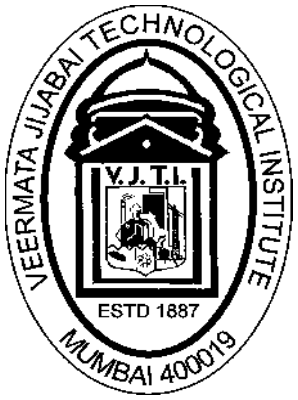
VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

(VJTI)

MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)



Curriculum

(Scheme of Instruction & Evaluation and Course contents)

For

Fourth Year Undergraduate Programme

Leading to Bachelor of Technology (B. Tech.) Degree

in Electronics & Telecommunication Engineering

Implemented from the batch admitted in Academic Year 2018-19

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

(Autonomous Institute affiliated to University of Mumbai)

Curriculum

(Scheme of Instruction & Evaluation and Course contents)

For

Fourth Year Undergraduate Programme Leading to
Bachelor of Technology (B. Tech.)
In

109 Electronics & Telecommunication Engineering

Institute Vision

To establish global leadership in the field of Technology and develop competent human resources for providing service to society

Institute Mission

- **To provide students with comprehensive knowledge of principles of engineering with a multi-disciplinary approach that is challenging**
- **To create an intellectually stimulating environment for research, scholarship, creativity, innovation and professional activity.**
- **To foster relationship with other leading institutes of learning and research, alumni and industries in order to contribute to National and International development.**

Department Vision

To establish global leadership in the field of Electrical, Electronics & Communication Engineering and to develop competent human resources for providing service to society.

Department Mission

- **To provide student with comprehensive knowledge for taking up challenges in the field of Electrical Engineering with a multi-disciplinary approach.**
- **To create an intellectually stimulating environment for research, industry interaction, creativity, innovation and professional activity.**
- **To foster relationship with renowned institutes of learning and research, alumni and industries in order to contribute to National and International development.**

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Electronics and Telecommunication Engineering Graduates will have ability to

1. Deliver fundamental as well advanced knowledge with research initiatives in the field of Electronics and Communication Engineering with emphasis on state of the art technology.

2. Design solutions for electronic systems for real world applications which are technically feasible and economically viable leading to societal benefits.

3. Demonstrate the leadership qualities and professional attitudes to deal with challenges.

PROGRAM OUTCOMES (POs)

Engineering Graduate will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as,

being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Electronics and Telecommunication Engineering Graduate will be able to:

1. Design, develop and test electronic and telecommunication systems in the areas related to analog and digital communication, signal processing and VLSI design.

2. Analyze, design and implement systems to strive balance between increasing complexity, robustness and performance of systems.

3. Design software and hardware systems, components or process to meet desired needs within realistic constraints.

Veermata Jijabai Technological Institute

Scheme of Instruction and Evaluation (R – 2018)

B. Tech. EXTC Semester VII

Sr. No	Course Code	Course Name	Hr/ Week			Credits	Scheme of Evaluation			
			L	T	P		TA	MST	ESE	ESE hours
1	R4ET4001S	Digital Image Processing	3	0	0	3	20	20	60	3
2	R4ET4002S	Optical Communication and Networks	3	0	0	3	20	20	60	3
3	R4ET4003T	Antenna Theory and Design	3	0	0	3	20	20	60	3
	R4ET4003P	Antenna Theory and Design LAB	0	0	2	1	60	-	40	2
4		Program Elective II	3	0	0	3	20	20	60	3
		Program Elective II LAB	0	0	2	1	60	-	40	2
5		Open Elective II	3	0	0	3	20	20	60	3
6	R4ET4901D	Project I	0	0	4	2	60	-	40	2
7	R4ET4701I	Internship	-	-	-	2				
		Total	15	0	8	21				

B. Tech (Electronics and Telecommunication Engineering) SEMESTER VII: Program Elective – II

S. No.	Course Code	Course Title
1.	R4ET4101T	RF Circuit Design
	R4ET4101P	RF circuit Design Lab
2.	R4ET4102T	Advanced Digital Signal Processing
	R4ET4102P	Advanced Digital Signal Processing Lab
3.	R4ET4103T	OFDM-MIMO Communication
	R4ET4103P	OFDM-MIMO Communication Lab

Open Elective II

S. No.	Course Code	Course Title
1.	R4ET4601S	Introduction to Nano Electronics

Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **IST**: In Semester Tests (comprise of average of two in semester tests), **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation

Veermata Jijabai Technological Institute
Scheme of Instruction and Evaluation (R – 2018)

B. Tech. EXTC Semester VIII

Sr. No	Course Code	Course Name	Hr/ Week			Credits	Scheme of Evaluation			
			L	T	P		TA	MST	ESE	ESE hours
1	R4ET4011S	Embedded Systems	3	0	0	3	20	20	60	3
2	R4ET4012S	Satellite Communication	3	0	0	3	20	20	60	3
3	R4ET4013S	Advanced Coding Techniques	3	0	0	3	20	20	60	3
4		Program Elective III	3	0	0	3	20	20	60	3
5		Program Elective IV	3	0	0	3	20	20	60	3
		Program Elective IV LAB	0	0	2	1	60	-	40	2
6	R4ET4902D	Project II	0	0	8	4	60	-	40	2
		TOTAL	**15**	**0**	**10**	**20**				

B. Tech (Electronics and Telecommunication Engineering) SEMESTER VIII: Elective – III

S. No.	Course Code	Course Title
1	R4ET4111S	Next Generation Networks
2	R4ET4112S	E-security
3	R4ET4113S	Statistical Theory of Communication
4	R4ET4114S	Pattern Recognition and Machine Vision

B. Tech (Electronics and Telecommunication Engineering) SEMESTER VIII: Elective – IV

S. No.	Course Code	Course Title
1.	R4ET4121T	Medical Electronics
	R4ET4121P	Medical Electronics LAB
2.	R4ET4122T	Applied machine learning and Fuzzy Systems
	R4ET4122P	Applied machine learning and Fuzzy Systems LAB
3.	R4ET4123T	Wireless Sensor Networks
	R4ET4123P	Wireless Sensor Networks LAB
4.	R4ET4124T	Advanced Image Analysis
	R4ET4124P	Advanced Image Analysis Lab

SEMESTER VII

Programme Name	**B. Tech. EXTC, Semester-VII**
Course Code	R4ET4001S
Course Title	**Digital Image Processing**
Pre-requisite	**Digital Signal processing**

COURSE OBJECTIVE

1. The objectives of this course are for students to learn the fundamental theories and techniques of digital image and video processing.
2. To study image representation and different transforms.
3. To study pre-processing of images and modeling of images.
4. To understand different features of image and extraction of these features from image.
5. To understand the basics of video object extractions.

COURSE OUTCOME

After successful completion of this course, students will be able to

1. Analyze image enhancement techniques in spatial and frequency domain.
2. Interpret application of transform theory for image analysis and employ them for various applications.
3. Implement methods of image segmentation and examine textural properties.
4. Describe feature extraction methods in video processing.
5. Implement object detection methods in video analysis.

COURSE CONTENTS

Module 1	**Digital Image fundamentals**
	Digital Image Representation, Elements of digital Image processing systems, Elements of Visual Perception, Sampling and Quantization, Basic relationships between pixels.
Module 2	**Image Transforms**
	2D DFT and its properties, Walsh Transform, Hadamard Transform, Haar Transform, Discrete Cosine Transform, Slant Transform, Hotelling Transform.
Module 3	**Image Restoration and Enhancement**
	Model of Image degradation and Restoration Process, Noise models, Spatial filtering, Frequency Domain Filtering, Modeling the degradation function, Inverse Filtering, Wiener Filtering. Spatial Domain Methods, Point Processing Neighbourhood Processing, spatial domain filtering, Zooming, Enhancement based on Histogram modeling, Enhancement in Frequency domain, Frequency domain filters, Generation of spatial mask from frequency domain.
Module 4	**Image Compression**
	Fundamentals, Image compression model, Redundancy, Error Criteria, Information Theory for Image compression, Lossy and lossless compression techniques, Image compression standards.
Module 5	**Image Segmentation**
	Image segmentation based on discontinuities (Point, Line & Edge detection), Edge Linking, Thresholding (Global, Local, Optimum), Region based Segmentation.
Module 6	**Spatial feature extraction and classifiers**
	Filtering techniques- Localized feature extraction- Boundary Descriptors- Moments- Texture, Descriptors- Co-occurrence features- Run length features- Feature selection, Maximum Likelihood Estimation- Bayesian

	approach- Pattern Classification by distance functions-BPN.
Text Books:	
1.	*Digital Image Processing*- By R. Gonzales, R. Woods- Pearson Education.
2.	*Fundamentals of Image Processing*- By Anil K. Jain, Prentice Hall of India Publication.
Recommended Reading:	
1.	*Image Processing Analysis and Machine vision*- Milan Sonka, Viciav Hivac, Roger Boyle- Thomson Learning Publication.
2.	*Digital Image Processing*, Pratt, 3rd ed., Wiley India.

Programme Name	**B. Tech. EXTC, Semester-VII**
Course Code	R4ET4002S
Course Title	**Optic Communication and Networks**
Pre-requisite	**Analog Communications**

COURSE OUTCOMES

After completion of this course, students will be able to

1. Identify and categorize different optical components.
2. Estimate the losses of the optical system.
3. Analyse an optical communication system.
4. Determine the various parameters with different measurement techniques.

