The students will be able to decide which is a good estimator for the given specifications.
CO3: By applying suitable criterion, the students will be able to detect the signals with minimum errors in the presence of noise.

Syllabus:

Unit 1 **(8 hours)**

Binary hypothesis testing; Bayes, minimax and Neyman-Pearson tests. Composite hypothesis testing.

Unit 2 **(8 hours)**

Signal detection in discrete time: Models and detector structures. Coherent detection in independent noise. Detection in Gaussian noise. Detection of signals with random parameters. Detection of stochastic signals. Performance evaluation of signal detection procedures.

Unit 3 **(8 hours)**

Bayesian parameter estimation; MMSE, MMAE and MAP estimates. Nonrandom parameter estimation. Exponential families. Completeness theorem.ML estimation. Information inequality. Asymptotic properties of MLEs.

Unit 4 **(8 hours)**

Discrete time Kalman- Bucy filter. Linear estimation. Orthogonality principle and its application in Communication Engineering. Wiener- Kolmogorov filtering – causal and noncausal filters.

Unit 5 **(8 hours)**

Signal detection in continuous time: Detection of deterministic signals in Gaussian noise. Coherent detection in White Gaussian noise

Text Books:

1. Kreyzig, 'Advanced Engineering Mathematics'.
2. Sen, M. K. and Malik, D. F.-Fundamental of Abstract Algebra, Mc. Graw Hill.

References books:

1. Khanna, V. K. and Bhambri, S. K.- Course of Abstract Algebra, Vikash Pub.
2. Scarborough, J. B.-Numerical Mathematical Analysis, Oxford University Press.
3. Rao, S. S.-Optimization Theory and Application, Wiley Eastern Ltd., New Delhi.

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OPTIMIZATION TECHNIQUES (WET-322)

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

Course Objectives:

- Analyze the advantages and disadvantages associated with the large-scale optimization techniques when applied to problems from Electrical and Computer Engineering (ECE) applications.
- Implement selected optimization algorithms commonly used in machine learning and other areas of ECE.
- Design and implement appropriate optimization approaches for specific ECE applications.

Course Outcome:

CO1: Formulate and solve linear programming problems.

CO2: Solve the problems on networks models such as Transportation, Assignment, Shortest path, minimal spanning tree, and Maximal flow.

CO3: Solve the problems of Project Management using CPM and PERT.

CO4: Solve Non-linear Programming problems of some kinds.

CO5: Implement the Linear programming techniques using C or any other optimization software.

Syllabus:

UNIT 1 Introduction:
Historical development, application to engineering problems, statement of optimization, classification of optimization, examples of optimization problems.

UNIT 2 Linear Programming:
Graphical method, simplex method, revised simplex method, Big-M method, 2- phase method, alternate optimal solutions, unbounded LPs, degeneracy and convergence, duality in linear programming, sensitivity analysis, dual simplex method, Transportation, assignment and other applications.

UNIT 3 Non-Linear Programming:
Unconstrained optimization techniques, direct search methods (Fibannoci method, golden section, quadrature and cubic interpolation) descent methods, constrained optimization, direct and indirect methods, optimization with calculm, kuhn-tucker conditions.

UNIT 4 Dynamic Programming:
Forward recursions, General problem, Reliability problem, Capital budgeting problem, Cargo-

loading problem, Multistage decision process, principles of optimality, computational procedures in dynamic programming.

UNIT 5 CPM and PERT:
Drawing of networks, Removal of redundancy, Network computations, Free slack, Total slack, Crashing, Resource allocation.
Software: Introduction to software for optimization techniques (TORA).

Text Books:

1. S.S. Rao, Engineering Optimization: Theory and Practice, Wiley and Sons, New Jersey, 2009.

Reference Books:

1. F.H. Hiller and G.J. Liberman, Introduction to Operations Research, Tata-McGraw-Hill, 2010.
2. W.L. Winston, Operations Research: Applications and Algorithm, 4th Edition, Cengage Learning, 1994.
3. K. Deb, Optimization for Engineering Design, Prentice Hall, 2013.
4. M.C. Joshi and K. M. Moudgalay, Optimization: Theory and Practice, Narosa, 2004.

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TELECOMMUNICATION SWITCHING & NETWORKS (WET-324)

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

Course Objectives:

- This subject aims at introducing to the students the knowledge about the telecommunication industry.
- its services and market, the theoretical basis about performance (queuing theory) and operation (multiplexing, switching, routing, and signaling) in telecom networks.

Course Outcome:

CO1: Describe and apply fundamentals of telecommunication systems and associated technologies.

CO2: Apply the principles of queuing theory in evaluating the performance of congested telecommunication networks.

CO3: Solve problems and design simple systems related to tele-traffic and trunking efficiency.

CO4: Understand and explain the reasons for switching, and the relative merits of the possible switching modes, e.g. packet and circuit switching.

CO5: Understand the principles of the internal design and operation of telecommunication switches, and the essence of the key signaling systems that are used in telecommunication networks .

