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
toBachelor of Technology (B.Tech.) Degree
in
Electronics Engineering

Implemented from the batch admitted in Academic Year 2018-19

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

(Autonomous Institute affiliated to University of Mumbai)

Curriculum

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For

Fourth Year Undergraduate Programme Leading
toBachelor of Technology (B. Tech.)
in

106 Electronics 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 Engineering Graduates will have ability to

• Apply analysis, design, optimization and implementation skills in order to formulate and solve Electronics Engineering and multidisciplinary problems.

• Take up higher studies, innovation, research & development and other such creative efforts in technology.

• Use their skills in professional manner to raise the satisfaction level of stake holders.

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 analyse 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 Engineering Graduate will be able to:

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

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

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

Scheme of Instruction and Evaluation

B. Tech (Electronics Engineering) SEMESTER VII								
Scheme of Instruction					Scheme of Evaluation			
Sr. No.	**Course Code**	**Course Title**	**L-T-P (Hours/week)**	**Credits**	**TA**	**MST**	**ESE**	**ESE hours**
1	R4EC4001S	Computer Communication and Networking	3-0-0=3	3	20	20	60	3
2	R4EC4002S	Principles of VLSI	3-0-0=3	3	20	20	60	3
3	R4EC4003T	Embedded Systems	3-0-0=3	3	20	20	60	3
	R4EC4003P	Embedded Systems LAB	0-0-2=2	1	60	-	40	2
4		Program Elective II	3-0-0=3	3	20	20	60	3
		Program Elective II LAB	0-0-2=2	1	60	-	40	2
5		Open Elective II	3-0-0=3	3	20	20	60	3
6	R4EC4901D	Project I	0-0-4=4	2	60	-	40	2
7	R4EC4004A	Information Technology Act	3-0-0=3	MNC	60	-	40	2
8	R4EC4701I	Internship	-	2				
		Total	**18-0-8=26**	**21**				

B. Tech (Electronics Engineering) SEMESTER VIII								
Scheme of Instruction					Scheme of Evaluation			
Sr. No.	**Course Code**	**Course Title**	**L-T-P (Hours/week)**	**Credits**	**TA**	**MST**	**ESE**	**ESE hours**
1	R4EC4011S	Microcomputer System Design	3-0-0=3	3	20	20	60	3
2	R4EC4012S	Microwave and Optical Communication	3-0-0=3	3	20	20	60	3
3	R4EC4013S	Wireless Communication Systems	3-0-0=3	3	60	-	40	2
4		Program Elective III	3-0-0=3	3	20	20	60	3
5		Program Elective IV	3-0-0=3	3	20	20	60	3
		Program Elective IV Lab	0-0-2=2	1	60	-	40	2
6	R4EC4902D	Project II	0-0-8=8	4	60	-	40	2
		Total	**15-0-10=25**	**20**				

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*

B. Tech (Electronics Engineering)
Elective Groups

Program Elective II

S. No.	Course Code	Course Title
1	R4EC4101T	Neural Networks and Fuzzy Systems
	R4EC4101P	Neural Network and Fuzzy Systems LAB
2	R4EC4102T	Audio, Video and Image Compression
	R4EC4102P	Audio, Video and Image Compression Lab
3	R4EC4103T	Speech Processing
	R4EC4103P	Speech Processing LAB
4	R4EC4104T	Medical Electronics
	R4EC4104P	Medical Electronics LAB
5	R4EC4105T	Deep Learning
	R4EC4105P	Deep Learning Lab

Program Elective III

S. No.	Course Code	Course Title
1	R4EC4111S	Biomedical Informatics
2	R4EC4112S	Computer and Network Security
3	R4EC4113S	Wireless Sensor Networks
4	R4EC4114S	Parallel Computing

Program Elective IV

S. No.	Course Code	Course Title
1	R4EC4121T	RF Circuits Techniques
	R4EC4121P	RF Circuits Techniques LAB
2	R4EC4122T	Advanced Digital Communication
	R4EC4122P	Advanced Digital Communication LAB
3	R4EC4123T	Natural Language Processing
	R4EC4123P	Natural Language Processing LAB
4	R4EC4124T	Advanced Digital Signal Processing
	R4EC4124P	Advanced Digital Signal Processing LAB

Open Elective II

S. No.	Course Code	Course Title
1.	R4EC4601S	Introduction to Nano Electronics

Program Name	B. Tech. Electronics Engineering, Semester-VII
Course Code	R4EC4001S
Course Title	COMPUTER COMMUNICATION AND NETWORKING
Prerequisite	Principles Of Communication

COURSE OUTCOMES

After completion of the course, students should be able to

- Describe the layered network architecture.
- Distinguish different networking components and their respective roles in a communication system.
- Explain the various routing protocols and algorithms
- Analyze the features and operation of various network protocols

COURSE CONTENTS

Module 1	**Data Communication:**
	Components, Direction of Data flow, Networks, Types of connections, Topologies (Bus, Star, Ring, Mesh). Transmission Media – Twisted-Pair Cable, Coaxial Cable, Fibre Optics, Line Coding. Physical layer standards Basics of Message switching, Packet switching, Circuit switching and cell switching. Introduction to LAN, MAN, WAN.
Module 2	**Protocols And Standards:**
	Standards – ISO/OSI reference model, Overview of TCP/IP architecture, TCP/IP model, Structured cabling and specification: Standard CAT5, 5E-RS232 Interfacing Standard.
Module 3	**Data Link Layer:**
	Link-layer and its services, IEEE 802 standards, Medium Access Control (MAC), Logical Link Control (LLC) and Link layer addressing. Local area networks and IEEE 802.11 wireless LANs, multiple-access protocols. Random access, efficiency of pure and slotted ALOHA, CSMA, CSMA/CD (IEEE 802.3), and CSMA/CA (IEEE 802.11n). Flow Control and Error control: Stop and wait, Go back N ARQ, Selective Repeat ARQ. HDLC and Introduction to VLAN.
Module 4	**Network and Transport Layer:**

