B. E. SYLLABUS

ELECTRONICS & COMMUNICATION ENGINEERING

VII & VIII SEMESTER

With

Scheme of Teaching

& Examination

DEPARTMENT: ELECTRONICS & COMMUNICATION ENGINEERING

1.	Dr. Rekha Bhandarkar	Ph.D	Professor & HoD
2.	Dr. M.K. Parasuram	Ph.D	Director
3.	Dr. Krishna Shenai	Ph.D	Director R&D
4.	Dr. K. Rajesh Shetty	Ph.D	Professor/Dean (Admissions & Alumni Affairs)
5.	Dr. K. V. S. S. S. S. Sairam	Ph.D	Professor
6.	Dr. Veena Devi Shastrimath V.	Ph.D	Professor
7.	Dr. Ananth A. G.	Ph.D	Professor
8.	Dr. K. S. Shivaprakasha	Ph.D	Assoc. Professor
9.	Dr. Krishnananda Shet	Ph.D	Assoc. Professor
10.	Dr. Usha Desai	Ph.D	Assoc. Professor
11.	Mr. Durga Prasad	M.Tech(Ph.D)	Assoc. Professor
12.	Mrs. Sushma P.S.	M.Tech(Ph.D)	Assoc. Professor
13.	Mrs. Shrividya G.	M.Tech(Ph.D)	Assoc. Professor
14.	Mrs. Padmavathi K.	M.Tech(Ph.D)	Assoc. Professor
15.	Mrs. Prabha Niranjan	M.Tech(Ph.D)	Assoc. Professor
16.	Mr. Sukesh Rao M.	M.Tech(Ph.D)	Assoc. Professor
17.	Mr. Subrahmanya Bhat	M.Tech(Ph.D)	Assoc. Professor
18.	Mr. Mahaveera K.	M.Tech(Ph.D)	Asst. Prof Gd III
19.	Mrs. Sunitha Lasrado	M.Tech(Ph.D)	Asst. Prof Gd III
20.	Mrs. Vidya Kudva	M.Tech(Ph.D)	Asst. Prof Gd III
21.	Mr. Satheesh Rao	M.Tech	Asst. Prof Gd III
22.	Dr. Ashish Singh	Ph.D	Asst. Prof Gd III
23.	Dr. Ansal V.	Ph.D	Asst. Prof Gd III
24.	Dr. Jagadeesh V. K.	Ph.D	Asst. Prof Gd III
25.	Mr. Ravindra K.S.	M.Tech	Asst. Prof Gd II
26.	Mr. Pradyumna G.R.	M.Tech	Asst. Prof Gd II

27.	Mrs. Roopa B. Hegde	M.Tech(Ph.D)	Asst. Prof Gd II
28.	Mrs. Charishma	M.Tech	Asst. Prof Gd II
29.	Mrs. Niju Rajan	M.Tech	Asst. Prof Gd II
30.	Mrs. Shubha B.	M.Tech	Asst. Prof Gd II
31.	Mr. Anil Kumar Bhat	M.Tech	Asst. Prof Gd II
32.	Mr. Shivakumar B. R.	M.Tech(Ph.D)	Asst. Prof Gd II
33.	Ms. Amrutha D. Pai	M.Tech	Asst. Prof Gd I
34.	Mrs. Deepa K.	M.Tech	Asst. Prof Gd I
35.	Mr. Bomme Gowda	M.Tech(Ph.D)	Asst. Prof Gd I
36.	Mr. Dileep Kumar M.J.	M.Tech(Ph.D)	Asst. Prof Gd I
37.	Mr. Sudharshana	M.Tech	Asst. Prof Gd I
38.	Mrs. Nagapriya Kamath K.	M.Tech	Asst. Prof Gd I
39.	Mrs. Ramya Shetty	M.Tech	Asst. Prof Gd I
40.	Mr. Prajwal Hegde N.	M.Tech(Ph.D)	Asst. Prof Gd I
41.	Mr. Karthik	M.Tech	Asst. Prof Gd I
42.	Mrs. Anupama B.	M.Tech	Asst. Prof Gd I
43.	Ms. Anusha R.	M.Tech(Ph.D)	Asst. Prof Gd I
44.	Mrs. Ashwini K.	M.Tech	Asst. Prof Gd I
45.	Mrs. Shankari N.	M.Tech	Asst. Prof Gd I
46.	Ms. Harshitha Bhat	M.Tech	Asst. Prof Gd I
47.	Mrs. Vaishali Y Suvarna	M.Tech(Ph.D)	Asst. Prof Gd I
48.	Ms. Lavanya B. L.	M.Tech	Asst. Prof Gd I
49.	Ms. Kavitha S.	M.Tech	Asst. Prof Gd I

DEPARTMENT: ELECTRONICS & COMMUNICATION ENGINEERING

Vision:

Empowering people, Partnering in Community Development by achieving expertise requiring the knowledge of state of the art technology in the field of Electronics and Communication.

Mission:

To impart specialized education in the field of Electronics & Communication that contributes to the socio-economic development of the region and to generate technical manpower with high degree of credibility, integrity and ethical standards by providing vibrant learning environment.

Program Educational Objectives (PEOs):

PEO1: The graduate should have effective foundation in mathematics, science as well as other relevant disciplines and a strong foundation in Electronics and Communication Engineering.

PEO2: The graduate will inculcate effective communication skills, teamwork, lifelong learning and leadership in preparation for a successful career in industry and academia with credibility, integrity and ethics.

PEO3: The graduate will be able to design and develop innovative system that contribute to socio-economic development.

Program Specific Outcomes (PSOs):

PSO1: Understand the concepts and applications in the field of communication, signal processing, VLSI, embedded systems, power electronics and control systems.

PSO2: Effectively apply the domain knowledge to arrive at optimum solutions to real time applications.

PSO3: Apply acquired skills in project management and execution to Electronics and Communication systems.

Program Outcomes (POs):

Engineering Graduates will be able to:

PO1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **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.

PO3: **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.

PO4: **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.

PO5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **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.

PO7: **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.

PO8: **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **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.

PO11: **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.

PO12: **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.

Graduate Attributes :

Sl. No.	Graduate Attributes
a	Engineering Knowledge
b	Problem Analysis
c	Design / development of solutions
d	Conduct investigations of complex problems
e	Modern tool usage
f	The engineer and society
g	Environment and sustainability
h	Ethics
i	Individual and team work
j	Communication
k	Project management and finance
l	Life-long learning

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF TEACHING AND EXAMINATION

VII SEMESTER B.E. **27 Hours/week**

Sl. No.	CODE	COURSE	Theory/Tuto./Prac./ Self Study	Total Hrs. / Week	C.I.E.	S.E.E.	CREDITS
1.	14EC701	Computer Communication Networks	4+0+0+0	4	50	50	4
2.	14EC702	Wireless Communication	4+0+0+0	4	50	50	4
3.	14EC703	Power Electronics	4+0+0+0	4	50	50	4
4.	14EC71X	Elective - IV	3+0+0+0	3	50	50	3
5.	14EC72Y	Elective - V	3+0+0+0	3	50	50	3
6.	14EC704	VLSI Lab	0+0+3+0	3	50	50	2
7.	14EC705	Seminar	0+0+3+0	3	50	-	1
8.	14EC706	Project	0+0+3+0	3	50	-	1
TOTAL			**27**	**27**	**400**	**300**	**22**

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
SCHEME OF TEACHING AND EXAMINATION

VIII SEMESTER B.E. **23 Hours/week**

Sl. No.	CODE	COURSE	Theory/Tuto./Prac./ Self Study	Total Hrs. / Week	C.I.E.	S.E.E.	CREDITS
1.	14EC801	Information Theory & Coding	4+0+0+0	4	50	50	4
2.	14EC81X	Elective - VI	3+0+0+0	3	50	50	3
3.	14EC82Y	Elective -VII	3+0+0+0	3	50	50	3
4.	14EC8XX	Open Elective	3+0+0+0	3	50	50	3
5.	14EC802	Power Electronics Lab	0+0+3+0	3	50	50	2
6.	14EC803	Project	0+0+7+0	7	50	50	7
		TOTAL	**23**	**23**	**300**	**300**	**22**

Elective - IV 14EC71X		**Elective - V 14EC72Y**	
14EC711	Biomedical Instrumentation	14EC721	RF Circuit Design
14EC712	Spread Spectrum Communication	14EC722	Satellite Communications Systems
14EC713	Image Processing	14EC723	Pattern Recognition
14EC714	Cryptography	14EC724	Data Structures using C++
14EC715	Automotive Electronics	14EC725	Artificial Intelligence
14EC716	Low Power VLSI	14EC726	Object Oriented Programming in Java

Elective - VI 14EC81X		**Elective -VII 14EC82Y**	
14EC811	Analog and Mixed Mode VLSI Design	14EC821	High Performance Communication Networks
14EC812	Multimedia Communications	14EC822	Biomedical Signal Processing
14EC813	Speech Processing	14EC823	Optical Computing
14EC814	Real Time Operating Systems	14EC824	Finance Management
14EC815	Adhoc and Sensor Networks	14EC825	Big Data Analytics

COMPUTER COMMUNICATION NETWORKS

Sub Code	**: 14EC701**	**Credits**	**: 04**
Hrs/Week	**: 4+0+0+0**	**Total Hours**	**: 52**

Course Learning Objectives:

This course will enable the students to

1. Appreciate the use of computer networking in various walks of life, describe the types of networks, network configurations and network topologies. Also Write the OSI and TCP/IP reference models for networking.
2. Explain responsibilities of data link layer, its implementation and associated protocols, algorithms/pseudo codes.
3. Explain the various techniques used to access a shared channel in the network and IEEE specifications for LANs.
4. List types of networking devices, backbone networks and Internet Protocol (IP) addressing.
5. Explain the responsibilities of network, transport and application layers.

UNIT - I

Introduction: Uses of Computer Networks: Business Applications, Home Applications, Mobile Users. Data communications, Network Criteria, point-to-point and multi point connection, physical topology Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Wireless Networks, protocols and standards.

Network Models: Layered tasks, Connection-Oriented and Connectionless Services, Service Primitives, The OSI Reference Model, The TCP/IP Reference Model, Comparison of the OSI and TCP/IP Reference Models, addressing.

Physical Layer: Basis for Data Communication: Transmission of digital signals: Bit rate, bit length, baseband and broadband transmission, transmission impairment, data rate limits, performance, Guided Transmission Media Twisted Pair Coaxial Cable and Fiber Optics. **12 Hours**

UNIT - II

Data Link Layer: Framing, Error Control, Flow Control, Error-Detection and correction: Introduction, Error detection using CRC.

Data Link Protocols: Simplest Protocol, Stop-and-Wait Protocol, Stop-and-Wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ, HDLC. **10 Hours**

UNIT - III

Multiple Accesses. Random Access: ALOHA, Carrier Sense Multiple Access (CSMA) Protocols, CSMA with Collision Detection, CSMA with Collision Avoidance.

Controlled Access: Reservation, Polling and Token Passing.

Channelization: FDMA, TDMA, CDMA.

Wired LAN: Ethernet, IEEE standards, Standard Ethernet. Changes in the standards, Fast Ethernet, Gigabit Ethernet. **10 Hours**

UNIT - IV

Connecting LANs, Backbone and Virtual LANs: Connecting devices, Back bone Networks, Virtual LANs.