COURSE CONTENTS

Module 1	**Overview Of Optical Fiber Communications**
	Communication system applications in the electromagnetic spectrum, elements of or fiber transmission link, advantages of optical fiber communication. **Light Propagation in Optical Fiber:** Filter types, rays and modes, ray theory transmission, electromagnetic mode theory propagation, single mode and multimode fibers, linearly polarized models.
Module 2	**Introduction to Optical Networks**
	Optical Networks- Multiplexing Techniques, second-Generation Optical Networks. The Optical Layer, Transparency and All-optical networks Optical Packet Switching, Transmission Basics and Network Evolution.
Module 3	**Signal Degradation in Optical Fibers**
	Propagation of signal in Optical Fiber, Attenuation, Dispersion, Nonlinear Effects, Photonic crystal fiber and Plastic Optical Fiber mode.
Module 4	**Optical Sources , Components and Detectors**
	Light emitting diodes, laser diodes, their characteristics modulation circuits, optical detection principles, PIN and Avalanche photodiodes. Optical Couplers, Isolators and Circulators, Multiplexers and Filters, Optical Amplifiers
Module 5	**Optical Receiver Operation**
	Fundamental Receiver Operation, Digital Receiver Performance Calculation, Per-amplifier Types, Analog receiver. Digital Transmission System:- Point to Point System, Eye Pattern, Noise Effects on system performance. Analog System:- Carrier to Noise ratio, Multiple Transmission Techniques. Coherent optical fiber communication:- homodyne and heterodyne detection, multiplexing.
Module 6	**Optical Fiber Measurements**
	Measurement of attenuation, dispersion, refractive index profile, numerical aperture diameter, OTDR.

Text Books:	
1.	John Senior, "*Optical Fiber Communication"* Prentice Hall of India Publication 4th edition.
2.	Gred Keiser, "*Optical Fiber Communication*", Mc- Graw Hill Publication. 2007
Additional Reading:	
1.	Selvarajan, Subartkar, T. Srinivas, "*Optical Fiber Communication"*- Tata Mc- Graw Hill Publication. 2011
2.	Pal B.P, "*Fundamentals of Fibre Optics in Telecommunication and sensor System"*, New Age International. 2007
3.	G. Agrawal, "*Fiber Optic Communication*", Wiley Publications 3rd edition.

Programme Name	**B. Tech. EXTC, Semester-VII**
Course Code	R4ET4003T
Course Title	**Antenna Theory and Design**
Pre-requisite	**Electromagnetic Wave Engineering**

COURSE OUTCOMES

After completion of this course, students will be able to

1. Classify the radio wave propagation.
2. Select antennas as per their operating frequency ranges and radiation patterns for a specific application.
3. Apply design principles to design an antenna.
4. Identify the atmospheric and terrestrial effects on radio wave propagation.

COURSE CONTENTS

Module 1	**Radio Wave Propagation and Antenna Fundamental Parameters**
	Ground Wave propagation, Ionosphere Layers and Sky wave propagation: Space Wave propagation: Tropospheric scattered propagation, Duct Propagation, Fading. **Introduction-** Types of Antennas, Radiation mechanism, Radiation Pattern, Radiation Power Density, Radiation Intensity, Beam width, Directivity, Numerical Techniques, Antenna Efficiency, Gain, Beam Efficiency, Bandwidth, Polarization, Input Impedance, Antenna Radiation Efficiency, Antenna Vector Effective Length and Equivalent Areas, Maximum Directivity and Maximum Effective Area, front to back ratio, Antenna Temperature, Antenna field zones, Friss Transmission Equation and Radar Range Equation, Far-Field radiation, Duality theorem, Reciprocity theorem.
Module 2	**Basic Wire Antennas & Arrays**
	Radiation characteristics of wire antennas, Current distribution on thin wire antenna, Resonant wire antennas (λ, 2λ) Non Resonant (Rhombic) Antenna, Folded dipole Antenna. **Loop Antennas** Field pattern of circular loop antenna & radiation resistance of loop antenna, directivity of circular loop antennas with uniform current. **Arrays (Linear)** Introduction, Concept of pattern multiplication, Two-Element Array, *N*-Elements Linear Array: Directivity, (Broadside, End fire, Super-directive), Arrays with non-uniform excitation-Binomial array, Yagi-Uda antenna.
Module 3	**Frequency Independent Antennas**
	Introduction, Log Periodic, Helical Antennas, Spiral antenna. **Horn Antennas** Introduction, *E*-Plane Sectoral Horn, *H*-Plane Sectoral Horn, Pyramidal Horn, Conical Horn, Corrugated Horn.
Module 4	**Microstrip (patch) Antennas**
	Rectangular and circular types, function, feeding mechanism, features analysis, design considerations and applications of broadband antennas, concept of Smart antennas.

Module 5	**Reflector Antennas and Lens Antennas**
	Plane Reflector, Corner Reflector, Parabolic Reflector, feeding methods, Non-metallic dielectric and artificial dielectric lens antennas, reflector lens antennas.
Text Books:	
1.	*John D. Cross, "Antennas"*, Tata Mc Graw Hill Publications. 2011
2.	C. A. Balani, *"Antenna Theory Design & Analysis"*, John Wiley & sons Publications. 2012
3.	G. S. N. Raju, "*Antennas and Wave Propagation"*, Pearson Education India. 2006
Additional Reading:	
1.	Jordan, Balmain, *"Electromagnetics Waves and Radiating Systems"*, PHI publications, 2nd edition.
2.	A.R.Harish, M.Sachidanada, "*Antennas and Wave propagation*", Oxford University Press, 1st Edition, 2007
3.	K.D. Prasad, Handa, Deepak, *"Antenna and Wave propagations"*, New Delhi: Satya Prakashan,3rd edition, 2003

Programme Name	**B. Tech. EXTC, Semester-VII**
Course Code	R4ET4003P
Course Title	**Antenna Theory and Design Lab**
Pre-requisite	**Electromagnetic Wave Engineering**

COURSE OUTCOMES

After completion of this course, students will be able to

1. Test various Antennas performance.
2. Plot the radiation pattern and calculate various parameters.
3. Design a micro strip antenna to the given specification
4. Simulation and analyse the design.

Sr. No	**Modules covered**	**Experiments**
1.	1,2	Plot the radiation pattern of half wave dipole and find HPBW.
2.	1,2	Check the radiation pattern of rhombic antenna.
3.	1,2	Plot radiation pattern of loop antenna and calculate its parameters.
4.	1,2	Plot radiation pattern of folded dipole antenna.
5.	1,3	Test the performance of the Log -periodic antenna.
6.	1,2	Plot radiation pattern of the broad side array antenna and calculate its parameters.
7.	1,2	Plot radiation pattern of the end fire array antenna and calculate its parameters.
8.	1,3	Test the performance of helical antenna in horizontal and vertical planes.
9.	1,5	Check the radiation pattern of parabolic reflector antenna.
10.	1,5	Test the performance of horn antenna.
11.	1,4	Design Microstrip Patch antenna using simulation software.
12.	1,2,3,4,5	Select the relevant Mobile Antenna System for a particular area.
Text Books:		
1.	*John D. Cross, "Antennas"*, Tata Mc Graw Hill Publications. 2011	
2.	C. A. Balani, *"Antenna Theory Design & Analysis"*, John Wiley & sons Publications. 2012	
3.	G. S. N. Raju, "*Antennas and Wave Propagation"*, Pearson Education India. 2006	

Program Elective II

Programme Name	**B. Tech. EXTC, Semester-VII**
Course Code	R4ET4101T
Course Title	**RF Circuit Design**
Pre-requisite	**Electromagnetic Wave Engineering, Microwave Engineering**

COURSE OUTCOMES

After completion of this course, students will be able to

1. Describe the various components of RF circuits.
2. Estimate the circuit parameters of RF circuits.
3. Implement various Impedance matching Techniques for RF applications.
4. Design filters needed for RF telecommunication applications.
5. Design RF Amplifiers.

