K.L.N. COLLEGE OF ENGINEERING

Pottapalayam, Sivagangai District

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Estd: 1994

FINAL YEAR CURRICULUM AND SYLLABUS

REGULATIONS 2020

For Under Graduate Program

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

CHOICE BASED CREDIT SYSTEM

(For the students admitted in the academic year 2020-2021)

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM

(An Autonomous Institution, Affiliated to Anna University, Chennai)

VISION OF THE INSTITUTION

To become a Centre of Excellence in Technical Education and Research in producing Competent and Ethical professionals to the society.

MISSION OF THE INSTITUTION

To impart Value and Need based curriculum to the students with enriched skill development in the field of Engineering, Technology, Management and Entrepreneurship and to nurture their character with social concern and to pursue their career in the areas of Research and Industry.

VISION OF THE DEPARTMENT

To promote as a center of excellence in educational and research activities related to electronics and communication engineering and its allied areas.

MISSION OF THE DEPARTMENT

To create educational and research environment to meet ever changing and ever demanding needs of electronics and communication industry along with IT and other interdisciplinary fields.
To mould the students to become ethically upright and recognized as responsible engineers.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1. To prepare graduates with a strong foundation in Engineering science and Technology with more emphasis in Electronics and Communication Engineering and its allied areas.

PEO 2. To prepare the students to pursue successful career in industry and to motivate them for higher education.

PEO 3. To prepare the graduates to sustain as good professional, researcher and to practice them in emerging technologies through lifelong learning.

PEO 4. To impart students with ethical standards, professional excellence through effective communication skills, team work, multi disciplinary projects and social responsibility.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1. Design and analyse the basic analog and digital electronic circuits.

PSO 2. Design and analyse the spectral components of communication signals and systems.

PSO 3. Develop the modules in VLSI and embedded systems.

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PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to

PO 1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5. **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.

PO 6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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

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

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REGULATIONS 2020

For Under Graduate Program

B.E.- ELECTRONICS AND COMMUNICATION ENGINEERING

CHOICE BASED CREDIT SYSTEM

CATEGORY OF COURSES

i. **Humanities and Social Sciences (HS) Courses** include Technical English, Environmental Science and Engineering, Engineering Ethics and human values, Communication Skills and Management courses.

ii. **Basic Sciences (BS) Courses** include Mathematics, Physics, and Chemistry.

iii. **Engineering Sciences (ES) Courses** include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering / Instrumentation etc.

iv. **Professional Core (PC) Courses** include the core courses relevant to the chosen programme of study.

v. **Professional Elective (PE) Courses** include the elective courses relevant to the chosen programme of study.

vi. **Open Elective (OE) Courses** include courses from other departments which a student can choose from the list specified in the curriculum of the students B.E. / B.Tech. Programmes.

vii. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.

viii. **Mandatory Courses (MC)** include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, etc

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REGULATIONS 2020

CHOICE BASED CREDIT SYSTEM

B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULAM AND SYLLABUS - VII & VIII SEMESTERS

SEMESTER - VII

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20EC701	Microwave and Optical Communications	PC	3	3	0	0	3
2.	20EC702	Wireless Communication	PC	3	3	0	0	3
3.	20EC703	Wireless Networks	PC	3	3	0	0	3
4.		Professional Elective – III / HX8001 - Professional readiness for innovation employability and entrepreneurship (Nalaia Thiran Project work)	PE / EEC	3	3	0	0	3
5.		Open Elective - II	OE	3	3	0	0	3
THEORY CUM PRACTICAL								
6.	20EC704	Embedded and Real Time Systems	PC	5	3	0	2	4
PRACTICAL								
7.	20EC7L1	Microwave and Optical Laboratory	PC	4	0	0	4	2
TOTAL				**24**	**18**	**0**	**6**	**21**

SEMESTER - VIII

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective – IV	PE	3	3	0	0	3
2.		Professional Elective –V	PE	3	3	0	0	3
PROJECT								
3.	20EC8L1	Project Work	EEC	20	0	0	20	10
TOTAL				**26**	**6**	**0**	**20**	**16**

SEMESTER - VII

PROFESSIONAL ELECTIVE – III

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EC7A1	Foundations for Nano Engineering	PE	3	3	0	0	3
2.	20EC7A2	Multicore Programming	PE	3	3	0	0	3
3.	20IT7A4	Deep Learning	PE	3	3	0	0	3
4.	20EC7A4	IoT Enabled System Design	PE	4	2	0	2	3
5.	20EC7A5	System on Chip Design	PE	3	3	0	0	3
6.	20EC7A6	Advanced Digital Signal Processing	PE	3	3	0	0	3
7.	20HS7A3	Engineering Technology and Management	HS	3	3	0	0	3

SEMESTER - VIII

PROFESSIONAL ELECTIVE – IV

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EC8A1	Wireless Adhoc and Sensor Networks	PE	3	3	0	0	3
2.	20EC8A2	Video Analytics	PE	3	3	0	0	3
3.	20EC8A3	Robotics and Automation	PE	3	3	0	0	3
4.	20EC8A4	Wireless Body Area Networks	PE	3	3	0	0	3
5.	20HS601	Operations Research	HS	3	3	0	0	3
6.	20HS8A1	Human Relations at Work	HS	3	3	0	0	3
7.	20HS8A2	Legal aspects in Engineering	HS	3	3	0	0	3

SEMESTER - VIII

PROFESSIONAL ELECTIVE – V

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EC8B1	Biomedical Imaging Systems	PE	3	3	0	0	3
2.	20EC8B2	Cooperative Communication Systems	PE	3	3	0	0	3
3.	20EC8B3	C-Based VLSI Design	PE	3	3	0	0	3
4.	20CS701	Data analytics	PE	3	3	0	0	3
5.	20CS8B3	Virtual Reality and Augmented Reality	PE	3	3	0	0	3
6.	20HS8B1	Introduction to NGO Management	HS	3	3	0	0	3
7.	20HS7A2	Total Quality Management	HS	3	3	0	0	3

OPEN ELECTIVE-II (OE-II) Courses offered to other Department

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE305	Fundamentals of Image Processing	OE	3	3	0	0	3
2.	20OE306	Consumer Electronics	OE	3	3	0	0	3
3.	20OE307	Fundamentals of Digital Signal Processing	OE	3	3	0	0	3
4.	20OE308	Introduction to VLSI Technology	OE	3	3	0	0	3

SEMESTER - VII

OPEN ELECTIVE – II

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE108	Industrial Safety Practices	OE	3	3	0	0	3
2.	20OE205	Industrial Energy Auditing and Management	OE	3	3	0	0	3
3.	20OE406	Java Scripting	OE	3	3	0	0	3
4.	20OE408	Essentials of Data Analytics	OE	3	3	0	0	3
5.	200E505	Essentials of Information Security	OE	3	3	0	0	3
6.	20OE506	Principles of Cyber Physical System	OE	3	3	0	0	3
7.	20OE507	Concepts of Ethical Hacking	OE	3	3	0	0	3
8.	20OE606	Modern Technologies for Vehicles	OE	3	3	0	0	3
9.	20OE608	Automotive Electrical and Electronics systems	OE	3	3	0	0	3
10.	20OE708	Instrumentation for agro food industry	OE	3	3	0	0	3

20EC701 MICROWAVE AND OPTICAL COMMUNICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To deal with the microwave generation techniques.
- To inculcate understanding of the microwave network theory.
- To instill knowledge on the properties of various microwave components.
- To inculcate understanding of the basics required for optical fibers communication.
- To deal with the optical sources and detectors.

PRE-REQUISITE:

Course Code: 20EC502
Course Name: Transmission lines and wave guides

UNIT - I MICROWAVE GENERATION 9

Limitations of conventional Tubes – Klystron: working of Klystron, velocity modulation process and it's derivation, efficiency. Reflex Klystron: working, velocity modulation process, efficiency. Magnetron: working, Hull's cutoff voltage equation, mode jumping, frequency pushing and pulling. TWT: similarities and differences with klystron, working of TWT, Backward wave oscillator.

UNIT - II HIGH FREQUENCY NETWORK THEORY 9

Review of Low frequency parameters; Different types of interconnection of Two port networks, High Frequency parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix, RF behavior of Resistors, Capacitors and Inductors.

UNIT - III PASSIVE AND ACTIVE MICROWAVE DEVICES 9

Terminations, Attenuators, E-Plane Tee, H-Plane Tee, Magic Tee, Directional Coupler, S matrix for Directional Coupler, Non reciprocal devices : Circulator and Isolator. S matrix for Circulator and Isolator. PIN diode, Gunn Diode, IMPATT, TRAPATT diode.

UNIT - IV OPTICS AND OPTICAL FIBERS 9

Ray theory transmission – Total internal reflection – Acceptance angle – Numerical aperture – Skew rays – Step Index and Graded Index, Single Mode and Multi Mode fibers – Attenuation in a fiber, absorption, linear and non linear scattering losses – Dispersion, Intra model, intermodal dispersion - Fiber to Fiber Joints-Fiber Splicing-Optical Fiber connectors - Fiber in local loop.

UNIT - V OPTICAL SOURCES AND DETECTORS 9

Optical sources: Light Emitting Diodes – LED structures – surface and edge emitters, mono and hetero structures – internal quantum efficiency – injection laser diode structures – comparison of LED and ILD Optical Detectors: PIN Photo detectors, Avalanche photo diodes, construction – Comparison of performance – Photo detector noise – Signal to Noise ratio. Detector response time.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Annapurna Das and Sisir K. Das, “Microwave Engineering”, Mc Graw Hill India, Fourth Edition, 2020.
2. John M. Senior, “Optical Fiber Communication: Principles & Practice”, Pearson, Third Edition, 2009.