Network Layer: Need for network layer, Logical addressing, Ipv4 addresses, Ipv6 addresses, Ipv4 and Ipv6 datagrams, Transition from Ipv4 to Ipv6. **10 Hours**

UNIT - V

Network Layer: Delivery, Forwarding, Types of Routing protocols, Unicast Routing Protocols, **The Transport Layer:** Process to process Delivery, User Datagram Protocol (UDP) and TCP.

Application layer: Domain name space, Distribution of name space, Resolution. **10 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Define computer networks, list network configurations, types, topologies, the applications of computer networks in different fields, network models and description of physical layer.
2. Reason the need for flow and error control at the data link layer and explain the associated protocols.
3. Enumerate the shared channel access methods, associated protocols and Wired LAN standards and implementations.
4. List the types of networking devices / equipments and also explain the addressing scheme used at the network layer.
5. Explain how network layer, transport layer and application layer facilitates the transfer of message from one node to another in a global network.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1		H										
2			M									
3			M									

4			L									
5											H	

L: Low M: Medium H: High

TEXT BOOK:

1. Behrouz A Forouzan, **"Data Communications and Networking"**, McGraw-Hill, 3rd Edition, 2004.

REFERENCE BOOKS:

1. Andrew S. Tanenbaum, **"Computer Networks"**, Pearson Education/PHI, 4th Edition, 2003.
2. William Stallings, **"Data and Computer Communication"**, Pearson Education Asia, 6th edition.
3. Kurose and Ross, **"Computer Networking"**, Pearson Education, 2002.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/106105081/
2. http://nptel.ac.in/courses/106105082/
3. https://www.mooc-list.com/course/networking-introduction-computer-networking-stanford-university

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WIRELESS COMMUNICATION

Sub Code	**:**	**14EC702**	**Credit**	**:**	**04**
Hrs/Week	**:**	**4+0+0+0**	**Total Hours**	**:**	**52**

Course Learning Objectives:

This course will enable the students to

1. Get an overall idea about the cellular communication system.
2. Realize the wireless propagation models
3. Know the need of diversity and coding.
4. Identify different multiple access techniques, its features and advantages.
5. Learn equalization and synchronization techniques.

UNIT – I

Introduction to Wireless Communication
History and evolution, Difference between wireless and fixed telephone networks
Cellular Concept – System design fundamentals

Introduction, Frequency reuse, Cellular geometry, Channel assignment strategies, Handoff strategies, Interference and System capacity, Trunking and GOS, Improving coverage and capacity of cellular systems. **10 Hours**

UNIT - II

Mobile Radio Propagation

Introduction to Radio wave propagation, Free space propagation model, Relating power to electric field, Basic propagation mechanism – Reflection, Diffraction and Scattering (Suitable models to be covered), Practical link budget design using path loss models, Outdoor and Indoor propagation.

Small scale multipath propagation, Impulse response model of multipath propagation, Parameters of mobile multipath channels, Types of small scale fading. **10 Hours**

UNIT - III

Diversity Techniques and Coding

Concepts of Diversity, Combining and Switching methods, Selection Diversity, Feedback Diversity, Maximal Ratio Diversity, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity.

Fundamentals of Channel Coding, Finite Fields, Convolutional Codes, TCM. **12 Hours**

UNIT – IV

Multiple Access Techniques for Wireless Communication

Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum Multiple Access, SDMA, Packet radio, CSMA, Capacity of Cellular Systems, GSM Architecture. **10 Hours**

UNIT - V

Equalization and Synchronization

Channel characterization, Equalizer Filter types, Transversal Filter, Zero Forcing Equalizer, Decision Feedback Equalizer, Introduction to Synchronization, Receiver Synchronization, Phase Synchronization, Symbol Synchronization, Synchronization with continuous phase modulation, Frame Synchronization. **10 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Understand the difference between wired and wireless communication, realize the cellular geometry, frequency reuse, channel assignment and handoff as well as appreciate the techniques for improving coverage and capacity of cellular systems.
2. Understand and appreciate mobile radio propagation, path loss models and its significance, fading and multipath channel parameters which quantify the channel.
3. Understand diversity techniques and its applications, apply fundamentals of channel coding and decoding techniques.
4. Appreciate the multiple access techniques.
5. Visualize the need of equalization techniques that can be used to mitigate ISI, understand the importance and issues relating to synchronization of wireless communication systems.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	M	L		M				M	M	H
2	H	H	H	L	M					M	M	H
3	H	H	H	M	M	H				M	M	H
4	H	M	L	L						M	L	H
5	H	H	H	L						M	M	H

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. T.S.Rappaport, **"Wireless Communications – Principles & Practice"**, Second Edition, PHI, 2010.
2. Bernard Sklar, **"Digital Communications – Fundamentals and Applications"**, Pearson Education, Second Edition, 2001.

REFERENCE BOOKS:

1. Andrea Goldsmith, "**Wireless Communication"**, Cambridge University Press, 2005.
2. **Simon Haykin, "Modern Wireless Communication",** Pearson Education Inc., 2005.

NPTEL/MOOC Links		
1	**nptel.ac.in/courses/117104099/2**	**Wireless Channel and fading**
2	**nptel.ac.in/courses/117104099/5**	**Diversity**
3	**nptel.ac.in/courses/117104099/10**	**Coherence Bandwidth of the Wireless Channel**

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POWER ELECTRONICS

Sub Code : 14EC703 **Credit : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives:

This course will enable the students to

1. Learn different uses of Power Electronics and power semiconductor devices utilized, different power converter circuits, switching characteristics, and their drive circuits.
2. Learn ON/OFF states and characteristics of Thyristors and their triggering circuits with expressions for essential parameters and, design of gate drive circuits and protection of S.C.R.
3. To learn working principles of various types of controlled rectifiers and learn working of various Thyristor Commutation Techniques and design aspects.

4. Learn and understand different types of A.C Voltage Regulators and also to understand the principles of DC Choppers and their analysis, designs using S.C.R's.
5. Understand the operations of Inverters and their design, and to learn different methods for controlling the output voltage, and to understand the operation of current source Inverter and its applications.

UNIT - I

Introduction, Applications of power electronics, Power semiconductor devices, Control characteristics, Types of power electronics circuits, Peripheral effects.
Power BJT's, switching characteristics, Switching limits, Base drive control, Base current overdrive, Power MOSFET's, Switching characteristics, Gate drive, IGBT's, Comparison of BJT, MOSFET, and IGBT for control ratio, maximum frequency of operation, and power efficiency, Isolation of gate and base drives, Numerical problems. **10 Hours**

UNIT - II

Introduction to Thyristors: Principle of operation states, Forward and reverse V-I characteristics for different gate currents, Two transistor model, Turn-on Methods, Dynamic Turn-on and Turn-off characteristics, Gate trigger circuits, di/dt and dv/dt protection, Thyristor firing circuits, Numerical problems. **10 Hours**

UNIT - III

Controlled Rectifiers: Introduction, Principles of phase controlled converter operation, 1 φ semi converters, 1φ fully controlled converters, Dual converters (all converters with RL load and continuous current operation only), and numerical problems.
Thyristor Turn-Off Methods: Natural and Forced commutation, Self-commutation, Impulse Commutation, Complementary commutation, Auxiliary commutation, and numerical problems. **12 Hours**

UNIT - IV

AC Voltage Controllers: Introduction, Principles of ON and OFF control, Principles of phase control, Single phase controllers with resistive loads and Inductive loads, numerical problems.
DC Choppers: Introduction, Principles of step down and step up choppers, Step down chopper with RL loads, Chopper classification, Analysis of impulse commutated Thyristor chopper (only qualitative analysis). **12 Hours**

UNIT - V

Inverters: Introduction, Principles of operation, Performance parameters, 1φ bridge Inverter, voltage control of 1φ Invertors, current source Inverters, Variable DC link Inverter.

8 Hours

Course Outcomes:

At the end of the course the student will be able to

1. Identify different applications of Power Electronics and know devices used, select and design drive circuits for various power semiconductor devices, understand ON/OFF and switching properties and their drive circuits.

2. Analyze S.C.R circuits and their characteristics, derive essential parameters, and design drive circuits.
3. Analyze various Controlled Rectifiers. Design S.C.R. Commutation Techniques and analyze their design aspects.
4. Analyze design aspects and operation of different types of A.C Voltage Controllers and D.C Choppers circuits using S.C.R's.
5. Explain and analyze operation of Inverters, methods for output voltage control and discuss operation of a current source Inverter and applications.

Mapping of PO's and CO's

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	M	-	H	H	H	-	-	-	-	-	-	-
2	M	H	H	M	H	-	-	-	-	-	-	-
3	H	H	M	M	M	-	-	-	-	-	-	-
4	H	H	H	M	-	-	-	-	-	-	-	-
5	H	M	H	M	-	-	-	-	-	-	-	-

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. M. H. Rashid, **"Power Electronics",** PHI / Pearson publisher, 3rd edition, 2004.
2. G. K. Dubey, S. R. Doradla, A. Joshi, and R. M. K. Sinha, **"Thyristorized Power Controllers",** New Age International Pvt Ltd Publisher, 2nd edition, 2010.

REFERENCE BOOKS:

1. Randall Shaffer, **"Fundamentals of Power Electronics with MATLAB",** Charles River Media publisher, 1st edition, 2006.
2. Daniel W. Hart, **"Power Electronics"**, McGraw Hill, 2010.
3. V Nattarasu and R.S. Anandamurthy, **"Power Electronics**", Pearson/Sanguine Pub. 2006.

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VLSI LAB

Sub Code	**:**	**14EC704**	**Credit**	**:**	**02**
Hrs/Week	**:**	**0+0+3+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

This course will enable the students to

1. Develop Verilog codes in switch level, behavioural and structural model for basic digital CMOS circuits, adder and counters.
2. Develop Verilog test bench and perform simulation using available EDA tool.
3. Synthesize the Verilog code using the available technological library, given the constraints.
4. Design CMOS schematic circuits, perform AC & DC analysis of an Inverter, MOS amplifiers and DAC.
5. Draw layout, perform DRC and simulation of Inverter, MOS amplifiers and DAC.

PART – A: DIGITAL DESIGN

Write Verilog Code for the following circuits in the indicated modeling styles and their testbench. Perform simulation for functional verification, observe the waveform and synthesize the code using available technological library, given the constraints*.

1. Verilog switch level model for
   a) CMOS inverter
   b) Tristate Buffer
   c) Transmission Gate (TG) and logic development using TGs
   d) Basic/universal/ given logic gates

2) Verilog Structural / Behavioral Model
   a) Serial adder
   b) 4-bit Synchronous and Asynchronous counters for given MOD-N, with reset control.

*An appropriate constraint should be given

PART - B: ANALOG DESIGN

1. Design an Inverter for the given specifications*.
   a. Draw the schematic circuit and perform the following
      i) DC Analysis
      ii) Transient Analysis
   b. Draw the Layout, perform DRC and perform simulation.

2. For the following circuits, draw the schematic circuit and perform DC Analysis, AC Analysis and Transient Analysis. Also draw the Layout, perform DRC and perform simulation.

   a) Common source amplifier. b) Common Drain amplifier

3. For a single stage differential amplifier, draw the schematic circuit and perform DC Analysis, AC Analysis and Transient Analysis.

4. Design a 4 bit R-2R based DAC using given op-amp in the library**. Draw the schematic and perform simulation.

* Appropriate specification should be given.
** Applicable Library should be added & information should be given to the designer.

Course Outcomes:

After studying this lab course, the student will be able to:

1. Develop Verilog code and testbench for the desired digital logic function / system, perform simulation using an EDA tool and synthesize the code with the given technological library.
2. Perform simulation of Inverter, MOS amplifiers and DAC using available EDA tool.

