Scheme for IV Year – 2019-20

VII SEMESTER B.E. ELECTRONICS AND COMMUNICATION ENGINEERING (Courses Under the Autonomous Scheme)							
Sl. No.	**Subject Code**	**Subject**	**Category**	**Contact Hrs/Week**			**No. of Credits**
				L	**T**	**P**	
1	EC0413	Wireless Communications	FCC	4	0	0	4
2	EC0414	Communication Networks	FCN	3	0	2	4
3	EC0509	CMOS VLSI circuits*	FCE	4	0	2	5
4	EC0411	Microwaves and Radar	FCC	4	0	0	4
5	EC0111	E-waste Management	GC	1	0	0	1
6	EC	Elective - 2		3	0	0	3
7	EC0304	Project Work	GC	0	0	6	3
		Total		**20**	**0**	**8**	**24**
Total Contact Hrs/Week – 27							
	ELECTIVES OFFERED						
1	EC0306	Satellite Communication	FEC	3	0	0	3
2	EC0316	Multimedia Communication	FES	3	0	0	3
3	EC0312	Micro Electronics	FEE	3	0	0	3
4	EC0311	Internet of Things	FEM	2	0	2	3
5	EC0328	Bio-Medical Instrumentation		3	0	0	3
6	EC0329	System Verilog		3	0	0	3
7	EC0330	IoT and applications		2	0	2	3

Open Elective Offered for IV Year

VII SEMESTER B.E. ELECTRONICS AND COMMUNICATION ENGINEERING (Courses Under the Autonomous Scheme)							
Sl. No.	**Subject Code**	**Subject**	**Category**	**Contact Hrs/Week**			**No. of Credits**
				L	**T**	**P**	
1	EC0311	Internet of Things	FEM	2	0	2	3

Offered in common for E&C, CS & IS Departments.

VIII SEMESTER B.E. ELECTRONICS AND COMMUNICATION ENGINEERING (Courses Under the Autonomous Scheme)							
Sl. No.	**Subject Code**	**Subject**		**Contact Hrs/Week**			**No. of Credits**
			Category	**L**	**T**	**P**	
1	EC0441	Engineering Management	GC	4	0	0	4
2	EC0305	Optical Fiber Communication	FCC	3	0	0	3
3	EC	Elective – 3		3	0	0	3
4	EC	Elective – 4		3	0	0	3
5	EC0102	Seminar	GC	0	0	2	1
6	EC0601	Project Work	GC	0	0	12	6
		Total		**13**	**0**	**14**	**20**
	Total Contact Hrs/Week – 31						
	ELECTIVES OFFERED						
1	EC0 317	Low Power VLSI Design	FEE	3	0	0	3
2	EC0318	Mixed Signal Modeling Using VHDL-AMS	FEE	3	0	0	3
3	EC0319	Network Security	FEN	3	0	0	3
4	EC0320	RF Microelectronics	FEC	3	0	0	3
5	EC0321	Automotive Electronics	FEE	3	0	0	3
6	EC0322	Speech Processing	FES	3	0	0	3
7	EC0323	Mobile Computing	FEC	3	0	0	3
8	EC0324	Wireless Networks	FEN	3	0	0	3
9	EC0331	Artificial Intelligence	FES	3	0	0	3

* Course integrated with Laboratory

WIRELESS COMMUNICATIONS (4:0:0)

Sub. Code: EC0413 **CIE: 50% Marks**
Hrs./week: 4 **SEE: 50% Marks**
SEE Hrs: 3 **Max Marks: 100**

Course Outcome:
On successful completion of the course, the students will be able to:

1. Explain and compare the various cellular systems and its components.
2. Apply and analyze mobile communication concepts.
3. Describe network and system architecture, channel concept and system operations in TDMA and CDMA systems.
4. Apply and analyze radio propagation models, coding and modulation techniques in Wireless Communication systems.

Unit 1: Introduction and Evolution of Mobile Radio Communication:
Evolution of Mobile Radio Communication, Frequencies for radio transmission, FCC Allocation for Mobile Radio transmission, Wireless communication standards, 1G,2G,3G and 4GCellular systems. **8Hrs.**
***SLE*:** Beyond 4G.

Unit 2: Mobile Communication Concepts:
Introduction, Concept of cellular communications, Cell Fundamentals, Frequency Reuse concepts, Concept of cell cluster, Cellular layout for frequency reuse, Geometry of hexagonal cell, Frequency Reuse Ratio, Co-channel and Adjacent Channel Interference, Various mechanism for capacity increase, Cell Splitting, Sectoring, Microcell Zone Concept, Channel Assignment Strategies, Handoff Strategies. **10Hrs.**
***SLE*:** Concepts of femto, Pico, micro, macro cells and umbrella cell approach

Unit 3: Common Cellular System Components:
Common Cellular Network Components, Hardware and Software Views of the Cellular Network, 3G Cellular Systems Components, Cellular Component Identification, Call Establishment. **8Hrs.**
***SLE*:** Cloud /Centralized RAN.

Unit 4: GSM and TDMA Technology:
GSM System Overview, GSM Network and System Architecture, GSM Channel Concept, GSM System Operation, GSM Identities, GSM System Operations, GSM Infrastructure Communications. **9Hrs.**
SLE: AT Commands.

Unit 5: CDMA Technology:
CDMA Overview, CDMA Network and System Architecture, CDMA Basics, CDMA Channel Concept, CDMA System Operations, 3G CDMA, IS-95B, CDMA2000. **9Hrs.**
SLE: WCDMA.

Unit 6: Wireless Modulation techniques:
Characteristics of air interface, Path loss models, wireless coding techniques, Digital modulation techniques, Spread Spectrum Modulation Techniques, Diversity techniques.
8 Hrs.

SLE: UWB Applications.

Text Books:

1. Sanjay Sharma, ***"Wireless Cellular Communications"***, Katson, 2nd Edition, 2007.
2. Mullet,***"Introduction to Wireless Telecommunications Systems and Networks",***Cengage Learning, 6th Edition, 2010.

Reference books:

1. Rappaport Theodore, ***"Wireless Communications: Principles and Practice"*** Pearson Education India, 2009**.**

COMMUNICATION NETWORKS (3:0:2)

Sub. Code: EC0414 **CIE: 50% Marks**
Hrs./week: 4 **SEE: 50% Marks**
SEE Hrs.: 3 **Marks: 100**

Course Outcome:
On successful completion of the course, the students will be able to:

1. Understand OSI and TCP/IP Protocol Stack, the Transmission Delays, correlation between Data Transmission delay and Propagation Delay.
2. Understand basics of data link layer control, deciphering data using suitable protocols and should be able to comprehend and work with the basics of socket programming
3. Solve different Networks, Class addresses, subnet and subnet masking, switching and different routing protocols
4. Processes and protocols applied in communication in TCP and UDP, and apply the protocols, authentication, other connected processes and other networking applications.

Unit 1: Introduction: Network Architecture:
Layering and protocols, OSI Architecture, Internet Architecture and Performance Parameter: Bandwidth and Latency, Delay Bandwidth Products, High Speed Networks **7 Hrs.**
***SLE*:** Application Performance Needs.

Unit 2: Data Link Layer and Introduction to socket programming:
Framing, Flow and Error control, Protocols, Noiseless Channels, Noisy Channels, Multiple Access: Random Access, ALOHA, CSMA, CSMA/CD, CSMA/CA, Socket Programming basics **6Hrs.**
***SLE*:** Reliable Transmission: Noisy and Noiseless Channels.

Unit 3: Network Layer: Address mapping Delivery and LAN's:
Mapping logical to physical address: ARP, Mapping physical to logical address: RARP and DHCP, Wired LAN, Wireless LAN, Wired: Ethernet (802.3), Wireless: Bluetooth (802.15.1), Wi-Fi (802.11) **6 Hrs.**
***SLE*:** WI Max (802.16)

Unit 4: Internetworking:
Global addresses: Datagram forwarding in IP, Sub netting, Host Configuration (DHCP), IPv4 Addresses and Data format, IPv6 Addresses and data format, Transport layer protocols: TCP and UDP. **7 Hrs.**
***SLE*:** Multicast Addresses

Unit 5: Switching and Routing:
Circuit switched networks: Three phases, efficiency and delay, Virtual circuit networks: addressing, three phases, efficiency and delay, Unicast Routing protocols: Optimization, intra and inter domain routing, distance vector routing, link state routing and path vector routing, Multicasting protocols: Routing protocols and applications. **8Hrs.**
***SLE*:** Remote Procedure Call (RPC)

Unit 6: Applications, Traditional Applications:
File transfer: FTP World Wide Web (HTTP), Domain Name Serviced (DNS), Network Management (SNMP). **6 Hrs.**
***SLE*:** Multimedia Applications, NS-2 Lab.