COURSE CONTENTS

Module 1	**Introduction**
	Importance of Radio Frequency Design, Dimensions and Units, Frequency Spectrum, RF Behavior of Passive Components, Chip Components and Circuit Board Considerations, RF Circuit Manufacturing Processes.
Module 2	**RF Circuit Fundamentals**
	Introduction, The decibel scale, Complex number review, Normalization, R-L-C voltage-current relationships, Complex impedance and admittance system, Unloaded and loaded Q definitions, Complex series impedance of RF components, Complex parallel admittance of RF components, Series and parallel L-C resonant circuits, Series and parallel conversions of lumped R-L-C networks, One port and multi-port networks, Importance of power transfer when cascading system components, Importance of impedance matching, RF components and related issues, Lumped elements versus transmission lines, Circuits parameter using waves relations, Impedance transformation and matching, Single ended versus differential circuits, Time domain versus frequency domain.
Module 3	**Impedance Matching Technique**
	The impedance match, Transmission zero definitions, Impedance matching into complex termination, Impedance matching with uneven resistive terminations, The Q-matching technique with L-C sections, Impedance matching of complex terminations, multi-section impedance matching to increase bandwidth, multi-section impedance matching to decrease bandwidth, Impedance matching with transmission line components, Impedance matching with transmission line with smith chart, Impedance matching of balanced circuits.
Module 4	**Filters and Resonant Circuits**
	Introduction, Filter Specifications, Various filter types, Low frequency versus RF/MW filters, Comparison of filter responses, Multiplexer Filters, Filter Design Outline Transmission Line (Distributed element) Filters, Network Transformations, LC resonant circuits in filter design, Other forms of resonators.
Module 5	**RF Transistor Amplifier Design**

	Characteristics of Amplifiers, Amplifier Power Relations, Stability Considerations, Constant Gain, Noise Figure Circles, Constant VSWR Circles.
Text Books:	
1.	Reinhold Ludwig and Gene Bogdanov, "*RF Circuit Design: Theory and Applications",* Pearson Education, Inc 2000
2.	Behzad Razavi, *"RF Microelectronics"*, Prentice Hall Books. 2012
Additional Reading:	
1.	Les Besser and Rowan Gilmore*, "Practical RF Circuit Design for Modern Wireless Systems Volume I",* Artech House, INC. 2002
2.	Chris Bowick*, "RF Circuit Design",* Newnes 2nd edition. 2011

Programme Name	**B. Tech. EXTC, Semester-VII**
Course Code	R4ET4101P
Course Title	**RF Circuit Design Lab**
Pre-requisite	**Electromagnetic Wave Engineering, Microwave Engineering**

COURSE OUTCOMES

After completion of this course, students will be able to

1. Select components for RF circuits as per the given specification.
2. Design RF circuits using various EDA tools.
3. .Design RF passive circuits, RF filters, RF amplifiers and RF oscillators.
4. Test RF passive circuits, RF filters, RF amplifiers and RF oscillators for telecommunication

COURSE CONTENTS

Module 1	**Introduction**
	1.1 Study of RF Passive Components. 1.2 Study of RF active components. 1.3 RF PCB design. 1.4 Study of RF circuit design tools like ADS and APLAC. 1.5 Study of VNA.
Module 2	**RF Circuit Fundamentals**
	2.1 RF R-L-C series circuits design and testing. 2.2 RF RLC parallel circuits design and testing. 2.3 RF tuned circuit design with loaded Q. 2.4 Torids design and testing. 2.5 RF components and related issues. 2.6 ABCD parameters measurements. 2.7 S-parameters measurements.
Module 3	**Impedance Matching Technique**
	3.1 Impedance matching passive circuit design with complex load. 3.2 The Q-matching technique with L-C sections. 3.3 Impedance matching active circuit design with complex load. 3.4 Impedance matching with transmission line components. 3.5 Impedance matching of balanced circuits. 3.6 Wideband matching network design.
Module 4	**Filters and Resonant Circuits**
	4.1 Butterworth and Chebyshev filter LP design with various terminations. 4.2 Butterworth and Chebyshev filter HP design with various terminations. 4.3 Dual network filter design. 4.4 Band Pass filter design. 4.5 Band reject filter design. 4.6 Multiplexer Filters design. 4.7 Filter Design Outline Transmission Line (Distributed element) Filters. 4.8 Network Transformations.

	4.9 LC resonant circuits in filter design. 4.10 Other forms of resonators.
Module 5	**RF Transistor Amplifier Design**
	5.1 Y parameters of RF transistors. 5.2 S parameters RF transistors. 5.3 Understanding of RF transistor data sheets. 5.4 RF transistor biasing, Stability in RF amplifier. 5.5 RF amplifier design using Y parameters. 5.6 Transducer gain measurement of RF amplifier. 5.7 RF amplifier design using S parameters. 5.8 RF amplifier design for optimum noise figure. 5.9 Multistage RF amplifier design. 5.10 RF power transistor characteristics. 5.11 RF broadband transformer design.
Module 6	**Oscillators and Mixers**
	6.1 Feedback oscillator design. 6.2 YIG oscillator design. 6.3 Voltage controlled oscillator design. 6.4 Various Mixer design.
Note:- At least 2 experiments per module should be conducted	
Text Books:	
1.	Reinhold Ludwig and Gene Bogdanov, "*RF Circuit Design: Theory and Applications",* Pearson Education, Inc 2000
2.	Behzad Razavi, *"RF Microelectronics"*, Prentice Hall Books. 2012
Additional Reading:	
1.	Les Besser and Rowan Gilmore*, "Practical RF Circuit Design for Modern Wireless Systems Volume I",* Artech House, INC. 2002
2.	Chris Bowick*, "RF Circuit Design",* Newnes 2nd edition. 2011

Programme Name	**B. Tech. EXTC, Semester-VII**
Course Code	R4ET4102T
Course Title	**Advanced Digital Signal Processing**
Pre-requisite	**Digital Signal Processing**

COURSE OBJECTIVES

1. To understand statistical signal processing system in various domains.
2. To introduce and learn applications of linear algebra concepts with emphasis on Eigen analysis.
3. To understand and develop various random processes.
4. To analyze and design MRA systems.
5. To design and implement wavelet based methods for various applications.

COURSE OUTCOMES

After successful completion of this course, students will be able to

1. Apply concept of linear algebra and Eigen analysis.
2. Design and implement ARMA, AR and MA processes.
3. Interpret and apply MRA concepts.
4. Design wavelet based MRA for 1D 2D processing.

COURSE CONTENTS

Module 1	**Multirate Digital Signal Processing**
	Decimation Interpolation Filter design and implementation Sampling rate conversion Application of multirate signal processing.
Module 2	**Review of Linear Algebra**
	Linear Algebra-Research part, abstractness, real life examples, Introduction to Random processes, numerical approach.
Module 3	**Filtering Discrete Time random processes**
	Spectral Estimation, Levinson Durbin, evolution of Tukey, MUSIC.
Module 4	**Spectral Factorization**
	Minimum phase signals & systems Partial energy & minimum delay Minimum phase & minimum delay property Spectral factorization theorem.
Module 5	**Spectral Estimation by Classical methods**
	The periodogram The modified periodogram Barlett, Welch & Blackman-Tuckey, approach.
Module 6	**Multiresolution Analysis using Wavelets**
	Introduction to time frequency analysis Short-time Fourier transform Wigner-Ville transform Continuous time wavelet transform Discrete wavelet transform Tiling of the time-frequency plane and wavepacket analysis, Construction of wavelets, orthogonal, biorthogonal basis
Text Books:	
1.	S.M. Kay, *Modern Spectral Estimation*, Prentice hall, 1988.
2.	J. G. Proakis, D.G. Manolakis, and D. Sharma, "*Digital Time Signal Processing: principles, algorithms, and applications*," Pearson Education, 2006.
3.	DaFatta, D. J., Lucas, J. G., and Hodgkiss, W. S. "*Digital Signal Processing: A system design approach*," Wiley publications, 1988.

Recommended Reading:	
1.	R. M. Rao, and A.S. Bopardikar, "*Wavelet Transforms*,*"* Pearson Education, 2001.
2.	C. S. Burrus, R. A. Gopinath, and H. Guo,. "*Introduction to Wavelets and Wavelets Transforms*," PrenticeHall, 1998.
3.	P. P. Vaidyanathan, *Multirate Systems and Filter Banks*, Prentice Hall, 1993.

Programme Name	**B. Tech. EXTC, Semester-VII**
Course Code	R4ET4102P
Course Title	**Advanced Digital Signal Processing Lab**
Pre-requisite	**Digital Signal Processing**

COURSE OBJECTIVES

1. To understand and implement statistical signal processing algorithms.
2. To introduce and learn applications of linear algebra concepts with emphasis on Eigen analysis from practical perspective.
3. To understand and develop various random processes practically.
4. To analyze and design MRA systems.
5. To design and implement wavelet based methods for various applications.

COURSE OUTCOMES

Students will be able to:

1. Apply and implement concept of linear algebra and Eigen analysis.
2. Implement ARMA, AR and MA processes.
3. Interpret and design MRA concepts.
4. Implement wavelet based MRA for speech and image signals.

COURSE CONTENTS

Module 1	**Multirate Digital Signal Processing**
	Multirate sampling,
Module 2	**Spectral Filtering**
	Auto Regressive, Moving average and ARMA processes.
Module 3	**Filtering Discrete Time random processes**
	Levinson Durbin, Schur, Tukey, MUSIC algorithms.
Module 4	**Spectral Estimation**
	Design and implementation of periodogram method, modified periodogram, Barlett, Welch & Blackman-Tuckey algorithms approach.
Module 5	**Multiresolution Analysis using Wavelets**
	MRA using filter banks.
Text Books:	
1.	J. G. Proakis, D.G. Manolakis, and D. Sharma, "*Digital Time Signal Processing: principles, algorithms, and applications*," Pearson Education, 2006.
2.	DaFatta, D. J., Lucas, J. G., and Hodgkiss, W. S. "*Digital Signal Processing: A system design approach*," Wiley publications, 1988.
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2.	C. S. Burrus, R. A. Gopinath, and H. Guo,. "*Introduction to Wavelets and Wavelets Transforms*," PrenticeHall, 1998.
3.	P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, 1993.