Mapping of POs & COs:

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12
1	M	M	L	L	H	-	-	-	M	L	H	M
2	M	M	M	L	H	-	-	-	M	L	H	M

L: Low **M: Medium** **H: High**

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BIOMEDICAL INSTRUMENTATION

Sub Code	**:**	**14EC711**	**Credit**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

1. With widespread use and requirements of medical instruments, this course gives knowledge of the principle of operation and design of biomedical instruments.
2. It attempts to render a broad and modern account of biomedical instruments.
3. It gives the introductory idea about human physiology system which is very important
4. Demonstrate a basic understanding of disease, medical conditions or physiological conditions.
5. Explain the functional components of various instruments.
6. Demonstrate a critical appreciation of various biomedical instruments.
7. Explore new developments for better management or assessment of conditions.

UNIT - I

Fundamentals of medical instrumentation: Anatomy and Physiology, Physiological Systems of the body, Sources of Biomedical Signals, Basic medical instrumentation system, Intelligent medical instrumentation system, General constraints in design of medical instrumentation system.

Bioelectric signals and electrodes: Origin of Bioelectric Signals, Recording Electrodes, Ag-AgCl Electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes for EMG, Electrical conductivity of Electrode Jellies and Creams, Microelectrodes**.** **15 Hours**

UNIT - II

Physiological transducers and recording systems: Classification of transducers, Pressure Transducers, Transducers for body temperature measurement, Pulse sensors, respiration sensors, Preamplifiers, Signal processing techniques, Recording system.

Biomedical recorders: ECG, VCG, PCG, EEG, EMG, Other biomedical recorders.

15 Hours

UNIT - III

Modern imaging systems: X-ray Machine and Digital Radiography, X-ray Computed Tomography, MRI System, Ultrasonic Imaging System, cardiac imaging-echocardiography-echoencephalography . **9 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Differentiate General Instrumentation and Biomedical Instrumentation system, Describe the constraints of measurement of biomedical signals,
2. Identify biometrics and measurement of them using electrodes.
3. Explain physiological transducers ,
4. Identify the electrodes for different bioelectric signals viz., ECG, EMG, EEG and various biomedical recording systems for ECG, EMG, EEG and others.
5. Describe principle and working of imaging systems like X-ray machine, Tomography, MRI scanning systems and ultrasonic imaging system.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H											
2	H		H								H	H
3	H		H								H	
4	H						H			H		H
5	H					H						H

L: Low **M: Medium** **H: High**

TEXT BOOK:

1. R.S.Khandpur, "**Handbook of Bio-Medical Instrumentation",** Tata McGraw Hill Publishing Co. Ltd., 2003.

REFERENCE BOOKS:

1. John W. Clark, John G. Webster, **"Medical Instrumentation",** John Wiley and Sons, 1998.
2. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, **"Bio-Medical Instrumentation and Measurements",** Pearson Education, 2002/PHI. 2nd edition,
3. L. A. Geddes and L. E. Baker, "**Principles of Applied Bio-Medical Instrumentation",** John Wiley & Sons, 1975.

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SPREAD SPECTRUM COMMUNICATION

Sub Code	**:**	**14EC712**	**Credit**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

This course will enable the students to

1. Get a notion about spread spectrum communication system and how it is used for secure communication.
2. Understand the concept of synchronization.
3. Understand the multiple access technique used in spread spectrum communication system.

UNIT - I

Introduction to Spread Spectrum Systems: Two communication problems, direct sequence spread spectrum, BPSK, QPSK, MSK direct sequence spread spectrum Frequency –Hop spread spectrum, hybrid direct sequence/ frequency –Hop spread spectrum, complex envelope representation of Spread – spectrum systems.

Binary Shift Register sequences for Spread – spectrum Systems: Introduction, Definitions, Mathematical background and sequence generator fundamentals, maximal length sequences, Gold Codes, Non linear code generators. **16 Hours**

UNIT – II

Code tracking Loops: Introduction, optimum tracking of Wide band signals, base band Delay lock tracking loop, Non-coherent Delay lock tracking loop, Tau-Dither non-coherent tracking loop, Double Dither non coherent tracking loop, Non coherent Delay lock tracking loop with arbitrary data and spreading modulation, code tracking loops for frequency – Hop systems**.**

Initial synchronization of the receiver spreading code: Introduction, Problem definition and the optimum synchronizer, serial search synchronization techniques, generalized analysis of average synchronization time, synchronization using a matched filter, synchronization by estimating the received spreading code, tracking loop pull in. **17 Hours**

UNIT – III

Code Division Multiple Access : Introduction, cellular radio concept, fundamentals of cellular radio system, co-channel interference protection prediction, and cellular concept revisited, CDMA digital cellular systems, Detection of spread spectrum signal. **6 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Understand the fundamentals of spread spectrum and types of spread spectrum systems.
2. Understand the need, generation and application of PN sequences.
3. Realize and appreciate the need of synchronization and also to understand the different synchronization techniques.
4. Appreciate the multiple access techniques like CDMA and compare it with other techniques.
5. Understand the multiuser detection principle of spread spectrum signals.

Mapping of POs & COs:

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	H	L	L	M				M		M
2	H	H	H	L	M	M				M		M
3	H	H	H	L	L	M				M		M
4	H	H	H	L	L	H				M	M	M
5	H	H	H	L	L	M				M	M	M

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. Peterson, Ziemer and Borth, **"Introduction to Spread Spectrum Communication",** Pearson Education Publication, 1995.
2. *Valeri Ipatov,* **"Spread Spectrum and CDMA Application",** John Wiley Publication, 2005.

REFERENCE BOOK:

1. Simon, Omura, Scholtz, Levitt, **" Spread Spectrum Communications Handbook",** McGraw Hill Publication, 1994.

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IMAGE PROCESSING

Sub Code	**: 14EC713**	**Credit**	**: 03**
Hrs/Week	**: 3+0+0+0**	**Total Hours**	**: 39**

Course Learning Objectives:

This course will enable the students to

1. Recall the mathematical & signal principles, forming the basis for methods for image processing.
2. Understand image representation, enhancement, filtering, restoration, analysis & reconstruction.
3. Know the processing techniques including various image transformations, image reconstruction, segmentation & recognition.
4. Design & conduct imaging experiments using MATLAB.
5. Convert image from RGB to gray, black & white, remove blurring effects, noise reduction, edge detection, compression and segmentation.

UNIT - I

Definition of Digital Image Processing: Origins and examples of DIP, Fundamental steps in DIP, Elements of visual perception, A simple image formation model, Concepts of sampling & quantization, Representation of digital images, Spatial and Gray level resolution, Zooming& Shrinking of digital images, basic relationships between pixels.

Image Enhancement in Spatial domain: Some basic gray level transformations, Histogram processing, Basics of spatial filtering, smoothing spatial filters, sharpening filters.

Image Enhancement in Frequency domain: Basics of filtering in frequency domain, Image smoothing using frequency domain filters, sharpening filters, Homomorphic filtering.

15 Hours

UNIT - II

Image Restoration: A model of image degradation & Restoration process, Noise models, Restoration in the presence of Noise only-spatial filtering, periodic noise reduction by frequency domain filtering, Inverse filtering, Minimum Mean Square (Wiener) filtering.

Color Fundamentals: Color models, Pseudocolor Image processing, Basics of Full color image processing, Color transformations, Smoothing & Sharpening, Noise in color images, Color image compression

Image Compression: Fundamentals, Image compression models, Some basic compression methods: Huffman coding, Arithmetic coding, Run length coding. **15 Hours**

UNIT - III

Morphological Image Processing: Introduction, Dilation & Erosion, Opening & Closing operations, Some basic morphological algorithms.

Image Segmentation: Fundamentals, Point, Line & edge detection, Thresholding, Region-based segmentation. **9 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Understand the image fundamentals and mathematical transforms necessary for improving resolution, zooming & shrinking operations.
2. Apply the image enhancement techniques in spatial & frequency domains.
3. Model the restoration systems in the presence & absence of noise.
4. Use color models in applications, implement image compression techniques.
5. Apply morphological operations and edge detection techniques for segmentation of images based on applications.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	M	L	L	M						
2	H	H	H	M	H		M				H	
3	H	H	H	H	M	L	L				H	
4	M	H	H	H	H	L	L				H	
5	M	H	H	H	H						H	

L: Low **M: Medium** **H: High**

TEXT BOOK:

1. R. C. Gonzalez and R. E Woods, **"Digital Image Processing"**, Pearson education (Asia)/Prentice Hall of India, 2nd Edition, 2004.

REFERENCE BOOK:

1. S. Jayaraman, S. Esakkirajan and T Veerakumar, **"Digital Image Processing",** Tata McGraw- Hill Education Pvt. Ltd, New Delhi, 3rd Edition, 2010.

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CRYPTOGRAPHY

Sub Code	**:**	**14EC714**	**Credit**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objective:

The course presents the basics of Cryptography that aims to:

1. Introduce OSI model, different types of encryption and decryption techniques
2. Introduce basic mathematical functions required to solve most of the Cryptographic algorithms
3. Arm the students with ability to select appropriate cryptographic algorithm based on the requirement
4. Introduce various Private and Public key cryptographic algorithms
5. Introduce basics of Digital Signature, Hash and MAC algorithms

UNIT – I

Overview: Services, Mechanisms and attacks, OSI security architecture, Model for network security

Introduction to finite fields: Groups, Rings and Fields, modular arithmetic, Euclid algorithm, Finite fields of the form GF(p), polynomial arithmetic, Finite fields of the form $GF(2^n)$.

Introduction to number theory: Prime numbers, Fermat's and Euler's theorem, Chinese Remainder Theorem, Discrete logarithm

Classical encryption techniques: Symmetric cipher model, Substitution techniques, Transposition techniques, Rotor machine, Steganography **16 Hours**

UNIT – II

Block ciphers and DES: Fiestel ciphers, Simplified DES, Block cipher principles, DES, Strength of DES, Block cipher design principles, Block cipher modes of operation, Problems , IDEA , Double DES, Triple DES, Blow–Fish, RC4, RC5

Public Key Cryptography and RSA: Principles of Public Key Cryptosystems, RSA algorithm, Problems, Knapsack problem, ElGamal cryptosystem

Other public key cryptosystems and key management: Key management, Diffie Hellman key exchange, Man in the middle attack, Elliptic curve arithmetic, Elliptic curve cryptography, Problems. Analog of Diffie-Hellman on ECC, Analog of ElGamal on ECC

16 Hours

UNIT – III

Message authentication and hash functions: Authentication requirements, Authentication functions, Message authentication codes, Hash functions, Security of Hash functions, and MAC, SHA-1 and MD5

Digital signature and authentication protocol: Digital signature and authentication protocol, Digital signature standard.

Introduction to quantum cryptography **7 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Understand OSI security architecture and security model.
2. Understand and Solve problems related to polynomial arithmetic using CRT, Euler's theorem and Fermat's theorem.
3. Understand Public key cryptosystem and Private key cryptosystem. Apply the knowledge of public key cryptographic algorithms.
4. Understand and Solve problems related to various public and private key cryptographic algorithms.
5. Understand the purpose of using message authentication functions. Apply the knowledge while communicating over the insecure medium.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H					H						L
2	H		L	M		M						M
3	H	M	L	M		H						M
4	H	M	L	M		H						M
5	H	M	L	M		H						M

L: Low **M: Medium** **H: High**

TEXT BOOK:

1. William Stallings, **"Cryptography and Network Security Principles and Practices",** 3rd Edition, Pearson Education /PHI 2003.