Text Books:

1. Behrouz A Forouzan,***"Data Communication and Networking",***Tata McGraw-Hill 4thEdition (Indian), 2006.

2. Larry. Peterson and Bruce S. Davie,***"Computer Networks",*** Morgan Kaufmann Publications, 5th Edition.

Reference Books:

1. Larry L. Peterson and Bruce S. Davie,***"ComputerNetworks",***Morgan Kaufmann Publications, 4th Edition, 2002.
2. Andrew S Tannenbaum, ***"Computer Networks",***Prentice Hall of India Pvt. Ltd., 4th Edition.

COMMUNICATIONS NETWORKS LABORATORY (0:0:2)

List of Experiments

1. Study of basic network commands and network configuration commands.
2. Simulate a three-node point-to-point network with a duplex link between them. Set the queue size and vary the bandwidth and find the number of packets dropped.
3. Simulate a four-node point-to-point network and connect the link as follows: Apply a TCP agent between n0 to n3 and apply a UDP agent between n1 and n3. Apply relevant applications over TCP and UDP agents changing the parameters and determine the number of packets sent by two agents.
4. Study of socket programming and implementation of client-server model using TCP/IP sockets
5. Implementation of Distance Vector Routing Algorithm.
6. Implementation of Link State Routing Algorithm.
7. Simulation of basic network topologies and subsequent analysis using NetSim.

CMOS VLSI CIRCUITS (4:0:2)

Sub Code: EC0509 **CIE: 50% Marks**
Hours / Week: 4 **SEE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Course Outcome:
On successful completion of the course, the students will be able to

1. Explain schematic,layout and fabrication process in cmos..
2. Explain V-I ,C-V characteristics for a MOS devices.
3. Discuss the Electronic analysis of CMOS logic gates, delay analysis, analysis of complex logic gates, power dissipation.
4. Explain the array subsystems and Testing and verification in VLSI.
5. Design and verify schematic and layout simulation of Analog and Digital CMOS VLSI Circuits.

Unit 1:
CMOS Logic and Layouts: Introduction and history, VLSI design flow: design specification, design entry, functional simulation, planning placement and routing, timing simulation,
MOS Transistor Theory: V-I Characteristics: simple MOS capacitance models, Detailed MOS Gate Capacitance model, Detailed MOS diffusion capacitance model, Nonideal V-I Effects, DC Transfer Characteristics, **10 Hrs**
***SLE*:** Switch level RC delay model

Unit 2:
CMOS Logic Circuits: Logic Gates, Pass Transistor and Transmission gates, Combinational Circuit Design: Circuit Families: Static CMOS, Ratioed Circuits, CVSL, Dynamic Circuits **8 Hrs**
***SLE*:** multiplexers, latches and flip-flops

.

Unit 3:
Circuit Characterization and Performance Estimation: Delay Estimation: RC delay model, linear delay model, Logical Effort (LE), Scaling of Models and scaling factors for device parameters. **8 Hrs**
***SLE*:** Latch-up

Unit 4:
NMOS and CMOS Fabrication, Stick diagrams, Lambda based Layout Design Rulesand Layout. **8 Hrs**
***SLE*:** BiCMOS Fabrication

Unit 5:
Data path Subsystems: Addition/subtraction, counters.
Array subsystems: SRAM, DRAM, PLA **10 Hrs**
SLE: SAM

Unit 6:
Manufacturing test principles:fault models, Fault coverage, ATPG, design for testability:adhoc testing,scan design, BIST. **8 Hrs**
***SLE*:** boundary scan.

Text books:

1. Neil Weste and David Harris, “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Tata McGraw Hill, 2010.
2. Douglas A Pucknell and Kamaran Eshraghian, “Basic VLSI Design”, 3rd Edition, PHI, 2009

Reference book:

1. Jan Rabaey, B. Nikolic, A. Chandrakasan, “Digital Integrated Circuits: A Design Perspective”, 2 nd Edition, Pearson, 2003.
2. Morris Mano and Michael Ciletti, “Digital Design”, 4th Edition, Prentice Hall, 2006.
3. Sung Mo Kang and Yusuf Leblebici, “CMOS Digital Integrated Circuits”, 4th Edition, McGraw Hill, 2014.

CMOS VLSI LABORATORY

DESIGN AND VERIFY THE FOLLOWING BY SCHEMATIC SIMULATION AND LAYOUT SIMULATION

1. Inverter using FETs.
2. Two input NAND, NOR, XOR gates.
3. Realization of Boolean expressions.
4. Combinational Circuit Design of Adders, MUX and its realizations.
5. Sequential Circuit Design of flip-flops, counters and Shift registers.
6. Schmitt trigger.
8. Common Source and Common Drain Amplifier.
9. Op-amp.

Note: Effect of changes in process technology parameters such as from 1.2 microns to 35nano microns and step-wise fabrication processes (2D/3D view) for the above experiments to be studied.

Text Books:

1. **'Introduction to VLSI Circuits and System'**, 'John P Uymeura', Wiley Publications, 2nd Edition, 2001.
2. Douglas A Pucknell and Kamaran Eshraghian, "Basic VLSI Design", 3rd Edition, PHI, 2009

MICROWAVES AND RADAR (4:0:0)

Sub. Code: EC0411 **CIE: 50% Marks**
Hrs /Week: 4 **SEE: 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks: 100**

Pre-requisite: Electro Magnetic Field Theory (EC0302)

Course Outcome:

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

1. Explain the types of transmission lines and analyze mode of propagation through them
2. Apply microwave network theory to analyze the operation of microwave components and devices
3. Design and test a microwave circuit
4. Demonstrate the use of software tools in designing microwave circuits.
5. Describe and analyze the basic principles of operation of RADAR systems
6. Analyze the various microwave hazards.

Unit 1: Transmission Lines and Waveguides:
Introduction, transmission lines equations, and solutions, reflection and transmission coefficients, standing waves and SWR, line impedance and line admittance, Applications and limitations of transmission lines, rectangular waveguides. **8 Hrs**
***SLE*:** High frequency transmission lines, use of Smith Chart

Unit 2: Microwave network Theory and Passive Devices:
Introduction to microwave networks and network parameters for microwave Circuits, Scattering Parameters and their properties, S matrix representation of multi port networks. Directional couplers, isolators, circulators, waveguide Tees. **10 Hrs**
***SLE*:** phase shifters, attenuators

Unit 3: Microwave Active Devices:
Introduction, Gunn Effect diodes – GaAs diode, Modes of operation, Avalanche transit time devices: READ diode, IMPATT diode, BARITT diode, parametric amplifiers , PIN diodes, Schottky barrier diodes, Klystron, cavity magnetron, cross field amplifier . **9 Hrs**
***SLE*:** Basic working principle of microwave oscillators, mixers and microwave tubes

Unit 4: Strip Lines:
Introduction, Microstrip Lines, Characteristic Impedance of Microstrip Lines, Losses in Microstrip Lines, Quality Factor Q of Microstrip Lines, Parallel Strip Lines, Distributed Lines, Characteristic Impedance, Attenuation Losses, Coplanar Strip Lines, Shielded Strip Lines. Numerical as applicable. **8 Hrs**
***SLE*:** Application of BJTs and FETs in microwave circuits

Unit 5: Monolithic Microwave Integrated-Circuits:
Introduction, Materials, Monolithic Microwave Integrated-Circuit Growth, MMIC Fabrication Techniques, Fabrication Example.Fabrication of MOSFETs. **7 Hrs**
***SLE*:** Hybrid integrated – circuit fabrication

Unit 6: An Introduction to Radar:

Basic Radar, The simple form of the Radar equation, Radar block diagram, Radar frequencies, application of Radar, Doppler effect, MTI Radar, delay line Cancellers, digital MTI processing, Moving target detector, pulse Doppler Radar **9 Hrs**
***SLE*:** Signal processing in Radar

Text Books:

1. **"Microwave Devices and circuits",** Samuel Y Liao, Prentice Hall,3rd Edition,2004
2. **"Introduction to Radar systems",** Merrill I Skolnik, TMH, 4th Edition, 2004.
3. **"Microwave Engineering",** Annapurna Das, Sisir K Das, TMH Publication.