	IP Addressing (IPv-4) methods, Sub-netting, Routing Network as a Graph, Distance Vector and Link State algorithms, Datagram Forwarding in IP. Distance Vector: Routing Information Protocol (RIP), Link State: Open Shortest Path Find (OSPF). Address Translation: Address Resolution Protocol (ARP). Host Configuration: Dynamic Host Configuration Protocol (DHCP).
	Error Reporting: Internet Control Message Protocol (ICMP). Global Internet - subnetting, classless routing, IPv6, Mobile IP. Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Port number, Flow control and congestion control, Connection establishment and teardown, Quality of services (QoS).
Module 5	**Application Layer:**
	Domain Name Space (DNS) – Services provided, DNS records and messages server. Simple Mail Transfer Protocol (SMTP) – Architecture and Services, Message format, Pretty good privacy technique. Hyper Text Transfer Protocol (HTTP) – Connections and Architecture. Message format, Web catching, World Wide Web (WWW) – Client Server Architecture-Browser settings, Telnet.
Module 6	**Networking Devices:**
	Internetworking device- hub, repeater, bridge- spanning tree algorithm, switch, router Interfaces and connectors. **Performance factors** – Throughput, Bandwidth and Latency, High speed networks, Application performance needs.
TEXT BOOKS:	
1.	Behrouz. A. Forouzan, "*Data Communication and Networking*", Tata McGraw Hill.2007
2.	Wlliam Stallings, "*Wireless Communication and Networks*", Prentice Hall, 2nd edition, 2005.
3.	Leon Garcia, Widjaja, "*Communication Networks*", Tata McGraw Hill.2004
Additional Reading:	
1.	Larry L. Peterson, Bruce S. Davie, "*Computer networks*", 4th Edition, Elsevier.2007
2.	Jean Walrand & PravinVaraiya, "*High Performance Communication Networks*", Elsevier.2014
3.	Curt M. White, "*Data Communication and Computer Network*" 6-th Edition, 2008.

Programme Name	**B. Tech. (Electronics Engineering), SEMESTER - VII**
Course Code	R4EC4002S
Course Title	**PRINCIPLES OF VLSI**
Prerequisite	Electronic Circuit Analysis and Design I & II, Integrated Circuits and Applications

COURSE OUTCOMES:

After completion of the course, students should be able to

- Describe basic VLSI design flow, hierarchy, styles and design quality parameters.
- Explain semiconductor grade silicon production, CMOS fabrication process and should be able to draw and describe layout.
- Describe MOSFET structure, operation, characteristics, physical effects and scaling and should be able to calculate vital parameters related to MOSFET.
- Analyze and design various MOSFET circuits using different MOSFET based topologies (especially CMOS topology) functionally as well as for different parameter (delay, power, noise) constraints.
- Analyze and design functional units such as adders, multipliers, RAMs etc.

COURSE CONTENTS

Module 1	**Introduction**
	Moore's law; VLSI Design flow; design hierarchy; concepts of regularity, modularity and locality; VLSI design styles; design quality.
Module 2	**Fabrication and Layout of CMOS Integrated Circuits**
	Semiconductor grade silicon production; CMOS fabrication process – photolithography, diffusion, ion-implantation, CMOS process flow, isolation – LOCOS and STI; modern CMOS process trends such as lightly doped drain, copper interconnects, low-k and high-k dielectrics, three dimensional IC; layout, layout design rules, CMOS inverter layout design; latchup and latchup prevention techniques.
Module 3	**Physics and Modeling of MOSFETs**
	Energy band diagram view of MOS system under external bias; MOSFET structure and operation; first order V-I characteristics of MOSFET; channel length modulation; substrate bias effect; MOSFET modeling – drain-source resistance, MOSFET capacitance, junction leakage currents; MOSFET scaling; Short channel effects such as classical short channel effect, reverse short channel effect, mobility degradation, velocity saturation, hot carrier effect, DIBL, subthreshold leakage; Narrow channel effect; Current equations for velocity saturated MOSFETs.
Module 4	**CMOS inverter: Analysis and Design**

	VTC of ideal inverter; noise margin; CMOS digital logic inverter – different regions of operation, calculation of critical voltage points on VTC; CMOS inverter switching characteristics; design of CMOS inverter; power dissipation in CMOS inverter; comparison of various MOSFET based inverter topologies with CMOS inverter; ratioed and ratioless designs.
Module 5	**Static Logic Circuits**
	CMOS based gates such as NAND, NOR, XOR, XNOR and complex logic circuits; transistor sizing for gates; adder, SR latch and D latch circuits; CMOS SRAM cell; Schmitt trigger and tri-state output circuits; implementation of logic gates using other MOSFET based topologies such as pseudo nMOS etc.
Module 6	**Transmission Gate & Dynamic Logic Circuits**
	nMOS and pMOS pass transistors; CMOS transmission gate; clock feedthrough, charge leakage, charge sharing; bootstrapping; dynamic CMOS logic; high performance dynamic CMOS circuits such as domino CMOS logic, NORA and TSPC CMOS logic; DRAM cell.
	TEXT BOOKS:
1	Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits-Analysis and Design, 3rd edition, McGraw Hill
2	Jan M. Rabaey, Anantha Chandrakasan & Borivoje NIkolic, Digital Integrated Circuits-A Design Perspective, 2nd edition, PHI
3	David A Hodges, Horace G Jackson & Resve A Saleh, Analysis and Design of Digital Integrated Circuits in deep submicron technology, 3rd edition, McGraw Hill
	ADDITIONAL READING:
1	Neil H E Weste & Kamran Eshragian, Principles of CMOS VLSI Deisgn- A systems perspective, Addison- Wesley
2	John P. Uyemura, CMOS Logic Circuit Design, Springer International Edition
3	Adel S. Sedra & Kenneth C. Smith, Microelectronic Circuits, 5th edition, Oxford University Press
4	S. M. Sze, VLSI Technology, 2nd edition, Bell Laboratories.

Programme Name	**B.Tech. (Electronics Engineering), SEMESTER - VII**
Course Code	R4EC4003T
Course Title	**EMBEDDED SYSTEMS**
Prerequisite	Microprocessors And Controllers

COURSE OUTCOMES

After completion of the course, students should be able to

- Describe the hardware and software architecture of embedded system.
- Identify the necessary communication Interface for the embedded system.
- Organize the complete embedded system development project.
- Design and develop the small-scale embedded system.