Programme Name	**B. Tech. EXTC, Semester-VII**
Course Code	R4ET4103T
Course Title	**OFDM-MIMO Communication**
Pre-requisite	**Digital Communication Systems, Analog Communication**

COURSE OUTCOMES:

After completion of this course, students will be able to

1. To learn about basic MIMO communication systems.
2. Explore and analyze the MIMO systems under different fading channels.
3. Take a comprehensive look at OFDM including channel modeling, spectrum efficiency, and resource management
4. Know how OFDM can combine with MIMO to give high data rate transmissions.

COURSE CONTENTS

Module 1	**Introduction to OFDM and MIMO-OFDM**
	OFDM, MIMO assisted OFDM, SDMA-based MIMO-OFDM systems OFDM Schematic, channel estimation for multicarrier systems, channel estimation for MIMO-OFDM, Signal detection, channel statistics, SDM-OFDM transceiver structure
Module 2	**SISO Channel Models:**
	Indoor Channel Models: General Indoor Channel Models, IEEE 802.11 Channel Model, & UWB Channel Model, Outdoor Channel Models: FWGN Model, & SUI Channel Model.
Module 3	**MIMO Channel Models**
	Statistical MIMO Model: Spatial Correlation, PAS Model. **I-METRA MIMO Channel** Model: Statistical Model of Correlated MIMO Fading Channel, Generation of Correlated MIMO Channel Coefficients, I-METRA MIMO Channel Model: Doppler Spectrum; Rician Fading for a MIMO Channel; Steering Matrix
Module 4	**Introduction to OFDM and standards**
	Basic Principle of OFDM:OFDM Modulation and Demodulation, OFDM Guard Interval, OFDM Guard Band, BER of OFDM Scheme, Water-Filling Algorithm for Frequency-Domain Link Adaptation. **Single-Carrier vs. Multi-Carrier Transmission:** Single-Carrier Transmission, Multi-Carrier Transmission, Single-Carrier vs. Multi-Carrier Transmission. Multiple Access Extensions of OFDM: Resource Allocation – Subchannel Allocation Types& Resource Allocation – Sub-channelization, Duplexing: FDD (Frequency Division Duplexing) and TDD (Time Division Duplexing), **OFDM standards: WiFi, 3GPP LTE, WiMAX Evolution** **WiMAX** IEEE 802.16d, IEEE 802.16e, system configuration, sub-carrier mapping, MIMO support
Module 5	**Coherently Detected SDMA-OFDMA systems**

	Coded OFDM, Channel coding assisted Space Time Block Code-OFDM systems, Alamouti's G2 STBC, Encoding decoding algorithms, STBC with LDPC, LDPC-Aided and TC-Aided STBCs, Channel Coding Aided STBC-OFDM, CM-Aided and LDPC-Aided STBC-OFDM Schemes Coded Modulation Assisted Multi-user SDMA-OFDM Using Frequency-Domain Spreading, Hybrid Multi-user Detection for SDMA-OFDM Systems
Text Books:	
1.	H. Jafarkhani, "*Space-time coding: Theory & Practice*", Cambridge University Press, 2005.
2.	E.G. Larsson and P. Stoica, "*Space-time block coding for Wireless communications*", Cambridge University Press, 2003.
3.	Lajos Hanzo, Yosef Akhtman, Li Wang, Ming Jiang, MIMO-OFDM for LTE, Wi-Fi and WiMAX, IEEE, John Wiley, UK, 2011.
Additional Reading:	
1.	Tolga M. Duman and Ali Ghrayeb, "*Coding for MIMO Communication systems*", John Wiley & Sons, West Sussex, England, 2007.
2.	A.B. Gershman and N.D. Sidiropoulus, "*Space-time processing for MIMO communications*", Wiley, Hoboken, NJ, USA, 2005.
3.	M. Janakiraman, "*Space-time codes and MIMO systems*", Artech House, 2004.
4.	Yi (Geoffrey) Li, and Gordon L. Stuber, " *Orthogonal Frequency Division Multiplexing*",Springer Science+Business Media Inc., NY, USA, 2006.
5.	Jeffrey G. Andrews, Arunabha Ghosh and Riaz Muhamed, "*Fundamentals of WIMAX:Understanding broadband wireless networking*", 1st Edition, Prentice Hall Inc., NJ, 2007.
6.	Lawrence Harte and Kalai Kalaichelvan, "*WIMAX explained: System fundamentals*", 1st Edition, Althos Publishing, 2007.
7.	Tao Jiang, Lingyang Song, and Yan Zhang, "*Orthogonal Frequency Division Multiple Access (OFDMA) Fundamentals and Applications*", Auberbach Publications, Taylor & Francis Group, 2010.

Programme Name	**B. Tech. EXTC, Semester-VII**
Course Code	R4ET4103P
Course Title	**OFDM-MIMO Communication Lab**
Pre-requisite	**Digital Communication Systems, Analog Communication**

COURSE OUTCOMES

After completion of this course, students will be able to

1. Model the indoor and outdoor channel fading.
2. Test the working of MIMO transmitter and receiver system.
3. Test the working of OFDM transmitter and receiver system.
4. Design and simulate modules like Single-Carrier Transmission, Multi-Carrier Transmission.

COURSE CONTENTS

Module 1	**The Wireless Channel: Propagation and Fading**
	1.1 General Path Loss Model. 1.2 IEEE 802.16d Model. 1.3 Indoor Channel Models- IEEE 802.11 Channel Model. 1.4 Outdoor Channel Models- FWGN Model.
Module 2	**MIMO Channel Models**
	2.1 Study of the PAS Model. 2.2 Performance of Statistical Model of Correlated MIMO Fading Channel.
Module 3	**OFDM**
	3.1 Modulation and Demodulation of OFDM. 3.2 BER of OFDM Scheme.
Module 4	**Single-Carrier vs. Multi-Carrier Transmission & OFDMA**
	4.1 Single-Carrier Transmission 4.2 Multi-Carrier Transmission 4.3 Multiple Access Extensions of OFDM
Text Books:	
1.	Cho, Yong Soo, et al. *MIMO-OFDM wireless communications with MATLAB*. John Wiley & Sons, 2010.
Additional Reading:	
1.	MIMO Manual.
2.	OFDM Manual.

Open Elective II

S. No.	Course Code	Course Title
1.	R4ET4601S	Introduction to Nano Electronics

Programme Name	B. Tech. EXTC, Semester-VII
Course Code	R4ET4601S
Course Title	Introduction to NANO ELECTRONICS

COURSE OBJECTIVE

- To study limitations of scaling of CMOS technology and its remedies.
- To study transition from single gate to multigate technology.
- To study different nanoscale devices like RTD, QCA, CNT, nanowire, SET.
- To introduce spin phenomena and its applications for nanoscale devices.
- To study molecular electronic devices.

COURSE OUTCOME

- The student should be familiar with certain nanoelectronic systems and building blocks such as: low-dimensional semiconductors, heterostructures, carbon nanotubes,quantum dots, nanowires etc.
- Design of electronic nanosystems like memory elements & Logic devices.
- Finally, a goal is to familiarize students with the present research front inNanoelectronics and to be able to critically assess future trends.

Course Content

Module 1	**Introduction**
	CMOS Scaling, Scaling Issues, Limit to Scaling, System Integration limit, InterconnectIssues, Shrinkdown approach, Strained Silicon, High k dielectric, Advance MOSFET concept, UTB – Ultra Thin Body, and Metal Gate
Module 2	**FINFET**
	Structure, working, power optimization, logic design using FINFET, modes of operation, TCMS circuit, logic design using TCMS, FINFET SRAM Design
Module 3	**Resonant Tunneling Diode (RTD)**
	Electron Tunneling, Coulomb blocked RTD Structure, working, V-I characteristics, equivalent circuit ,programmable logic gates,multi valued logicgates and MOBILE circuit.
Module 4	**Single Electron Devices**
	Single Electron BOX, Single Electron Transistor (SET), and Application of Single ElectronDevices for logic circuit
Module 5	**Module 5. Quantum dots**
	Electronics properties, structure, Quantum Cellular Automata (QCA) , and Circuit Designusing QCA
Module 6	**Carbon Nano Tubes**

	Physical Properties, Band Structure, Band Modulation, Electrical properties of CNTs, CNT Transistor, CNT based Electronics Devices, Field Emission Devices, MEMS, Electrical Sensor, and SRAM Cells
Module 7	**Spintronics**
	Physical properties of Spintronic Devices, Spin Relaxation Mechanisms, Spin Injection, Spin Detection. Spintronic Devices, Spin Filter, Spin Valves, Spin Pumps, Spin Diodes, Spin Transistors, Spin-Based Optoelectronic Devices, Spintronic Computation
Module 8	**Molecular Electronics Devices**
	Electrical Conduction of Molecules, Molecular Electronics Devices, Molecular Architectures for Nanoelectronics, Molecular-Based Optic and Optoelectronics Devices, Molecular Computing Devices
Text Books:	
1.	Introduction to nanotechnology, C.P.Poole JV, F.J.Owens, Wiley (2003).
2.	Nanoelectronics and information technology (Advanced electronic materials and Novel Devices Waster Ranior, Wiley VCH (2003)
References:	
1	Nanoelectronics: Principles and Devices, 2nd Edition, M. Dragoman, D. Dragoman,Artech House - 2008
2	Nanoelectronic Circuit Design, Niraj K. Jha, Deming Chen, Springer - 2010.