Reference Book:
"Microwave Engineering", David M Pozar, John Wiley,3rd Edition,2005

E-WASTE MANAGEMENT (1:0:0)

Sub. Code: EC0111 **CIE: 50% Marks**
Hrs /Week: 1 **SEE: 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks: 100**

Unit -1:
Introduction, Electronic waste Environment and Society, Current and New Electronic waste Recycling Technologies, Materials used in Manufacturing Electrical and Electronic Products, Dumping, Burning and Landfill, Recycling and Recovery.

Unit -2:
Integrated approach to e-waste recycling waste management: Key Learning's from around the world, Current International flows of electronic wastes, Future perspectives on electronic scrap.

Text books

1. Hester, Ronald E., and Roy M. Harrison. *Electronic waste management*. Vol. 27. Royal Society of Chemistry, 2009.
2. Hieronymi, Klaus, RamzyKahhat, and Eric Williams, eds. *E-waste Management: From Waste to Resource*. Routledge, 2012.

ELECTIVES OFFERED
SATELLITE COMMUNICATION (3:0:0)

Sub. Code: EC0306 **CIE: 50% Marks**
Hrs./week: 3 **SEE: 50% Marks**
SEE Hrs.: 3 **Max Marks: 100**

Course Outcome:

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

1. Explain the fundamentals of orbital mechanism, the characteristics of common orbits and launch methods and technologies in satellite systems.
2. Describe the working of communications satellite and limitations encountered in the design of a communications satellite system and accurate link budget for a satellite system.
3. Evaluate the performance of the radio propagation channel for Earth station to satellite and satellite to satellite
4. Design antenna systems to accommodate the needs of a particular satellite system and use of analog and digital technologies for satellite communications networks.

Unit1: Overview of Satellite Systems:

Introduction, Frequency Allocation, INTE Satellites. **3Hrs.**

***SLE*:** Polar Orbiting Satellites.

Unit2: Orbital Mechanics:

Introduction, Keplar 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 mix antenna, limits of visibility earth eclipse of satellite, sun transit outage, launching orbits. **7 Hrs.**

***SLE*:** launching vehicles.

Unit 3:Space Link Satellite Subsystems:

Introduction, EIRP, transmission losses, link power budget, system noise, CNR, uplink, downlink, effects of rain. Satellite subsystems, attitude and orbit control systems (AOCS), telemetry, tracking, command and alonitoring, power systems, communication subsystems, satellite antennas. **9 Hrs.**

***SLE*:** Combined CNR, Equipments reliability and space qualification.

Unit 4: Satellite Link Design:

Basic transmission theory, System Noise temperature and G/T ratio, design of downlinks, satellite systems, using small earth stations, uplink design, design for specified C/N; combining C/N and C/I values in satellite links, system design examples. **8 Hrs.**

***SLE*:** Implementation of error detection on satellite links.

Unit 5: Low Earth Orbit and Non-Geostationary Satellite System:

Introduction, orbit consideration, delay and through put considerations, operational NGSO constellation design – iridiumteledesic **7 Hrs.**

***SLE*:** coverage and frequency considerations.

Unit 6: Satellite Specialized Services:
Introduction, orbital spacing, power ratio, frequency and polarization, transponder capacity, bit rates for digital TV, satellite mobile services, USAT, Radar Sat, GPS, orb communication. **7 Hrs.**

***SLE*:** Iridium.

Text Books:

1. 'Dennis Roddy', **"Satellite Communications"**, 4th Edition, MHI.
2. 'Timothy Pratt, Charles Bostain and Jeremy Allnet', **"Satellite Communications"**, JW & Sons, 2nd Edition 2003.

Reference Books:

1. 'Wertz and Larson', **"Space Missing Analysis and Design (SMAD)"**, Microcosm Pren, 3rd Edition, 1999.

MULTIMEDIA COMMUNICATIONS (3:0:0)

Sub. Code: EC0316 **CIE: 50% Marks**
Hrs./week: 3 **SEE: 50% Marks**
SEE Hrs.: 3 Hrs. **Max Marks: 100**

Course Outcome:

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

1. Understand the techniques that are used to transmit multimedia data.
2. Have knowledge of the application of multimedia.
3. Understanding the coding techniques involved in transmitting multimedia data.
4. Understand real-time applications in multimedia.

Unit1: Multimedia communications:

Introduction, multimedia information representation, multimedia networks, multimedia applications, media types, communication modes, network types, network QoS. **6Hrs.**

***SLE*:** Multipoint conferencing.

Unit2: Multimedia information representation:

Introduction, digital principles, text, images, audio, video. 7**Hrs.**

***SLE*:** PC video.

Unit3: Text and image compression:

Introduction, compression principles, text compression, image compression. **6 Hrs.**

***SLE*:** Digitized documents.

Unit4: Audio compression:

Introduction, Code exited LPC, perceptual coding, Dolby audio coders and MPEG audio coders. **7Hrs.**

***SLE*:** Dolby AC-2, Dolby AC-S.

Unit5: Video compression:

Video compression principles, H.261, H.263, MPEG **6 Hrs.**

***SLE*:** MPEG-1,2,4

Unit6: Standards for Multimedia Communications:

Standards relating to interpersonal communication, interactive applications over internet. **7 Hrs.**

SLE: Standard for entertainment applications.

Text Book:

1. Fred Halsall, *"**Multimedia Communications: Applications, Networks, Protocols and Standards"***, Pearson Education, 2nd Edition (Indian), 2002.

Reference Books:

1. Nalin K. Sharda,***"Multimedia Information Networking"***PHI, 2003.
2. Ralf Steinmetz, Klara Narstedt,,***"Multimedia Fundamentals: Vol 1 - Media Coding and Content Processing"***,Pearson Education, 2004.
3. Prabhat K. Andleigh, Kiran Thakrar, ***"Multimedia Systems Design"***,PHI, 2004.

MICRO ELECTRONICS (3:0:0)

Sub. Code: EC0312 **CIE: 50% Marks**
Hrs./week: 3 **SEE: 50% Marks**
SEE Hrs.: 3 **Max Marks: 100**

Course Outcome:

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

1. Explain and apply the semiconductor concepts of drift, diffusion, donors and acceptors, majority and minority carriers, excess carriers, low level injection, minority carrier lifetime.
2. Explain how devices and integrated circuits are fabricated and describe discuss modern trends in the microelectronics industry.
3. Explain the underlying physics and principles of operation of p-n junction diodes, and MOS field effect transistors (MOSFETs).
4. Describe and apply simple large signal circuit models for metal oxide-semiconductor (MOS) capacitors devices which include charge storage elements and analyze the secondary effects of MOSFET.

Unit 1: Fundamentals of Semiconductors:

Effective mass, intrinsic and extrinsic semiconductors, mobility, drift current and conductivity, diffusion process. **8Hrs.**

***SLE*:** Diffusion current.

Unit 2: Fabrication Technology:

Introduction, Czochralski growing process, fabrication process. **6Hrs.**

***SLE*:** Photolithography and ion implantation

Unit 3: PN Junction Diode:

Introduction, space-charge region, analytical relations at equilibrium, diode conditions with voltage applied. **6Hrs.**

***SLE*:** Derivation of diode current equation.

Unit 4: Metal – Semiconductor Junctions:

Energy band diagrams of metal and N-Semiconductor, Schottky barrier diode, VI characteristics of N-Semiconductor Schottky diode. **6Hrs.**

***SLE*:** Tunnel Diode

Unit 5: Metal-oxide-Semiconductor systems:

Introduction, Energy band diagrams, Band bending and effect of bias voltages, analytical relations for charge densities, threshold voltage, and oxide charges in MOS capacitors. **8 Hrs.**

***SLE*:** Sub Threshold voltage.

Unit 6: Metal Oxide Semiconductor Field Effect Transistors:

Construction and basic operation, region of operation, current-voltage analytical relations, secondary effects. **6 Hrs.**

***SLE*:** Usage of Simulation tools.

Text Book:

1. Kanaan Kano,***"Semiconductordevices",***Pearson Education.

Reference Books:

1. Ben G Streetman, Sanjay Banerjee, ***"Solid State Electronic devices"***Pearson Education, 5th Edition.

INTERNET OF THINGS (2:0:2)

Sub. Code: EC0311 **CIE: 50% Marks**
Hrs/week: 2 **SEE: 50% Marks**
SEE Hrs: 3 **Max Marks:**

Course Outcome:
On successful completion of the course, the students will be able to

1 Explain the application, challenges and architecture of IoT.
2 Discuss various protocols and WSN.
3 Discuss various cellular networks and IoT platforms.
4 Develop sample applications for IoT.
5 Develop programs to interface sensors.