REFERENCES:

1. David M. Pozar, “Microwave Engineering”, Wiley India Pvt. Ltd., New Delhi, 2008.
2. Robert E, Colin, “Foundations for Microwave Engineering”, John Wiley & Sons Inc., 2005.
3. Gerd Keiser, “Optical Fiber Communication”, McGraw Hill International, Fourth Edition, 2010.
4. Samuel Y. Liao, “Microwave devices and Circuits”, Tata McGraw Hill Inc., 2004.
5. John Gowar, “Optical Communication Systems”, Prentice Hall India, 2001.
6. Govinda P. Agarwal, “Fiber-Optic Communication Systems”, John Wiley & Sons, Third Edition, 2004.
7. George Kennedy, Brendan Davis and Srm Prasanna, "Electronic Communication Systems", McGraw Hill Education, 5th Edition, 2011.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Microwave and Optical Communications		**Course Code :** 20EC701			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C401.1	Derive the mathematical parameters of various microwave sources.	1	K3	1,2,3,8,10	2
C401.2	Identify the high frequency parameters for Microwave network.	2	K3	1,2,3,8,10	2
C401.3	Explain the working principle of active microwave devices.	3	K2	1,2,8,10	2
C401.4	Compute S parameters for passive microwave devices.	3	K3	1,2,3,8,10	2
C401.5	Determine the basic parameters and characteristics of optical fiber.	4	K3	1,2,8,10	2
C401.6	Explain the working principle and characteristics of optical sources and detectors.	5	K2	1,2,3,8,10	2

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C401.1	3	2	1					2		2				2	
C401.2	3	2	1					2		2				2	
C401.3	2	1						2		2				1	
C401.4	3	2	1					2		2				2	
C401.5	3	2	1					2		2				1	
C401.6	2	1						2		2				2	

20EC702	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the various cellular architectures.
- To know the characteristic of wireless channel.
- To understand the concepts behind various digital signaling schemes for fading channels.
- To familiar the various multipath mitigation techniques.
- To understand the various multiple antenna systems.

PRE-REQUISITE:
Course Code: 20EC503
Course Name: Analog and digital communication

UNIT - I CELLULAR ARCHITECTURE 9

Evolution of wireless communication Standards from 2G to 5G -Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept- Frequency reuse - channel assignment - hand off - interference & system capacity- trunking & grade of service – Coverage and capacity improvement.

UNIT - II WIRELESS CHANNELS 9

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters-Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

UNIT - III DIGITAL SIGNALING FOR FADING CHANNELS 9

Structure of a wireless communication link, Principles of Offset - QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR – NOMA.

UNIT - IV MULTIPATH MITIGATION TECHNIQUES 9

Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macrodiversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

UNIT - V MULTIPLE ANTENNA TECHNIQUES 9

MIMO systems – spatial multiplexing - System model - transmitter diversity, receiver diversity - Massive MIMO - Beamforming and MIMO – Cognitive radio - software defined radio - Communication relays - Spectrum sharing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", Pearson Education, Second Edition, 2014.
2. Andreas F. Molisch, "Wireless Communications", John Wiley India Pvt. Ltd., 2006.

REFERENCES:

1. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.
2. Upena Dalal, "Wireless Communication", Oxford University Press, 2009.
3. R.Van Nee and Ramji Prasad, "OFDM for wireless multimedia communications", Artech House, 2000.
4. Aditya K. Jegannatham, "Principles of Modern Wireless Communication Systems", Tata McGraw Hill, 2016.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Wireless Communication		**Course Code :** 20EC702			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C402.1	Apply the cellular concept to determine frequency reuse, co-channel interference	1	K3	1,2,3,8,10	2
C402.2	Derive the free space model and two ray model to characterize the wireless channels.	1	K3	1,2,3,8,10	2
C402.3	Determine the channel parameters for various fading channels.	2	K3	1,2,3,8,10	2
C402.4	Apply various signaling schemes for fading channels.	3	K3	1,2,3,8,10	2
C402.5	Apply equalization and diversity techniques to mitigate multipath fading.	4	K3	1,2,3,8,9,10	2
C402.6	Apply MIMO systems with transmitter and receiver diversity for fading channels.	5	K3	1,2,3,8,9,10	2

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C402.1	3	2	1					2		2				2	
C402.2	3	2	1					2		2				2	
C402.3	3	2	1					2		2				2	
C402.4	3	2	1					2		2				2	
C402.5	3	2	1					2	2	2				2	
C402.6	3	2	1					2	2	2				2	

20EC703 **WIRELESS NETWORKS**

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand the concept about wireless networks, protocol stack and standards.
- To understand and analyze the network layer solutions for wireless networks.
- To have in depth knowledge on internetworking of WLAN and WWAN.
- To study about fundamentals of 4G Services.
- To learn about evolution of 5G Networks, its architecture and applications.

PRE-REQUISITE:NIL

UNIT - I WIRELESS LAN 9

Introduction – WLAN technologies – IEEE 802.11: System architecture, protocol architecture, 802.11b, 802.11a – HiperLAN: WATM, BRAN, HiperLAN2 – WPAN: IEEE 802.15.4, Wireless USB, Wireless HART.

UNIT - II MOBILE NETWORK LAYER 9

Introduction – Mobile IP: IP packet delivery, Agent discovery Tunneling and encapsulation, IPV6, Network layer in the internet, Mobile IP session initiation protocol – Mobile ad-hoc network: Routing, Destination Sequence distance vector, AODV Protocol using NS2 – IoT: CoAP.

UNIT - III WIRELESS WIDE AREA NETWORK 9

Internetworking objectives and requirements – Schemes to connect WLANS and 3G Networks – Session Mobility – Internetworking Architecture for WLAN and GPRS – System Description – Local Multipoint Distribution Service – Multichannel Multipoint Distribution System.

UNIT - IV 4G NETWORKS 9

Overview of 3G networks – Introduction to 4G networks – 4G vision – 4G features and challenges – Applications of 4G – Multicarrier Modulation – Smart antenna techniques – IMS Architecture – LTE – Advanced Broadband Wireless Access and Services – MVNO – Software Defined Radio.

UNIT - V 5G NETWORKS 9

Introduction to 5G networks – Building blocks of 5G – Building blocks of 5G architecture – 5G for IoT applications – 5G road map – Pillars of 5G – IoT relation to 5G – 5G system concepts – 5G applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jochen Schiller, “Mobile Communications”, Pearson Education, 2012.
2. Afif Osseiran, Jose F. Monserrat and Patrick Marsch, “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016.

REFERENCES:

1) Vijay Garg, “Wireless Communications and networking”, Elsevier, 2007.
2) Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, “3G Evolution HSPA and LTE for Mobile Broadband”, Academic Press, 2008.
3) Anurag Kumar, D.Manjunath and Joy kuri, “Wireless Networking”, Elsevier, 2011.
4) Simon Haykin, Michael Moher and David Koilpillai, “Modern Wireless Communications”, Pearson Education, 2013.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Wireless Networks		**Course Code :** 20EC703			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C403.1	Explain the various protocols and standards of wireless LAN.	1	K2	1,2,8,10	2
C403.2	Build wireless network environment for mobile application using wireless protocols and standards.	2	K3	1,2,3,8,10	2
C403.3	Determine the various schemes to connect WLANs and 3G networks.	3	K3	1,2,3,8,10	2
C403.4	Explain the 4G technology and its applications.	4	K2	1,2,8,10	2
C403.5	Explain the evolution of 5G networks.	5	K2	1,2,8,10	2
C403.6	Explain the 5G architecture and its IOT applications.	5	K2	1,2,8,10	2

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C403.1	2	1						2		2				1	
C403.2	3	2	1					2		2				2	
C403.3	3	2	1					2		2				2	
C403.4	2	1						2		2				1	
C403.5	2	1						2		2				1	
C403.6	2	1						2		2				1	

20EC704	EMBEDDED AND REAL TIME SYSTEMS	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To learn the architecture and features of ARM 7 processor.
- To study different peripheral interfacing using LPC2148 microcontroller.
- To learn the architecture and features of ARM Cortex M4 processor.
- To study different peripheral interfacing using STM32F466XX microcontroller.
- To learn the basic concepts of RTOS Embedded Programming.

PRE-REQUISITE:

Course Code: 20EC402, 20EC504

Course Name: Computer Architecture and Organization, Microprocessors and Microcontrollers

UNIT - I ARM 7 ARCHITECTURE AND PROGRAMMING 9

Architecture - Programmer's Model - Development Tools - Memory Organization - Addressing Modes - Registers - Pipeline - Interrupts - Coprocessors - Interrupt Structure - Instruction Sets - I/O Ports - Assembly Language Programming - Embedded C Programming.

LAB COMPONENT

1. Interfacing LED, LCD and Keypad
2. Interfacing Stepper Motor, DC Motor and Seven Segment Display **6**

UNIT - II PERIPHERALS OF ARM LPC2148 MICROCONTROLLER 9

Features of the LPC 214X Family - I/O Memory - EEPROM - SRAM - Peripherals: Timer, ADC, DAC, PWM, RTC, Serial Communication Protocols (UART, SPI, I^2C, CAN), Wireless Communication Protocols (Wi-Fi, Bluetooth, Zigbee).

LAB COMPONENT

3. Interfacing UART, PWM, ADC and DAC
4. Interfacing RTC using I^2C, Wi-Fi and zigbee **6**

UNIT - III ARM CORTEX M4 ARCHITECTURE AND PROGRAMMING 9

Introduction to ARM Cortex-M Processors - Embedded Software Development - Technical Overview - Architecture - Instruction Set - Memory System - Exceptions and Interrupts - Memory Protection Unit (MPU).

LAB COMPONENT

5. Interfacing LED and Push button
6. Interfacing LCD **6**

UNIT - IV STM32F446XX ARM CORTEX M4 MICROCONTROLLER 9

Memory and Bus Architecture - Power Control - Reset and Clock Control - GPIOs - System Configuration Controller - NVIC - ADC - DAC - Timers - RTC - USART/UART - SPI - I^2C.

LAB COMPONENT

7. Interfacing UART, PWM and ADC
8. Interfacing LCD using I^2C **6**

UNIT - V RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS - Task - process & threads - interrupt routines in RTOS - Multiprocessing and Multitasking - Preemptive and non-preemptive scheduling - Task communication - context switching - interrupt latency - shared memory - message passing - Inter process Communication - Introduction to process synchronization using semaphores - Case study: Free RTOS, µC/OS-III.