REFERENCE BOOKS:

1. Neal Koeblitz, **"A Course in Number Theory and Cryptography",** 2nd Ed., Springer verlag, 2006.
2. Behrouz A.Forouzan, Debdeeep Mukhopadhyay, "**Cryptography and Network Security",** 2nd Ed, Mc Graw Hill.
3. Bruce Schneier, "**Applied Cryptography",** 2nd Ed., John Wiley and Sons, 2001.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/106105031/
2. http://nptel.ac.in/courses/106103015/

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AUTOMOTIVE ELECTRONICS

Sub Code : 14EC715 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hrs : 39**

Course Learning Objectives :

After studying this Course, the student should be able to:

1. Understand the overall Electrical and Electronic architecture of a vehicle
2. Know about the Automotive Control Systems
3. Understand the working of sensors and actuators needed in Automotive applications
4. Understand the use of different communication protocols used in Automotive systems
5. Know about the infotainment systems
6. Know the working of active and passive safety systems

UNIT - I

Electrical And Electronic Systems in the Vehicle: Overview, Motronic-engine management system, Electronic diesel control, Lighting technology, electronic stability program, adaptive cruise control, occupant-protection system.
Networking And Bus System: The requirement for the bus system, Classification of the bus system, Applications in the vehicle, Coupling of networks, examples of networked vehicles.

15 Hours

UNIT – II

Automotive Sensors & Measuring Principle: Features of vehicle sensors, Sensor classification, Error type and tolerance requirements, Physical effects for sensors, Selection of sensor technologies. Sensors for the measurement of position, speed, rpm, acceleration, pressure, force and torque, Flowmeters, Gas sensors and Concentration Sensors, Temperature sensors. Engine speed sensors, Hall phase sensors, Sensors for transmission control and wheel speed, Yaw-rate sensors, Accelerator-pedal sensors, Steering angle sensors, Position sensors, Axle sensors, Piezoelectric knock sensors, Air mass sensors, Acceleration sensors, Rain/light sensors. **15 Hours**

UNIT - III

Architecture of Electronic Systems & Control Units: Basics and Overview, vehicle system architecture. Control units, Operating conditions, Design and data processing. Digital modules in the control unit. Automotive Applications. **9 Hours**

Course Outcomes:

- **CO1.** Describe the overall Electrical and Electronic architecture of a vehicle.
- **CO2.** Compare between various Communication protocols used in Automotive Applications
- **CO3.** Classify different sensors and Select appropriate sensor for the given application.
- **CO4.** Explain the principle of measurement using sensors and actuators.
- **CO5.** Discuss the various aspects of Automotive Control Systems

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1.	M	-	L	-	-	M	L	-	-	-	-	-
2.	M	M	L	-	-	-	-	-	-	-	-	-
3.	H	M	L	M	-	-	-	-	-	-	-	L
4.	H	-	-	-	-	L	-	-	-	-	-	-
5.	M	-	M	-	L	-	-	-	-	-	-	-

L: Low M: Medium H: High

TEXT BOOKS:

1. Robert Bosch GmbH, **"Bosch Automotive Electrics and Automotive Electronics",** 5th Edition. John Wiley & Sons Ltd, 2007.
2. Tom Denton, **"Automobile Electrical and Electronic Systems",** 3rd Edition**,** Elsevier Butterworth-Heinemann Publication, 2004

REFERENCE BOOKS:

1. William B.Ribbens **"Understanding Automotive Electronics**", 6th Edition, Elsevier, 2003

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LOW POWER VLSI

Sub Code : 14EC716 **Credit : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This course will enable the students to

1. Get a clear understanding of the physics and different sources of power dissipation in CMOS circuits.
2. Be able to appreciate the need for low power design.
3. Gain knowledge about the different power analysis techniques.
4. Get a firm understanding on the different low power techniques used in circuit level and logic level.
5. Gain knowledge on the different special low power approaches in clock distribution.
6. Get a firm understanding on the different low power techniques used in circuit level and logic level

UNIT - I

Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches, Basic Principles of Low Power Design.

Physics of power dissipation in CMOS devices – The MIS structure, Long channel MOSFET, Submicron MOSFET, Gate induced drain leakage.

Power dissipation in CMOS – Short circuit dissipation, Dynamic dissipation, Load capacitance. **10 Hours**

UNIT - II

Simulation Power analysis: SPICE circuit simulation, Gate Level Logic Simulation- Architecture Level Analysis, Data Correlation Analysis in DSP Systems, Monte Carlo simulation.

Probabilistic Power Analysis: Random Logic Signals, Probability and Frequency, Probabilistic Power Analysis Techniques, Signal Entropy.

Low Power Design at Circuit Level: Transistor and Gate Sizing- Sizing an Inverter chain, Transistor and Gate sizing for Dynamic Power Reduction, Transistor Sizing for Leakage Power Reduction. Network Restructuring and Reorganization, Special Latches and Flip flops.

15 Hours

UNIT - III

Low Power Design at Logic level: Gate reorganization, Signal Gating, Logic Encoding, State Machine Encoding, Pre-Computation Logic.

Low power Clock Distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew.

Special Techniques: Power reduction in clock networks, CMOS Floating Node, Low Power Bus, Delay Balancing, Low Power Techniques for SRAM.

Low Power Design at Architecture and System Level: Power and Performance Management, Switching Activity Reduction, Parallel Architecture with Voltage Reduction, Flow Graph Transformation. **14 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Justify the need for low power design, identify the sources of power dissipation in CMOS circuits and understand the basic and emerging low power design approaches.
2. Explain the physics of power dissipation in CMOS devices
3. Understand the various simulation techniques to analyse and estimate the power dissipation in VLSI circuits.
4. Understand the various power reduction techniques at the circuit level.
5. Understand the different approaches of low power design in clock distribution, at logic, architectural and system levels.

Mapping of PO's & CO's:

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12
1	L	L	M	-	-	-	-	-	-	L	-	H
2	L	L	-	L	-	-	-	-	-	L	-	M
3	H	L	-	-	H	-	M	-	H	-	-	H
4	-	M	M	-	-	-	-	-	-	-	-	H
5	-	M	M	-	-	-	-	-	H	-	-	H

L: Low **M: Medium** **H: High**

REFERENCE BOOKS:

1. Gary K. Yeap, "**Practical Low Power Digital VLSI Design**", KAP, 2002
2. Kaushik Roy, Sharat Prasad, "**Low-Power CMOS VLSI Circuit Design**", Wiley, 2000
3. Rabaey, Pedram, "**Low Power Design Methodologies**", Springer, 2009.

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RF CIRCUIT DESIGN

Sub Code	**:**	**14EC721**	**Credit**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

This course will enable the students to

1. To study the radio frequency and medium wave concepts and the circuit representations of RF and MW networks.
2. To learn the application of Smith chart in lumped and distributed element circuit applications.
3. To design the matching networks.
4. To learn the design of small signal and large signal RF/MW Amplifiers considering the gain.
5. To design an RF/MW oscillator considering the stability.
6. To design an RF/MW frequency converters, rectifiers, detectors, mixers etc.

UNIT - I

Wave Propagation in Networks: Introduction to RF/MW concepts and applications; RF electronic concepts Fundamental concepts in wave propagation, circuit representation of two port RF/MW networks.
Passive Circuit Design: Smith Chart, Applications of smith chart in distributed and lumped element circuit applications, Design of matching networks. **16 Hours**

UNIT - II

Basic considerations in Active networks: Stability consideration in active networks, Gain considerations in Amplifiers.
Active Networks: Linear and Nonlinear Design: RF/MW Amplifiers small signal design, large signal design, RF/MW oscillator design. **16 Hours**

UNIT - III

RF/MW frequency converters, rectifier and detector design, Mixer design, RF/MW control circuit design. **7 Hours**

Course Outcomes:

After studying this subject student will be able to understand:

1. The RF/MW concepts and their circuit representations
2. The application of smith chart to solve impedance matching problems

3. The stability and gain consideration in the design of amplifiers
4. The design of small signal and large signal RF/MW amplifiers and oscillators
5. The design of RF/MW frequency converters, rectifiers, detectors and mixers.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	H	L	H				L		H	M
2	H	H	H	L	M						M	M
3	H	H	H	L	M				L			
4	H	H	H	M	M				L	M	M	M
5	H	H	H	M	M				M	M	M	M

L: Low **M: Medium** **H: High**

TEXT BOOK:

1. Mathew M. Radmanesh, **"Radio Frequency & Microwave Electronics Illustrated",** PE (Asia) Pte. Ltd 2004.

REFERENCE BOOK:

1. Reinhold Ludwig and Pavel Bretchko, **"RF Circuit Design Theory and Applications"**, PE (Asia) Pte. Ltd 2004.

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SATELLITE COMMUNICATION SYSTEMS

Sub Code	**:**	**14EC722**	**Credit**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

This course will enable the students to

1. Learn general laws governing Satellite orbits & its parameters also discuss overall design of satellites.
2. Learn the propagation impairments of the Electromagnetic wave and consider losses for link power calculations and implementation of various controls
3. Learn applications of Satellite and different communication systems used for access.

UNIT – I

Over view of Satellite Systems: Introduction, frequency allocation, INTEL Satellites.
Orbits: Introduction, Kepler's laws, definitions, orbital element, apogee and perigee heights, orbit perturbations, inclined orbits, calendars, universal time, sidereal time, orbital plane, local mean time and sun synchronous orbits.

Geostationary orbit: Introduction, antenna, look angles, polar mount antenna, limits of visibility, earth eclipse of satellite, sun transit outage, launching orbits.
Propagation impairments: Introduction, atmospheric loss, ionospheric effects, rain attenuation, other impairments.
Space link: Introduction, EIRP, transmission losses, link power budget, system noise, CNR, uplink, down link, effects of rain, combined CNR **16 Hours**

UNIT – II

Space Segment: Introduction, power supply units, attitude control, station keeping, thermal control, TT&C, transponders, antenna subsystem.
Earth Segment: Introduction, receive only home TV system, out-door unit, indoor unit, MATV, CATV, Tx.–Rx. earth station.

Satellite access: single access, pre-assigned FDMA, SCPC (spade system), TDMA, pre-assigned TDMA, demand assigned TDMA**. A**

15 Hours

UNIT – III

DBS: Introduction, orbital spacing, power rating and number of transponders, frequency and polarization, transponder capacity, bit rates for digital TV.
Other Satellite services: Satellite mobile; VSAT, 'Radarsat', GPS**.** **8 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Get detailed knowledge about fundamental principles of Satellite communication systems
2. Understand the Propagation impairements of satellite link.
3. Discuss about the effects on the EM waves in propagation through space.
4. Understand the different communication systems used for satellite access.
5. Will have knowledge of applications of commonly used satellite services.