Unit 1: Introduction to Internet of Things: Introduction, Definition and characteristics of IoT, Physical design of IoT, Logical Design of IoT, IoT Enabling Technologies, Domain specific IoT's.. **4 Hrs**
***SLE*:** M2M

Unit 2: **IoT Protocols:** Application Protocols – MQTT, CoAP, LoRa, IPv6 for IoT and Gateway, Wireless sensors networks: Characteristics, Architecture and operating systems for WSN **6Hrs**
***SLE*:** Bluetooth

Unit 3: Fundamentals of 3GPP LTE: 3GPP standards evolution, Fundamentals of EPS: System architecture overview, functional description of nodes, functional details of EPS, LTE/EPS management, Fundamentals of LTE RAN: OFDMA basics, Downlink and uplink air interface structure.

4 Hrs

***SLE*:** MIMO

Unit 4: Cloud and IoT: Cloud trends in supporting ubiquitous computing, Performance of distributed system and cloud, enabling technologies for IoT. **4 Hrs**
***SLE*:** Iaas and Paas

Unit 5: Programming with cloud IoT platforms: Amazon web services IoT, IBM Watson IoT, and Microsoft Azure IoT suit. **4 Hrs**
***SLE*:** Introduction Apache Hadoop, Apache Spark

Unit 6: IoT challenges: Security requirements of IoT infrastructure, AAA framework, Security threats and solutions for Smart devices, security concerns in IoT components, security for IoT Platforms. **4 Hrs**
***SLE*:** Security threats in different use case of IoT**.**

Text Books:

1 **"Internet of Things A Hands-On- Approach**", Vijay Madisetti, ArshdeepBahga,2014.
2 "**The Internet of Things: Enabling Technologies, Platforms, and Use Cases**", Pethuru Raj and Anupama C. Raman.
3 **"Internet of Thing sand Data Analytics Handbook",**HwaiyuGeng, Wiley.
4 **"Distributed and cloud computing from Parallel processing to IoT",** Kai Hwang, Geoffrey C. Fox. Jack J. Dongarra

Reference Books:

1 "**Designing the Internet of Things**", Adrian McEwen, Wiley Publishers, 2013,

2 "**Building the Internet of Things with IPv6 and MIPv6",**Daniel Minoli, Wiley Publisher.
3 **"Big Data Science & Analytics**", Arshdeep Bhaga and Vijay Madisetti.
4 Research papers.

MOOC's:

1. https://www.coursera.org/learn/cloud-iot-platform

LABORATORY EXPERIMENTS(0:0:2)

1. Interacting with device peripherals (GPIO, ADC)
2. Connecting to the Internet (Ex: the device showing the current weather forecast)
3. Exposition of device functionality as services. (COAP protocol)
4. Machine-to-machine communication (broadcast communication protocols)
5. Machine-to-machine communication (communication based on the message exchange – MQTT protocol).
6. Interfacing with devices used in healthcare, automation, transportation using Intel boards.

Bio-Medical Instrumentation (3-0-0)

Sub Code : EC0328 **CIE : 50% Marks**
Hrs/week : 3+0+0 **SEE : 50% Marks**
SEE Hrs : 3 **Max marks : 100**

Course Outcomes

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

1. Describe the physiology of the human body and origin of biomedical signals.
2. Explain the working of different diagnostic instruments, Clinical Lab Equipments and different imaging modalities
3. Emphasize the knowledge on Telemedicine and Patient safety

UNIT-1: Fundamentals of Medical Instrumentation: Anatomy, Physiology, Physiology systems of the body, sources of bio-medical signals, basics of medical instrumentation, Performance requirements, Origin of biomedical signals.

06 Hours

SLE: action potential, general constraints in design of medical instrumentation systems

UNIT-2: Diagnostics and Monitoring: General concepts, ECG, Measurement of pulse rate, blood pressure measurement, Cardiac output measurement, measurement of respiration rate, EEG, oxymeter

08 Hours

SLE : Capnography (CO_2 method of respiration rate)

UNIT-3: Medical Image Processing: X-ray: Basics of diagnostic radiology, Nature Production of X-ray, Computed tomography & system components. **MRI**: Principles and Image reconstruction techniques

07 Hours

SLE: Radiation hazard reduction and biological impact

UNIT -4: Surgical and Therapeutic: Defibrillator: Need and DC defibrillators, Lithotriptors: First and Modern Lithotriptor, Anaesthesia: Anesthesia machine, Ventilators: Mechanics of respiration, artificial ventilation, ventilators, types of ventilators

Drug Delivery systems: Infusion pumps and components, Implantable infusion systems,

07 Hours

SLE: ESU

Unit-5: Clinical Lab Equipment: Equipments: Spectrophotometery, Spectrophotometer, Colorimerter, Blood gas analyzers – Acid-base balance, Ph, PCO2 pO2 measurement (Intra-arterial blood gas monitoring), Types of blood cell, Method of blood cell counting.

06 Hours

SLE: Automated biochemical analysis system

Unit-6 Telemedicine and patient safety: Shock hazard, leakage current, safety code for medical devices, safety analyzers, Radiation safety, Regulations of medical device, Telemedicine.

06 Hours

SLE: Testing of biomedical equipment.

Text Book:

1. R S Khandpur, ***" Handbook of Biomedical instrumentation",*** 2nd Edn., TMH,

Reference Books:

1. Nandini K Jog, ***"Electronics in medicine and biomedical Instrumentation",*** PHI, New Delhi, 2013
2. Anand Natarajan,***" Biomedical instrumentation and measurement",*** 2nd Edn. PHI New Delhi,
3. Raja Rao and Guha, ***"Princiles of medical electronics and biomedical instrumentation"***, Universities press, Hydeabad, 2013
4. Mandeep Singh, ***"Introduction to bio-medical instrumentation"***, 2nd Edn, PHI New Delhi, 2014
5. Shakti Chatterjee , ***"Biomedical Instrumentation system",*** Delmer Cengage, 2010

System Verilog (3:0:0)

Sub. Code: EC0329 **CIE:50%Marks**
Hrs./week: 3 **SEE: 50% Marks**
SEE Hrs.: 3 **Max Marks: 100**

Course Outcomes: This course will enable students to:

1. Understand digital system verification using object oriented methods
2. Learn the System Verilog language for digital system design and verification.
3. Create/build test benches for the basic design/methodology.
4. Use constrained random tests for verification
5. Understand concepts of functional coverage

Part A: System Verilog for Design

Case study: Design a synchronous and asynchronous counters

Unit 1

Data Types: Built in Data types, fixed and dynamic arrays, Queues, associative arrays, linked lists, array methods, choosing a storage type, creating new types with type def, creating user defined structures, type conversion, Enumerated types, constants and strings, Expression width. **7 Hrs**

***SLE*:** Net Types

Unit 2

Procedural Statements and Routines: Procedural statements, Tasks, Functions and void functions, Task and function overview, Routine arguments, returning from a routine, time values. **7 Hrs**

***SLE*:** Local data storage

Unit 3

Randomization: Introduction, Randomization in System Verilog, Constraint details, Solution probabilities, Valid constraints, In-line constraints, Random number functions, Common randomization problems, Iterative and array constraints, Random control. **7 Hrs**

***SLE*:** Random Generators and Random Device Configuration

Part B: System Verilog for Verification

Case study: Verify a synchronous and asynchronous counters

Unit 4

Verification Guidelines: The verification process, basic test bench functionality, directed testing, methodology basics, constrained random stimulus, randomization, functional coverage, test bench components.