Syllabus:

Unit I : **(8 Hours)**

Introduction

Introduction to telephone communication, manual switching system, Automatic strowger switching system, crossbar switching system, Signaling in Automatic Strowger Switching System,Elements of a Switching System, Design parameters of Switching System.

Unit II : **(8 Hours)**

Elements of Tele-Traffic

Network traffic Load and parameters, grade of service,TrunkingEffienciency and blocking probability, modeling switching systems, incoming traffic and service time characterization, blocking models and loss estimates, delay systems.

UnitIII : **(8 Hours)**

Switching: Electronic space division switching: Stored program control; centralized and distributed, software architecture, application software, enhanced services, single and multistage networks.
Time division switching; Basic time division space switching, basic time division time switching, time multiplexed space switching, time multiplexed space switching, combination switching, multistage combination switching

Unit IV : **(8 Hours)**

Telephone Networks: Analog termination requirements, BORSCHT configuration, digital termination requirements, signaling tones, touch tone dial generation, design consideration, touch tone detection, switching hierarchy and routing, transmission plan, numbering plan- CCITT No. 7 Signaling systems.

Unit V: **(8 Hours)**
Data Networks: Data transmission in PSTN's switching, techniques for data transmission, data communication architecture, link to link layers, end to end layers, PABX, data network standards, Metropolitan Area Network (MAN),Satellite based data networks, fibre optic networks..
Network Hierarchy: Network hierarchy in the telephone network, Network hierarchy in other networks;
Network Intelligence.

BOOKS

1. ThiagarajanVishwanathan/ Telecommunication Switching Systems and Networks/PHI
2. Joseph Y. Hui/Switching and Traffic Theory for Integrated Broad Band Networks/Kleewer Academic publishers, 1990
3. V.E. Benes/Mathematical Theory of connecting Networks & Telephone Traffic/Academic Press, 1965.
4. G. Hebuterve / Traffic Flow in Switching Systems / Artech House, 1987.
5. J.C. Bellamy/Digital Telephony/John Wiley 2nd Ed., 1992
6. Anders Hellman & Gudrun Bager/ Understanding Telecommunication 1/Printed in Sweden, Student literature, Lund Ericcson Telecom AB, Competence Development centre

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ADAPTIVE SIGNAL PROCESSING(WET-325)

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

Course Objectives:

- To introduce some practical aspects of signal processing, and in particular adaptive systems
- To introduce current applications for adaptive systems are in the fields of communications, radar, sonar, seismology, navigation systems and biomedical engineering
- This course will present the basic principles of adaptation, will cover various adaptive signal processing algorithms (e.g., the LMS algorithm) and many applications, such as adaptive noise cancellation, interference canceling, system identification, etc.

Course Outcomes:

CO1: The student will be able to explain the importance of signal processing in non-stationary environment.

CO2: List and apply the various mathematical models to adaptive signal processing

CO3: Understand the problem of finding the minimum error criteria.

CO4:A good understanding of techniques like Kalman Filtering and Recursive Least-Squares techniques will be useful to extend them to machine learning paradigms

Syllabus:

UNIT 1 **(8 hours)**

Adaptive Systems – Definition and characteristics – Properties – Applications and examples of an adaptive system. Stochastic Processes and Models: Characterization – Mean ergodic theorem – Correlation matrix – Stochastic models – Power spectral density – Properties of power spectral Density – Linear transformations – Power spectral estimation.

UNIT 2 **(8 hours)**

Wiener filters – Linear optimum filtering – Minimum mean-square error – Wiener- Hopf equations – Multiple linear regression model – Steepest-descent algorithm – Linear prediction – Forward linear prediction, Levinson-Durbin algorithm. Kalman filter – Extended kalman filter (8 hours)

UNIT 3 **(8 hours)**

Least-Mean-Square (LMS) adaptive filters – LMS algorithm, LMS adaptation algorithm – applications. Method of Least Squares – Data windowing, Normal equations and linear least square filters, Recursive least squares algorithm. (8 hours)

UNIT 4 **(8 hours)**

Particle Filtering: The Basic Idea, The Choice of Proposal Distribution and Resampling, Some Particle Filtering Methods, Handling Constant Parameters, Rao–Blackwellization, Prediction, Smoothing.

UNIT 5 **(8 hours)**

Applications of adaptive signal processing - adaptive modeling and system identification inverse adaptive modeling, deconvolution and equalization adaptive control systems adaptive interference canceling canceling noise, canceling periodic interference, canceling interference in ECG signals

Text Books:

1. Simon Haykins, "Adaptive Filter Theory", Pearson Education, Fifth Edition, 2013.
2. B. Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

References books:

1. Todd K. Moon, Wynn C. Stirling, "Mathematical Methods and Algorithms for Signal Processing" Prentice Hall, First edition, 1999.
2. John. R. Triechler, C. Richard Johnson (Jr), Michael. G. Larimore, "Theory and Design of Adaptive Filters", Prentice Hall India Private Limited, 2004
3. Bernard Widrow and Samuel. D. Stearns, "Adaptive Signal Processing", Pearson Education, 2001.