Mapping of CO's and PO's

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	**H**	**M**	**M**		**L**							
2		**H**			**M**	**L**						
3	**H**			**L**		**L**	**L**					
4						**H**	**H**					
5						**H**	**H**	**M**				

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. Dennis Roddy, "**Satellite Communications**", 4th Edition, McGraw-Hill International edition, 2006
2. Chartrand M R, "**Satellite Communications**", Cengage learning

REFERENCE BOOKS:

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt, "**Satellite Communications**", 2nd Edition, John Wiley & Sons, 2003
2. W.L. Pritchard, H.L. Suyderhoud, R.A. Nelson, "**Satellite Communication Systems Engineering**", 2nd Edition, Pearson Education, 2007
3. Manjit Mitra,"**Satellite Communications**", PHI,2007
4. Agarwal,"**Satellite Communications**", Khanna Publs,2013

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PATTERN RECOGNITION

Sub Code	**:**	**14EC723**	**Credit**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

This course will enable the students to

1. Make use of Probability& Statics and Image Processing to understand the basic concepts of Pattern Recognition.
2. Learn various parameters used in Pattern Recognition by choosing appropriate decision making technique
3. Make use of Artificial Neural Networks for Pattern Recognition.
4. Apply the knowledge of various Image enhancement techniques and signal processing on the waveforms.

UNIT - I

Introduction: Applications of Pattern recognition, statistical decision theory, Image processing and analysis.

Probability: Introduction, Probability of events, Random variables, Joint distributions and densities, Moments of random variables, estimation of parameters from samples, minimum risk estimators.

Statistical Decision Making: Introduction, Bayes theorem, Multiple features, conditionally independent features, Decision boundaries, Unequal costs of error, Estimation of error rates, The leaving-One-Out technique, Characteristic curves, Estimating the composition of populations. **15 Hours**

UNIT - II

Non Parametric Decision Making: Introduction, Histograms, Kernel and Window estimators, Nearest neighbor classification techniques, Adaptive decision boundaries,

Adaptive discriminant functions, Minimum squared error discriminant functions, choosing a decision making technique.

Clustering: Introduction, Hierarchical clustering, partitional clustering.

Artificial Neural Networks: Introduction, Nets without hidden layers, Nets with hidden layers, the back-Propagation algorithm, Hopfield nets; an application. **15 Hours**

UNIT - III

Processing of waveforms and Images: Introduction, Gray level scaling transformations, equalization, Geometric Image Scaling and Interpolation, Smoothing Transformations, Edge detection, Laplacian and Sharpening operators, Line detection and Template matching, Logarithmic Gray Level Scaling, Statistical significance of image features. **9 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Understand concepts of Probability& Statistics and Image Processing
2. Apply various parameters used in Pattern Recognition by choosing appropriate decision making technique
3. Understand nonparametric decision making algorithms and clustering techniques
4. Make use of Artificial Neural Networks for Pattern Recognition.
5. Apply various Image enhancement techniques on images to study the significance of image features

Mapping of CO's & PO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	M	L	L								
2	L	H		L	L	L						
3	L	L	L	L	H	L	M	L				
4	L	H	L	M	L	L	L	L				
5	H	H	L	H	H							

TEXT BOOK:

1. Earl Gose, Richard Johnsonburg & Steve Joust, **"Pattern Recognition",** Prentice-Hall of India-2003.

REFERENCE BOOKS:

1. Duda and Hart, **"Pattern Recognition",** (Pattern recognition a scene analysis)
2. Robert J Schalkoff, **"Pattern Recognition"** Statistical, Structural and Neural Approaches, John Wiley.

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DATA STRUCTURES USING C++

Sub Code	**:**	**14EC724**	**Credits**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

This Course will enable students to

1. Outline the concepts of data structures, types and overview of data structures.
2. Make use of linear data structures like stack, queue and their applications.
3. Make use of nonlinear data structures like binary tree and their usage.

UNIT - I

Introduction: Functions and parameters, Dynamic memory allocation classis, Testing and debugging. Data Representation, Introduction, Linear lists, Formula-based representation linked representation, Indirect addressing simulating pointers.
Arrays And Matrices: Arrays, Matrices, Special matrices sparse matrices. **15 Hours**

UNIT - II

Stacks: The abstract data types, Derived classes and inheritance, Formula-based Representation, Linked representation, Applications.
Queues: The abstract data types, Derived classes and inheritance, Formula-based representation, Linked representation, Applications.
Skip Lists and Hashing: Dictionaries, Linear representation, Skip list representation, Hash table representation. **15 Hours**

UNIT - III

Binary And Other Trees: Trees, Binary trees, Properties and representation of binary trees, Common binary tree operations, Binary tree traversal the ADT binary tree, ADT and class extensions.
Search Trees: Binary search trees, B-trees, Applications. **9 Hours**

Course Outcomes:

After studying this Course, the student should be able to:

1. Understand the basic concepts of data structures.
2. Implement linear data structure concepts like stack, queue and its applications.
3. Relate the data structure concepts to its real world applications.
4. Understand the concepts of implement their operations.
5. Develop applications using basic data structures in C++.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	L		M								
2	H				M							L
3	M	L		H								
4	H	M			M							
5	M				M							L

L: Low **M: Medium** **H: High**

TEXT BOOK:

1. Sartaj Sahni, **"Data Structures, Algorithms, and Applications in C++",** McGraw Hill, 2000.

REFERENCE BOOKS:

1. Balaguruswamy, **"Object Oriented Programming in C++"**, TMH, 1995.
2. Balaguruswamy, **"Programming in C++",** TMH, 1995 Litivin, Vikas Publication, 2003.

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ARTIFICIAL INTELLIGENCE

Sub Code	**:**	**14EC725**	**Credit**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

The course presents basics of Artificial Intelligence that aims to

1. Introduce AI, propositional calculus, graph theory and Heuristic approach
2. Arm the students with the basics of issues involved with knowledge presentation and history of Al representational systems
3. Introduce Role of knowledge in language understanding

UNIT - I

Introduction, the propositional calculus, predicate calculus using inference rules to produce predicate calculus expressions.

Introduction to graph theory, strategies for state space, using state space to represent reasoning with the predicate calculus.

Introduction to Heuristic approach, an algorithm for heuristic approach, admissibility, monotonicity and informedness, using heuristics in games, complexity issues. Introduction to control and implementation of state space search, production systems **16 Hours**

UNIT - II

Issues in knowledge representation, a brief history of Al representational systems, conceptual graphs-a network language, alternatives to explicit representation, agent based and distributed problem solving.
Introduction to weak methods theorem proving, the general problem and difference tables, resolution theorem proving, prolog and automated reasoning. **16 Hours**

UNIT – III

Role of knowledge in language understanding, deconstructing language- a symbolic analysis, syntax 559, syntax and knowledge with A TN parsers. **7 Hours**

Course Outcomes:

A student who successfully fulfills the course requirements will have demonstrated:

1. An understanding of the concepts AI, basics of propositional calculus.
2. An understanding of graph theory and Heuristic approach.
3. An understanding of basics of issues involved with knowledge presentation.
4. An understanding of history of AI representational systems
5. An understanding of role of knowledge in language understanding.
6.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	L	M	M	L								H
2	L	M	M	L								H
3	L	M	M	L								H
4	L	M	M	L								H
5	L	M	M	L								H

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. Rich and Knight, **"Artificial Intelligence",** TMH, 2nd Edition, 1991.
2. Charniak and Mc Dermott, **"Introduction to Artificial Intelligence",** Pearson Education, 1999.

REFERENCE BOOK:

1. George F Luger, **"Artificial Intelligence",** Pearson Education, 4th Edition, 2002.

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ORIENTED PROGRAMMING IN JAVA

Sub Code	**:**	**14EC726**	**Credit**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

The course presents basic Object Oriented Programming in Java programming that aims to

1. Introduce Java Operators, Arrays and Data Structures
2. Arm the students with the basic object oriented programming concepts
3. Introduce different techniques like Inheritance, Multithreaded Programming and HTML

UNIT - I

Introduction to Java: Java history, Connection between Java and Internet, JVM –The heart of Java, Java's Magic Bytecode, Servlets: Java on the Server Side and Java Buzzwords, Overview of Java: Two Paradigms, Three OOP Principles – Encapsulation, Inheritance, Polymorphism, Lexical issues. **3 Hours**

Data Types, Variables and Arrays in Java: Primitive data types, Integers, Floating-Point Types, Characters, Booleans, Variables, Type Conversion and Casting, Java Operators- Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator ,The ? Operator, Operator Precedence, Control Statements- Selection Statements, Iteration Statements, Jump Statements, and Arrays- One-Dimensional Arrays, Multidimensional Arrays. **7 Hours**

Methods and Classes: Overloading Methods, Argument Passing, Returning Objects, Recursion, Access Specifiers, static member, final variable, String Class. **4 Hours**

UNIT – II

Inheritance: Inheritance basics, superclass, Multilevel Inheritance, Method Overriding, final and abstract keyword, basics of Packages and Interfaces. **6 Hours**

Exception Handling: Exception Types, try and catch, Multiple catch Clauses, Nested try Statements, throw, Java's Built-in Exceptions. **2 Hours**

Multithreaded programming: Main Thread, Creating threads, extending the thread class, Thread priority, Synchronization, Stopping and blocking a thread, Basics of Enumerations. **3 Hours**

Java Servlets: Benefits, A simple Java Servlet, Anatomy of a Java Servlet, Reading data from a client, Reading HTTP Request Headers, Sending data to a client and writing the HTTP Response Header, Working with Cookies, Tracking Sessions. **4 Hours**

UNIT - III

Java Server pages (JSP), JavaScript & HTML: Basics of JSP Tags, Attributes, URLs, Links, Applet, The APPLET Element, Naming Applets JAR Archives, The OBJECT Element and Passing Parameters to Applets. Introduction to JavaScript(JS),HTML DOM,JS Data Type, Loops in JS, functions in JS, Embedding JS in HTML. **10 Hours**
Hours

Course Outcomes:

A student who successfully fulfills the course requirements will have demonstrated:

1. An understanding of the basics of Java applications, Classes.
2. An understanding of the usage of Data types and Variables in Java.
3. An ability to write simple Object oriented programs using Inheritance, Exception handling, understanding of Java servlets and Multithreaded programming.
4. An ability to write simple HTML codes, and understanding of JSP.
5. An ability to write object-oriented programs of moderate complexity in Java.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	M	M	M		M					M	M	H
2	M	M	M		M					M	M	H
3	M	M	M		M					M	M	H
4	M	M	M		M					M	M	H
5	M	M	M		M					M	M	H

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. Herbert Scheldt, **"The Complete reference JAVA"**, 7th Edition, Tata McGraw – Hill, ISBN: 0-07-063677
2. Cay Horstmann , **"Computing Concepts with Java 2 Essentials"**, 2nd Edition, WILEY INDIA, ISBN: 81-265-0931-9.

REFERENCE BOOKS:

1. Cay Horstmann , **"Big java"**, 2nd Edition, WILEY INDIA, ISBN: 81-265-0879-5.
2. E Balagurusamy , **"Programming with JAVA Primer"**, 3rd Edition, Tata McGraw –Hill, ISBN: 0-07-061713-9.

NPTEL/ MOOC Link:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-092-introduction-to-programming-in-java-january-iap-2010/index.htm
2. https://www.udacity.com/course/intro-to-java-programming--cs046

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SEMINAR

Sub Code : 14EC705 **Credit: 01**
Hrs/Week : 3+0+0+0

Course Learning Objectives:

The objectives of this course is

1. To inculcate skills of public speaking.
2. To acquire knowledge of contemporary issues in Electronics & Communication Engineering.
3. To develop skills in report writing, reading, and understanding the research articles.