Converting the test bench and design: Separating the test bench and design, The interface construct, Stimulus timing, Interface driving and sampling, System Verilog assertions. **8 Hrs**

***SLE*:** Connecting It All Together and Program – Module Interactions

Unit 5

Threads and Interprocess Communication: Working with threads, Disabling threads, Interprocess communication, Events, semaphores, Mailboxes, Building a test bench with threads and Interprocess Communication **7 Hrs**

SLE: Synthesis guidelines for interface methods

Unit 6

Functional Coverage: Coverage types, Coverage strategies, Simple coverage example, Anatomy of Cover group and Triggering a Cover group, Coverage options, Analyzing coverage data, measuring coverage statistics during simulation. **5 Hrs**

***SLE*:** Verification with interfaces

Text Book :

Chris Spear, System Verilog for Verification – A guide to learning the Test bench language features‘, Springer Publications, 2nd Edition, 2010.

Stuart Sutherland, Simon Davidmann, Peter Flake, ―System Verilog for Design A guide to using system verilog for Hardware design and modeling‖, Springer Pulications, 2nd Edition, 2006

Stuart Sutherland, “RTL modeling with System Verilog for simulation and synthesis : using System Verilog for ASIC and FPGA design” Tualatin, 2017

IOT AND APPLICATIONS (2:0:2)
(Industry Driven Elective)

Sub. Code: EC0330 **CIE: 50% Marks**
Hrs./week: 4 **SEE: 50% Marks**
SEE Hrs.: 3 **Max Marks: 100**

Course Outcome:

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

1. Understand the implementation and role of computer networks for IOT, the different application protocols used in the IOT domain and the various use cases that are encountered.
2. Understand the testing, security and development cycle of software pertaining to IOT and the use of Raspberry Pi in the IOT scenario
3. Comprehend the basics of wireless communication in terms of LTE and basics of cellular IOT
4. Perceive the implementation of IOT on cloud and other platforms and interpret it's impact.

Unit 1: Wireless Connectivity Technology Options:

OneM2M and IoT World Forum standardized architecture and LTE -1(LTE Network Architecture). LTE-2 LTE-3, WiFi, 5G : General introduction and IoT specific features. **8 Hrs**

Unit 2: Software Engineering:

Software Development Life Cycle, Software Testing, Security. **2 Hrs**

Unit 3: IoT : Introduction and end to end architecture – I:

LoRA & SigFox, Sensors & Actuators layer, Communication Network Layer. **5 Hrs**

Unit 4: IoT : Introduction and end to end architecture – II:

Applications & Analytics layer,Key Design Considerations **2 Hrs**

Unit 5: Cellular IoT:

Cellular Technologies for IOT **6 Hrs**

Unit 6: Cloud and IOT Platforms:

Cloud and Virtualization, Analytics, IMPACT **4 Hrs**

Text Books:

1. Vijay Madisetti, **"Internet of Things AHands-On- Approach"**ArshdeepBahga, 2014
2. Rajkumar Buyya, Amir Vahid Dastjerdi, **'Internet of Things**, 1st Edition.

Reference Books:

1. Behrouz A Forouzan, **"Data Communication and Networking",** Tata McGraw-Hill Publishing Company Limited, Indian 4th Edition, 2006
2. Liberg, Marten Sundberg and EricWang**"Cellular Internet of Things: Technologies, Standards and Performance"**.

MOOC – Principles of Machine Learning (3:0:0)

Sub. Code: EC0331 **CIE: 50% Marks**
Hrs./week: 3 **SEE: 50% Marks**
SEE Hrs.: 3 **Max Marks: 100**

Course Outcome:
On successful completion of the course students will be able to:

CO1 : Understand what is Machine Learning and Loss functions applied to models
CO2 : Learn about Data Processing and ML Model Building and Predictions
CO3 : Monitoring, Evaluating and learn about custom models
CO4 : To Apply the model and train distributed training.

Unit 1: Getting started with ML, Overview of Machine Learning (Process and Techniques, Demonstration of ML concepts with Deep Playground)
Unit 2: Data Input and Pre-processing
Unit 3: Machine Learning Model Building, Prediction
Unit 4: Monitoring and evaluating models, Building custom models - CNNs, Scaling up for large datasets
Unit 5: Distributed training with hardware accelerators

ENGINEERING MANAGEMENT (4:0:0)

Sub. Code: EC0441 **CIE: 50% Marks**
Hrs./week: 4 **SEE: 50% Marks**
SEE Hrs.: 3 **Max Marks: 100**

Course Outcome:

On successful completion of the course students will be able to:

1. Describe the history of scientific management and distinguish between organization type and structures.
2. Explain the fundamental concepts of Engineering Economics.
3. Interpret financial statements and nuances of long term sources of finance.
4. Describe product development life cycle.
5. Interpret human behavior in organizations.
6. Identify the constraints in Project management.

Unit 1: Management

History of scientific management, types of ownership. Organization structures. **8 Hrs.**

***SLE*:** Types of planning.

Unit 2: Engineering Economics and Financial Management

Law of demand & supply, Market Equilibrium, interest rates simple interest, compound interest, interest formulae, NPV analysis of alternatives, depreciation concepts, elements of cost, fixed cost, variable cost, marginal cost, sunk cost, Break-even analysis and numerical problems. **10 Hrs.**

***SLE*:** Replacement analysis.

Unit 3: Financial Management:

Brief description on evolution of financial management (Goals, financial decisions in a firm, risk-return trade off), financial statements(Concepts of balance sheets and income statements), long term sources of finance (shares, debentures, loans, primary and secondary markets and venture capital), dividends, mergers and acquisitions. **10 Hrs.**

***SLE*:** Budgets.

Unit 4: New Product Development and Marketing:

Product Development Life Cycle, market strategy and concept of sales **8 Hrs.**

***SLE*:** New product failures.

Unit 5: Organizational Behavior:

Motivation, Content Theories: Maslow, Herzberg and McGregor, Stress and Conflict: Team building, Negotiation, Management by Objectives. **8 Hrs.**

***SLE*:** Leadership.

Unit – 6: Project management:

basic concepts of project management such as scope, time, cost and quality, network diagrams and critical path, 7 QC tools. **8 Hrs.**

***SLE*:** Subcontract management.

Text Books:

1. Banga and Sharma,***"Industrial Organization and Management",*** Khanna Publishers. New Delhi, 2007.
2. Ramesh Burbure, ***"Management and Entrepreneurship",*** Rohan publishers, 2009.
3. Dale H. Bester field,***"Total Quality Management",***Pearson Education India Publisher,3rd Edition.
4. I.M. Pandey Vikas, ***"Financial Management",*** Publishing House Pvt Ltd, 9th Edition 2009.

5. R. Panneerselvam,***"Engineering Economics",*** PHI Learning Pvt. Ltd, 5thEdition, 2004.

Reference Books:

1. Harold Koontz, Heinz Weiglunch,***"Essentials of Management – An international perspective",***7th Edition, Tata McGraw Hill, 2007.
2. John W. Mollins, ***"The New business Road Test",***by Pearson Education, 1st Edition, 2007.
3. Peter F. Drucker,***"The Frontiers of Management",***Elsevier Publications, 2006.

OPTICAL FIBER COMMUNICATION (3:0:0)

Sub. Code: EC0305 **CIE: 50% Marks**
Hrs/week: 3 **SEE: 50% Marks**
SEE Hrs: 3 **Max Marks: 100**

Course Outcome:

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

1. Identify the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. Analyze the different kind of losses, signal distortion in optical wave guides and their signal degradation factors and the various optical source materials, LED structures, aser diodes.
3. Apply the fiber optical receivers concepts in communication,basics of optical amplifiers, receiver operation and configuration.
4. Analyze the fiber optical network components, variety of networking aspects, SONET/SDH and operational principles WDM.

Unit 1: Overview of optical fiber communication:

Basic optical laws and definitions, optical fiber modes and configuration, Mode theory of circular wave guides: Overview, summery of key modal concepts,

7 Hrs

***SLE*:** Fiber fabrication.

Unit 2: Signal Degradation in Optical Fibers:
single mode fibers, graded index fibers, fiber materials. Attenuation, signal losses and distortion in optical wave guides, .