LAB COMPONENT

9. Mini Project: Sample project titles are given here.

1) Real Time Personnel Monitoring System Using Wi-Fi Technology Based on ARM
2) Theft Control, Accident Detection and Vehicle Positioning System Using ARM
3) Remote Monitoring & Control of Industrial parameters using ARM Controller
4) ARM Based Wireless Sensor Networks for Temperature Measurement
5) Wireless Automatic Meter Reading & Control System Using ARM Processor **6**
6) An Energy Efficient LED Lighting System for Domestic Applications
7) Involuntary Railway Gate Control System using ARM controller
8) ARM Based Implementation of Text-to-Speech (TTS) for Real Time Embedded System
9) Automated Fare Collection System for Public Transport Based on ARM Processor
10) ARM based Gas Monitoring System

TOTAL: 45 + 30 PERIODS

TEXT BOOKS:

1. Steve Furber, “ARM system on chip architecture”, Second Edition, Addison-Wesley Educational Publishers Inc, 2000.
2. Joseph Yiu, “The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors”, Third Edition, Newnes, 2013.

REFERENCES:

1. Andrew Sloss, Chris Wright and Dominic Symes, "ARM System Developer's Guide: Designing and Optimizing System Software", Morgan Kaufmann Publishers Inc., Illustrated Edition, 2004.
2. Raj Kamal, "Embedded Systems - Architecture, Programming and Design", McGraw Hill Education, Third Edition, 2017.
3. James K. Peckol, "Embedded Systems: A Contemporary Design Tool", Wiley, 2008.
4. Trevor Martin, "The Insider's Guide To The Philips ARM7-Based Microcontrollers", Hitex (UK) Ltd., 2005.
5. Reference Manuals: ARM Architecture Reference Manual - LPC214x, STM32F446XX ARM CORTEX M4.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Embedded and Real Time Systems		**Course Code :** 20EC704			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C404.1	Develop I/O programming using ARM 7 processor.	1	K3	1,2,3,5,8,9,10	3
C404.2	Demonstrate peripherals with ARM LPC2148 microcontroller using appropriate protocols.	2	K3	1,2,3,5,8,9,10	3
C404.3	Develop I/O programming using ARM Cortex M4 processor.	3	K3	1,2,3,5,8,9,10	3
C404.4	Demonstrate peripherals with ARM Cortex M4 STM32F446XX microcontroller using appropriate protocols.	4	K3	1,2,3,5,8,9,10	3
C404.5	Discuss the role and features of RT operating system that makes multitask execution possible by processors.	5	K2	1,2,8,10	3
C404.6	Identify any societal problem and solve by applying the acquired knowledge in embedded and real time systems.	5	K3	1,2,3,5,8,9,10, 11,12	3

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C404.1	3	2	1		2			2	2	2					2
C404.2	3	2	1		2			2	2	2					2
C404.3	3	2	1		2			2	2	2					2
C404.4	3	2	1		2			2	2	2					2
C404.5	2	1						2	-	2					1
C404.6	3	2	1		2	2	2	2	2	2	2	2			2

20EC7L1	MICROWAVE AND OPTICAL LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- Understand the working principle of optical sources, detector, fibers and microwave components.
- Develop understanding of simple optical communication link.
- Learn about the characteristics and measurements in optical fiber.
- Know about the behavior of microwave components.
- Practice simulation of wireless experiments.

PRE-REQUISITE:

Course Code: 20EC5L1
Course Name: Communication systems laboratory

LIST OF MICROWAVE EXPERIMENTS:

1. Mode characteristics of Reflex klystron.
2. Characteristics of Gunn diode.
3. Measurement of VSWR, frequency, wavelength.
4. Directional Coupler Characteristics.
5. Radiation Pattern and Gain of Horn Antenna.
6. E plane Tee, H Plane Tee, Magic Tee characteristics.
7. Characteristics of isolator and circulator.

LIST OF OPTICAL EXPERIMENTS:

8. Fiber optic Analog link and its band width.
9. Fiber optic digital Link.
10. Measurement of Attenuation and bending losses.
11. Numerical Aperture determination for Fibers.
12. DC Characteristics of LED.

TOTAL: 60 PERIODS

Note: Microwave test bench comprises of Reflex klystron or Gunn diode with power supply, Gunn oscillator, PIN modulator, Isolator, Fixed and Variable Attenuator, frequency meter, Slotted line section, Wave guides, detector with mount, Termination, Movable short, Slide screw tuner, Horn antenna, Directional coupler and 20 MHz Digital / Analog Oscilloscope.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS: (3 STUDENTS PER EXPERIMENT)

S.NO	NAME OF THE EQUIPMENT REQUIRED	Quantity
1.	Trainer kit for carrying out LED and PIN diode characteristics, Digital multi meter, optical power meter	2 Nos
2.	Trainer kit for determining the losses in optical fiber	2 Nos
3.	Trainer kit for analyzing Analog and Digital link performance, 10 MHz signal generator, 20 MHz Digital storage Oscilloscope	2 Nos
4.	Kit for measuring Numerical aperture and Attenuation of fiber	2 Nos
5.	Microwave test Bench at X band to determine Reflex klystron or Gunn diode characteristics.	2 Nos
6.	Microwave test Bench at X band and Antenna turn table to measure Radiation pattern of Horn antenna, 2 Horn antennas.	2 Nos
7.	Microwave test Bench at X band to determine VSWR, VSWR meter, Directional coupler, E Plane Tee, H plane Tee and Detector.	2 Nos
8.	20 MHz Digital / Analog Oscilloscope.	2 Nos

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Microwave and Optical Laboratory		**Course Code :** 20EC7L1			
CO	**Course Outcomes**	**Experiment No.**	**K-CO**	**POs**	**PSOs**
C405.1	Demonstrate the characteristics of microwave generators.	1.2	K3	1,2,3,8,9,10	2
C405.2	Determine VSWR, frequency, wavelength and radiation pattern.	3,4,5	K3	1,2,3,8,9,10	2
C405.3	Experiment with microwave passive devices and obtain its characteristics.	6,7	K3	1,2,3,8,9,10	2
C405.4	Illustrate the characteristics of analog and digital optical fiber link.	8,9	K3	1,2,3,8,9,10	2
C405.5	Determine the losses and numerical aperture of the fiber.	10,11	K3	1,2,3,8,9,10	2
C405.6	Determine the characteristics of LED.	12	K3	1,2,3,8,9,10	2

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C405.1	3	2	1					2	2	1				2	
C405.2	3	2	1					2	2	1				2	
C405.3	3	2	1					2	2	1				2	
C405.4	3	2	1					2	2	1				2	
C405.5	3	2	1					2	2	1				2	
C405.6	3	2	1					2	2	1				2	

20EC8L1	PROJECT WORK	L	T	P	C
		0	0	20	10

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.
- The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor.
- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Department.
- A project report is required at the end of the semester.
- The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

PRE-REQUISITE: Course Code: All core courses & Laboratories

TOTAL: 300 PERIODS

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Project Work		**Course Code :**20EC8L1			
CO	**Course Outcomes**	**Exp**	**K-CO**	**POs**	**PSOs**
C427.1	Identify and apply the real world and societal importance problems in the Electronics and Communication Engineering and its allied area.	---	K4	1 to 12	1,2,3
C427.2	Identify, analyze, design, implement and handle prototype projects with a complete and organized solution methodologies.	---	K4	1 to 12	1,2,3
C427.3	Apply modern engineering tools for solution.	---	K4	1 to 12	1,2,3
C427.4	Contribute as an individual or in a team in development of technical projects.	---	K4	1 to 12	1,2,3
C427.5	Develop effective communication skills for presentation of project related activities.	---	K4	1 to 12	1,2,3
C427.6	Prepare reports and examination following professional ethics.	---	K4	1 to 12	1,2,3

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C427.1	3	3	2	1	1	2	1	2	3	3	3	1	2	2	3
C427.2	3	3	2	1	1	2	1	2	3	3	3	1	2	2	3
C427.3	3	3	2	1	1	2	1	2	3	3	3	1	2	2	3
C427.4	3	3	2	1	1	2	1	2	3	3	3	1	2	2	3
C427.5	3	3	2	1	1	2	1	2	3	3	3	1	2	2	3
C427.6	3	3	2	1	1	2	1	2	3	3	3	1	2	2	3

20EC7A1	FOUNDATIONS FOR NANO ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- The objectives of the course is to introduce quantum mechanics concepts, approximations and statistical mechanics for understanding nano systems.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO QUANTUM MECHANICS 9

Particles – waves – probability amplitudes – schrodinger equation – wave packets solutions – operators – expectation values – eigenfuntions – piecewise constant potentials.

UNIT - II SIMPLE HARMONIC OSCILLATORS AND APPROXIMATIONS 9

SHM Operators – SHM wavepacket solutions – Quantum LC circuit – WKB approximations – variational methods.

UNIT - III SYSTEMS WITH TWO AND MANY DEGREES OF FREEDOM 9

Two level systems with static and dynamic coupling – problems in more than one dimensions – electromagnetic field quantization – density of states.

UNIT - IV STATISTICAL MECHANICS 9

Basic concepts – microscopic – quantum systems in equilibrium – statistical models applied to metals and semiconductors.

UNIT - V APPLICATIONS 9

Hydrogen and Helium atoms – electronic states – Atomic force microscope – Nuclear Magnetic Resonance – Carbon nanotube properties and applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rainer Waser, “Nanoelectronics and Information Technology”, Wiley, Third Edition, 2012.
2. Hagelstein L. Peter, Stephen D. Senturia and Terry P. Orlando, “Introduction to Applied Quantum and Statistical Physics”, Wiley, New York, 2004.

REFERENCES:

1. Michael A. Nielsen and Isaac L. Chuang, “Quantum Computation and Quantum Information”, Cambridge University Press, 2000.
2. Neil Gershenfeld, “The Physics of Information Technology”, Cambridge University Press, 2000.
3. Adrian Ionesu and Kaustav Banerjee, “Emerging Nanoelectronics Life with and after CMOS”, Vol I, II, and III, Kluwer Academic, 2005.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Foundations For Nano Engineering		**Course Code :** 20EC7A1			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C406.1	Apply mathematical tools to solve the problems of quantum mechanics.	1	K3	1,2,3,8,10	1
C406.2	Comprehend the significance of simple harmonic oscillators.	2	K2	1,2,8,10	1
C406.3	Apply the fundamentals of quantum mechanics to solve the one or two dimensional problems.	3	K3	1,2,3,8,10	1
C406.4	Explain the fundamentals of statistical mechanics.	4	K2	1,2,8,10	1
C406.5	Apply the fundamental knowledge of statistical mechanics to develop statistical models in metals and semiconductors.	4	K3	1,2,3,8,10	1
C406.6	Explain the application of Nano Electronics in the area of Helium & Hydrogen atoms, atomic force microscope, Nuclear magnetic resonance and Carbon nano tube.	5	K2	1,2,8,9,10	1

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C406.1	3	2	1					2		2			2		
C406.2	2	1						2		2			2		
C406.3	3	2	1					2		2			2		
C406.4	2	1						2		2			2		
C406.5	3	2	1					2		2			2		
C406.6	2	1						2	2	2			2		

20EC7A2	MULTICORE PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need for multi-core processors, and their architecture.
- To understand the challenges in parallel and multi-threaded programming.
- To learn about the various parallel programming paradigms.
- To develop multicore programs and design parallel solutions.