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SEMESTER VIII

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4011S
Course Title	**Embedded Systems**
Pre-requisite	**Microprocessor and Microcontroller Systems**

COURSE OUTCOMES

After completion of this course, students will be able to

1. Explain the hardware and software architecture of embedded system.
2. Identify the necessary communication Interface for the embedded system.
3. Organize the complete embedded system development project.
4. Design and implement the embedded systems.

COURSE CONTENTS

Module 1	**Introduction to Embedded system**
	Introduction To Embedded Systems, Definition Of Embedded System, Embedded Systems Vs General Computing Systems, History Of Embedded Systems, Classification, Major Application Areas, Purpose Of Embedded Systems, Characteristics And Quality Attributes Of Embedded Systems. Embedded Processor Requirements, Features, Types, RISC Processors, Harvard Architecture, Super Harvard Architecture, Selection Of Processors & Microcontrollers.
Module 2	**Architecture of Embedded System**
	Hardware Architecture: 8051, Arm, Memory, Clock Circuitry, Watchdog Timer, Chip Select, I/O Devices, Debug Port, Communication Interfaces, Power Supply Unit. Software Architecture: Services Provided By OS, Architecture Of Embedded OS, Categories Of Embedded OS, Application Software, Communication Software, Development And Testing Tools.
Module 3	**Communication Interfaces**
	Need For Communication Interfaces, OSI Reference Model, Basic Of Networks, Network Topology, RS232/UART,RS422/RS485, USB, Infrared, Ethernet, IEEE 802.11, Bluetooth, SPI, I2C, CAN, Wifi, Flex Ray, LIN Bus, Zigbee.
Module 4	**Embedded Software**
	Software Developments Tools, Cross Platform Development, Programming Languages Like Embedded C, Embedded C++ And J2ME , Device Drivers, Debuggers, Profilers, Code Optimization, Overview Of RTOS, Architecture Of Kernel, Task & Task Scheduler, ISR, Semaphore, Mutex, Mailbox, Message Queues, Event Registers, Pipes, Signals, Timers, Memory Management, Priority Inversion Problem.
Module 5	**Embedded System Development & Testing**
	Different Embedded System Development Models, Requirement

	Engineering, Design Tradeoff, Co-Design, Hardware Design, Software Design, Implementation, Integration & Testing, Packaging, Configuration Management, Managing Embedded System Development Projects, Embedded System Fiascos.
Module 6	**Design Examples & Case Studies of Embedded System**
	Digital Thermometer, Handheld Computer, Navigation Systems, IP Phone, Software-Defined Radio, Smart Card, RF Tag, Case Study Of Coding For Sending Application Layer Byte Streams On A TCP/IP Network Using RTOS.
Text Books:	
1.	Raj Kamal, *"Embedded system"* , 3rd Edition, Tata McGraw Hill.
2	Prasad, *"Embedded Real time systems"*, 2nd Edition Dream tech Wiley Publication
Additional Reading:	
1	David Simon*, "An embedded Software Primer",* 2nd Edition ,Pearson Publication
2	Frank Vahid*, "Embedded system-A unified Hardware Software Introduction",* 3rd Edition ,John Wiley and Sons.

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4012S
Course Title	**Satellite Communication**
Pre-requisite	**Basics of Communication, Digital Communication**

COURSE OUTCOMES:

After completion of this course, students will be able to

1. Design and implement simple programs using various satellite technology, satellite subsystems, for different types of satellite missions and areas of application of satellite technology.
2. Analyze the orbits and trajectories of satellites.
3. Describe the Satellite Launch procedures and various in-orbit operations
4. Analyze multiple access techniques in Satellite Communication and distinguish tradeoff in satellite link design related aspects

COURSE CONTENTS

Module 1	**Introduction to Satellites and their Applications**
	Ever-expanding Application Spectrum , What is a Satellite?, History of the Evolution of Satellites, Evolution of Launch Vehicles, Future Trends
Module 2	**Satellite Orbits and Trajectories**
	Definition of an Orbit and a Trajectory, Orbiting Satellites – Basic Principles, Orbital Parameters, Injection Velocity and Resulting Satellite Trajectories, Types of Satellite Orbits
Module 3	**Satellite Launch and In-orbit Operations**
	Acquiring the Desired Orbit, Launch Sequence, Orbital Perturbations, Satellite Stabilization, Orbital Effects on Satellite's Performance, Eclipses, Look Angles of a Satellite, Earth Coverage and Ground Tracks
Module 4	**Satellite Hardware**
	Satellite Subsystems, Mechanical Structure, Propulsion Subsystem, Thermal Control Subsystem, Power Supply Subsystem, Attitude and Orbit Control, Tracking, Telemetry and Command Subsystem, Payload, Antenna Subsystem, Space Qualification and Equipment Reliability
Module 5	**Multiple Access Techniques**
	Introduction to Multiple Access Techniques, Frequency Division Multiple Access (FDMA), Single Channel Per Carrier (SCPC) Systems, Multiple Channels Per Carrier (MCPC) Systems, Time Division Multiple Access (TDMA), TDMA Frame Structure, FDMA vs. TDMA, Code Division Multiple Access (CDMA), Space Domain Multiple Access (SDMA)
Module 6	**Satellite Link Design**
	Transmission Equation, Satellite Link Parameters, Frequency Considerations, Propagation Considerations, Techniques to Counter Propagation Effects, Noise Considerations, Interference-related Problems, Antenna Gain-to-Noise Temperature (G/T) Ratio, Link Design

Text Books:	
1.	*Satellite Technology- Principles And Applications,*3rd edition, 2014 by Anil K. MainiVarsha Agrawal. John Wiley & Sons Ltd,
2.	*Satellite Communications*, 3rd edition 2001 by Dennis Roddy. McGraw-Hill
3.	*Introduction to Satellite communication*, 3rd edition 2008 by Bruce R Elbert. Artech House.
4.	*Satellite communication* 2009 by Dharma Raj Cheruku. I K International Publishing House Pvt Ltd New Delhi
Additional Reading:	
1.	*Satellite Communication* 2012 by Joseph N Pelton, Springer
2.	*Satellite Communication Engineering* 2013, by Michael Olorunfunmi Kolawole. CRC press

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4013S
Course Title	**Advanced Coding Techniques**
Pre-requisite	Digital Communication Systems

COURSE OBJECTIVE

1. The course is designed to provide a brief idea of linear algebraic functions and differentiate vectors according to their properties.
2. Evaluation of the performance of binary and non-binary error correcting codes.
3. Study of different error correcting codes for wireless environment.

COURSE OUTCOME

After successful completion of this course, students will be able to

1. Understand different codes are used for encoding the data.
2. Design a code with greater compression ratio and with minimum error and high signal to noise ratio.
3. Implement different encoding algorithms for various codes.

COURSE CONTENTS

Module 1	**Linear Abstract Algebra and Finite Fields**
	Groups, Fields, Rings, Vector spaces, subspaces, Galois field, Extension fields, Primitive element, primitive polynomial, GCD of polynomial, LCM of polynomial, minimal polynomial, factorization of (X^n-1) over a Galois field, construction of generator polynomial & parity check polynomial primitive n^{th} root of unity.
Module 2	**Cyclic Codes**
	Properties, Various methods of generation and detection of cyclic codes, error detecting capability, cyclic Hamming code and Golay code.
Module 3	**Binary and Non-Binary BCH codes**
	nary primitive BCH codes, decoding, iterative algorithm for finding the error location polynomial, error location numbers and error correction, implementation of error correction. Q-ary linear block codes, primitive BCH codes, RS codes, decoding of BCH and RS codes.
Module 4	**Convolutional Codes**
	Encoder and decoder, structural properties, optimum decoding of Convolutional codes, Viterbi, soft output Viterbi BCGR algorithm.
Module 5	**Turbo coding and Low Density Parity Check Codes**
	Encoding and decoding. Encoding and detection, sum-product algorithm, simplification of sum product algorithm
Module 6	**Trellis coded Modulation and Space-Time Coding**
	Background on Signal constellation, construction and detection. Fading channels and Space-Time codes, Rayleigh channel and MIMO channel, space-time block codes, space-time trellis codes.

Text Books:	
1.	Shu Lin, Daniel J.Costello, "*Error Control Coding*", 2nd Edition, Pearson, Reprint 2012.
2.	Jorge Castineira Moreira, Patrick Guy Farrell, "*Essentials of Error Control Coding*", 1st Edition, Wiley, Reprint 2013.
Recommended Reading:	
1.	Todd K. Moon, "*Error Correction Coding: Mathematical Methods and Algorithms*", 1st Edition, Wiley, Reprint 2013.
2.	Stephen B. Wicker, "*Error control systems for Digital communication & storage*".

Program Elective III

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4111S
Course Title	**Next Generation Networks**
Pre-requisite	**Digital Communication Systems and Data Communication**

COURSE OUTCOMES

After completion of this course, students will be able to

1. State the technical features and design considerations of the next generation mobile networks.
2. Compare the carious IMS Services
3. Describe the common technologies used in the core, distribution and access layers.
4. Design a network with good capacity and efficiency.