7 Hrs

***SLE*:** Characteristics of single mode fibres.

Unit 3: Optical Sources and Detectors:

Introduction, LED's, LASER diodes: LASER diodes Modes and threshold conditions, single mode Lasers, Principles of Photo diodes.

7 Hrs

***SLE*:** Photo detector noise, avalanche multiplication noise.

Unit 4: Optical Receiver and Digital Transmission System:

Fundamental receiver operation: Digital signal transmission, error sources, receiver configurations. Point to Point links: System considerations, link power budget, rise time budget. **7 Hrs**

SLE: Burst mode receivers.

Unit 5: Analog Systems and Optical Amplifiers:

Overview of analog links, basic applications and types of optical amplifiers, semiconductor optical amplifiers, Erbium doped fiber amplifiers. **6 Hrs**

***SLE*:** Wide band Optical Amplifiers.

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Unit 6: Optical Networks:

SONET / SDH, Broadcast and select WDM networks, Nonlinear effects on network performance. **6 Hrs**

***SLE*:** High speed Light wave Links.

Text Book:

1. **'Optical Fiber Communication'**, 'Gerd Keiser', MGH, 3th Ed., 2008.

Reference Book:

1. **'Optical Fiber Communications'**, 'John M. Senior', Pearson Education. 3rd Impression, 2007

ELECTIVES OFFERED
LOW POWER VLSI DESIGN (4:0:0)

Sub. Code: EC0422 **CIE: 50% Marks**

Hrs/week: 4 **SEE: 50% Marks**

SEE Hrs: 3 **Max Marks: 100**

Course Outcomes:

At the end of the course the student should be able to:
1. Identify the source of power dissipation in VLSI Circuits.
2. Understand the power optimization at circuit and logic level.
3. Applying the power optimization approaches to VLSI architecture and systems.

4. Understand the concepts of synthesis and software design for low power.
5. Understand the different techniques of power estimation and probabilistic analysis and emphasis on advanced techniques in VLSI systems.

UNIT-I

Device & Technology Impact on Low Power: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches, Physics of power dissipation in CMOS devices. Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.

10Hrs

UNIT-II

Low Power Design at Circuit and logic level: Power consumption in circuits. Flip Flops & Latches design, high capacitance nodes, low power digital cells library, Gate reorganization, signal gating, logic encoding, State machine encoding, precomputation logic. 10Hrs

UNIT- III

Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy. 6Hrs

Unit- IV

Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components, low power memory design.

Synthesis and software design for low power: Introduction, design flow, Algorithmic level analysis and optimization, Architectural level estimation & synthesis. 12Hrs

Unit- V

Power estimation, Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, Data Correlation Analysis in DSP Systems, Monte Carlo simulation.

8Hrs

UNIT-VI

Advanced Techniques: Adiabatic Switching Circuits, Battery-aware Synthesis, Variation tolerant design, CAD tools for low power synthesis. 06 Hrs

Text Books:

1. Kaushik Roy, Sharat Prasad, "**Low-Power CMOS VLSI Circuit Design**", Wiley, 2000.
2. Gary K. Yeap, "**Practical Low Power Digital VLSI Design**", KAP, 2002.
3. Rabaey, Pedram, "**Low Power Design Methodologies**", Kluwer Academic, 1997.

Reference book:

1. Anantha P. Chandrakasan& Robert W. Brodersen, **"Low Power Digital CMOS Design"** Kluwer AcademicPublications, 1994.

MIXED SIGNAL MODELLING USING VHDL-AMS (3:0:0)

Sub. Code: EC0318 **CIE: 50% Marks**
Hrs./week: 3 **SEE: 50% Marks**
SEE Hrs.: 3 Hrs. **Max Marks: 100**

Course Outcome:

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

1. Apply AHDL models for analogue circuitry.
2. Design and model analogue circuitry using combinations of AHDLs and circuitry.
3. Critically analyze the constraints in real circuits in terms of conflicting design requirements.
4. Gain an understanding of the AHDL language, its strengths and its current weakness.

Unit1:

Signal flow modeling in VHDL nature, terminal, quantity definition of a nature terminal nodes, free quantities, across and through quantities, electrical package. **7 Hrs.**
SLE: VHDL syntax and semantics.

Unit2:

Simultaneous statements, implicit quantities, solvability, simultaneous if and case statements, Examples: resistor, capacitor, diode, netlists terminal and quantity ports, component instantiation. **6 Hrs.**
SLE: Signal flow modeling.

Unit3:

Procedural statements sequential programming constructs,equivalent simultaneous statements, equivalent functions, Examples: MOSFET **6 Hrs.**
SLE: Modeling Op-amps.

Unit4:
Mixed-signal simulation cycle, initialization, break statements, time step control, frequency and noise domain modeling mixed-signal modeling, mixing concurrent and simultaneous constructs. **7 Hrs.**
SLE: Events and their significance.

Unit5:
Mixed signal focus command and control system design, digitise/encode block, decode /pulse-width-block, pulse-width/analog converter block, frequency and transfer function modeling, frequency –based modeling, noise-modeling. **7 Hrs.**
SLE: Laplace transfer functions and discrete transfer functions.

Unit6:
Case study: DC-DC power converter modeling with VHDL-AMS, capacitor model, ideal switch model, voltage mode control, averaged model, compensation design, load and line regulation, Case study: Communication systems Frequency Shift Keying. FSK detection.
7 Hrs.
SLE: Non-Coherent and coherent PLL Detection.

Text Book:
1. Peter Ashenden, Gregory Peterson, Darrel, ***"System Designers Guide to VHDL-AMS"***,Morgan Kaufmann Publishers 2005.

NETWORK SECURITY (3:0:0)

Sub. Code: EC0319 **CIE: 50% Marks**
Hrs./week: 3 **SEE: 50% Marks**
SEE Hrs.: 3 **Max Marks: 100**

Course Outcome:

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

1. Understand importance of security issues and objectives of information security.
2. Compose basic cryptographic algorithms.
3. Apply the concepts of private and public key encryption techniques. Understand Key Management techniques, Authentication services and Web security concepts.
4. Explain Digital Signatures along with Wireless and Mobile Device security.
5. Describe Intrusions, Intrusion detection and Firewall concepts.

Unit 1: Introduction and Symmetric Ciphers:

Services, mechanisms and attacks, OSI security architecture, model for network security, symmetric cipher model, substitution techniques and transposition techniques. **7 Hrs.**

SLE: Steganography and program on multiplicative inverse of modulus.

Unit 2: Block Cipher and Encryption Standards:

Simplified DES, Data Encryption Standard (DES), Strength of DES, block cipher design principles and modes of operation, The AES cipher (overview). **6 Hrs.**

SLE: Block cipher principles, finite fields.

Unit 3: Public-Key Encryption and Hash Functions:

Principles of Public-Key Cryptosystems, The RSA algorithm, Key Management: Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography (ECC), Applications of Cryptographic Hash Functions, Message Authentication Functions. **7 Hrs.**

SLE: program on a^b modulus n.

Unit 4: Digital Signatures and Authentication Protocols:

Digital signatures, Elgamal digital signature scheme, Digital Signature Standard, web-security consideration, security socket layer (SSL) and transport layer security, secure electronic transaction, Wireless Network threats, Wireless security measures, Mobile Device security threats, Mobile Device security strategy. **8 Hrs.**

SLE: Cloud security risks and countermeasures.

Unit 5: Intruders and Malicious Software:

Intruders, Intrusion Detection, password management, types of malicious software, viruses, virus Countermeasures. . **6 Hrs.**

SLE: Distributed intrusion detection, Behavior-Blocking Software.

Unit 6: Firewalls:

The need for Firewalls, Firewall characteristics, types of Firewalls. **6 Hrs.**

SLE: Firewall configurations.

Text Book:

1. William Stalling, ***"Cryptography and Network Security",*** Pearson Education, 4th Edition, 2011.

Reference Books:

1. William Stalling, ***"Cryptography and Network Security"***, Pearson Education, 6th Edition, 2014
2. Behrouz A. Forouzan, ***"Cryptography and Network Security",*** TMH, 3rd Edition, 2015.
3. Atul Kahate, ***"Cryptography and Network Security",*** TMH, 2013.