PRE-REQUISITE:

Course Code: 20EC402, 20EC504, 20EC505

Course Name: Computer Architecture and Organization, Microprocessors and Microcontrollers, Digital VLSI Design and FPGA Implementation

UNIT - I MULTI-CORE PROCESSORS **9**

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks – Symmetric and Distributed Shared Memory Architectures – Cache coherence – Performance Issues – Parallel program design.

UNIT - II PARALLEL PROGRAM CHALLENGES **9**

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

UNIT - III SHARED MEMORY PROGRAMMING WITH OPENMP **9**

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

UNIT - IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI **9**

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation.

UNIT - V PARALLEL PROGRAM DEVELOPMENT **9**

Case studies: n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Thomas Rauber and Gudula Rünger, “Parallel Programming”, Springer Berlin, Heidelberg, 2013.
2. Darryl Gove, “Multicore Application Programming for Windows, Linux, and Oracle Solaris”, Pearson, 2011.

REFERENCES:

1. Michael Quinn, “Parallel programming in C with MPI and OpenMP”, McGraw-Hill Education, 2003.
2. Victor Alessandrini, “Shared Memory Application Programming: Concepts and Strategies in Multicore Application Programming”, Morgan Kaufmann, First Edition, 2015.
3. Yan Solihin, “Fundamentals of Parallel Multicore Architecture”, Chapman and Hall/CRC, First Edition, 2015.
4. Peter S. Pacheco, “An Introduction to Parallel Programming”, Morgan-Kauffman/Elsevier, 2011.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Multicore Programming		**Course Code :** 20EC7A2			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C407.1	Describe multicore architectures and identify their characteristics and challenges.	1	K2	1,2,8,10	3
C407.2	Compare and contrast programming for serial processors and programming for parallel processors.	1	K2	1,2,8,9,10	3
C407.3	Determine the issues in programming Parallel Processors.	2	K3	1,2,3,8,10	3
C407.4	Develop the programs using OpenMP.	3	K3	1,2,3,8,10	3
C407.5	Develop the programs for data-level parallelism and thread-level parallelism.	4	K3	1,2,3,8,10	3
C407.6	Design the parallel programming solutions to common problems.	5	K3	1,2,3,8,10	3

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C407.1	2	1						2		2					1
C407.2	2	1						2	2	2					1
C407.3	3	2	1					2		2					2
C407.4	3	2	1					2		2					2
C407.5	3	2	1					2		2					2
C407.6	3	2	1					2		2					2

20IT7A4	DEEP LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic ideas and principles of neural networks.
- To understand the basic concepts of big data and statistical data analysis.
- To familiarize the student with the image processing facilities like tensorflow and keras.
- To learn to use deep learning tools and framework for solving real-life problems.
- To use Python for deep learning.

Pre-requisite: NIL

UNIT - I INTRODUCTION TO NEURAL NETWORKS 9

Basic concept of Neurons – Perceptron Algorithm – Feed Forward and Back Propagation Networks.

UNIT - II INTRODUCTION TO DEEP LEARNING 9

Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – RelU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.

UNIT - III CONVOLUTIONAL NETWORKS 9

Convolution operation – Motivation – Pooling – Convolution and Pooling as strong prior – Efficient convolution algorithms – Unsupervised features – Sequence Modeling: Recurrent and Recursive Nets – LSTM Networks – Applications – Computer Vision – Speech Recognition – Natural Language Processing.

UNIT - IV DEEP LEARNING ARCHITECTURES 9

LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive – Variational Autoencoders – Adversarial Generative Networks – Autoencoder and DBM.

UNIT - V DEEP LEARNING WITH PYTHON 9

Introduction to Keras and Tensorflow – Deep Learning for computer vision – convnets – Deep Learning for Text and Sequences – Generative Deep Learning – Text Generation with LSTM – Deep Dream – Neural Style Transfer – Generating images with variational autoencoders – Generative Adversarial Networks (GAN).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, The MIT Press, 2016.
2. Nikhil Buduma and Nicholas Lacascio, “Fundamentals of Deep Learning”, O.Reilly, First Edition, 2017.

REFERENCES:

1. Josh Patterson and Adam Gibson, “Deep Learning: A Practitioner's Approach”, O'Reilly Media, 2017.
2. Laura Graesser and Wah Loon Keng, “Foundations of Deep Reinforcement Learning: Theory and Practice in Python”, Addison-Wesley Professional, 2020.
3. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
4. Jon Krohn, Grant Beyleveld and Aglaé Bassens, “Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence”, Addison-Wesley Professional, First Edition, 2019.
5. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Deep Learning		**Course Code :** 20IT7A4			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C408.1	Explain the basic concepts of neural network.	1	K2	1,2,8,10	3
C408.2	Identify the deep learning algorithms for various domains	2	K2	1,2,8,10	3
C408.3	Explain about basics of Convolutional Neural Networks.	3	K3	1,2,3,8,10	3
C408.4	Apply appropriate deep learning models for analyzing the data.	4	K3	1,2,3,8,10	3
C408.5	Illustrate the concept of Tensor Flow/Keras in deep learning	5	K2	1,2,8,10	3
C408.6	Develop an application using deep learning techniques	5	K3	1,2,3,5,8,10, 12	3

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C408.1	2	1						2		2					1
C408.2	2	1						2		2					1
C408.3	3	2	1					2		2					2
C408.4	3	2	1					2		2					2
C408.5	2	1						2		2					1
C408.6	3	2	1		1			2		2		2			2

20EC7A4	IOT ENABLED SYSTEM DESIGN	L	T	P	C
		2	0	2	3

OBJECTIVE:

- To appraise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IoT.
- To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies behind Internet of Things (IoT).
- To explain the students how to code for an IoT application using Raspberry Pi open platform.
- To understand the various applications in IoT.

Pre-requisite: NIL

UNIT - I INTRODUCTION TO INTERNET OF THINGS 6

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT.

LAB COMPONENT	1. Study of different operating systems and installation for Raspberry Pi.	**6**

UNIT - II COMMUNICATION TECHNOLOGIES OF IoT 6

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Communication modules (Bluetooth, Zigbee, Wi-Fi, GPS, GSM Modules)

LAB COMPONENT	2. Interface various sensors and communication modules with Raspberry Pi.	**6**

UNIT - III PROTOCOLS AND TECHNOLOGIES BEHIND IoT 6

IoT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, Big Data Analytics, Cloud Computing.

LAB COMPONENT	3. Develop a server application by using suitable IoT protocol	**6**

UNIT - IV OPEN PLATFORMS AND PROGRAMMING 6

IOT deployment for Raspberry Pi platform - Architecture - Programming - Interfacing - Accessing GPIO Pins - Sending and Receiving Signals Using GPIO Pins - Connecting to the Cloud.

LAB COMPONENT	4. Interface the Raspberry Pi with cloud to trans-receive data from sensors and actuators.	**6**

UNIT - V APPLICATIONS AND CASE STUDIES 6

Business models for the internet of things - Smart city - Smart mobility and transport - Industrial IoT - Smart health - Environment monitoring and surveillance - Home Automation - Smart Agriculture.

LAB COMPONENT	5. Design business model and deploy Home Automation using Raspberry Pi	**6**

TOTAL: 30 + 30 PERIODS

TEXT BOOKS:

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
2. Samuel Greengard, The Internet of Things, The MIT Press, 2015.

REFERENCES:

1. Perry Lea, "Internet of things for architects", Packt, 2018.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.
3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.
4. Peter Waher, "Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3", First Edition, Packt Publishing, 2018.
5. John C. Shovic, "Raspberry Pi IoT Projects: Prototyping Experiments for Makers", Packt Publishing, 2016.

Course Name : IoT Enabled System Design		**Course Code :** 20EC7A4			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C409.1	Explain IoT architecture, fog, edge and cloud computing	1	K2	1,2,8,10	3
C409.2	Build an IoT ecosystem that interfaces with various hardwares and wireless communication modules.	2	K3	1,2,3,5,8,9, 10	3
C409.3	Make use of data analytics and cloud computing to develop an application with suitable IoT protocol.	3	K3	1,2,3,5,8,9, 10	3
C409.4	Demonstrate the use of GPIO pins to interface raspberry pi with cloud	4	K3	1,2,3,5,8,9, 10	3
C409.5	Discuss different business models for IoT	5	K2	1,2,8,10	3
C409.6	Identify any societal problem and solve by applying acquired knowledge of IoT enabled system design	5	K3	1,2,3,5,6,7,8, 9,10	3

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C409.1	2	1						2		2					1
C409.2	3	2	1		2			2	2	2					2
C409.3	3	2	1		2			2	2	2					2
C409.4	3	2	1		2			2	2	2					2
C409.5	2	1						2	-	2					1
C409.6	3	2	1		2	1	1	2	2	2					2

20EC7A5	SYSTEM ON CHIP DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To design, optimize, and program a modern System-on-a-Chip.
- To decompose the task into parallel components that cooperate to solve the problem.
- To characterize and develop real-time solutions.
- To implement both hardware and software solutions, and perform hardware/software co-design.
- To understand and estimate key design metrics and requirements.

PRE-REQUISITE :
Course Code: 20EC402, 20EC504, 20EC505
Course Name: Computer Architecture and Organization, Microprocessors and Microcontrollers, Digital VLSI Design and FPGA Implementation

UNIT - I INTRODUCTION TO THE SYSTEM APPROACH 9

System Architecture – Components of the system – Hardware and Software – Processor Architectures – Memory and Addressing – System level interconnection – An approach for SOC Design – System Architecture and Complexity.