COURSE CONTENTS

Module 1	**Introduction**
	Evolution of public mobile services - motivations for IP based services, Wireless IP network Architecture – 3GPP packet data network architecture, Introduction to next generation networks -Changes, Opportunities and Challenges, Technologies, Networks, and Services, Next Generation Society, future Trends.
Module 2	**IMS and Convergent Management**
	IMS Architecture - IMS services, QoS Control and Authentication, Network and Service management for NGN, IMS advantages, Next Generation OSS Architecture - standards important to OSS architecture, Information framework, OSS interaction with IMS, NGN OSS function/ information view reference model, DMTF CIM.
Module 3	**MPLS AND VPN**
	Technology overview –MPLS &QoS, MPLS services and components – layer 2 VPN, layer 2 Internet working, VPN services, signaling, layer 3 VPN –Technology overview, Remote Access and IPsec integration with MPLS VPN.
Module 4	**Multicast**
	MPLS Multicast VPN overview – Applications, examples, IPv6 and MPLS - Technology overview, Future of MPLS – Integrating IP and optical networks, Future layer 3 services, future layer 2 services.
Module 5	**NGN Management**
	Network Management and Provisioning – Configuration, Accounting, performance, security, case study for MPLS, Future enhancements – Adaptive self-healing networks.
Text Books:	
1.	Thomas Plavyk, "*Next generation Telecommunication Networks, Services and Management*", Wiley& IEEE Press Publications, 2002.
2.	Neill Wilkinson, "*Next Generation Network Services*", John Wiley 2002
Additional Reading:	
1.	Monique J. Morrow, "*Next Generation Networks*", CISCO Press, 2007.
2.	Robert Wood, "*MPLS and Next Generation Networks: Foundations for NGN and EnterpriseVirtualization*", CISCO Press, 2006.

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4112S
Course Title	**E-security**
Pre-requisite	**Digital Communication, Computer Networks**

COURSE OUTCOMES

After completion of this course, students will be able to

1. Apply concepts of E-security.
2. Explain the different aspects of management and security of the networking.
3. Implement standards for integrity, authentication and key management.
4. Design firewalls for different applications

COURSE CONTENTS

Module 1	**INTRODUCTION ON SECURITY**
	Security Goals, Types of Attacks: Passive attack, active attack, attacks on confidentiality, attacks on Integrity and availability, Security services and mechanisms, Techniques: Cryptography, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers- Steganography- Revision on Mathematics for Cryptography.
Module 2	**SYMMETRIC & ASYMMETRIC KEY ALGORITHMS**
	Data Encryption Standards (DES), Advanced Encryption Standard (AES), RC4, principle of asymmetric key algorithms, RSA Cryptosystem.
Module 3	**INTEGRITY, AUTHENTICATION AND KEY MANAGEMENT**
	Message Integrity, Hash functions: SHA 512, Whirlpool, Digital signatures: Digital signature Standards, Authentication: Entity Authentication: Biometrics, Key management Techniques.
Module 4	**NETWORK SECURITY, FIREWALLS AND WEB SECURITY**
	Introduction on Firewalls, Types of Firewalls, Firewall Configuration and Limitation of Firewall, IP Security Overview, IP security Architecture, Authentication Header, Security payload, Security associations, Key Management, E-mail security: PGP, MIME,S/MIME, Web security requirement, secure sockets layer, transport layer security, secure electronic transaction, dual signature.
Module 5	**WIRELESS NETWORK SECURITY**
	Security Attack issues specific to Wireless systems: Worm hole, Tunnelling, DoS, WEP for Wi Finetwork, Security for Broadband networks: Secure Ad hoc Network, Secure Sensor Networks
Text Books:	
1.	Behrouz A. Forouzan," *Cryptography and Network security*" Tata McGraw- Hill, 2008.
2.	William Stallings,"*Cryptography and Network security: Principles and Practice*", 2nd Edition, Prentice Hall of India, New Delhi, 2002.

	Atul Kahate," *Cryptography and Network security*", 2nd Edition, Tata McGraw-Hill, 2008.
Additional Reading:	
1.	H. Yang et al., "*Security in Mobile Ad Hoc Networks: Challenges and Solution*", IEEE Wireless Communications, Feb. 2004.
2.	Lidong Zhou et al."*Securing Ad Hoc Networks*", IEEE Network Magazine, vol. 13, no. 6, pp.24-30, December 1999.
3.	"Security of Wireless Ad Hoc Networks", http://www.cs.umd.edu/~aram/wireless/survey.pdf
4.	David Boel et.al (Jan 2008), "*Securing Wireless Sensor Networks – Security Architecture Journal of networks*", Vol. 3. No. 1. pp. 65 -76.
5.	Perrig, A., Stankovic, J., Wagner, D. (2004), "*Security in Wireless Sensor Networks*", Communications of the ACM, 47(6), 53-57.

Programme Name	Final year B. Tech. (Electronics & Telecommunication Engineering), SEMESTER - VIII
Course Code	R4ET4113S
Course Title	STATISTICAL THEORY OF COMMUNICATION

COURSE OBJECTIVES

1. To develop statistical concepts in telecom networks.
2. To achieve ability to guide telecom network with tangible and secure rules and Regulations
3. To develop ability to prove concepts in modeling of telecom systems.
4. To develop ability to make manufacture mini-systems that depend on telecom Fundamentals
5. To study fundamentals of stochastic modeling.

COURSE OUTCOMES

After completion of the course, students will be able to

1. Understand utility of statistical concepts in telecom networks.
2. Apply and relate statistical concepts to communication fundamentals.
3. Comprehend statistical models in applied communication link (telephone systems)
4. Analyze fundamentals of stochastic modeling in communication.

COURSE CONTENTS

Module I	Overview
	The random variable g(x), Distribution of g (x), Moments, Characteristic functions, Two random variables: Bi-variate distribution, One function of two random variables, Two function of two random variables, Joint moments, Joint Characteristic functions, Conditional distribution
Module II	Stochastic Processes
	General concepts, Conditional densities, Characteristic functions and normality, Mean square estimation, Stochastic convergence and limit theorems , Random variables: meaning and generation **Random walks and other Applications:** Random walks, Poisson points and shot noise, Modulation , Cyclostationary process , Band limited process and sampling theory , Deterministic signals in noise , Bispectra and system identification, The Poisson sum formula, The Schwarz Inequality.
Module III	Spectrum estimation
	Ergodicity, Spectrum estimation, Extrapolation and system identification, The general class of extrapolating spectra Youla's parametrization, Minimum phase functions, All phase functions.
Module IV	Stationary Queues
	Single server queues, Processor sharing queue, Parallel queue, The queue with S server, Infinite server queues, Queues with impatient customers, Family of finite dimensional distribution, Expectations, Stationary random signals Linear filtering of random signals, Periodicity, Continuity of Continuous time signals, Point processes, Second order Random signals
Module V	Statistical models for Random signals Markov Process
	Introduction of white noise, Random walks and Brownian motion , Gaussian

	signals with stationary increments, Spherically invariant and circular signals
Text Books:	
1.	*Random Signals and Systems*, 1993by Bernard Picinbobo. Prentice Hall Signal Processing
2	*Probability Random Variables and Stochastic Processes*, 4th edition 2002 by A. Papoulis. McGrawHill
Reference Books:	
1	*Statistical Theory Communication*, 2007 by S.P.Eugene Xavier, New Age International (P) limited.
2	*Statistical Theory Communication*, 2013, by Yuk Wing Lee. Literacy Licensing

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4114S
Course Title	**Pattern Recognition and Machine Vision**
Pre-requisite	Digital Image Processing

COURSE OBJECTIVES

1. To understand basic concepts in pattern recognition.
2. To study the fundamentals of characterizing and recognizing patterns and features of interest in numerical data.
3. To learn the basic tools and theory for signal understanding problems.
4. To gain knowledge about state-of-the-art algorithms used in pattern recognition research.

COURSE OUTCOMES

After successful completion of this course, students will be able to

1. Explain concepts in pattern recognition.
2. Describe pattern recognition theories, such as Bayes classifier, linear discriminant analysis.
3. Interpret features of interest in numerical data.
4. Apply pattern recognition techniques in practical problems.

COURSE CONTENTS

Module 1	**Introduction**
	Introduction to Pattern Recognition, Feature Detection, Classification, Review of Probability Theory, Conditional Probability and Bayes Rule, Random Vectors, Expectation, Correlation, Covariance, Review of Linear Algebra, Linear Transformations
Module 2	**Statistical Methods**
	Decision Theory, ROC Curves, Likelihood Ratio Test, Linear and Quadratic Discriminants, Fisher Discriminant, Sufficient Statistics, Coping with Missing or Noisy Features, Template-based Recognition, Feature Extraction, Eigenvector and Multilinear Analysis, Training Methods, Maximum Likelihood and Bayesian Parameter Estimation, Linear Discriminant/Perceptron Learning, Optimization by Gradient Descent, Mixture modelling, Expectation maximization
Module 3	**Classifiers**
	Support Vector Machines, K-Nearest-Neighbor Classification, Non-parametric Classification, Density Estimation, Parzen Estimation, Unsupervised Learning, Clustering, Vector Quantization, K-means
Module 4	**Miscellaneous Topics**
	Hidden Markovian modes, Viterbi, Baum-Welch Algorithm, Bayesian Networks, Decision Trees, Multi-layer Perceptrons, Reinforcement Learning with Human Interaction, Genetic Algorithms, Combination of Multiple Classifiers "Committee Machines"
Text Books:	
1.	Bishop, C. M. Pattern Recognition and Machine Learning. Springer. 2007
2.	Duda, Richard O., Peter E. Hart, and David G. Stork. *Pattern Classification*. New York, NY: John Wiley & Sons, 2000. ISBN: 9780471056690.
3.	Mallot, Hanspeter A. *Computational Vision: Information Processing in*

	Perception and Visual Behavior. Translated by John S. Allen. Cambridge, MA: MIT Press, 2000. ISBN: 0262133814.
Recommended Reading:	
1.	Hastie, Trevor, Robert Tibshirani, and Jerome Friedman. *The Elements of Statistical Learning: Data Mining, Inference, and Prediction: with 200 full-color illustrations*. New York, NY: Springer, c2001. ISBN: 0387952845.
2.	Forsyth, David A., and Jean Ponce. *Computer Vision: a Modern Approach*. Upper Saddle River, NJ: Prentice Hall, 2003. ISBN: 0130851981.