RF MICRO ELECTRONICS (3:0:0)

Sub. Code: EC0320 **CIE: 50% Marks**
Hrs./week: 3 **SEE: 50% Marks**
SEE Hrs.: 3 **Max Marks: 100**

Course Outcome:

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

1. Calculate radio, microwave and link power and noise budgets.
2. Analyze lumped and distributed microwave filters.
3. Design an optimal microwave transistor amplifiers.
4. Design microwave transistor oscillators and mixers. Interpret and manipulate network analyzer measurements.

Unit1:Basic Concepts in RF Design:

Introduction, non-linearity and time variance, random processes and noise, sensitivity and dynamic range, passive impedance transformation. **7Hrs.**

SLE: Scattering parameters**.**

Unit2:Transceiver Architectures:

General considerations, Receiver architectures: heterodyne and homodyne receivers, Transmitter architectures. **7Hrs.**

SLE: OOK Transceiver.

Unit3:Low Noise Amplifiers and Mixers:

Low noise amplifiers: General considerations input matching, simple bipolar LNA. Down conversion mixers: General considerations, Passive and active mixers. **7 Hrs.**

SLE: Single balanced mixer

Unit4: Oscillators:

General considerations, basic LC oscillator topologies, Voltage controlled oscillators. **7 Hrs.**

SLE: LC VCOs with Wide Tuning Range

Unit5: Frequency Synthesizers:

General considerations, Phase locked loops: Basic concepts, Basic PLL, Charge pump PLLs. **7Hrs.**

SLE: Phase noise in PLLs**.**

Unit6: Power Amplifiers:

General considerations, Classification of power amplifiers, High efficiency power amplifiers. **7Hrs.**

SLE: Doherty Power Amplifier**.**

Text Books:

1. Behzad Razavi,***"RF Microelectronics"***,Prentice Hall Communications Engineering And Emerging Technologies Series.

Reference Books:

1. Reinhold Ludwig, Pavel bretchko, ***"RF circuit design: Theory and applications"*** Prentice Hall Publications.

AUTOMOTIVE ELECTRONICS (3:0:0)

Sub. Code: EC0321 **CIE: 50% Marks**
Hrs./week: 3 **SEE: 50% Marks**
SEE Hrs.: 3 **Max Marks: 100**

Course Outcomes:
On successful completion of the course, the students will be able to:

1. Explain in a concise manner how the general automotive electronics useful in the design and development of vehicles.
2. Understand constraints and opportunities of sensors and actuators used in the modern vehicle design.
3. Use basic measurement tools to determine the real-time performance of vehicles.
4. Analyze the implementation of the interconnected wireless embedded sensor networks and the Electronic Control Systems.
5. Understanding the basics of Automotive Instrumentation, Safety factors and diagnostics of Automobile systems.

Unit 1: Introduction:
Automotive fundamentals overview: four stroke cycle, engine control, ignition system, spark plug, spark pulse generation, ignition timing, drive train, transmission, brakes, steering system, battery, starting system. air/fuel systems fuel handling, air intake system. **6 Hrs.**
***SLE*:** Air/fuel management

Unit 2: Sensors:
Sensors: Oxygen (O2/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP) Sensor, magnetic reluctance, position sensor, engine speed sensor, ignition timing sensor, hall effect position sensor, shielded field sensor, optical crankshaft position, sensor, Manifold Absolute Pressure (MAP) Sensor - strain gauge and capacitor capsule, Engine Coolant Temperature (ECT) sensor, Intake Air Temperature (IAT) sensor, knock sensor, airflow rate sensor. **8 Hrs.**
***SLE*:** Throttle angle sensor

Unit 3:Actuators:
Actuators–fuel metering actuator, fuel injector, ignition actuator, exhaust after-treatment systems–air, catalytic converter, Exhaust Gas Recirculation (EGR). **8 Hrs.**
***SLE*:** Evaporative emission systems

Unit 4: Electronic Engine Control:
Engine parameters, variables, engine performance terms, electronic fuel control system, electronic ignition control, idle sped control. **6 Hrs.**
***SLE*:** EGR control.

Unit 5:Communication:
Serial Data, Communication Systems, Protection, Body and Chassis Electrical Systems, Remote Keyless Entry. **6 Hrs.**
***SLE*:** GPS.

Unit 6: Applications:

Vehicle Motion Control-Cruise Control, Chassis, Power Brakes, Antilock Brake System (ABS), Electronic Steering Control, Power Steering, Traction Control, Electronicallycontrolled suspension, Automotive Instrumentation–Sampling, Measurement & Signal Conversion of various parameters. **6 Hrs.**

***SLE*:** Integrated Body

Text Books:

1. William B. Ribbens,***"Understanding Automotive Electronics",***6th Edition, SAMS/Elsevier Publisher, 2010.
2. Robert Bosch Gambh, *"**Automotive Electrics Automotive Electronics Systems and Components"***, 5th Edition, John Wiley& Sons Ltd., 2007.

SPEECH PROCESSING (3:0:0)

Sub. Code: EC0322 **CIE: 50% Marks**
Hrs./week: 3 **SEE: 50% Marks**
SEE Hrs.: 3 **Max Marks: 100**

Pre-requisite: Digital Signal Processing (EC0510)

Course Outcome:
On successful completion of the course, the students will be able to:

1. Qualitatively describe the mechanisms of human speech production and study time dependent processing of speech
2. Analyze, Manipulate, visualize speech signals. Perform various decompositions, codifications, and modifications of speech signal.
3. Explain the main principles of common audio signal processing operations viz. equalization, dynamic control, perceptual audio coding.
4. Discuss the principles of speech synthesis and speech recognition.

Unit1: Introduction:
Process of speech production Time Domain Models for Speech Processing: Time dependent processing of speech, Short time energy and average magnitude, Speech vs silence discrimination using energy & zero crossings. **7 Hrs.**
***SLE*:** Pitch period estimation and Median smoothing.

Unit2: Digital Representations of the Speech Waveform:
Sampling speech signals, Instantaneous quantization, Adaptive quantization, Differential quantization, Differential PCM, Comparison of systems. **7 Hrs.**
***SLE*:** Direct digital code conversion.

Unit3: Short Time Fourier Analysis:
Fourier Transform Interpretation, Linear Filtering interpretation, Filter bank summation method, overlap addition method, Design of digital filter banks, Implementation using FFT, Spectrographic displays. **7 Hrs.**
***SLE*:** Analysis synthesis systems

Unit4: LPC and Speech Enhancement:
Basic principles of linear predictive analysis, Pitch Detection using LPC parameters, Formant Analysis using LPC parameters, LPC Vocoder, Voice Excited LPC vocoder. Speech Enhancement: Spectral subtraction & filtering, Harmonic filtering, parametric re-synthesis, **8 Hrs.**
***SLE*:** Adaptive noise cancellation, Enhancement by resynthesize.

Unit5: Speech Synthesis: Principles of speech synthesis, Synthesizer methods, Synthesis of intonation, Speech synthesis for different speakers, Speech synthesis in other languages, Evaluation. **7 Hrs.**
***SLE*:** Practical speech synthesis.

Unit6: Automatic Speech Recognition:

Introduction, Speech recognition vs. Speaker recognition, Signal processing and analysis methods, Hidden Markov Models, Artificial Neural Networks. **8 Hrs.**
***SLE*:** Pattern comparison techniques.

Text Books:

1. L. R. Rabiner and R. W. Schafer, ***"Digital Processing of Speech Signals",*** Pearson Education, 2004.
2. D. O'Shaughnessy, ***"Speech Communications: Human and Machine",*** Universities Press, 2001.

Reference Books:

1. Thomas F Quatieri, ***"Discrete Time Speech Signal Processing, Principles and Practice",*** Pearson Education (Asia) Pte. Ltd., 2004.
2. L. R. Rabiner and B. Juang,***"Fundamentals of Speech Recognition",***Pearson Education, 2004.