COURSE CONTENTS

Module I	**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 II	**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 III	**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 IV	**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 V	**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 VI	**Design Examples & Case Studies of Embedded System**
	Digital Thermometer, Navigation Systems, Smart Card, RF Tag
Text Books:	
1.	Raj Kamal "Embedded system" Tata McGraw Hill.2003
2.	Prasad "Embedded Real time systems" Dream tech Wiley Publication.2003
Additional Reading:	
1.	David Simon, "An embedded Software Primer" Pearson Publication, 1999
2.	Frank Vahid, "Embedded system- A unified Hardware Software Introduction" John Wiley and Sons.2002

Programme Name	**B.Tech. (Electronics Engineering), SEMESTER - VII**
Course Code	R4EC4003P
Course Title	**EMBEDDED SYSTEM LAB**
Prerequisite	**Microprocessors And Controllers**

COURSE OUTCOMES

After completion of the course, students should be able to

- Design and implement programs on 8051 microcontroller and its derivatives
- Connect sensors and implement programs using them
- Using RTOS in embedded projects
- Design build and test an embedded product

COURSE CONTENTS

Module 1	**Embedded Software Development Tools**
	Keil µ vision 4 and 5 project management, Study How to create Embedded Project, Compile and Test Project for 8051 it's Derivative, Testing of 8051 based project on Target Board, Programming of Flash Memory, use Debugger. Flowcode, Arduino open source software and hardware platform.
Module 2	**Embedded Hardware Development Board**
	Programming 8051 and Arduino UNO
Module 3	**Embedded sensors and peripheral modules**
	Test several sensors and peripherals modules with 8051 and Arduino UNO boards.
Module 4	**Deployment of embedded system**
	Deployment of software into hardware and testing hardware, software and hardware with software and measure design parameters.
Module 5	**RTOS**
	Study of Various Commands of RTOS like RTX51 tiny. Free RTOS, RTLinux and programming and develop multitasking software applications.
Module 6	**Embedded system design and implementation**
	Design, build and test embedded product for various embedded applications using development systems and open source platforms.
Module 7	**System on chip design**
	Design, build and test hardwired embedded system using FPGA Design, build and test medium scale embedded system using Xilinx ZYNQ.
Text Books:	
1.	Raj Kamal "Embedded system" Tata McGraw Hill,2003.
2.	Prasad "Embedded Real time systems" Dream tech Wiley Publication.2003
Additional Reading:	
1.	Mazidi "8051 microcontroller and embedded system" Pearson,2005

2.	Cornel Amariei, Arduino Development Cookbook, Packet publishing
3.	Pete Cockerell “ARM assembly language programming”
4.	Rahul Dubey, “Introduction to embedded system design using FPGA” Springer, 2013

Programme Name	**B.Tech. (Electronics Engineering), SEMESTER - VII**
Course Code	R4EC4004A
Course Title	**Information Technology Act**
Prerequisite	

COURSE OUTCOMES

After completion of the course, students should be able to

- Describe cyber laws in general
- Describe the various facets of cyber crimes
- Solve problems arising out of e-commerce transactions
- Interpret Intellectual Property issues in the cyber space and the growth and development of the IT Act
- Differentiate the regulation of cyber space at national and international level

COURSE CONTENTS

Module 1	**Concept of Information Technology and Cyber Space**
	Interface of Technology and Law, Jurisdiction in Cyber Space and Jurisdiction in traditional sense, Internet Jurisdiction, Indian Context of Jurisdiction, Enforcement agencies, International position of Internet Jurisdiction, -Cases in Cyber Jurisdiction
Module 2	**Information Technology Act, 2000**
	Aims and Objects, Overview of the Act, Jurisdiction, Electronic Governance, Legal Recognition of Electronic Records and Electronic Evidence, Digital Signature Certificates, Securing Electronic records and secure digital signatures, Duties of Subscribers, Role of Certifying Authorities, Regulators under the Act, The Cyber Regulations Appellate Tribunal, Internet Service Providers and their Liability, Powers of Police under the Act, Impact of the Act on other Laws
Module 3	**E-Commerce**
	UNCITRAL Model, Legal aspects of E-Commerce, Digital Signatures, Technical and Legal issues, E-Commerce, Trends and Prospects, E-taxation, E-banking, online publishing and online credit card payment, Employment Contracts, Contractor Agreements, Sales, Re-Seller and Distributor Agreements, Non-Disclosure Agreements, Shrink Wrap Contract, Source Code, Escrow Agreements
Module 4	**Cyber Law and IPRs**
	Understanding Copy Right in Information Technology, Software, Copyrights vs Patents debate, Authorship and Assignment Issues, Copyright in Internet, Multimedia and Copyright issues, Software Piracy, Patents, Understanding Patents, European Position on Computer related Patents, Legal position of U.S. on Computer related Patents, Indian Position on Computer related Patents, Trademarks, Trademarks in Internet, Domain name registration, Domain Name Disputes & WIPO, Databases in Information Technology, Protection of databases, Position in USA, EU and India
Module 5	**Cyber Crimes**

	Meaning of Cyber Crimes, Different Kinds of Cyber-crimes, Cyber-crimes under IPC, Cr.P.C and Indian Evidence Law, Cyber-crimes under the Information Technology Act-2000, Cyber-crimes under International Law, Hacking, Cyber Stalking, Denial of service Attack, Virus Dissemination, Software Piracy, Internet Relay Chat (IRC) Crime, Credit Card Fraud, Net Extortion, Phishing etc, Cyber Terrorism, Violation of Privacy on Internet, Data Protection and Privacy
Text Book	
1.	Vakul Sharma and Seema Sharma, Information Technology Law and Practice, LexisNexis publishers, 6th Edition, 2019
Additional Reading	
1.	K. L. James, The Internet: A User's Guide, Prentice Hall of India, New Delhi, 2003
2	Chris Reed, Internet Law-Text and Materials, Universal Law Publishing Co., 2nd Edition, 2005
3	Vakul Sharma, Hand book of Cyber Laws, Macmillan India Ltd, New Delhi
4	S.V.Joga Rao, Computer Contract & IT Laws (in 2 Volumes), Prolific Law Publications, New Delhi, 2005

PROGRAM ELECTIVE II

Programme Name	**B Tech Electronics Engineering Sem VII**
Course Code	R4EC4101T
Course Title	**Neural Networks 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 Electronics Engineering Sem VII**
Course Code	R4EC4101P
Course Title	**Neural Networks 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

- Students will be able to implement basic supervised learning algorithms.
- Students will be able to use algorithms for unsupervised methods.
- Students will be able to describe how statistical models work.
- Students will be able to simulate fuzzy controller

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. Electronics Engineering, Semester-VII**
Course Code	R4EC4102T
Course Title	**Audio, Video and Image Compression**
Pre-requisite	Digital Signal processing

COURSE OBJECTIVES

1. To evaluate various Lossless and Lossy compression techniques for different types of data.
2. To develop coding for text compression and audio compression techniques
3. To develop image and video compression techniques
4. To analyze various quantization techniques

COURSE OUTCOMES

After completing this course, students will be able to

1. Understand and evaluate various lossless and lossy compression methods.
2. Understand various types of redundancies in an image and methods to remove them
3. Analyze and compare audio and video compression standards
4. Understand and analyze various quantization techniques