Program Elective IV

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Program Elective IV LAB

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4121T
Course Title	**Medical Electronics**
Pre-requisite	**Signal and Systems, Integrated Circuits and Application**

COURSE OUTCOMES

After completion of this course, students will be able to

1. Integrate the information about generation of bio-potentials
2. Apply electronic engineering principles for data acquisition and measurement of bio-potentials
3. Analyze the working and design aspects of the instruments used in medical field.
4. Evaluate the necessity of prosthetic devices and develop block schematic

COURSE CONTENTS

Module 1	**Fundamentals of Medical Instrumentation**
	Anatomy and Physiology, Physiological Systems of the Body, Problems in measuring the Physiological variables, Components of Medical Instrument.
Module 2	**Bioelectric Signals and Electrodes, Transducers**
	Origin of Bioelectric signals, Resting and Action Potentials, Depolarization and Repolarization, Propagation of Action Potentials. Electrode Theory, Recording Electrodes, Silver-Silver Chloride Electrodes, Microelectrodes. Transducer Principle, Classification of Transducers, various Transducers for the measurement of Physiological Events, Amplifiers and Signal Processing.
Module 3	**The Cardiovascular System and Measurements**
	The Heart and Cardiovascular System: Heart Sounds and their measurements with Phonocardiograph, Stethoscope etc., Phonocardiogram. Blood Flow: Characteristics of Blood Flow, Measurement of Blood flow and Cardiac output with Magnetic Blood Flow meter, Ultrasonic Blood Flow Meter & Radio Graphic Method. Blood Pressure: Measurement of Blood Pressure with Indirect and Direct methods, Sphygmomanometry, Programmed Electro-sphygmomanometry, Digital Blood Pressure meter, Impedance Plethysmography.
Module 4	**Generation & Recording of Bio Electrical Activities**
	Electrocardiogram: ECG Electrode Placement- "Bipolar Limb Lead Configuration by Einthoven, Unipolar Limb Leads (Wilson leads), Augmented Unipolar Limb Leads, Precordial and Marriott Leads", ECG Recorders. Electromyogram: EMG System, Electrodes used and their placement, Latency, Applications. Electroencephalogram: EEG Electrodes and their placement- 'Anterior-Posterior' and 'Lateral' measurements, Recording Modes of EEG, Applications of EEG. ElectroRetinogram: Human Eye System, ERG Recording techniques, Standards of ERG, Applications of ERG. ElectroOculogram: EOG basics, Recording methods, patient preparation, Arden Index, Diagnostic Utility of EOG
Module 5	**Measurements in the Respiratory System**

	Introduction, Physiology of the Respiratory System, Lung Volumes/Capacities, Instrumentation for measuring the Mechanics of Breathing- Kymograph, Spiro meter etc.
Module 6	**Prosthesis**
	Introduction, Types of Prosthetic Devices, Application and working principle of various prosthetic devices eg.Myoelectric Control System for paralyzed arm, Audiometry and Hearing Aids. Dialysis: Introduction, Function of the Kidneys, Artificial Kidney, Dialyzers, Membranes for Dialysis, Haemodialysis, Peritoneal Dialysis.
Module 7	**Therapeutic Equipment**
	Introduction, High Frequency Heat Therapy, Short-wave Diathermy, Microwave Diathermy, Ultrasonic Therapy Unit., Endoscopy, Gastroscope, Bronchoscope, Sigmoidoscope, Laproscope, Pacemakers and Defibrillators.
Module 8	**Medical Imaging Systems**
	Introduction, X-ray Machines and Digital Radiography, Computed Tomography, CT Scanners, Ultrasonic Imaging Systems, MRI & PET Scan, Thermal Imaging Systems
Module 9	**Bio Telemetry and Telemedicine**
	Introduction to Biotelemetry, The Components of a Biotelemetry System, Implantable Units, Single-Channel/Multi-Channel/Multi-Patient Telemetry Systems, Application of Telemetry in Patient Care, Telemedicine.
Module 10	**Patient Care and Monitoring**
	The elements of Intensive-Care Monitoring, Patient-Monitoring Equipment – Different types, The Organization of Hospital for Patient-Care Monitoring.
Module 11	**Patient Safety**
	Physiological effects of Electric Current, Shock Hazards and Leakage Currents, precautions to minimize Electric Shock Hazards and Leakage Current, Methods of Accident Prevention, Safety codes for electro medical equipment
Text Books:	
1.	R.S.Khandpur, "*Handbook of Biomedical Instrumentation*", Tata McGraw Hill Education Private Limited, 3rd Edition, 2014
2.	"*Biomedical Instrumentation and Measurements*" by Leslie Cromwell, Fred J. Weibell & Erich A. Pfeiffer, Prentice Hall of India publication, 2nd Edition ,2011
Additional Reading:	
1.	Joseph J. Carr and John M. Brown, "*Introduction to Biomedical Equipment Technology*" , Pearson Education,4th Edition ,2011,
2.	Strong P., "*Biophysical measurements*" , Measurement Concepts publication, 2nd Edition, 2005
3.	Leslie Alexander Geddes, L. E. Baker "*Principles of applied biomedical instrumentation*", Wiley publication ,3rd Edition,2009
4.	"*Medical Instrumentation Application and Design*" by John G. Webster , Wiley publication, 5th Edition ,2011
5.	G. E. Donovan, "*Medical Electronics*" , Butterworth & Co, 3rd Edition,2009
6.	"*Biomedical Instruments: Theory and Design*" by Walter Welkowitz, Sid Deutsch & Metin Akay, Academic Press,2nd Edition,2010

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4121P
Course Title	**Medical Electronics Lab**
Pre-requisite	**Signal and Systems, Integrated Circuits and Application**

COURSE OUTCOMES

After completion of this course, students will be able to

1. Analyze the salient traits of medical instruments.
2. Apply electronic engineering principles to design signal conditioning systems for bio potentials.
3. Demonstrate the experimentation related to medical instruments.
4. Develop software for bio potentials processing.

COURSE CONTENTS

Experiment 1	Analyze the salient traits of the following medical instruments and demonstrate the related experimentation :-ECG System
Experiment 2	BP Monitor
Experiment 3	Heart Rate Monitor
Experiment 4	Respiration Rate Monitor
Experiment 5	EMG System
Experiment 6	EEG System
Experiment 7	Phonocardiograph System
Experiment 8	Design and demonstration of ECG amplifier system
Experiment 9	Design and demonstration of signal conditioning system for biopotentials
Experiment 10	Develop algorithms for biopotentials processing (using MATLAB/ LabVIEW, etc)
Text Books:	
1.	R.S.Khandpur, "*Handbook of Biomedical Instrumentation*",Tata McGraw Hill Education Private Limited, 3rd Edition, 2014,
2.	Leslie Cromwell, Fred J. Weibell & Erich A. Pfeiffer, "*Biomedical Instrumentation and Measurements*" , Prentice Hall of India publication. 2nd Edition ,2011
Additional Reading:	
1.	Joseph J. Carr and John M. Brown, "*Introduction to Biomedical Equipment Technology*" , Pearson Education,4th Edition ,2011,
2.	Strong P., "*Biophysical measurements*" , Measurement Concepts publication, 2nd Edition, 2005
3.	Leslie Alexander Geddes, L. E. Baker "*Principles of applied biomedical instrumentation*", Wiley publication ,3rd Edition,2009
4.	"*Medical Instrumentation Application and Design*" by John G. Webster , Wiley publication, 5th Edition ,2011
5.	G. E. Donovan, "*Medical Electronics*" , Butterworth & Co, 3rd Edition,2009
6.	"*Biomedical Instruments: Theory and Design*" by Walter Welkowitz, Sid Deutsch & Metin Akay, Academic Press,2nd Edition,2010

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4122T
Course Title	**Applied Machine Learning and Fuzzy Systems**

COURSE OBJECTIVE

The course is designed to introduce the field of artificial neural networks systems and machine learning. The course will give the student the basic idea and intuition behind modern data processing algorithms as well as a bit more formal understanding of how, why, and when they work.