UNIT - II PROCESSORS 9

Introduction – Processor Selection for SOC – Basic concepts in Processor Architecture – Basic concepts in Processor Micro Architecture – Basic elements in Instruction handling – Buffers – minimizing Pipeline Delays – Branches – More Robust Processors – Vector Processors and Vector Instructions extensions – VLIW Processors – Superscalar Processors.

UNIT - III MEMORY DESIGN FOR SOC 9

Overview of SOC external memory – Internal Memory – Size – Scratchpads and Cache memory – Cache Organization – Cache data – Write Policies – Strategies for line replacement at miss time – Types of Cache – Split – I, and D – Caches – Multilevel Caches – Virtual to real translation – SOC Memory System – Models of Simple Processor – memory interaction.

UNIT - IV INTERCONNECT CUSTOMIZATION AND CONFIGURATION 9

Inter Connect Architectures – Basic Bus Architectures – SOC Standard Buses – Analytic Bus Models – Using the Bus model – Effects of Bus transactions and contention time – Overview of SOC Customization – Customizing Instruction Processor – Reconfiguration Technologies – Mapping design onto Reconfigurable devices – Instance Specific design – Customizable Soft Processor – Overhead analysis on Reconfiguration – trade-off analysis on reconfigurable Parallelism.

UNIT - V APPLICATION STUDIES / CASE STUDIES 9

SOC Design approach – AES algorithms: Design and evaluation - Image compression: JPEG compression.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Michael J. Flynn and Wayne Luk, “Computer System Design: System-on-Chip”, Wiley India Pvt. Ltd., First Edition, 2011.
2. Steve Furber, “ARM System on Chip Architecture”, Addison-Wesley, Second Edition, 2000.

REFERENCES:

1. Ricardo Reis and Jochen A.G. Jess, “Design of System on a Chip: Devices and Components”, Springer, First Edition, 2004.
2. Jason Andrews, “Co-Verification of Hardware and Software for ARM SoC Design”, Newnes, Pap/Cdr Edition, 2004.
3. Peter Marwedel, “Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems”, Springer, Second Edition, 2011.
4. Michael Keating, “The Simple Art of SoC Design: Closing the Gap between RTL and ESL”, Springer, 2011.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : System On Chip Design		**Course Code :** 20EC7A5			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C410.1	Explain the functional and nonfunctional performance of the system in the design process to support design decisions.	1	K2	1,2,8,10	3
C410.2	Explain the hardware/software tradeoffs, algorithms, and architectures to optimize the system based on requirements and implementation constraints.	1	K2	1,2,8,10	3
C410.3	Analyze the characteristics of various processors for suitable SOC selection.	2	K4	1,2,3,4,8,10	3
C410.4	Analyze the various memory design techniques for SOC.	3	K4	1,2,3,4,8,10	3
C410.5	Explain the customization of interconnection methods with Reconfigurable architectures.	4	K2	1,2,8,9,10	3
C410.6	Estimate the issues in system-on-chip design associated with co-design, such as intellectual property, reuse, and verification.	5	K5	1,2,3,4,5,6,8, 10,11,12	3

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C410.1	2	1						2		2					1
C410.2	2	1						2		2					1
C410.3	3	3	2	1				2		2					3
C410.4	3	3	2	1				2		2					3
C410.5	2	1						2	2	2					1
C410.6	3	3	3	2	1	1		2		2	1	1			3

20EC7A6	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the concepts of stationary and non-stationary random signals and characterization of discrete time random process.
- To estimate power spectral density of random process.
- To derive adaptive filter algorithm.
- To analyze multi rate signal processing.

PRE-REQUISITE:

Course Code: 20EC405

Course Name: Principles of Digital Signal Processing

UNIT - I DISCRETE TIME RANDOM PROCESS 9

Review of linear algebra: Vector spaces - basis vectors - Linear equations - Eigen values and Vectors. Random Variables: Definitions - Ensemble averages - Jointly distributed random variables - Joint moments - Independent, uncorrelated and orthogonal random variables - Linear mean square estimation - Gaussian random variables - Parameter estimation. Random Process: Definitions - Ensemble averages - Gaussian Processes - Stationary processes - Auto covariance and auto correlation matrices - ergodicity - white noise - Power spectrum. Filtering of random process - Spectral factorization - Special types of random processes.

UNIT - II SPECTRUM ESTIMATION 9

Non parametric methods: The periodogram - performance of the periodogram - The modified periodogram - Bartlett's method - Welch's method - Blackman-Tukey approach - Performance comparisons. Parametric methods: Auto regressive spectrum estimation - moving average spectrum estimation - ARMA spectrum estimation. Frequency estimation: Eigen decomposition of the auto correlation matrix - MUSIC algorithm.

UNIT - III LINEAR PREDICTION AND OPTIMUM LINEAR FILTERS 9

Innovations Representation of a Stationary Random Process - Forward and backward linear predictions: Forward linear predictions - Backward linear predictions - The optimum reflection coefficients for the Lattice forward and backward predictors - Relationship of an AR process to linear predictions. Solutions of the Normal Equations: The Levinson-Durbin algorithm - The Schur algorithm – Properti es of linear Prediction error filters - AR Lattice and ARMA Lattice-Ladder filters. Wiener filters for filtering and prediction: FIR Wiener filter - Orthogonality principle in Linear mean Square estimation - IIR Wiener filter - Non causal wiener filter - Discrete Kalman filter.

UNIT - IV ADAPTIVE FILTERS 9

Adaptive Direct Form FIR filter: Minimum Mean square error Criterion - LMS algorithm - Related Stochastic algorithm - properties of LMS algorithm - RLS algorithm - Fast RLS algorithm - Properties of RLS algorithm. Applications of adaptive filters: adaptive channel equalization - Echo cancellation - Adaptive Line enhancer - Adaptive noise cancelling - Adaptive arrays.

UNIT - V MULTIRATE DIGITAL SIGNAL PROCESSING 9

Review of Decimation – Interpolation - sampling rate conversion - Applications of multirate signal processing: design of phase shifters - Interfacing of digital systems with different sampling rates - Implementation of narrowband low pass filters - Sub band coding of speech signals. Digital Filter Banks: Polyphase structures of Uniform Filter Banks - Trans multiplexers - Two channel Quadrature mirror filter.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Monson H. Hayes, “Statistical Digital signal Processing and Modeling”, Wiley, 2012.
2. John G. Proakis and Dimitris G. Manolakis, “Digital Signal Processing – Principles, Algorithms and Applications”, Pearson Education, Fourth Edition, 2016.

REFERENCES:

1. Simon Haykin, “Adaptive Filter Theory”, Pearson Education, Fifth Edition, 2014.
2. Emmanuel C. Ifeacher and Barrie W. Jervis, “DSP-A Practical approach”, Pearson Education, Second Edition, 2002.
3. S.M.Kay, “Modern Spectral Estimation: Theory & Applications”, PHI, 1999.
4. Dr. Shaila D Apte, “Advanced Digital Signal Processing”, Wiley, 2021.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Advanced Digital Signal Processing		**Course Code :** 20EC7A6			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C411.1	Apply the fundamental concept of random process and random variable to derive the statistical parameters while filtering the random process.	1	K3	1,2,3,8,10	2
C411.2	Compute spectrum estimation using parametric and non parametric methods.	2	K3	1,2,3,8,10	2
C411.3	Apply the prediction methods to compute the reflection parameters.	3	K3	1,2,3,8,10	2
C411.4	Compute prediction error and mean square error Lattice and Wiener filters respectively.	3	K3	1,2,3,8,10	2
C411.5	Apply adaptive filter algorithms to compute the filter coefficients for the given applications.	4	K3	1,2,3,8,9,10	2
C411.6	Analyze the spectral characteristics for the output signal of the decimator and interpolator.	5	K4	1,2,3,8,10	2

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C411.1	3	2	1					2		2				2	
C411.2	3	2	1					2		2				2	
C411.3	3	2	1					2		2				2	
C411.4	3	2	1					2		2				2	
C411.5	3	2	1					2	2	2				2	
C411.6	3	2	1					2		2				2	

20HS7A3	ENGINEERING TECHNOLOGY AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand engineering managers are problem solvers and implementers.
- To understand engineering managers apply engineering principles to business practice.
- To understand engineering graduates can enter into product development, manufacturing operations, testing, technical operations, marketing, construction, and project management.
- Demonstrate the engineering technology management program focuses on the knowledge and skills needed to apply technology and human resources to solve problems.

PRE-REQUISITE: NIL

UNIT - I TRENDS IN ENGINEERING TECHNOLOGIES 9

Applied Machine Learning - Data Science for Business Intelligence - Operations and Supply Chain Management - Systems Engineering and Architecture - Environmental Systems Analysis - Information Security Management - Emergency and Risk Management.

UNIT - II ENGINEERING AND TECHNOLOGY 9

Career opportunities for engineering technology - basic engineering principles of problem solving and its methodology - Materials - Processes - Testing - manufacturing processes and applications - Industrial Accident Prevention - personal protective equipment.

UNIT - III QUALITY SYSTEMS AND TOOLS 9

History and philosophy of quality, systems of quality, Engineering design and management - design communication - problem definition - concept generation - concurrent engineering - economic evaluation - project planning - decision making.

UNIT - IV ECONOMIC ANALYSIS 9

Principles of investment economic analysis - decision-making among alternatives - replacement analysis - Inflation - depreciation - cost concepts - bond - income tax - research and development in technology.

UNIT - V BEST PRACTICES 9

Workplace Law for the Technical Manager - Lean Manufacturing Systems - Six Sigma Green Belt - Production Planning and Control - Plant Layout and Material Handling - Industrial Supervision - Cooperative Industrial Practice - Creativity and Ideation Techniques and Practices.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Erik Larson and Clifford Gray, “Project Management: The Managerial Process”, McGraw Hill Education, Sixth Education, 2017.
2. Greg M. Horine, “Project Management Absolute Beginner's Guide”, QUE, Fourth Edition, 2017.