COURSE CONTENTS

Module I	Data Compression Techniques
	Loss less compression, Lossy compression, Entropy Measures of performance, Modeling and Coding Minimum variance Huffman coding, Extended Huffman coding, Adaptive Huffman coding, Shannon Fano Coding, Arithmetic coding, Dictionary coding techniques, LZ 77, LZ 78, LZW
Module II	Audio Compression
	High quality digital audio, Frequency, Spectral and Temporal masking, Lossy sound compression, Format of Compressed Data 22 M-law and A-law companding, MPEG audio standard 23 DPCM and ADPCM audio compression, Frequency Domain coding
Module III	Image and Video Compression
	Two D Image Transforms, Lossless Image compression techniques, PCM, DPCM, JPEG, JPEG –LS and JPEG 2000 standards Video Compression, Intra frame coding, motion estimation and compensation, Introduction to MPEG - 2 H-264 encoder and decoder, MPEG Industry Standards
Module IV	Quantization
	Problems in quantization Uniform, adaptive, forward adaptive, backward adaptive, nonuniform quantization

	4.3 Vector quantization and algorithms (Linde Buzo Gray algorithm, tree, pyramid, polar, lattice spherical quantization
Text Books:	
1	*Data Compression: The Complete reference*, 4th edition 2007 by David Salomon. Springer Publication.
2	*Introduction to Data Compression*: 3rd Edition 2006 by Khalid Sayood. Morgan Kaufmann Series,
Reference Books:	
1	*The Data Compression Book* 2nd Edition: by Mark Nelson. BPB publication,
2	*Handbook of data compression*, 2010 Salomon, David, Motta, Glovanni. Spriger Publications

Programme Name	**B. Tech. Electronics Engineering, Semester-VII**
Course Code	R4EC4102P
Course Title	**Audio, Video and Image Compression LAB**
	Digital Signal processing

COURSE OUTCOMES

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

1. Implement Lossless and Lossy compression algorithms
2. Implement various image compression techniques
3. Simulate audio compression algorithm and estimate parameters
4. Study and simulate video compression algorithms
5. Implement various quantization techniques and measure parameters for performance evaluation

COURSE CONTENTS

Module I	Data Compression Techniques
	1.1 Loss less compression and Lossy compression Implementation 1.2 Entropy Measures of Performance Simulation 1.3 Modeling and Coding Simulation 1.4 Image Compression Coding
Module II	Audio Compression
	2.1 Frequency, Spectral and Temporal masking Coding 2.2 M-law and A-law companding coding, 2.3 DPCM and ADPCM Implementation 2.4 Audio compression Implementation 2.5 Frequency Domain coding
Module III	Image and Video Compression
	3.1 Image Compression Implementation 3.2 Video Compression Implementation 3.3 MPEG encoder and decoder Simulation
Module IV	Quantization
	4.1 LBG algorithm 4.2 Estimation of parameters in quantization
Lab Instructions	At least 2 experiments should be conducted on each module
Text Books:	
1	*Data Compression: The Complete reference*, 4th edition 2007 by David Salomon. Springer Publication,
2	*Introduction to Data Compression*: 3rd Edition 2006, by Khalid Sayood.

Programme Name	**B. Tech. Electronics Engineering, Semester-VII**
Course Code	R4EC4103T
Course Title	**Speech Processing**
Pre-requisite	Signal Processing

COURSE OBJECTIVES

1. To introduce the characteristics of Speech signals and the related time and frequency domain representations.
2. To introduce the different applications of speech like synthesis, coding and recognition.

COURSE OUTCOMES

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

1. Analyze the speech signal to identify the different parameters
2. Apply different methods for speech processing
3. Carry out analysis of speech signals using different techniques
4. Understand applications of speech processing

COURSE CONTENTS

Module 1	**Speech production and perception**
	Speech production mechanism, Auditory System and Hearing Mechanism, Classification of speech, sounds, nature of speech signal, models of speech production. Speech signal processing: purpose of speech processing, digital models for speech signal, Digital processing of speech signals, Significance, short time analysis.
Module 2	**Time domain methods for speech processing**
	Time domain parameters of speech, methods for extracting the parameters, Zero crossings, Auto correlation function, pitch estimation.
Module3	**Frequency domain methods for speech processing**
	Short time Fourier analysis, filter bank analysis, spectrographic analysis, Format extraction, pitch extraction, Analysis - synthesis systems, Auditory models.
Module 4	**Linear predictive coding of speech**
	Formulation of linear prediction problem in time domain, solution of normal equations, Interpretation of linear prediction in auto correlation and spectral domains.
Module5	**Speech signal analysis**
	Cepstral analysis of speech, Mel frequency cepstral coefficients (MFCC), format and pitch estimation.
Module6	**Applications of speech processing**
	Speech Synthesis, Speech Coding, Speech and Speaker recognition and verification. Vector quantization, Hidden Markov modeling for isolated word and continuous speech recognition.
Text Books:	
1.	Lawrence Rabiner and Ronals Schafer, "*Theory and Applications of Digital Speech Processing*", Prentice Hall, 2011

2.	T.F. Quatieri, *Discrete-Time Speech Signal Processing*, Prentice Hall 2002.
3.	L.T. Rabiner and R. Schafer, *Digital Processing of Speech Signals*, Prentice Hall, 1978.
Recommended Reading:	
1.	Douglas O"Shaughnessy, *Speech Communciations: Human and Machine*, Universities Press, 2001.
2.	*J.L Flanagan: Speech Analysis Synthesis and Perception* - SprengerVertag,
3.	*I.H.Witten: Principles of Computer Speech*, Academic press.

Programme Name	**B. Tech. Electronics Engineering, Semester-VII**
Course Code	R4EC4103P
Course Title	**Speech Processing Lab**
Pre-requisite	Digital Signal Processing

COURSE OBJECTIVES

1. To introduce the characteristics of Speech signals and the related time and frequency domain representations.
2. To introduce the different applications of speech like synthesis , coding and recognition

COURSE OUTCOMES

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

1. Analyze the speech signal and to identify the different parameters of speech signal like voiced/unvoiced, vowel/consonant, types of articulation etc.
2. Develop various speech models using various features vectors like LPC, Cepstrum, MFCC
3. Develop simple speech processing applications like Speech Recognition, Speaker Recognition, Speech Coding

COURSE CONTENTS

Module 1	Three experiments in time domain operations like Zero crossing detector, Energy Estimation, Autocorrelation etc by recording speech signal
Module 2	Study of spectrogram for various combination of speech syllables
Module3	Three experiments on Frequency domain methods for speech processing pitch extraction formant extraction etc.
Module 4	Experiments on simple some applications of speech.
Text Books:	
1.	Lawrence Rabiner and Ronals Schafer, "*Theory and Applications of Digital Speech Processing*", Prentice Hall, 2011
2	T.F. Quatieri, *Discrete-Time Speech Signal Processing*, Prentice Hall 2002.
3	L.T. Rabiner and R. Schafer, *Digital Processing of Speech Signals*, Prentice Hall, 1978.