MOBILE COMPUTING (4:0:0)

Sub. Code: EC0323 **CIE: 50% Marks**
Hrs./week: 3 **SEE: 50% Marks**
SEE Hrs.: 3 **Max Marks: 100**

Course Outcome:
On successful completion of the course, the students will be able to:

1. Explain basics of Mobile Computing, Architecture and Technologies.
2. Development of Interfaces like, Voice over IP and implementation of simple Voice over XML.
3. Explain the basics of RFID, Mobile IP, Java Card in developing the Mobile units.
4. Discuss GSM, SMS and GPRS operations.

Unit 1: Introduction:
Introduction, Mobile Computing, Networks, Middleware and Gateways, Developing Mobile Computing Applications,. **7 Hrs.**
SLE: Security in Mobile Computing

Unit 2: Architecture:
Mobile Computing Architecture, Goals of Mobile Computing, Mobile Computing Components and its use, Three-Tier Architecture, Mobile Computing through Internet, **7 Hrs.**
SLE: Mobile Computing Applications.

Unit 3: Applications:
Mobile Computing through Telephone, Developing IVR applications, Voice XML, **6 Hrs.**
SLE: Telephony Application Programming Interface (TAPI).

Unit 4:Emerging Technologies:
Blue tooth, RFID, WIMAX, Mobile IP. **7 Hrs.**
SLE: IPv6 and Java Card.

Unit 5: GSM:
GSM Introduction, GSM Architecture and Entities, GSM Routing, GSM Addresses and Identifiers, GSM Network Aspects, Mobility Management, **8Hrs.**
SLE: GSM Frequency Allocation.

Unit 6: SMS and GPRS:
SMS, Value Added Service through SMS, Accessing SMS Bearers, GPRS, GPRS Architecture, GPRS Operation, GPRS Data Services, GPRS Applications. **7Hrs.**
***SLE*:** Blue Tooth Technology, WhatsApp, International Roaming, 1-800 Implementation.

Text Books:
1. Kaveh Pahlavan, Prasanth Krishnamoorthy,***"Principles of Wireless Networks",*** PHI/Pearson Education, 2003.
2. Asoke k Talukar, Harsam Ahmed, Roopa yavugal, *"**Mobile Computing**",* 2nd Edition.

Reference Books:
1. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, ***"Principles of Mobile Computing",***Springer, New York, 2003.
2. HazysztofWesolowshi**, *"Mobile Communication Systems",***John Wiley and Sons Ltd, 2002.

WIRELESS NETWORKS (3:0:0)

Sub. Code: EC0324 **CIE: 50% Marks**
Hrs./week: 3 **SEE: 50% Marks**
SEE Hrs.: 3 **Max Marks: 100**

Pre-requisite: 1.Wireless Communication (EC0413)
2. Communication Networks (EC0414)

Course Outcome:

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

1. Explain the fundamentals of wireless networking.
2. Describe and analyze various Wireless Networks like LAN, WAN, PAN and MAN& their performance analysis.
3. Describe and compare Broad Band Satellite and Microwave Systems.
4. Explain air interface technologies and emerging wireless technologies.

Unit 1: Cellular Wireless Data Networks-2.5 and 3G Systems:

Introduction to wireless networks and architecture, classification of wireless networks, wireless network issues,CDPD, GPRS, and EDGE Date Networks, CDMA date networks, evolution of GSM and NA-TDMA to 3G, evolution of CDMA to 3G.

9Hrs.

***SLE*:** Long Term Evolution (LTE) telecommunication technology.

Unit 2: Wireless LAN's /IEEE 802.11x:

Introduction, wireless LAN Network components and standards, IEEE 802.11 design Issue, design requirements of WLAN, network architecture, MAC layer operations, higher rate standards, wireless LAN security, WLAN applications. **7 Hrs.**

***SLE*:** WAVE (Vehicular Environments)

Unit 3: Wireless PANs/IEEE 802.15x:

Introduction, wireless PAN architecture,WPAN components, technologies and protocols,Bluetooth (IEEE 802.15.1), Bluetooth Link Controller basics, IEEE 802.15.1 protocols and Host Control Interface, standards, WPAN applications. **8 Hrs.**

***SLE*:** Zigbee, WPAN applications.

Unit 4: Broadband Wireless MAN's/IEEE 802.16x:

Introduction to WMAN/IEEE 802.16x technologies,WMANIEEE 802.16 architecture,MAC Layer Details, Physical Layer details, common system operations, WMAN applications.

7 Hrs.

***SLE*:** OFDMA.

Unit 5: Broad Band Satellite and Microwave Systems:

Introduction, line-of sight propagation, fundamentals of satellite systems, broadband satellite networks. **7 Hrs.**

***SLE*:** Satellites.

Unit 6: Emerging Wireless Technology:

Introduction, new and emerging air interface technologies, new wireless network implementations, wireless Adhoc networks. **7 Hrs.**

***SLE*:** Remote Sensing.

Text Books:

1. Mullet,***"Introduction to Wireless Telecommunications Systems and Networks",***Cengage Learning, Indian Edition, 2006.
2. S SManvi and M S Kakkasageri, ***"Wireless and Mobile Networks concepts and protocols"***, Wiley, 1st Edition, 2010.

Reference Books:

1. Vijay K Gard,***"IS-95 CDMA and CDMA 2000 Cellular/PCS System Implementation",***Pearson Education.

ARTIFICIAL INTELLIGENCE (3:0:0)

Sub. Code: EC0332 **CIE: 50% Marks**
Hrs./week: 3 **SEE: 50% Marks**
SEE Hrs.: 3 **Max Marks: 100**

Course Outcomes:

On Successful completion of the course the students will be able to:

1. Understand AI and how it is represented in different Semantic Forms.
2. Understand different search techniques, Rules and Rule-based systems.
3. Understand how AI plays games, and to solve Constraint Satisfaction Problems.
4. Solve Machine Learning using Nearest Neighbor, ID Trees and Deep Neural Nets

UNIT 1:**Introduction:**

Introduction to AI, What is Artificial Intelligence, Semantic Nets and Description Matching. Generate and Test, MeansEnds Analysis and Problem Reduction exploring Goal Trees. **7Hrs.**

SLE**:** https://en.wikipedia.org/wiki/Chinese_room

UNIT 2: **Search and Rule Based Systems:**

Nets and Basic Search, Optimal Search: British Museum, Depth First, Breadth First, Hill Climbing and Beam. Trees and adversarial Search. Rule and Rule Chaining: Rule-Based deduction systems, Procedures for forward and backward chaining, Rule-based Systems as Substrate. **7 Hrs.**

SLE**:** Best First Search and AO* Algorithm.

UNIT 3:**Game playing and CSP:**

MINMAX Gaming, Alpha-Beta Pruning, Propagation of Probability bounds through Opinion Nets (Constraint Satisfaction Problems). **6Hrs.**

SLE**:** Numeric Constraints and Propagation – Numeric constraints (CryptoArithmetic)
http://intelligence.worldofcomputing.net/expert-systems-articles/rule-based-expert-systems.html#.WvnXT4iFPIU

UNIT 4: **Different Learnings:**

Learning by Analyzing Differences, Introduction to Learning, Nearest Neighbors, Learning: Identification Trees, Disorders. **7 Hrs.**

SLE**:** Inductive Logical Programming.

UNIT 5: **Neural Networks:**

Training by Neural Nets, Deep Neural Nets, Back Propagation in NN, Convolution Neural Network (CNN), Learning by Genetic Algorithms **7 Hrs.**

***SLE*:**

https://www.tutorialspoint.com/artificial_neural_network/artificial_neural_network_hopfield.htm

UNIT 6: SVM and Probabilistic Models:

Support Vector Machines, Learning Probabilistic Models: Statistical Learning, Learning with Complete Data, Learning with Hidden Data: The EM algorithm **6 Hrs.**

***SLE*:** Learning Boosting.

Text books:

1. **"Artificial Intelligence",** Patrick Henry Winston, 3rd Edition, 1999 or 2002.

References books:

1. Stuart J Russell, Peter Norvig, ***"Artificial Intelligence 3e: A Modern Approach",*** 3rd Edition, Pearson learning, 2016.
2. James Barrat, ***"Our Final Invention: Artificial Intelligence and the End of the Human Era",*** Thomas Dunne Books,2015.
3. https://medium.com/machine-learning-for-humans/why-machine-learning-matters-6164faf1df12