REFERENCES:

1) Jack Ferraro, “Project Management for Non-Project Managers”, AMACOM, Special Edition, 2012.
2) Harold Kerzner, “Project Management Case Studies”, Wiley, Fifteenth Edition, 2017.
3) Ken Schwaber, “Agile Project Management with Scrum”, Microsoft Press US, First Edition, 2004.
4) Gerald Kendall, “Advanced Multi-project Management: Achieving Outstanding Speed and Results with Predictability”, J Ross Publishing, 2012.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Engineering Technology and Management		**Course Code :** 20HS7A3			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C412.1	Determine the tools of project management.	1	K2	8,9,10,11	
C412.2	Explain the project reporting tools and techniques.	2	K2	8,9,10,11	
C412.3	Formulate and appraise the changing business climate and how the changes have influenced project management.	3	K2	8,9,10,11	
C412.4	Explain the importance of risk, cost, schedule and resource control and management of a project.	4	K2	8,9,10,11	
C412.5	Describe the need for effective project management skills, training and the specific training needs of project managers.	5	K2	8,9,10,11	
C412.6	Demonstrate an understanding of the role of project management vs. functional management.	5	K2	8,9,10,11,12	

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C412.1								2	2	2	2				
C412.2								2	2	2	2				
C412.3								2	2	2	2				
C412.4								2	2	2	2				
C412.5								2	2	2	2				
C412.6								2	2	2	2	2			

20EC8A1 WIRELESS ADHOC AND SENSOR NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn about the issues and challenges in the design of wireless ad hoc networks.
- To understand the working of MAC and Routing Protocols for ad hoc and sensor networks.
- To learn about the Transport Layer protocols and their QoS for ad hoc and sensor networks.
- To understand various security issues in ad hoc and sensor networks and the corresponding solutions.

PRE-REQUISITE:

Course Code: 20EC503, 20EC602

Course Name: Analog and Digital Communication Techniques, Communication Networks.

UNIT - I MAC & ROUTING IN AD HOC NETWORKS 9

Introduction – Issues and challenges in ad hoc networks – MAC Layer Protocols for wireless ad hoc networks – Contention-Based MAC protocols – MAC Protocols Using Directional Antennas – Multiple-Channel MAC Protocols – Power-Aware MAC Protocols – Routing in Ad hoc Networks – Design Issues – Proactive, Reactive and Hybrid Routing Protocols.

UNIT - II TRANSPORT & QOS IN AD HOC NETWORKS 9

TCP's challenges and Design Issues in Ad Hoc Networks – Transport protocols for ad hoc networks – Issues and Challenges in providing QoS – MAC Layer QoS solutions – Network Layer QoS solutions – QoS Model.

UNIT - III MAC & ROUTING IN WIRELESS SENSOR NETWORKS 9

Introduction – Applications – Challenges – Sensor network architecture – MAC Protocols for wireless sensor networks – Low duty cycle protocols and wakeup concepts – Contention-Based protocols – Schedule-Based protocols – IEEE 802.15.4 Zigbee – Topology Control – Routing Protocols.

UNIT - IV TRANSPORT & QOS IN WIRELESS SENSOR NETWORKS 9

Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless Sensor Networks – Congestion Control in network processing – Operating systems for wireless sensor networks – Examples.

UNIT - V SECURITY IN AD HOC AND SENSOR NETWORKS 9

Security Attacks – Key Distribution and Management – Intrusion Detection – Software based Anti-tamper techniques – Water marking techniques – Defense against routing attacks - Secure Ad hoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. C. Siva Ram Murthy and B.S. Manoj, “Ad Hoc Wireless Networks – Architectures and Protocols”, Pearson Education, 2006.
2. Holger Karl and Andreas Willing, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, 2011.

REFERENCES:

1. M.Ibrahiem, M.El Emary and S.Rama Krishnan, “Wireless Sensor Networks: From Theory to Applications”, Taylor and Francis Group Publications, First Edition, 2016.
2. Subir Kumar Sarkar, T.G. Basavaraju and C. Puttamadappa, “Ad Hoc Mobile Wireless Networks”, Auerbach Publications, 2008.
3. Carlos De Morais Cordeiro and Dharma Prakash Agrawal, “Ad Hoc and Sensor Networks: Theory and Applications”, World Scientific Publishing, Second Edition, 2011.
4. Waltenegus Dargie and Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, John Wiley and Sons, 2010.
5. Xiang-Yang Li, “Wireless Ad Hoc and Sensor Networks: Theory and Applications”, Cambridge university Press, 2008.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Wireless Adhoc and Sensor Networks		**Course Code :** 20EC8A1			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C413.1	Describe the MAC protocol issues of ad hoc networks.	1	K2	1,2,8,10	2
C413.2	Analyze protocols developed for ad hoc and sensor networks.	2	K3	1,2,3,8,10	2
C413.3	Design routing protocols for ad hoc systems.	3	K3	1,2,3,8,10	2
C413.4	Discuss the WSN routing issues by considering QoS measurements.	4	K2	1,2,8,10	2
C413.5	Identify and understand security issues in ad hoc and sensor networks.	5	K3	1,2,3,8,10	2
C413.6	Establish a Sensor network environment for different type of applications.	5	K3	1,2,3,8,10	2

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C413.1	2	1						2		2				1	
C413.2	3	2	1					2		2				2	
C413.3	3	2	1					2		2				2	
C413.4	2	1						2		2				1	
C413.5	3	2	1					2		2				2	
C413.6	3	2	1					2		2				2	

20EC8A2	VIDEO ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the basic principles and concepts in digital image and video processing.
- To explore and demonstrate real time image and video analytics in solving practical problems of commercial and scientific interests.

PRE-REQUISITE:
Course code: 20EC6B1
Course Name: Digital Image Processing

UNIT - I INTRODUCTION TO IMAGE SEGMENTATION AND COLOUR IMAGE PROCESSING 9

Overview of Image processing system – Image Enhancement – Image Segmentation – Detection of Discontinuities – Edge Linking and Boundary Detection – Thresholding – Region-Based Segmentation – Colour Image Processing – Transformations – Image Smoothing and Sharpening – Noise Reduction – colour based Image Segmentation.

UNIT - II OBJECT RECOGNITION AND IMAGE RETRIEVAL 9

Overview of Object Recognition – Feature Extraction – Intensity features – Shape feature extraction – PCA – SIFT – SURF – Texture Analysis: statistical, structural and spectral analysis – Bayes' Parametric classification – Feature Selection and Boosting – Image Retrieval – Content – Feature and Object.

UNIT - III DIGITAL VIDEO PROCESSING, VIDEO SEGMENTATION AND TRACKING 9

Digital Video – Sampling of video signal – Video Enhancement and Noise Reduction – Rate control and buffering – H.264 – Inter frame Filtering Techniques – Fundamentals of Motion Estimation and Motion Compensation Change Detection – Background modelling – Motion Segmentation – Simultaneous Motion Estimation and Segmentation – Motion Tracking – Multi-target/Multi-camera tracking.

UNIT - IV VIDEO ANALYSIS AND FOREGROUND EXTRACTION 9

Video Analysis Action Recognition – Video based rendering – Context and scene understanding – Video Surveillance – Background estimation – Averaging – Gaussian Mixture Modelling – Optical Flow based-Image Segmentation – Region growing – Region splitting – Morphological operations – erosion – Dilation – Tracking in a multiple camera environment.

UNIT - V VIDEO ANALYTICS FOR SECURITY, TRAFFIC MONITORING AND ASSISTANCE 9

Abandoned object detection – human behavioral analysis – human action recognition – perimeter security – crowd analysis and prediction of crowd congestion – Customer behavior analysis – people counting – Traffic rule violation detection – traffic congestion identification for route planning – Advanced Driver Assistance System.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson Education, Fourth Edition, 2018.
2. Nilanjan Dey, Amira Ashour and Suvojit Acharjee, “Applied Video Processing in Surveillance and Monitoring Systems”, IGI Global, 2016.

REFERENCES:

1. Murat Tekalp, “Digital Video Processing”, Prentice Hall, Second Edition, 2015.
2. Oge Marques, “Practical Image and Video Processing using MATLAB”, Wiley-IEEE Press, 2011.
3. Yu Jin Zhang, “Image Engineering: Processing, Analysis and Understanding”, Tsinghua University Press, 2009.
4. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, Academic Press, Third Edition, 2012.
5. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2010.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Video Analytics				**Course Code :** 20EC8A2		
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**	
C414.1	Explain the concepts of colour image processing.	1	K2	1,2,8,9,10	2	
C414.2	Identify the algorithm for feature extraction and retrieval of images.	2	K3	1,2,3,8,10	2	
C414.3	Apply sampling for video enhancement and noise reduction.	3	K3	1,2,3,8,10	2	
C414.4	Employ various methods for motion tracking.	3	K3	1,2,3,8,10	2	
C414.5	Apply foreground extraction for video surveillance.	4	K3	1,2,3,8,10	2	
C414.6	Describe the applications of video processing.	5	K2	1,2,8,9,10	2	

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C414.1	2	1						2	2	2				1	
C414.2	3	2	1					2		2				2	
C414.3	3	2	1					2		2				2	
C414.4	3	2	1					2		2				2	
C414.5	3	2	1					2		2				2	
C414.6	2	1						2	2	2				1	

20EC8A3	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the various kinematics and robot dynamics.
- To study the trajectory planning and control for robot.
- To study the control of robots for some specific applications.

PRE-REQUISITE: NIL

UNIT - I BASIC CONCEPTS OF ROBOTS **9**

Introduction of robots – Classification of robots – Present status and future trends – Basic components of robotic system – Mechanisms and transmission – End effectors – Grippers – different methods of gripping – Specifications of robot.

UNIT - II DRIVE SYSTEMS AND SENSORS **9**

Drive system – hydraulic, pneumatic and electric systems – Sensors in robot: Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

UNIT - III KINEMATICS AND DYNAMICS OF ROBOTS **9**

2D & 3D Transformation – Scaling – Rotation – Translation – Homogeneous coordinates – multiple transformation – Simple problems – Matrix representation – Forward and Reverse Kinematics of Three Degree of Freedom – Homogeneous Transformations – Inverse kinematics of Robot – Robot Arm dynamics – Basics of Trajectory Planning.