Course Outcomes :

At the end of this course, the student will be able to

1. Identify current topics in Electronics & Communication Engineering, understand and interpret the same.
2. Prepare technical report and communicate effectively with peers.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	L	M	L	-	-	-	L	-	-	-	H	-
2	-	-	-	-	-	-	H	-	-	M	-	-

L: Low **M: Medium** **H: High**

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PROJECT

Sub Code : **14EC706** **Credits:** 1
Hrs/Week : **0+0+3+0**

Student will carry out a project using the knowledge gathered from the courses successfully completed to arrive at some useful conclusions using any of the methods listed below:

i) Designing and testing a circuit for a new concept
ii) Conceptual development of a new idea in the field of electronics
iii) Literature survey of any topic of importance in electronics

Course Outcomes:

After completion of this Project Phase the student will be able to

1. Assimilate background work and formulate problem statement, analyze its requirement and plan for its execution.
2. Record and document the work done.

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	M	M	H	H	M	M	M	H	L	H	H
2	L	L	L	L	L	L	L	L	H	H	L	H

L: Low **M: Medium** **H: High**

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INFORMATION THEORY AND CODING

Sub Code : 14EC801 **Credits : 04**
Hrs/Week : 4+0+0+0 **Total Hours : 52**

Course Learning Objectives:

This course will enable students to

1. Understand how information is measured in terms of probability.
2. Understand the basics of information theory to analyze entropy, information rate, source extensions and Markoff sources.
3. Illustrate the properties of codes, to identify the instantaneous codes, devise source codes using various coding techniques.
4. To determine the efficiency and redundancy for various encoding algorithms.
5. Identifying communication channels based on their channel diagram and to calculate entropy, mutual information and channel capacity.
6. Illustrate the concepts of Shannon's Channel Capacity theorem, Shannon-Hartley Law and Shannon's Limit.
7. Describe a linear block code in matrix form, understand binary cyclic code and to design an encoder and syndrome calculation circuit for linear block codes and binary cyclic codes.
8. Illustrate error detection and correction capabilities of linear block codes, cyclic codes and implement them using feedback shift registers.
9. Understand the working of encoder for convolutional codes.
10. Illustrate the Viterbi and Sequential search algorithm methods for decoding and to understand the concept of Turbo coding.

UNIT - I

Information Theory: Introduction, Model of a communication system, Elements of digital communication system[T1-1], Review of Probability theory[T1-3], Measure of information, Average information content(entropy) of symbols in long independent sequences[T1-4], Information rate, Properties of entropy, Extension of discrete memoryless (zero-memory) sources [T2-2],Average information content(entropy) of symbols in long dependent sequences, Markoff statistical model for information source, Entropy and information rate of Markoff sources[T1-4]. **10 Hours**

UNIT - II

Source Coding: Properties of codes- Block codes, Non-singular codes, Uniquely decodable codes. Instantaneous codes and Optimal codes, Prefix of a code, Test for instantaneous property, Construction of Instantaneous code, decision tree, Kraft's inequality, Source coding theorem (Shannon's Noiseless coding theorem)[T2-2],Shannon's encoding algorithm, Shannon-Fano encoding algorithm(binary, ternary)[T1-4], Huffman minimum redundancy code (binary, ternary and quaternary), code efficiency and redundancy [T2-2]. **10 Hours**

UNIT – III

Channels and Mutual Information Introduction, Discrete communication channels, Representation of a channel, Probability relations- priori, posteriori entropy, equivocation, mutual information, properties[T2-2],rate of information transmission over a discrete channel, capacity of a discrete memoryless channel, Shannon's theorem on channel capacity (Shannon's second theorem),Special channels- symmetric, binary symmetric, binary erasure, noiseless, deterministic and cascaded channels, Estimation of channel capacity by Muroga's method, Continuous channels, Shannon-Hartley theorem and its implications, Shannon's limit [[1-4]. **10 Hours**

UNIT - IV

Error Control Coding-I: Introduction, Types of errors, Examples, Methods of controlling errors, Types of codes, Linear Block Codes- matrix description, encoding circuit, syndrome and error detection, syndrome circuit, Hamming weight, Hamming distance, Minimum distance of a block code [T3-3] error detection and correction capabilities of a linear block code, single error-correcting hamming codes, table lookup decoding using standard array [T1-9], general decoder for a linear block code [T3-3]. Binary cyclic codes, Algebraic structures of cyclic codes,Generator and parity-check matrices of cyclic codes, Encoding using (n-k) bit shift register, syndrome calculation, error detection and error correction[T1-9]. **12 Hours**

UNIT - V

Error Control Coding-II: BCH codes, RS codes, Golay codes, Shortened cyclic codes, Burst error correcting codes, Burst and Random error correcting codes, Convolution codes-encoders, Time domain approach, Transform domain approach, code tree, trellis, state diagram, Sequential search and Viterbi algorithm[T1-9] , Principle of Turbo coding[T3-16]. **10 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Understand and explain the basic concepts of information theory to analyze entropy, information rate, source extensions and Markoff sources.
2. Understand and explain the basic concepts of source coding, devise source codes using various coding techniques.
3. Categorize various channels for information transmission and interpret Shannon's first and second theorems, Shannon Hartley Law and Shannon's limit in continuous channels.
4. Apply linear block code and binary cyclic code in error detection and error correction.
5. Construct state tables, state diagrams, code-tree diagram and trellis diagrams for Convolutional encoders and use Viterbi and sequential search algorithms for decoding convolutional codes and understand the use of Turbo codes.m

Mapping of PO's and CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	M	L				H						
2	M	L				H						
3	L	M										
4	L		M									
5		M	L		L							

TEXT BOOKS:

1. K. Sam Shanmugham,"Digital and Analog Communication Systems",John Wiley Publications, 1996.
2. Simon Haykin, "Digital Communications", John Wiley Publications, 2003
3. Shu Lin, Daniel J. Costello, "Error Control Coding", Pearson / Prentice Hall, 2nd Edition, 2004.

REFERENCE BOOKS:

1. Muralidhar Kulkarni and K S Shivaprakasha, "Information Theory and Coding", Wiley (India), 2015.
2. Glover and Grant, "Digital Communications", Pearson 2 nd Edition, 2008.
3. Abramson, "Information theory & coding", McGraw-Hill, 1963.

NPTEL/ MOOC Link:

1. http://nptel.ac.in/courses/117101053/

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POWER ELECTRONICS LAB

Sub Code : 14EC802 **Credit : 02**
Hrs/Week : 0+0+3+0

Course Learning Objectives:

This course will enable the students to

1. Understand static characteristics of various power devices.
2. Design and characterize various types of firing circuits.
3. Understand the forced commutation techniques.
4. Be skilled in building and analyzing various types of power converters.
5. Get an understanding of how converters behave in presence of inductance in the load.

LIST OF EXPERIMENTS

1. Static characteristics of SCR and TRIAC.
2. Switching characteristics of MOSFET and IGBT.
3. Controlled HWR and FWR using RC triggering circuit.
4. SCR turn off using LC circuit
5. SCR turn off using Auxiliary Commutation.
6. Generation of firing signals for Thyristors / TRIACs using digital circuits.
7. AC voltage controller using TRIAC–DIAC combination.
8. Single phase Fully Controlled Bridge Converter with R-L loads.
9. Voltage (Impulse) commutated chopper both constant frequency and variable frequency operations.
10. Speed control of universal motor.
11. Parallel inverter
12. Series inverters.

Note: Experiments to be conducted with isolation transformer and low voltage

Course Outcomes :

At the end of the course the student will be able to

1. Understand the static characteristics of various power devices.
2. Study the working of different firing circuits.
3. Understand the working of different forced commutation techniques.
4. Be skilled in building and analyzing various types of power converters with resistive loads.
5. Get an understanding of how power converters behave in the presence of inductance in the load.

Mapping of PO's &CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H											
2	M											
3	M	M			L		L					
4	M		M		L		L					L
5	M		M		M		L					L

L: Low **M: Medium** **H: High**

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ANALOG AND MIXED MODE VLSI DESIGN

Sub Code	**:**	**14EC811**	**Credit**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

This course will enable the students to

1. Learn different types of MOS device models, single stage amplifiers, current mirrors & differential amplifiers.
2. Understand Op-Amp design, fundamentals and architecture of different data converters.
3. Understand the design of capacitors, resistors, MOSFET Switch, Delay and Adder elements etc. in sub-micron CMOS technology.

UNIT - I

Review of MOS device physics, MOS device models.
Single stage amplifiers: Basic concepts, common source, source follower, common gate stage, cascode stage amplifiers
Current mirrors (basics), Differential amplifiers: Single-ended and differential operation, basic differential pair (qualitative analysis only), common mode response, differential pair with MOS loads, Gilbert cell. **14 Hours**

UNIT - II

Op-Amp design: General considerations, One-stage Op-Amp, Two Stage Op-Amp
Data Converter fundamentals: Analog versus Digital Discrete Time Signals, Sample & Hold Circuits, DAC Specifications, ADC Specifications, Mixed –Signal Layout Issues.
Data Converter Architectures: DAC Architectures: Resistors String, R-2R Ladder Networks, Current Steering, Charge Scaling DAC, Cyclic DAC, Pipeline DAC, ADC Architectures: Flash, 2-step Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC. **17 Hours**

UNIT - III

Sub-Micron CMOS circuit design: Process flow, capacitors and resistors, MOSFET Switch, Delay and Adder elements, Analog Circuits MOSFET Biasing. **8 Hours**

Course Outcomes:
At the end of the course the student will be able to

1. Design & analyze different types of single stage MOS amplifiers.
2. Understand the operation, analyze and design current mirrors and differential amplifiers.
3. Analyze and design one and two stage Op-Amps.
4. Understand the operation of Sample & Hold circuit, DAC & ADC architectures.
5. Design capacitors, resistors, MOSFET Switch, Delay and Adder elements etc. in sub-micron CMOS technology.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	M	M	L	-	M	-	-	-	L	M	M	L
2	M	M	L	-	M	-	-	-	L	M	M	M
3	M	M	M	-	M	-	-	-	L	M	M	M
4	L	M	L	-	M	-	-	-	L	M	M	L
5	L	-	-	L	-	-	-	-	-	L	-	L

L: Low **M: Medium** **H: High**

TEXT BOOKS:

1. Behzad Razavi, **"Design of Analog CMOS Integrated Circuits",** Tata McGraw Hill, 2002.
2. R. Jacaob Baker, Harry W Li, David E Boyce, **"CMOS Circuit Design, Layout, Simulation",** PHI Edn, 2005.
3. R. Jacob Baker, **"Mixed Signal Circuit Design (Vol II of CMOS: Circuit Design, Layout and Simulation)",** CMOS –IEEE Press and Wiley Interscience, 2002.

REFERENCE BOOK:

1. P.E. Allen and D.R. Holberg, **"CMOS Analog Circuit Design"**, Oxford University Press, 2nd Edition, 2002.

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MULTIMEDIA COMMUNICATIONS

Sub Code	**:**	**14EC812**	**Credit**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

The course presents basics of Multimedia Communication that aims to

1. Introduce basics of Multimedia Communication
2. Introduce the students with knowledge of Audio Video Compression and Multimedia information Networks
3. Introduce Multimedia transport and management protocols.
4. Introduce the multimedia information representation techniques.
5. Introduce the networks significance in multimedia.

UNIT – I

Multimedia Communications: Introduction, multimedia information representation, multimedia networks, multimedia applications, media types, communication modes, network types, multipoint conferencing, network QoS application QoS.

Multimedia Information Representation: Introduction, digital principles, text, images, audio, video. Text and image compression: introduction, compression principles, text compression, image compression. **15 Hours**

UNIT – II

Audio and Video Compression: Introduction, audio compression, DPCM, ADPCM, APC, LPC, video compression, video compression principles, H.261, H.263, MPEG, MPEG-1, MPEG-2, and MPEG-4.