Programme Name	**B. Tech. Electronics Engineering, Semester-VII**
Course Code	R4EC4104T
Course Title	**MEDICAL ELECTRONICS**
Prerequisite	Instrumentation Systems

COURSE OUTCOMES

After completion of the course, students should be able to

- To integrate the information about generation of biopotentials
- Apply electronic engineering principles for data acquisition and measurement of biopotentials
- Analyze the working and design aspects of the instruments used in medical field.
- 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 Electrosphygmomanometry, 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. Electro Encephalogram: EEG Electrodes and their placement-'Anterior-Posterior' and 'Lateral' measurements, Recording Modes of EEG, Applications of EEG. Electro Retinogram: 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.	"Handbook of Biomedical Instrumentation" by R.S.Khandpur, Third Edition 2014, Tata McGraw Hill Education Private Limited
2	"Biomedical Instrumentation and Measurements" by Leslie Cromwell, Fred J. Weibell & Erich A. Pfeiffer, Second Edition (2011), Prentice Hall of India publication
Additional Reading:	
1	"Introduction to Biomedical Equipment Technology" by Joseph J. Carr and John M. Brown, Fourth Edition(2011), Pearson Education
2	"Biophysical measurements" by Strong P., Second Edition, Measurement Concepts publication

3	“Principles of applied biomedical instrumentation” by Leslie Alexander Geddes, L. E. Baker, Third Edition, Wiley publication
4	“Medical Instrumentation Application and Design” by John G. Webster, Third Edition (2011), Wiley publication
5	“Medical Electronics” by G. E. Donovan, published by Butterworth & Co.
6	“Biomedical Instruments: Theory and Design” by Walter Welkowitz, Sid Deutsch & Metin Akay, Second Edition, Academic Press

Programme Name	**B. Tech. Electronics Engineering, Semester-VII**
Course Code	R4EC4104P
Course Title	**MEDICAL ELECTRONICS LAB**
Prerequisite	Instrumentation Systems

COURSE OUTCOMES

After completion of the course, students should be able to

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

COURSE CONTENTS

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

5	“Medical Electronics” by G. E. Donovan, published by Butterworth & Co.
6	“Biomedical Instruments: Theory and Design” by Walter Welkowitz, Sid Deutsch & Metin Akay, Second Edition, Academic Press

Programme Name	**B Tech Electronics Engineering Sem VII**
Course Code	R4EC4105T
Course Title	**Deep Learning**

COURSE OUTCOME

After completing this course,

- Student will be able to explain the concept of Deep Learning
- Student will be able to understand different networks of CNN for learning
- Student will be able to describe tensor flow method.
- Students will be able to explain and simulate U-net based deep learning models

COURSE CONTENTS

Module 1	**Introduction**
	Motivations for Studying deep learning, Introduction to deep learning, perceptron models, activation functions, Deep vs shallow neural network, Binary cross entropy loss, squared error loss, Loss optimization, gradient descent (SGD, Adam, Adadelta Adagrad, RMSProp)
Module 2	**Classical networks**
	Convolutional neural networks, various architectures, RESNET, FuseNets, U-Net, modified U-Net, MRA based CNN, MRA based U Net, Self-driving cars, feature extraction, learning, fully connected nets
Module 3	**Deep sequence modeling and tensor flow**
	Sequence modeling, word example, recurrent neural networks, Vanilla NN, computational graphs, back propagation through time, gradient flow, long term dependencies, Long short term memory, introduction to tensor flow
Module 4	**Generative models and reinforcement learning**
	Supervised vs unsupervised learning, generative models, Debiasing, Outliers, latent variables, autoencoders, Variational autoencoders (VEA), VEA optimizations, generative adversarial networks, case studies on GAN, reinforcement learning, learning in different environments, Q-function, value learning, Deep Q networks
Module 4	Neural Rendering and Case studies
	Neurosymbolic AI, evolution of AI, ObjectNet, ImageNet, neural rendering, models vs pictures, value and policy networks, RenderNet, Case studies: Debiasing face recognition, word modeling
	TEXTBOOKS
1	Deep learning with Python, Francois Chollet, Manning Publications, 2017
2	Simon Haykin, “Neural Networks - A Comprehensive Foundation”, Macmillan Publishing Co., New York, 1994.
3	A Cichocki and R. Unbehauen, “Neural Networks for Optimization and Signal Processing”, John Wiley and Sons, 1993.

Programme Name	**B Tech Electronics Engineering Sem VII**
Course Code	R4EC4105P
Course Title	**Deep Learning 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

- Students will be able to simulate CNN implement basic supervised learning algorithms.
- Students will be able to use algorithms for supervised and unsupervised methods.
- Students will be able to simulate tensor flow.
- Students will be able to simulate U net and MRA Net

Course Contents

Sr	Experiments
1	To simulate CNN for various examples (3 experiments)
2	To simulate and analyse U net for classification and semantic segmentation (3 experiments)
3	To extract MRA features and simulate MRA nets (2 experiments)

OPEN ELECTIVE II

Programme Name	B. Tech. Electronics Engineering, Semester-VII
Course Code	R4EC4601S
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 in Nanoelectronics and to be able to critically assess future trends.

Overview

Module 1: Introduction

CMOS Scaling, Scaling Issues, Limit to Scaling, System Integration limit, Interconnect Issues, 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. Quantum dots

Electronics properties, structure, Quantum Cellular Automata (QCA) , and Circuit Designusing QCA.

Module 6. Carbon Nanotube

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.

Recommended Reading

1. Introduction to nanotechnology, C.P.Poole JV, F.J.Owens, Wiley (2003).
2. Nanoelectronics and information technology (Advanced electronic materials andNovel Devices Waster Ranior, Wiley VCH (2003)
3. Nanoelectronics: Principles and Devices, 2nd Edition, M. Dragoman, D. Dragoman,Artech House - 2008
4. Nanoelectronic Circuit Design, Niraj K. Jha, Deming Chen, Springer - 2010.