UNIT - IV ROBOT CONTROL **9**

Robot controls – Point to point control – Continuous path control – Intelligent robot – Control system for robot joint – Control actions – Feedback devices – Encoder – Resolver – LVDT – Motion Interpolations – Adaptive control.

UNIT - V ARTIFICIAL INTELLIGENCE IN ROBOTICS **9**

Application of Machine learning – Artificial Intelligence – Expert systems – Tele-robotics and Virtual Reality – Micro and Nanorobots – Unmanned vehicles – Cognitive robotics – Evolutionary robotics – Humanoids.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mikell P. Groover, Nicholas G. Odrey, Mitchel Weiss, Roger N. Nagel and Ashish Dutta, “Industrial Robotics, Technology programming and Applications”, McGraw Hill, 2017.
2. J.J.Craig, “Introduction to Robotics - mechanics and control”, Addison-Wesley, Fourth Edition, 2008.

REFERENCES:

1. S.R.Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education, 2009.
2. Richard D. Klafter, A.Thomas, Chri Elewski and Michael Negin, “Robotics Engineering an Integrated Approach”, PHI Learning, 2009.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Robotics and Automation		**Course Code :** 20EC8A3			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C415.1	Explain the basic concepts of robotics.	1	K2	1,2,8,10	3
C415.2	Classify the various sensors used in robotics.	2	K3	1,2,3,8,10	3
C415.3	Explain about the differential kinematic in robotics.	3	K2	1,2,8,9,10	3
C415.4	Classify the various dynamics in robotics.	3	K3	1,2,3,8,10	3
C415.5	Discuss the different controls of robot.	4	K2	1,2,8,9,10	3
C415.6	Apply Artificial Intelligence in the field of robotics.	5	K3	1,2,3,8,10	3

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C415.1	2	1						2		2					1
C415.2	3	2	1					2		2					2
C415.3	2	1						2	2	2					1
C415.4	3	2	1					2		2					2
C415.5	2	1						2	2	2					1
C415.6	3	2	1					2		2					2

20EC8A4 WIRELESS BODY AREA NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the support system of WBAN.
- To get knowledge about the various protocol design.
- To understand the power management of WBAN.
- To know the application of WBAN in medical field.
- To understand the various wearable applications of WBAN.

PRE-REQUISITE: NIL

UNIT - I OVERVIEW AND SUPPORT SYSTEMS OF WBAN 9

Introduction – WBAN – Hardware: Wireless body sensors – Sensor nodes and hardware designs – Wireless systems and platforms – Wireless transceivers and microcontrollers – Existing sensor boards – Design of implanted sensor nodes for WBAN – WBAN Systems – Software programs and monitoring.

UNIT - II PROTOCOL DESIGN FOR WBAN 9

Network topologies and configuration – Basics of MAC protocol – Traffic characteristics – Scheduled protocol – Random access protocol – Hybrid MAC protocol – Energy management in WBAN – Patient Monitoring Network Design – Performance analysis of WBAN.

UNIT - III POWER MANAGEMENT 9

The Case for Transmit Power Control in Body Area Networks: Normal Walk, Slow Walk, Resting, Optimal Off-Line Transmit Power Control, Practical On-Line. Transmit Power Control: A Simple and Flexible Class of Schemes. Example: Adaptations of the General Scheme, Tuning the Parameters.

UNIT - IV APPLICATIONS OF WBAN IN MEDICAL 9

Monitoring patients with chronic disease – Hospital patients – Elderly patients – Cardiac arrhymias monitoring – Multi patient monitoring systems – Multichannel Neural recording – Gait analysis – Sports Medicine – Electronic pill.

UNIT - V WEARABLE SYSTEMS 9

Need for Wearable Systems – Applications of Wearable Systems – Recent developments – Global and Indian Scenario – Types of Wearable Systems – Components of wearable Systems – Physiological Parameters commonly monitored in wearable applications – Smart textiles & textiles sensors – Wearable Systems for Disaster management.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Huan-Bang Li and Kamya Yekeh Yazdandoost Bin-Zhen, “Wireless Body Area Networks”, River Publishers, 2010.
2. Mehmet R. Yuce and Jamil Y. Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd, Singapore, 2012.

REFERENCES:

1. Annalisa Bonfiglio and Danilo De Rossi, “Wearable Monitoring Systems”, Springer, 2011.
2. Terrance J. Dishongh and Michael Mcgrath, “Wireless Sensor Networks for Healthcare Applications”, Artech House, First Edition, 2009.
3. Guang-Zhong Yang and M.Yacoub, “Body Sensor Networks”, Springer, First Edition, 2006.
4. Huan-Bang Li, Kamya Yekeh Yazdandoost and Bin Zhen, “Wireless Body Area Network”, River Publishers’ Series in Information Science and Technology, 2010.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Wireless Body Area Networks		**Course Code :** 20EC8A4			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C416.1	Explain the support system of wireless body area network.	1	K2	1,2,8,10	2
C416.2	Develop network protocols for wireless body area network.	2	K3	1,2,3,8,10	2
C416.3	Explain the power management systems in wireless body area networks.	3	K2	1,2,8,10	2
C416.4	Apply the concepts of Wireless body area network in medical field.	4	K3	1,2,3,8,10	2
C416.5	Explain the fundamentals of wearable systems.	5	K2	1,2,8,10	2
C416.6	Classify different types of Wearable systems.	5	K3	1,2,3,8,10	2

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C416.1	2	1						2		2				1	
C416.2	3	2	1					2		2				2	
C416.3	2	1						2		2				1	
C416.4	3	2	1					2		2				2	
C416.5	2	1						2		2				1	
C416.6	3	2	1					2		2				2	

20HS601	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge about optimization techniques and approaches.
- To formulate a real time problem as a mathematical programming model.
- To gain mathematical, computational and communication skills for solving problems.
- To gain knowledge to solve networking and inventory problems.
- To gain knowledge on solving different waiting line models.

PREREQUISITE: NIL

UNIT - I LINEAR PROGRAMMING 9

Introduction to Operations Research, Linear programming (LP): assumptions, properties of LP solutions, Formulations of linear programming problem – Graphical method. Solutions to LPP: simplex, Big M method.

UNIT - II TRANSPORTATION AND ASSIGNMENT MODELS 9

Transportation Problem – Mathematical Model – Types – Balanced and Unbalanced – Solution to Transportation Problem – Finding the initial basic solution – Optimizing the basic feasible solution applying U–V Method (Modi method). Assignment problem: Hungarian method, Travelling salesman problem – Branch and Bound technique.

UNIT - III NETWORK MODELS 9

Network problem: shortest path – Systematic method – Dijkstra's algorithm – Floyd's algorithm – Minimal spanning tree – PRIM and Kruskal's algorithm – Maximum flow models – linear programming models – maximal flow problem algorithm. Project network representation – Critical Path Method computations – construction of time schedule – linear programming formulation of CPM – PERT networks.

UNIT - IV INVENTORY MODELS 9

Inventory models – Quantity Discount – Purchase Inventory Model – Q System – P System – Multiple-item Model – Shortage Limitation – Inventory Carrying Cost Constraint – EOQ Model – Multi-item Joint Replenishment with and without Shortages – Space Constraint.

UNIT - V QUEUEING MODELS 9

Queuing models – Queuing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Hamdy A. Taha, "Operations Research: An Introduction", MacMillan India Ltd., Tenth Edition, 2017.
2. R.Panneerselvam, "Operations Research", Prentice Hall India, 2016.
3. D.Hira and P.K.Gupta, "Operations Research", S.Chand Publications, First Edition, Reprint 2016.

REFERENCES:

1. G.Srinivasan, “Operations Research: Principles and Applications”, PHI Ltd., 2016.
2. Kanti swarup, P.K.Gupta and Man Muhan, “Operations Research”, Sultan Chand & Sons India Ltd., Twelth Edition, 2016.
3. Philips, Ravindran and Solberg, “Operations Research principle and practise”, John Wiley, 2016.
4. Hiller and Liberman, “Introduction to Operations Research”, McGraw Hill, 2015.
5. P.Ramamurthy, “Operations Research”, New Age International Publishers, Second Edition, 2007.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Operations Research		**Course Code :** 20HS601			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C417.1	Solve linear programming problems by appropriate technique.	1	K3	1,2,3,8,10	
C417.2	Determine the performance characteristics such as time and cost in solving shortest route, transportation problems with an appropriate model.	2	K3	1,2,3,9,10	
C417.3	Solve the given assignment problem with an appropriate method.	2	K3	1,2,3,8,10	
C417.4	Determine the optimal solution for a project scheduling problem.	3	K3	1,2,3	
C417.5	Determine the order quantity of goods under different constraints.	4	K3	1,2,3,8	
C417.6	Determine the solutions to single and multi channel Queuing problems.	5	K3	1,2,3,8,9,10	

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C417.1	3	2	1					2		2		2	3	2	
C417.2	3	2	1						2	2		2	3	2	
C417.3	3	2	1					2		2		2	3	2	
C417.4	3	2	1									2	3	2	
C417.5	3	2	1					2				2	3	2	
C417.6	3	2	1					1	2	2		2	3	2	

20HS8A1	HUMAN RELATIONS AT WORK	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To create awareness of human relations at work its relationship with self.
- To create awareness about the processes involved in interaction with people at work.
- To understand the importance of psychological and physical health in maintaining human relations at work and progressing in career.

Pre-requisite : NIL

UNIT-I INTRODUCTION TO HUMAN RELATIONS 9

Understanding and Managing Yourself – Human Relations and You – Self-Esteem and Self – Confidence – Self-Motivation and Goal Setting – Emotional Intelligence – Attitudes and Happiness – Values and Ethics – Problem Solving and Creativity.

UNIT-II HUMAN RELATIONS AT WORK 9

Dealing Effectively with People – Communication in the Workplace – Specialized Tactics for Getting Along with Others in the Workplace – Managing Conflict – Becoming an Effective Leader – Motivating Others and Developing Teamwork – Diversity and Cross-Cultural Competence.

UNIT - III STAYING PHYSICALLY HEALTHY 9

Yoga: Ashtanga, Yam and Niyam, Asan – Pranayam – Exercise: Aerobic and anaerobic.

UNIT - IV STAYING PSYCHOLOGICALLY HEALTHY 9

Managing Stress and Personal Problems – Meditation – Cognitive, behavioural and emotional well-being.