Multimedia Information Networks: Introduction, network performance parameters, throughput, networking delay, delay variance, error rate, quality of service. QoS perspectives, QoS Processing, multimedia transmission, requirements, transmission over WANs, Multimedia Transmission over LANs, ATM Networks, Wireless LANs. **16 Hours**

UNIT – III

Multimedia transport and management protocols

Multimedia transport**:** RTP and RTCP

Multimedia management protocols: H.323, SIP, SDP, SAP. **8 Hours**

Course Outcomes:

A student who successfully fulfils the course requirements will have demonstrated:

1. An understanding of the concepts of Multimedia Communication.
2. An understanding of audio video compression and multimedia information networks.
3. An understanding of multimedia transport and management protocols.
4. To know about the QoS in multimedia networks.
5. To understand the significance of image compression techniques.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	M	L	L			H						H
2	M	M	H			H						H
3	M	L	L			H						H
4	L					M						
5		H							M			

L: Low M: Medium H: High

TEXT BOOKS:

1. Fred Halsall, **"Multimedia Communications: Applications, Networks, Protocols, and Standards"**, Pearson Education, Asia, 2nd Edition Indian reprint 2002.
2. Nalin K. Sharda, **"Multimedia Information Networking",** PHI, 2003.
3. Ralf Steinmetz, Klara Narstedt, **"Multimedia Fundamentals: Vol. 1-Media Coding and Content Processing",** Pearson Education, 2004.

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SPEECH PROCESSING

Sub Code : 14EC813 **Credit : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives:

This course will enable students to

1. Obtain knowledge of basic characteristics of speech signal in relation to production and hearing of speech by humans.
2. Describe signal processing techniques for real-time processing of speech signals.
3. Discover practical aspects of speech processing and relate experimental methodology into practice.

UNIT – I

Production and classification of speech sounds: introduction, mechanism of speech production. Acoustic phonetics: vowels, diphthongs, semivowels, nasals, fricatives, stops and affricates.
Time-domain methods for speech processing: time dependent processing of speech, short time energy and average magnitude, short-time average zero crossing rates**.** **16 Hours**

UNIT – II

Analysis and Synthesis: Brief Applications of temporal processing of speech signals in synthesis, enhancement, hearing applications and clear speech.
Frequency domain methods for speech processing: introduction, definitions and properties: Fourier transforms interpretation and linear filter interpretation, sampling rates in time and frequency**.** **15 Hours**

UNIT – III

Filter bank summation and overlap add methods: for short-time synthesis of speech, sinusoidal and harmonic plus noise method of analysis/synthesis.
Homomorphic speech processing: Introduction, homomorphic system for convolution, the complex cepstrum of speech, homomorphic vocader. **8 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Comprehend basic characteristics of speech signal in relation to production and hearing of speech by humans and study the time domain methods of speech processing
2. Apply speech signal processing in synthesis, enhancement and hearing applications
3. Apply state-of-the-art technology systems for visualizing and manipulating speech waveforms.
4. Make use of Filter bank methods for analysis/synthesis of speech
5. Understand the concept of homomorphic speech processing

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	M	H	L	H	L	M			H	
2	H	L	H	M	H	M	L	H			H	L
3	H	M	H	H	H	L	L			L	M	
4	H	H	H	H	M							
5	H	H	L	L	M	M	H	H				

L: Low M: Medium H: High

TEXT BOOK:

1. L. R. Rabiner and R. W. Schafer, **"Digital Processing of Speech Signals"**, Pearson Education Asia, 2004.

REFERENCE BOOKS:

1. T. F. Quatieri, "**Discrete Time Speech Signal Processing"**, Pearson Education Asia, 2004.
2. B. Gold and N. Morgan, "**Speech and Audio Signal Processing**: **Processing and Perception of Speech and Music",** John Wiley, 2004.

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REAL-TIME OPERATING SYSTEMS

Sub Code	**:**	**14EC814**	**Credit**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

This course will enable the students to

1. Understand the difference between a Real Time System and General computing system.
2. Calculate performability of a Real Time System.
3. Be familiar with various task scheduling methods and their intended usage.
4. Learn various multiple access protocols used in Real Time Systems.
5. Know the services offered issues involved in Real Time Operating Systems and analyze some of the basic Real Time Systems through case studies.

UNIT - I

Introduction: Issues in Real Time Computing, Task classes. Characterizing Real Time Systems and Tasks: Performance measures for Real Time Systems, Estimating Program runtimes**.**

Task Assignment & Scheduling: Classical Uniprocessor scheduling algorithms: Rate Monotonic and Earliest Deadline First; Multiprocessor scheduling: Utilization-Balancing Algorithm, Next-Fit Algorithm, Bin-Packing Assignment. **16 Hours**

UNIT – II

Real Time Communication: Network topologies, Network architecture issues; Protocols: Contention-based protocol (VTCSMA only) and Token-based protocols: Timed Token Protocol**.**

Real Time Operating Systems (RTOS): OS Services, Real Time & Embedded System OS, RTOS Task scheduling models, OS security issues. **16 Hours**

UNIT – III

RTOS Tools with case studies: Use of MUCOS/OS-II, Use of Vx Works, Case studies of Automatic Chocolate Vending machines, Coding for sending application layer byte streams on a TCP/IP network. (Excluding programming). **7 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Understand the concept and structure of real time systems with an example, types of real time systems, various task classes, time constraints, Performability and Source code analysis.
2. Understand the scheduling algorithms such as RM algorithm, EDF algorithm, IRIS algorithms, Utilization balancing algorithm etc.

3. Understand network architectural issues and study the real time protocols such as VT-CSMA algorithm, Timed token protocol, Window protocol and Token ring protocol.
4. Understand RTOS services, Kernel services, Scheduling algorithms, OS security issues.
5. Understand the features of MUCOS and Vx-Works along with its applications such as ACVS, Sending application layer bytes on a TCP/IP protocol.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1		L				M						
2			H									
3	H		M									
4	H			L								
5		L				L						

L: Low **M: Medium** **H: High**

TEXT BOOKS:

T1. C M Krishna & Kang G Shin, **"Real Time Systems",** MGH, 1997.
T2. Raj Kamal, **"Embedded System Architecture, Programming & Design",** TMH 2003.

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ADHOC AND SENSOR NETWORKS

Sub Code	**: 14EC815**	**Credits**	**: 03**
Hrs/Week	**: 3+0+0+0**	**Total Hours**	**: 39**

Course Learning Objectives:

This course will enable the students to

1. Establish the concept of forming a network with sensor nodes with radio frequency (RF) link
2. Analyze the architecture, performance of the wireless and adhoc networks with protocols of Physical, MAC and network layer
3. Describe the time synchronization and localizations of the adhoc and wireless sensor networks
4. Observe the characteristics of various layers of wireless sensor networks using simulation tools
5. Construct a layout of wireless/body sensor networks with the help of development platforms.

UNIT - I

Introduction to sensors:

Sensor basics, Sensor types, Characteristics, Applications **4 Hours**

Introduction to Wireless Sensor Networks (WSN):

Factors influencing the WSN design, hardware constraints, Power consumption,

Communication, simplified energy model **4 Hours**

WSN Architecture, Hardware components, Physical layer, Radio Frequency(RF), UWB, Modulation, path loss.

Transceiver tasks and characteristics, Physical layer transceiver design

Medium access control layer: Energy consumption.

Network layer functionalities. **4 Hours**

Protocol stack, embedded operating systems, Tiny OS, Contiki OS**.** **3 Hours**

UNIT - II

MAC Protocols:

Fundamentals, Classes of MAC protocols, MAC protocols for WSN, low duty cycle protocols, Wake up radio concepts, Contention and Schedule based protocols, IEEE 802.15.4 MAC protocol.

Time synchronization:

Properties, light weight time synchronization protocols (LTS) **8 Hours**

Localisation and Positioning:

Procedures, Possible approaches, Combining hierarchical topologies, and power control.

Pilot based power control, Adhoc Network design algorithm (ANDA), Energy efficiency unicast routing protocol. **8 Hours**

UNIT - III

Wireless Body Area Networks,
Network topologies, scenarios, WPAN technology, inertial energy scavenging technique, Wireless sensor network development platforms. **8 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Know the basic concepts of sensors and sensor networks
2. Understand the of issues related to various layers of the architecture
3. Elaborate the knowledge on the architecture, protocols of MAC layer and related parameters
4. Discuss the localization and positioning concepts
5. Explain the concept of Wireless Body Sensor Networks and energy scavenging techniques.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1.								H		L		
2.	L			M								
3.						H	M					
4.	L		M			H						
5.			M			L		H				

L: Low **M: Medium** **H: High**

TEXT BOOK:

1. Ian F. Akyildiz, Mehmet Can Vuran, **"**Wireless Sensor Networks", John Wiley & Sons Ltd., 2010
2. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd.. 2005
3. Guang-Zhong Yang (Ed.), "Body Sensor Networks", Springer-Verlag London Limited, 2006.

REFERENCE BOOKS:

1. Waltenegus Dargie and Christian Poellabauer, "Fundamentals of Wireless Sensor Networks", John Wiley & Sons Ltd., 2010.
2. Kazem Sohraaby,Daniel Minoli and Taieb Znati, "Wireless Sensor Networks Technology, Protocols and Applications", John Wiley & Sons Ltd., 2007.

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HIGH PERFORMANCE COMMUNICATION NETWORKS

Sub Code : 14EC821 **Credit : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

Course Learning Objectives :

This course will enable the students to

1. Build the connectivity between different types of communication networks.
2. Maximizing the high performance estimation through physical and logical layer connectivities.
3. Compiling the different network control management techniques , various services and applications etc.,
4. Importance between optical connectivity and wireless connectivity through network evaluation criterion approach.
5. Evaluating the different networks qualitative analysis by enhancing through intelligent networks and Derived demand for network services.

UNIT - I

Introduction: Networking principles, Future networks Internet, Pure ATM Network, Cable Network and Wireless. Network services and Layered Architecture, Applications, Traffic characterization and quality of services, Network services, High performance networks, Network Elements., Layered applications, Open data network model, Network architectures, Network bottlenecks.

Internet and TCP/IP Networks: IPV4 Reliable multicast ,Multicast IP, Mobile IP, TCP and UDP, Applications, FTP, SMTP. Internet success and limitations, Performance of TCP/IP Networks, Performance of circuit switched Networks. **14 Hours**

UNIT – II

ATM And Wireless Network: ATM: Main features of ATM, Addressing, signalling and Routing, ATM header structure, ATM AAL, Internetworking with ATM

Wireless Networks: Link level design, Channel Access, Network design, Wireless networks today, Future networks, ad hoc networks, High speed Digital cellular, Home RF and Bluetooth.

Network controls: Control of networks, Objectives and methods of control, Circuit switched networks, datagram Networks, Network economics, Derived demand for network services, ISPs, subscriber demand model. **18 Hours**

UNIT - III

Optical Networks: Optical Links, WDM systems, Optical cross connects, Optical LANs, Optical paths and Networks. SONET, DWDM, FTH, DSL, Intelligent networks CATV.