SEM-VIII

Programme Name	**B. Tech. Electronics Engineering, Semester-VIII**
Course Code	R4EC4011S
Course Title	**MICROCOMPUTER SYSTEM DESIGN**
Prerequisite	**Microprocessor Systems**

COURSE OUTCOMES

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

- Describe the architecture of Pentium processor
- Illustrate cache structures implemented in Pentium processor
- Implement PCI bus for computer systems
- Interpret USB data and control transfers

COURSE CONTENTS

Module 1	**The Pentium Processor**
	Functional units of Pentium processor. Overview of cache operation and cache types. Pentium cache overview. Pentium signals interface. Address bus, data bus, misaligned transfers, Communications with 8, 16, 32 and 64 Bit devices, bus control signals, bus master signals, System test and initialization. System management tools. Reliability and error reporting. Code cache and Instruction pipeline. Introduction to the pre-fetcher, Instruction branch prediction, code cache organization and operation, the floating point pipeline. The data cache and burst bus cycles. Introduction to internal data cache, structure of internal data cache, and the bus cycle state machine, anatomy of write hit and miss, inquire cycles. Bus cycle overview, burst cycles, single transfer bus cycle - pipelined and non-pipelined, special cycles. Interrupt acknowledge bus cycle, bus cycle state machine, bus and bus state transition.
Module 2	**PCI Bus**
	Local Bus concept. Introduction to PCI Bus operation; Introduction to Reflected wave switching; PCI Bus functional signal groups. PCI Bus Arbitration, Arbiter, Arbitration algorithms, hidden bus arbitration, example of arbitration between two masters, bus access latency, PCI read and write transfers, PCI I/O addressing, Interrupt acknowledge. Interrupt routing, Interrupt chaining.
Module 3	**Peripheral Bus Interfaces**
	The SATA interface, timing specifications, SATA protocol, Model of an SATA Disk Drive.
Module 4	**Universal Serial Bus (USB)**
	Introduction to USB,PC requirements, Bus topology, understanding the host and the peripheral, the development process. USB transfer basics, Elements of a transfer, successful transfers. Transfer types, Control transfer, Bulk transfer, Interrupt transfer, Isochronous transfer, time critical transfers. USB versions
	TEXT BOOKS:

1	Don Anderson et al, Pentium Processor System Architecture, Addison-Wesley Professional; second edition, 1995
2	Tom Shanley et al, PCI System Architecture,. Addison-Wesley Professional; fourth edition, 1999
3	Don Anderson, SATA storage Technology, Serial ATA, Mindshare Press, 2007
	Jan Axelson, USB complete, Penram Publication, fourth edition, 2011

Programme Name	**B. Tech. (Electronics Engineering), SEMESTER – VIII**
Course Code	R4EC4012S
Course Title	**MICROWAVE AND OPTICAL COMMUNICATION**
Prerequisite	Electromagnetics and Fields, Principles Of Communication

COURSE OUTCOMES

After completion of the course, students should be able to

- Design various matching circuits and describe various waveguide devices.
- Analyze and distinguish modal propagation in metallic and dielectric waveguides.
- Describe the working principle of various microwave and optical sources and detectors.
- Quantify the various power losses and dispersion mechanism in optical fibers and transmission lines.

COURSE CONTENTS

Module 1	**Transmission Lines**
	Introduction, Lumped Element Model of Transmission Lines, Telegraphers equation, propagation constant, Characteristic Impedance, Reflection Coefficient , VSWR and Impedance Transformation relation in a Transmission Line, Power Relations in Transmission Line
Module 2	**Smith Chart**
	Graphical Representation of Transmission Line on Smith Chart, Impedance and Admittance Chart, Quarter Wave Transformer, Single and Double Stub Matching
Module 3	**Waveguides**
	Modal Propagation, TE,TM and TEM Waves, Wave Propagation in Parallel Plate, Rectangular and Circular Waveguide
Module 4	**Microwave Active and Passive Devices**
	Waveguide Devices : magic tee, e plane tee, h plane tee, circulator, coupler Active Devices (Solid State) (Only Qualitative Analysis): Gunn Diode, Tunnel Diode, IMPATT Diode Active Devices (Vacuum Tube) (Only Qualitative Analysis): Klystron, Reflex Klystron, Magnetron, TWT
Module 5	**Optical Fiber Technology**
	Light Propagation in Optical Fiber, Types of Fiber based on refractive index profile and mode transmission
Module 6	**Transmission Characteristics of Optical Fiber**
	Attenuation, absorption, bending losses and dispersion in optical fibers, OTDR
Module 7	**Optical Fiber Sources and Detectors**
	Working principle and characteristics of LED, LASER, PIN and APD.
TEXT BOOKS:	
1	R. K. Shevgaonkar, Electromagnetic Waves, Tata McGraw-Hill,2005
2	David Pozar, Microwave Engineering, Wiley,2011

References	
1	S.Liao, Microwave Devices and Circuits, Pearson Publication,3rd Edition 2003
2	Gerd Keiser, Optical Fiber Communication, McGraw Hill Publication,2008

Programme Name	B. Tech. Electronics Engineering, Semester-VIII
Course Code	R4EC4013S
Course Title	WIRELESS COMMUNICATION SYSTEMS
Prerequisite	Basics of Communication Engineering

COURSE OUTCOMES:

After completion of the course, students should be able to

- Describe various fundamental concepts of mobile communication.
- Characterize different indoor and outdoor propagation models related to losses and different types of fading.
- Explain CDMA concepts and architecture, frame structure, system capacity, services provided.
- Compare and contrast the 2.5G, 3G and 4G technologies evolution with their characteristics and limitations.

COURSE CONTENTS

Module 1	**Fundamentals of Wireless Communication**
	Overview of wireless communications and systems Review of digital communications Cellular systems from 1G to 3G Wireless 4G systems
Module 2	**Radio Propagation and propagation path-loss models**
	Study of indoor and outdoor propagation models. Small scale fading and multi-path Small-scale multi-path propagation, parameter of multi-path channels, types of small scale fading, Raleigh and Ricean distribution.
Module 3	**Evolution of 1G-2G Technologies**
	AMPS, GSM Network architecture, signaling protocol architecture, identifiers, channels, introduction frame structure, speech coder RPE-LTP, authentication and security, call procedure, handoff procedure, services and features. **GSM evolution in GPRS and EDGE:** Architecture and services offered. **CDMA-1:** Frequency and channel specifications of forward and reverse CDMA channel, packet and frame formats, mobility and radio resource management.
Module 4	**3G Technology**
	IMT-2000/UMTS: Network architecture, air Interface specification, forward and reverse channels in W-CDMA and CDMA 2000, spreading and modulation. Cell search and synchronization, establishing a connection, hand off and power control in 3G system.
Module 5	**3GPP LTE 4G**

	Introduction and system overview. Frequency bands and spectrum ,network structure, and protocol structure Frame slots and symbols, modulation, coding, multiple antenna techniques **Logical and Physical Channels:** Mapping of data on to logical sub-channels physical layer procedures, establishing a connection, retransmission and reliability, power control. 4G Introduction and vision. Multi antenna Technologies: MIMO; software defined radio. Adaptive multiple antenna techniques, radio resource management, QOS requirements. Introduction to 5G
	TEXT BOOKS:
1	Rappaport, T.S., "Wireless communications", Second Edition, Pearson Education, 2010
2	Andreas. F. Molisch, "Wireless Communications", John Wiley – India, 2006
3	Vijay Garg , "Wireless Communications and networking", First Edition, Elsevier 2007.
	ADDITIONAL READING:
1	Young Kyun Kim and Ramjee Prasad, "*4 G Roadmap and Emerging Communication Technologies*", Artech house.2006
2	Raj Pandya, "*Mobile And Personal Communications Systems And Services*", Prentice hall.2000
3	Upena Dalal, " Wireless Communication", Oxford University Press, 2009
4	C.Y Lee , "*Mobile Communication*", Wiley.