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CLOUD COMPUTING (DET 323)

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

Course Objectives:

- To understand the concept of cloud computing.
- To appreciate the evolution of cloud from the existing technologies.
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.

Course Outcomes:

CO1: Articulate the main concepts, key technologies, strengths and limitations of cloud computing.

CO2: Learn the key and enabling technologies that help in the development of cloud.

CO3: Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.

CO4: Be able to install and use current cloud technologies.

CO5: Evaluate and choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

Syllabus:

UNIT 1 **(8 hours)**

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

UNIT 2 **(8 hours)**

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery. (8 hours)

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UNIT 3 **(8 hours)**

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

(8 hours)

UNIT 4 **(8 hours)**

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

UNIT 5 **(8 hours**

)Hadoop – MapReduce – Virtual Box -- Google App Engine – Programming Environment for Google App Engine — Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.

Text Books:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security‖, CRC Press, 2017.

References books:

1. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing‖, Tata Mcgraw Hill, 2013.

2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach‖, Tata Mcgraw Hill, 2009.

3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)‖, O'Reilly, 2009.

ARTIFICIAL INTELLIGENCE (DET-326)

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

Course Objectives:

- To learn the difference between optimal reasoning Vs human like reasoning
- To understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities
- To learn different knowledge representation techniques
- To understand the applications of AI: namely Game Playing, Theorem Proving, Expert Systems, Machine Learning and Natural Language Processing

Course Outcomes:

CO1: Articulate the main concepts, key technologies, strengths and limitations of Artificial Intelligence

CO2: Learn the key and enabling technologies that help in the development of Artificial Intelligence.

CO3: Develop the ability to understand the forms of learning.

CO4: Be able to implement NLP.

CO5: Analyze and apply the AI tools.

Syllabus:

UNIT 1 **(8 hours)**

Introduction: What is AI? Foundations of AI, History of AI, Agents and environments, The nature of the Environment, Problem solving Agents, Problem Formulation, Search Strategies

UNIT 2 **(8 hours)**

Knowledge and Reasoning: Knowledge-based Agents, Representation, Reasoning and Logic, Prepositional logic, First-order logic, Using First-order logic, Inference in First-order logic, forward and Backward Chaining

UNIT 3 **(8 hours)**

Learning: Learning from observations, Forms of Learning, Inductive Learning, Learning decision trees, why learning works, Learning in Neural and Belief networks

UNIT 4 **(8 hours)**Practical Natural Language Processing: Practical applications, Efficient parsing, Scaling up the
lexicon, Scaling up the Grammar, Ambiguity, Perception, Image formation, Image processing operations for Early vision, Speech recognition and Speech Synthesis

UNIT 5 **(8 hours)**Robotics: Introduction, Tasks, parts, effectors, Sensors, Architectures, Configuration spaces, Navigation and motion planning, Introduction to AI based programming Tools.

Text Books:

1. Stuart Russell, Peter Norvig: "Artificial Intelligence: A Modern Approach",2nd Edition,

Pearson Education, 2007

References books:

1. Artificial Neural Networks B. Yagna Narayana, PHI

2. Artificial Intelligence , 2nd Edition, E.Rich and K.Knight (TMH).

3. Artificial Intelligence and Expert Systems – Patterson PHI.

4. Expert Systems: Principles and Programming- Fourth Edn, Giarrantana/ Riley, Thomson.

5. PROLOG Programming for Artificial Intelligence. Ivan Bratka- Third Edition – Pearson Education.

6. Neural Networks Simon Haykin PHI

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Technical Writing and Presentation Skills (AHT-303)

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

Course Objectives:

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

Course Outcomes:

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

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

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

CO3: Communicate in an ethically responsible manner.

Course Contents:

WRITING SKILLS

Unit-I **(4 hours)**

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

Unit-II **(4 hours)**

Principles of Summarizing: Abstract, Summary, Synopsis

Unit-III **(6 hours)**

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

PRESENTATION SKILLS

Unit-IV **(6 hours)**

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

Unit-V **(8 hours)**

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

References:

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8. Kumar, Sanjay &PushpLata, “Communication Skills”, Oxford UniversityPress,2011.
9. Quirk & Randolph, “A University Grammar of English”, Pearson,2006.
10. Rutherford, Andrea J., “Basic Communication Skills for Technology”, Pearson 2007.
11. Rizvi, M Ashraf, “Effective Technical Communication”, McGraw Hill,2009.
12. Leigh, Andrew & Maynard, Michael, “The Perfect Presentation”, Random House.
13. Barker, Larry L., “Communication”, Prentice-Hall.
14. Lesikar&Flatley, “Basic Business Communication-Skills for Empowering the Internet Generation”, Tata McGraw-Hill.