7 Hours

Course Outcomes:

At the end of the course the student will be able to

1. Determine the evaluation of Networking Principles and Layered Architectures.
2. Know the concepts like quality of services w.r.t network services and High performance networks.
3. Solve the problems of traffic network of multi-stage networks using wireless communication.
4. Know the significance of various network models, controls and their applications.
5. Understand the concepts and working modes of OFN (Optical Fiber Networks), various components, network systems and applications OFN.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H						M					
2			M		H							
3		H		H			M					
4						M		M				
5					M							L

L: Low M: Medium H: High

TEXT BOOKS:

1. Warland and Varaiya, **"High Performance Communication Networks",** Morgan Kauffman, Elsevier, 2nd Edition 2000.
2. William Stallings, **"High-Speed Networks and Internet: Performance and Quality of Service",** Pearson Edu., 2001.

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BIOMEDICAL SIGNAL PROCESSING

Sub Code: 14EC822 **Credits : 03**
Hrs/week: 3+0+0+0 **Total Hours : 39**

Course Learning Objectives (CLOs):

1. Understand the general characteristics of medical data.
2. Identify different techniques to record ECG.
3. Analyze digital & integer filters in biomedical applications.
4. Learn application of adaptive filters in biomedical signal processing.
5. Learn importance of signal averaging in signal processing.
6. Understand different data reduction techniques.
7. Analyze an ECG signal using different techniques.

UNIT - I

Overview of Biomedical Signals: Sources and nature of biomedical signals, Types of biomedical signals: deterministic, stochastic, fractal and chaotic. Characteristics of medical data, Objectives of biomedical signal analysis.Introduction to ECG, EEG, EMG, PCGand their signal characteristics.

Artifacts in Biomedical Signals: Baseline wander, Power-line noise and High frequency noise sources.

Digital and Integer Filters: Digital filters pole-zero plot, Integer filters: Basic design concept, Low-pass, High-pass, Band-pass and Band-reject integer filters. **14 Hours**

UNIT - II

Adaptive Filters and Signal Averaging: Principal noise canceller model, 60-Hz adaptive canceling using a sine wave model, Applications of adaptive filtering, Basics of signal averaging.
Data Reduction Techniques: Overview of data reduction techniques, Turning point algorithm, Huffman coding.
Characterization of Nonstationary Signals: Mean, Variance, Measures of activity, Higher-order statistics
Advanced Biomedical Signal Analysis techniques: Power spectrum estimation, Discrete Cosine Transform (DCT) and Short-time Fourier Transform (STFT), Discrete Wavelet Transform (DWT) **14 Hours**

UNIT – III

ECG QRS Detection: Differentiation techniques, Template matching techniques, Pan-Tompkins QRS detection algorithm.
Computer-Aided Biomedical Signal Interpretation: Overview of computer-aided diagnosis, ECG interpretation, Computer-assisted classification, Portable arrhythmia monitor.
Instructions to access the biomedical data: Demo to open source database PhysioNet, Acquisition of signal from database, Simulation of signals using MATLAB. **11 Hours**

Course Outcomes (COs):

At the end of the course the student will be able to

1. To apply knowledge of digital signal processing for analysis of biomedical signals for extracting useful information.
2. To analyze the noise sources affecting the physiological signals.
3. Develop the algorithms for efficient representation of physiological signals.
4. To study the non-stationary signal processing techniques.
5. Aims to discover research challenges and computer-aided diagnosis of physiological signals.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	H	-	-	-	-	M	L	-	L	-	-
2	M	L	-	-	L	-	M	L	M	-	-	
3	L	M	M	H	L	M	-	-	-	M	H	M
4	M	M	H	M	H	-	L			-	L	-
5	L	H	H	H	H	H		M	M	H	H	H

L: Low L:Low M: Medium H: High

TEXTBOOKS:

1. Willis J. Tompkins, **"Biomedical Digital Signal Processing: C-language Examples and Laboratory Experiments for the IBM PC,"**Prentice Hall, 1993.

2. Rangaraj M. Rangayyan, **"Biomedical Signal Analysis: A Case-Study Approach,"** Wiley-IEEE Press, 2001.
3. Eugene N. Bruce,**"Biomedical Signal Processing and Signal Modeling,"**Wiley-Interscience, 2001.

REFERENCE BOOKS:

1. Arnon Cohen, **"Biomedical Signal Processing,"** 2nd Ed., CRC Press, 2002.
2. MetinAkay, **"Biomedical Signal Processing,"** Academic Press, 1994.
3. MetinAkay, **"Time Frequency and Wavelets in Biomedical Signal Processing,"** Wiley-IEEE Press, 1997.

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OPTICAL COMPUTING

Sub Code	**:**	**14EC823**	**Credit**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

This course will enable the students to

1. Understand the overall Electrical and Electronic architecture of a vehicle
2. Know about the Automotive Control Systems
3. Understand the working of different types of sensors and actuators
4. Understand the use of different communication protocols
5. Know about the different infotainment systems
6. Analyze the working of active and passive safety systems

UNIT - I

Linear Optical Processing: Introduction, photographic film, spatial filtering using binary filters, holography, inverse filtering, de-blurring

Optical Arithmetic: Introduction, Half-tone processing, non-linear optical processing, arithmetic operation

Recognition using analog optical systems: Introduction, matched filter, joint transform correlation, phase only filter, AM recognition filters, generalized correlation filter, Mellin transform based correlation

Devices: Non-linear devices, integrated objects, threshold devices **16 Hours**

UNIT - II

Shadow casting and symbolic substitution: Shadow casting system and design algorithm, POSC logic operation, POSC multiprocessor, parallel ALU using POSC, sequential ALU using POSC, symbolic substitution

Optical matrix processing: Multiplication, Multiplication using convolution, matrix operations, cellular logic architecture. **15 Hours**

UNIT - III

Artificial Intelligence Computations: Neural networks, associative memory, optical implementations, interconnections. **8 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Understand basics of Optical Arithmetic, Recognition using analog optical systems.
2. Understand the working of optical devices
3. Understand the principles of shadow casting and symbolic substitution
4. Understand the basics of Optical matrix processing
5. Understand the basics of AI computations

Mapping of PO's & CO's:

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12
1	H	M	H			H	M					M
2	H	M	H			H	M					M
3	H	M	H			H	M					M
4	H	M	H			H	M					M
5	H	M	H			H	M					M

L: Low **M:Medium** **H:High**

TEXT BOOK:

1. Karim and Awwal, **"Optical Computing: An Introduction",** John Wiley, 2003.

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FINANCIAL MANAGEMENT

Sub Code	**:**	**14EC824**	**Credit**	**:**	**03**
Hrs/Week	**:**	**3+0+0+0**	**Total Hours**	**:**	**39**

Course Learning Objectives:

This Course will enable students to

1. Develop basic financial management knowledge essential to make a managerial career in professional life.
2. Impart some of the crucial and basic skills required to work in the area of budgeting, investment and financial decision making.
3. Enable in making a right decisions on selection of projects for investment
4. Understand the basics of finance and financial markets, project evaluation and selection

UNIT - I

Financial Management: Concepts and Meaning – Introduction to Finance; Objectives of Financial Management; Profit Maximization; EVA; Changing Role of Financial Managers

Time Value of Money: Techniques and Applications of Compounding and Discounting

13 Hours

UNIT - II

Cost of Capital: Sources of various Types of Capital; Cost of Debenture Capital; Cost of Preferential Capital; Cost of Term Loans; Cost of Equity Capital.

Working Capital : Factors influencing Working Capital Requirements

Inventory Management: Techniques of Inventory Management and Control – EOQ, ABC Analysis, Just-in-Time (JIT) System. **13 Hours**

UNIT - III

Capital Budgeting (Investment Evaluation Techniques): Payback Period Method; Present Worth Method; Annual Worth Method; Future Worth Method; Estimation of IRR.

BreakEven Analysis: Estimation of Break-Even Point and Values. **13 Hours**

Course Outcomes:

At the end of the course the student will be able to

1. Demonstrate the basic financial management skills required for a professional
2. Demonstrate techniques and applications of compounding and discounting
3. Demonstrate the basics of cost of capital and working capital
4. Demonstrate the basics of inventory management
5. Demonstrate the basics of capital budgeting and breakeven analysis

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1				M					M		H	H
2				M	M						H	H
3				H					M	L	H	H
4				H					M	L	H	H
5				H					M	L	H	H

L : Low **M: Medium** **H : High**

TEXT BOOKS :

1. "Financial Management – Text, Problems & Cases", - M Y Khan, P K Jain; 7th Edition, 2015; McGraw Hill Education (India) Pvt. Ltd, New Delhi.
2. "Financial Management" - I M Pandey; 11th Edition, 2015; Vikas Publishing House Pvt. Ltd. (UP) India.
3. "Engineering Economics", 4th Edition, - James L. Riggs, David D. Bedworth, Sabah U. Randhawa; Tata McGraw Hill Edition.

REFERENCE BOOKS :

1. "Financial Management", - Prasanna Chandra; 6th Edition, 2004; Tata McGraw Hill Publishing Company Ltd, New Delhi.
2. "Operation Research", - S. D. Sharma.

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BIG DATA ANALYTICS

Sub Code : 14EC825 **Credits : 03**
Hrs/Week : 3+0+0+0 **Total Hours : 39**

UNIT - I

Introduction to Big Data Analytics: Definition, Overview and Big data in Industry.
Overview of Data Analytics Lifecycle: Phases of typical analytics lifecycle-discovery, data preparation, model planning, model building
Introduction to R programming: Using R programming for Initial Analysis of the Data, Basic visualization using R. **16 Hours**

UNIT - II

Advanced Analytics and Statistical Modeling for Big Data - Theory and Methods: Core methods used by data scientist, candidate selection using Naïve Bayesian Classifier, categorization using K-means clustering algorithm and association rules, predictive modelling using decision trees, linear and logistic regression and time series analysis and text analysis.
13 Hours

UNIT - III

Advanced Analytics and Statistical Modeling for Big Data – Technology and Tools: Analytic tools for unstructured data, MapReduce and the Hadoop ecosystem. In-database analytics with SQL extensions and other advanced SQL techniques and MADlib functions for in-database analytics. **10 Hours**

Course Outcomes:

At the end of the course the student should be able to

1. Define Big Data and its data analysis process
2. Basic visualization of R programming for data acquired.
3. Make use of the tools and techniques required for big data analytics.
4. Analyse diverse data types and usage of statistical tools.
5. Understand the basics of SQL techniques.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	L		M						M	M	
2	H	M			H							
3	M	M		L						L		
4	M	L						M			L	
5	H							M				

L: Low **M: Medium** **H: High**

REFERENCE BOOKS:

1. Michael Minnelli, Michele Chambers, Ambiga Dhiraj, **"Big Data Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses**", Wiley India Pvt. Ltd., 2013.
2. Arvind Sathi, **"Big Data Analytics"**, MC Press, LLC, 2012.
3. Vignesh Prajapathi, **"Big Data Analytics with R and Hadoop"**, PACKT, 2013.R4. Emmanuel Paradis, R for Beginners (Open Source).

NPTEL/ MOOC Link:

https://onlinecourses.nptel.ac.in/noc16_mg06

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PROJECT

Sub Code : 14EC803 **Credits : 07**
Hrs / Week : 0+0+7+0

Students will carry out a detailed project in Electronics either singly or in small groups to show case the extent of knowledge gained during the regular classes in the relevant and useful applications on the subject of electronic circuits, systems, using either or both hardware and software.

Course Outcomes:

After completion of the Project student will be able to

1. Design and model a system based on the requirements ; Implement, test and analyze the performance of the system.
2. Record and document the work done.

Mapping of PO's & CO's:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12
1	H	M	M	H	H	M	M	M	H	L	H	H
2	L	L	L	L	L	L	L	L	H	H	L	H

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