PROGRAM ELECTIVE III

Programme Name	**B. Tech. Electronics Engineering, Semester-VIII**
Course Code	R4EC4111S
Course Title	**Biomedical Informatics**
Pre-requisite	

COURSE OUTCOMES

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

1) Comprehend utility of learning algorithms in healthcare
2) Analyze and interpret nature of clinical data
3) Understand structure of healthcare information system and flow
4) Apply learning algorithms on medical data for knowledge representation and inference

COURSE CONTENTS

Module 1	**Introduction**
	Nature of clinical data, standards, data in narrative texts, gene, expression and protein data, architecture of healthcare information systems
Module 2	**Probabilistic and graphical models**
	Information theoretic metrics, decision support via probabilities and utilities, decision support via expert systems, modeling and Bayesian network, learning Bayesian networks, classical machine learning algorithms, feature extraction and mapping
Module3	**Knowledge representation and inference**
	Propositional and first order logic, rule based systems, graph search, constraint satisfaction, privacy and security issues, medical expert systems
Module 4	**Miscellaneous Topics**
	Informatics in radiology, patient monitoring and intensive care, predictive genomics, patient data privacy, public health informatics, challenges from health care, Telemedicine,
Module5	**Case studies**
	Quantitative trait mapping, molecular traits, missing heritability, complex traits, diagnosis by pattern matching
Text Books	
1.	Jones, Neil C., and Pavel Pevzner. *An Introduction to Bioinformatics Algorithms*. MIT Press, 2004. ISBN: 9780262101066.
2.	Shortliffe, E. H., L. E. Perreault, G. Wiederhold, and L. M. Fagan. *Medical Informatics: Computer Applications in Health Care and Biomedicine* . 2nd ed. New York, NY: Springer, 2003
Recommended Reading:	
1.	Schwartz, W. B., R. S. Patil, and P. Szolovits. "Artificial intelligence in medicine: where do we stand." *New England Journal of Medicine* 316 (1987): 685-688.
2.	Lasko, T. A., J. G. Bhagwat, K. H. Zou, and L. Ohno-Machado. *The Use of Receiver Operating Characteristic Curves in Biomedical Informatics*.

Programme Name	**B. Tech. Electronics Engineering, Semester-VIII**
Course Code	R4EC4112S
Course Title	**Computer and Network Security**
Pre-requisite	

COURSE OUTCOMES

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

1) Comprehend utility of number theory in security
2) Understand and explain various encryption algorithms like IDEA and AES
3) Understand and simulate encryption algorithms like RSA and Diffie-Hellman
4) Explain the network security mechanism including real time communication applications

COURSE CONTENTS

Module 1	**Introduction**
	OSI model, active and passive attacks, layers and cryptography, Viruses, Trojans Horses and Worms, multi-level model of security,
Module 2	**Encryption**
	Secret codes, encryption scheme, integrity check, Perfect secrecy , one-time pad, public key cryptography, digital signatures, cryptographic hash functions, password hashing, message integrity, message fingerprint, hashing applications and constructions, Secret key cryptography, data encryption standard, International Data Encryption Algorithm, Advanced Encryption Standard, modes and messages
Module3	**Public Key Algorithms**
	Introduction, modular arithmetic, RSA, Diffie-Hellman key exchange and crypto groups, pedestrian commitment, PK encryption, DDH, Chinese remainder theorem, authentication, security handshakes elliptic curves
Module 4	**Network Security and Protocols**
	SSL, HTTPs, private browsing, anonymous communication, side channel attacks, Web security model, securing web applications, symbolic execution, Firewalls
Module5	**Real-time communication security**
	Perfect forward secrecy, IPsec: IKE, email security, public and secret keys, Pretty Good privacy
Text Books	
1.	Stamp, Mark. *Information Security: Principles and Practice*. John Wiley & Sons, 2011. ISBN: 9780470626399
2.	Katz, Jonathan, and Yehuda Lindell. *Introduction to Modern Cryptography*. Chapman and Hall / CRC, 2007. ISBN: 9781584885511
Recommended Reading:	
1.	Menezes, Alfred, Paul van Oorschot, and Scott Vanstone. *Handbook of Applied Cryptography*. CRC Press, 1996
2.	Kaufman, Charlie, Radia Perlman, and Mike Speciner. *Network Security: Private Communication in a Public World*. 2nd ed. Prentice Hall, 2002

Programme Name	**B. Tech. (Electronics Engineering), SEMESTER - VIII**
Course Code	R4EC4113S
Course Title	**WIRELESS SENSOR NETWORKS**
Prerequisite	Wireless Communication, Data Communication

COURSE OUTCOMES

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

- Describe the concepts, network architectures and applications of ad hoc and wireless sensor networks.
- Analyze the protocol design issues of ad hoc and sensor networks.
- Explain the concepts of communication, MAC, routing protocols and also study about the naming and addressing in WSN.
- 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. Electronics Engineering, Semester-VIII**
Course Code	R4EC4114S
Course Title	**Parallel Computing**
Pre-requisite	Microprocessor Systems

COURSE OUTCOMES

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

1) Understand and explain sequential versus parallel programming examples
2) Understand and explain various types of parallelism
3) Explain SIMD and MIMD architectures
4) Analyze parallel computing case study for signal and image processing application