COURSE OUTCOME

This course is aimed at the introductory graduate level. It will provide a foundational understanding of how artificial intelligence, machine learning and statistical algorithms work. Students will have a toolbox of algorithms that they can use on their own datasets after they leave the course.

- Student will be able to implement basis supervised learning algorithms.
- Student will be able to use algorithms for unsupervised methods.
- Student will be able to describe how statistical models work.

COURSE CONTENTS

Module 1	**Introduction: Biological neurons and memory**
	Motivations for Studying ML, Supervised and Unsupervised learning, Machine Learning in the Large Structure and function of a single neuron; Artificial Neural Networks (ANN); Typical applications of ANNs: Classification, Clustering, Vector Quantization, Pattern Recognition, Function Approximation, Forecasting, Control, Optimization.
Module 2	**Supervised Learning**
	Single-layer networks; Perceptron-Linear separability, Training algorithm, Limitations; Multi-layer networks-Architecture, Back Propagation Algorithm (BTA) Adaptive Multi-layer networks-Architecture, training algorithms; Recurrent Networks; Feed-forward networks; Radial-Basis-Function (RBF) networks
Module 3	**Unsupervised Learning**
	Winner-takes-all networks; Hamming networks; Maxnet; Simple competitive learning; Vector-Quantization; Counter propagation networks; Adaptive Resonance Theory; Kohonen's Self-organizing Maps; Principal Component Analysis
Module 4	**Classical and Theoretical ML Topics**
	Concept Learning, Learning from Analogy, Explanation Based Learning, Structure Learning, Reinforcement Learning, Decision Tree Learning, Decision List Learning , Oracle Based Learning, Probably Approximately Correct (PAC) Model, Boosting, Bayesian Learning: Maximum Likelihood Estimates, Parameter Estimation, Bayesian Belief Networks
Module 5	**Introductory Graphical Models Based Learning**
	Expectation Maximization as a fundamental technique, Hidden Markov Models (HMM): Motivation for Generative Models, Forward-backward Algorithm, Baum Welch Iteration, Feature Enhanced HMM.

Module 6	**Fuzzy Systems**
	Fuzzy sets, rules, rough sets, relations and operations, extension principle, membership functions, laws, semantics with examples, fuzzification and defuzzification, fuzzy inference systems, Mamdani model, fuzzy based controllers
	TEXTBOOKS
1	Simon Haykin, "Neural Networks - A Comprehensive Foundation", Macmillan Publishing Co., New York, 1994.
2	A Cichocki and R. Unbehauen, "Neural Networks for Optimization and Signal Processing", John Wiley and Sons, 1993.
3	Thimothy J. Ross, - Fuzzy Logic with Engineering Applications, Wiley India Publications
	Reference
1	Bart Kosko, - Neural networks and Fuzzy Systems", Pearson Education.
2	J. M. Zurada, "Introduction to Artificial Neural Networks", (Indian edition) Jaico Publishers, Mumbai, 1997.

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4122P
Course Title	**Applied Machine Learning and Fuzzy Systems Lab**

COURSE OBJECTIVE

The course is designed to introduce the field of artificial neural networks systems and machine learning. The course will give the student the practical and implementation aspects of data processing algorithms.

COURSE OUTCOME

- Student will be able to implement basis supervised learning algorithms.
- Student will be able to use algorithms for unsupervised methods.
- Student will be able to describe how statistical models work.

Course Contents

Module 1	Linear and Polynomial Regression
Module 2	Logarithmic Regression
Module 3	Gradient Descent Algorithm with Boosting
Module 4	Back propagation and Radial basis function based neural net implementation
Module 5	k-means, fuzzy c- means clustering
Module 6	Fuzzy controller design and implementation
	TEXT BOOK
1	Simon Haykin, “Neural Networks and Learning Machines”, Pearson Publication, New Delhi, 2012.

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4123T
Course Title	**WIRELESS SENSOR NETWORKS**
Pre-requisite	**Wireless Communication, Data Communication**

COURSE OUTCOMES

After completion of this course, students will be able to

1. Describe the concepts, network architectures and applications of ad hoc and wireless sensor networks.
2. Analyze the protocol design issues of ad hoc and sensor networks.
3. Explain the concepts of communication, MAC, routing protocols and also study about the naming and addressing in WSN.
4. Describe routing protocols for ad hoc and wireless sensor networks with respect to some protocol design issues.

COURSE CONTENTS

Module 1	**Overview Of Wireless Sensor Networks**
	Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, Advantages of sensor networks- energy advantage, detection advantage, Sensor network applications- Habitat Monitoring, Tracking chemical plumes- Smart transportation.
Module 2	**Architectures**
	Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.
Module 3	**Networking Sensors**
	Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts- S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.
Module 4	**Infrastructure Establishment**
	Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.
Module 5	**Sensor Network Platforms And Tools**
	Sensor Node Hardware- Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.
Text Books:	
1.	Holger Karl & Andreas Willig, "*Protocols And Architectures for Wireless Sensor Networks*", John Wiley, 2005.
2.	Feng Zhao & Leonidas J. Guibas, "*Wireless Sensor Networks- An Information Processing Approach*", Elsevier, 2007.

Additional Reading:	
1.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks-Technology, Protocols, And Applications”, John Wiley, 2007.
2.	Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
3.	K. Akkaya and M. Younis, “A survey of routing protocols in wireless sensor networks”, Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325—349.
4.	Philip Levis, “TinyOS Programming”.
5.	Anna Ha´c, “Wireless Sensor Network Designs”, John Wiley & Sons Ltd.

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4123P
Course Title	**WIRELESS SENSOR NETWORKS LAB**
Pre-requisite	**Wireless Communication, Data Communication**

COURSE OUTCOMES

After completion of this course, students will be able to

1. Describe the concepts, network architectures and applications of ad hoc and wireless sensor networks.
2. Analyze the protocol design issues of ad hoc and sensor networks.
3. Explain the concepts of communication, MAC, routing protocols and also study about the naming and addressing in WSN.
4. Describe routing protocols for ad hoc and wireless sensor networks with respect to some protocol design issues.

COURSE CONTENTS

Experiment 1	To study various wireless sensor network architectures
Experiment 2	To simulate adhoc sensor network and compute performance metrics
Experiment 3	To study MAC and routing protocols
Experiment 4-6	To design adhoc network using sensors, implement using hardware and establish communication link among them (3 experiments for 3 different applications)

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4124T
Course Title	**Advanced Image Analysis**
Pre-requisite	**Digital Signal Processing, Digital Image Processing**

COURSE OBJECTIVES

1. To make students understand enhancement techniques and their analysis in context of aerial/satellite images
2. To make students interpret transforms for multidimensional signals
3. To make students analyze and perform classification of remotely sensed images
4. To make students understand and apply various accuracy measurements.

COURSE OUTCOMES

After successful completion of this course, students will be able to

1. To explain and analyse image enhancement techniques in spatial and frequency domain
2. To interpret application of transform theory for image analysis and employ them for various applications
3. To describe and classify methods of image segmentation and examine textural properties
4. To interpret and analyse multispectral imageries with spatial and spectral properties
5. To model and perform post-classification analysis with statistical accuracy estimation

COURSE CONTENTS

Module 1	**Introduction**
	Review of image processing in spatial and Fourier domains with basic filtering operations, Methods of acquisition of digital images from conventional and space-borne scanners, Radiometric and geometric corrections, False color composite representation
Module 2	**Transform Domain Analysis**
	Review of Fourier Analysis for digital images, Discrete Cosine Transforms for images and decomposition in-terms of basis images, Wavelet basis representation and their utility, Colour and PCT Arithmetic operations
Module 3	**Object Based Image Analysis**
	Soft Computing, Feature Selection, Support Vector Machines, MRA based analysis, Mathematical Morphology, Texture analysis and content based image retrieval
Module 4	**Applications**
	Identification of data sets for the task, Preparation of the Base Map, Identification of Landuse/Landcover based on Tone, Texture, Study of Spectral Behavior of Terrain, Water, Vegetation, Rocks, Soil
Module 5	**Post Classification Analysis**
	Pattern Association, Analysis through Supervised and Unsupervised Classification, Accuracy assessment using statistical methods
Text Books:	
1.	Fundamentals of Remote Sensing and Airphoto Interpretation, T.E. Avery and L.B. Graydon, Prentice Hall, 1992.
Recommended Reading:	
1.	Computer Vision, L Shapiro and G Stockman, Prentice Hall, 2001

Programme Name	**B. Tech. EXTC, Semester-VIII**
Course Code	R4ET4124P
Course Title	**Advanced Image Analysis LAB**
Pre-requisite	**Digital Signal Processing, Digital Image Processing**

COURSE OUTCOMES

After successful completion of this course, students will be able to

1. To explain and analyse image enhancement techniques in spatial and frequency domain
2. To interpret application of transform theory for image analysis and employ them for various applications
3. To describe and classify methods of image segmentation and examine textural properties
4. To interpret and analyse multispectral imageries with spatial and spectral properties
5. To model and perform post-classification analysis with statistical accuracy estimation

COURSE CONTENTS

Sr.	Experiments
1	To implement image enhancement techniques for analysis in different domains (2 experiments)
2	To implement textural segmentation methods (3 experiments)
3	To implement and analyse multispectral images, their bands and properties (3 experiments)
4	To perform accuracy assessment using various techniques (2 experiments)