COURSE CONTENTS

Module 1	**Introduction**
	Types of parallel computers, memory systems, cache design, pipelines, instruction scheduling, loop unrolling, multiple processors and processes, networks, applications, linear algebra, LAPACK and BLAS, gradient methods
Module 2	**Parallelism**
	Parallel computing hardware, uniprocessor architecture (CPU, memory, interfaces), instruction level parallelism, data level parallelism, thread level parallelism, shared memory and caches, cache coherency, parallel architectures: memory parallelism, interconnects, CPU parallelism, I/O and networking for parallel processors, shared and distributed memory, hybrid systems, scalability and load balance, pipeline parallelism, memory hierarchy systems, performance analysis and tuning
Module3	**Single Instruction Multiple Data (SIMD)**
	Introduction, data dependencies, pipelining and segmentation, branching and conditional execution, basic linear algebra examples, recurrence polynomial example, shared memory parallelism
Module 4	**Multiple Instructions Multiple Data (MIMD)**
	MPI commands and examples, matrix and vector operations, distribution of vectors, basic operation with vectors, two dimensional block cyclic matrix distribution, MPI FFT example
Module5	**Applications**
	Case studies, high performance computing in signal and image processing, Monte-Carlo simulations
Text Books	
1.	Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, Introduction to Parallel Computing, 2nd Ed. Pearson, 2004.
Recommended Reading:	
1.	Jack Dongarra, Ian Foster, Geoffrey C. Fox, William Gropp, Ken Kennedy, Linda Torczon, Andy White, The Morgan Kaufmann Series in Computer Architecture and Design, Morgan Kaufmann Publishers, Year: 2003

PROGRAM ELECTIVE
IV

Programme Name	**B. Tech. (Electronics Engineering), Semester-VIII**
Course Code	R4EC4121T
Course Title	**RF Circuit Techniques**
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
References	
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. (Electronics Engineering), Semester-VIII**
Course Code	R4EC4121P
Course Title	**RF Circuit Techniques 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. Electronics Engineering, Semester-VIII**
Course Code	R4EC4122T
Course Title	**Advanced Digital Communication**
Pre-requisite	Principles of Communication

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	**Information Theory and Linear Algebra**
	Entropy, Source coding Theorem, Lossless data compression Algorithm Discrete memory less channels, Mutual Information, Channel capacity Channel coding Theorem, Differential entropy and mutual information for continuous random ensembles, Information capacity of colored noisy channel Rate distortion Theory, Groups, Fields, Rings, Vector spaces, subspaces, Galois field, Extension fields, Primitive element, primitive polynomial
Module 2	**Modulation and Demodulation Techniques**
	Baseband techniques, Synchronization, ISI, Optimum filter, Passband model, Signal space diagram, Probability of Error, Coherent and noncoherent detection, Power spectra of coherent BPSK, BFSK and QPSK and Geometric Representation, Generation and detection of - M-array PSK, M-array QAM and their error probability, Generation and detection of -Minimum Shift Keying, Gaussian MSK, Non-coherent BFSK, DPSK and DEPSK, Channel coding, waveform coding, Types of error control
Module 3	**Coding Theory**
	Cyclic Codes: Properties, Various methods of generation and detection of cyclic codes, error detecting capability, cyclic Hamming code and Golay code. **Convolutional Codes:** Encoder and decoder, structural properties, optimum decoding of Convolutional codes, Viterbi, soft output Viterbi BCGR algorithm. **Turbo coding and Low Density Parity Check Codes:** Encoding and decoding. Encoding and detection, sum-product algorithm, simplification of sum product algorithm
Module 4	**Spread Spectrum Techniques**

	Allocation of the communication resource, Multiple access communication system and Architecture, Access Algorithm, Multiple access techniques Pseudonoise sequences, Direct sequence spread spectrum systems, Frequency Hopping systems
Text Books:	
1.	*Digital Communications fundamentals and applications* 2nd edition, 2009 by Bernard Sklar, Pabitra Kumar Ray. Pearson
2.	*Digital Communication System*, 2014 by Simon Haykin. Wiley
Recommended Reading:	
1.	Shu Lin, Daniel J.Costello, "*Error Control Coding*", 2nd Edition, Pearson, Reprint 2012.

Programme Name	**B. Tech. Electronics Engineering, Semester-VIII**
Course Code	R4EC4123T
Course Title	**Natural Language Processing**
Pre-requisite	Digital Signal Processing, Speech Processing

COURSE OUTCOMES

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

1. Understand approaches to syntax and semantics in NLP.
2. Understand approaches to discourse, generation, dialogue and summarization within NLP.
3. Understand current methods for statistical approaches to machine translation.
4. Understand machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods, log-linear and discriminative models, and the EM algorithm as applied within NLP.

COURSE CONTENTS

Module 1	**Introduction**
	Introduction to natural language processing, estimation techniques and language modelling, Expectation, Correlation, Covariance, Review of Linear Algebra, Linear Transformations
Module 2	**Word Modeling**
	Automata and linguistics, Phonology, morphology, Kimmo
Module 3	**Stochastic Modeling**
	EM algorithm in NLP, Parsing and Syntax, stochastic tagging, log-linear models, probabilistic similarity measures and clustering, precision, recall and accuracy
Module 4	**Parsing and Lexicon**
	Parsing, shift reduce parsers, Earley's algorithm, chart parsing, context free parsing, efficiency issues, feature based parsing, NL system design considerations Hidden Markovian models
Module 5	**Semantics and Machine Translation**
	Compositionality, Quantifiers, lexical semantics, constraint based systems, machine translation, language learning, computational methods of language change
Text Books:	
1.	Jurafsky, and Martin. *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech*. Prentice Hall, 2000. ISBN: 0130950696.
2.	Manning, C. D. and H. Schütze: *Foundations of Statistical Natural Language Processing*. The MIT Press. 1999. ISBN 0-262-13360-1.
Recommended Reading:	
1.	Allen, J. *Natural Language Understanding*. The Benajmins/Cummings Publishing Company Inc. 1994. ISBN 0-8053-0334-0.

Programme Name	**B. Tech. Electronics Engineering, Semester-VIII**
Course Code	R4EC4123P
Course Title	**Natural Language Processing LAB**
Pre-requisite	Digital Signal Processing, Speech Processing

COURSE OUTCOMES

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

1. Implement mapping of word syntax and semantics in NLP.
2. Implement algorithms for statistical approaches to machine translation.
3. Design and realize HMM model, EM in NLP.

COURSE CONTENTS

Sr.	Experiments
1	To compute moments and moment generating functions
2	To implement syntax modelling for words
3	To implement EM algorithm in NLP
4	To implement HMM in NLP
5	To perform parsing stochastic tagging
6	To implement log-linear models in NLP
7	To design and implement clustering algorithms and computing precision, recall and accuracy

Programme Name	**B. Tech. Electronics Engineering, Semester-VIII**
Course Code	R4EC4124T
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. Electronics Engineering, Semester-VIII**
Course Code	R4EC4124P
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.