UNIT - V DEVELOPING CAREER THRUST 9

Getting Ahead in Your Career – Learning Strategies – Perception – Life Span Changes – Developing Good Work Habits.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Andrew DuBrin, “Human Relations for Career and Personal Success: Concepts, Applications, and Skills”, Pearson Education, Eleventh Edition, 2016.
2. Swami Vivekananda, “Raja-Yoga or Conquering the Internal Nature”, Vedanta Press, 1998.

REFERENCES:

1. Jerrold S. Greenberg, “Comprehensive Stress Management”, McGraw-Hill Humanities Social, Thirteenth Edition, 2012.
2. Y.Udai, “Yogasan aur pranayama”, N.S. Publications, New Delhi, 2015.
3. Janardan Swami Yogabhyasi Mandal, “Yogic Asanas for Group Training - Part-I”, Nagpur.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Human Relations at Work		**Course Code :** 20HS8A1			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C418.1	Implement the elements of Emotional Intelligence and create a plan for continual improvement.	1	K3	6,8,9,10	
C418.2	Demonstrate the elements of teamwork such as team development stages, leadership skills, team dynamics, problems solving and decision-making approaches, and team building.	2	K3	6,8,9,10	
C418.3	Employ active listening skills including paraphrasing, questioning, empathetic listening, analytic listening, responding and communicating non-verbally while respecting individual differences.	2	K3	6,8,9,10	
C418.4	Identify various Yoga Postures.	3	K3	6,8,9,10	
C418.5	Develop an action plan to increase personal motivation in a personal and or workplace situation.	4	K3	6,8,9,10	
C418.6	Identify different elements of organizational behavior and change including organizational climate, culture, power, ethics, and organizational development techniques to develop a change model for an aspect of their personal and or professional life.	5	K3	6,8,9,10	

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C418.1						3		3	3	3					
C418.2						3		3	3	3					
C418.3						3		3	3	3					
C418.4						3		3	3	3					
C418.5						3		3	3	3					
C418.6						3		3	3	3					

20HS8A2	LEGAL ASPECTS IN ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a basic understanding of the legal concepts and issues relevant to those wishing to practice as Engineers.
- To explain a section of the Contract Law or Arbitration Act and it is followed by examples.
- To learn as you realise what goes on in the disputes which you may have read somewhere in a newspaper or may have to face.
- To provides for many opportunities for active learning.

PRE-REQUISITE: NIL

UNIT - I THE LEGAL SYSTEM **9**

Enacted law: Acts of Parliament – Common Law or Case law – The Court System in India and Foreign Courtiers: District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court – Arbitration: Alternative to resolving disputes.

UNIT - II CONTRACT LAW AND SALE OF GOODS LAW **9**

Introduction to Contract and Agreement – Formation of Contract and Drafting – Types of Contract – Process of Engineering Contract Formation – Contract Administration, Shortcomings, and Remedies – Records: Record keeping, Sets of records, important records, managing the records – Function of Contract Administrators – Legal aspect of Contract Administration – Arbitration and Arbitration Law.

UNIT - III BUSINESS ORGANISATIONS **9**

Sole Traders – Partnerships: Limited Liability Partnership, General Partnership, Limited Partnerships – Companies: The nature of companies, Classification of companies, Formation of companies, Features of a public company, carrying on business – Directors: Their Powers and Responsibilities/Liabilities.

UNIT - IV INDUSTRIAL LAW AND SOCIETY **9**

Laws Relating to Industrial Pollution – Accident – Environmental Protection – Health and Safety at Work – Interdisciplinary nature of Law – Legal Ideologies/Philosophy/Schools of Jurisprudence – Case Studies: Important Legal Disputes and Judicial Litigations.

UNIT - V INFORMATION TECHNOLOGY LAW AND CYBER CRIMES **9**

Electronic Governance – Attribution – Acknowledgement and Dispatch of Electronic Records – Secure Electronic Records and Secure Electronic Signature – Regulation of Certifying Authorities – Electronic Signature Certificates – Duties of Subscribers – Penalties – Compensation and Adjudication – The Appellate Tribunal – Offences – Examiner of Electronic Evidence.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Donald L. Marston, “Law for Professional Engineers”, McGraw Hill Ryerson Publication, Fourth Edition, 2008.
2. The Information Technology Act, 2000.

REFERENCES:

1. Charles Evan Fowler, “Law and Business of Engineering and Contracting”, Palala Press, 2015.
2. Vibha Arora and Kunwar Arora, “Law for Engineers”, Central Law Publications, 2017.
3. MC Kuchhal and Vivek Kuchhal, “Business Law”, Vikas Publishing House Private Limited, Seventh Edition, 2021.
4. G.T.Gajria, “Law relating to Building and Engineering Contracts in India”, Lexis Nexis, Fourth Edition, 2000.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Legal Aspects in Engineering		**Course Code :** 20HS8A2			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C419.1	Explain the implications of different laws in Indian legal system.	1	K2	6,8,9,10	
C419.2	Explain the laws related to contracts and sale of goods.	2	K2	6,8,9,10	
C419.3	Classify the various business organizations and their roles and responsibilities.	3	K3	6,8,9,10	
C419.4	Examine the implications of legal instruments on the engineering business and the implications of non-compliance.	4	K4	6,8,9,10	
C419.5	Illustrate the information technology act and cyber security issues.	5	K2	6,8,9,10	
C419.6	Demonstrate the differences in legal implications in information technology domain in India compared to other countries.	5	K3	6,8,9,10	

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C419.1						2		2	2	2					
C419.2						2		2	2	2					
C419.3						3		3	3	3					
C419.4						3		3	3	3					
C419.5						2		2	2	2					
C419.6						3		3	3	3					

20EC8B1	BIOMEDICAL IMAGING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- A study of the principles and design of medical imaging systems such as X-ray, ultrasound, nuclear medicine, and nuclear magnetic resonance.
- The rapidly growing field of biomedical imaging enables one to visualize physiological structures.
- Provide an overview of physical processes of imaging biological tissues.
- Provide the students with mathematical and computational tools to analyse and interpret a range of biomedical images.

PRE-REQUISITE:
Course Code: 20EC6B1
Course Name: Digital Imaging and Computer Vision

UNIT - I FUNDAMENTALS OF MEDICAL IMAGING SYSTEMS 9

Medical imaging with x-rays: CT, MRI and ultrasound – X-ray radiography – ultrasound – radionuclide imaging – magnetic resonance imaging (MRI) – Biological effects of each modality – Topographical reconstruction principles – including X-ray computed tomography (CT) – position emission tomography (PET) – single-photon emission computed tomography (SPECT).

UNIT - II X-RAY IMAGING 9

The EM spectrum – interactions of EM radiation with tissue – ionizing radiation – x-ray production – photo electric effect – Compton scatter – X-ray imaging – Planar imaging: characterizing x-ray beams, Beer's law, linear attenuation coefficients, radiation dose, filtering and collimation, projection radiography, blurring and resolution, SNR. Basic concepts, evolution of x-ray CT scanners, hardware. CT measurement, CT numbers, line integrals and Radon transform. Projection slice theorem. Image reconstruction by filtered backprXojection for parallel and fan beam data. Conbeam CT. Sampling issues; resolution and noise in CT, beam hardening and scatter.

UNIT - III NUCLEAR MEDICINE 9

Radioactive decay and radioisotopes. Types of radioactive decay, gamma rays and positrons. Common sources in nuclear medicine. Radiopharmacy and kinetic modeling. The Anger camera and planar imaging. Collimators and imaging equations. Resolution and SNR. SPECT imaging basics, imaging equation, reconstruction. Resolution and noise properties. Quantitation: scatter, background, sensitivity. PET imaging basics, imaging equation, reconstruction. Resolution and noise properties.

UNIT - IV ULTRASOUND IMAGING 9

Wave equation, reflections and refractions, attenuation and absorption. Ultrasound transducer design, A, M and B mode display. Imaging signal model for pulse echo imaging, Image formation, and resolution and noise characteristics.

UNIT - V MAGNETIC RESONANCE IMAGING 9

MR hardware, spin physics, Bloch equations, Signal detection, spectroscopy, noise, RF excitation, Spin echoes, relaxation, contrast. Spatial encoding, image reconstruction, resolution, Artifacts, fMRI, diffusion MRI.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Thomas Martin Deserno, "Biomedical Image Processing", Springer, 2011.
2. G.R.Sinha and B.C.Patel, "Medical Image Processing: Concepts and Applications", Prentice Hall, 2014.

REFERENCES:

1. Karen M. Mudry, Robert Plonsey and Joseph D. Bronzino, "Biomedical Imaging", CRC Press, 2003.
2. Z.H. Cho, J.P. Jones and M. Singh, "Foundations of Medical Imaging", Wiley, 1993.
3. R.M.Rangayyan, "Biomedical Image Analysis", CRC Press, Fifth Edition, 2005.
4. Kayvan Najarian and Robert Splinter, "Biomedical Signal and Image Processing", CRC Press, Second Edition, 2014.
5. T.M.Deserno, "Biomedical Image Processing", Springer, 2011.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Biomedical Imaging Systems		**Course Code :** 20EC8B1			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C420.1	Describe how biomedical imaging systems are used in biological and medical research.	1	K2	1,2,8,10	2
C420.2	Analyze the x ray imaging systems used for needed biomedical applications.	2	K4	1,2,3,4,8,10	2
C420.3	Explain about Nuclear medicine used in SPECT and PET imaging basics.	3	K2	1,2,8,10	2
C420.4	Discuss the concept of the Anger camera and planar imaging.	3	K2	1,2,8,9,10	2
C420.5	Explain the fundamentals of ultrasound imaging and also ultrasound transducer design.	4	K2	1,2,8,9,10	2
C420.6	Illustrate the types and basis of MRI systems.	5	K3	1,2,3,8,10	2

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C420.1	2	1						2		2				1	
C420.2	3	3	2	1				2		2				3	
C420.3	2	1						2		2				1	
C420.4	2	1						2	2	2				1	
C420.5	2	1						2	2	2				1	
C420.6	3	2	1					2		2				2	

20EC8B2 COOPERATIVE COMMUNICATION SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- Understand network architectures, issues in cooperative cellular wireless networks, trade-offs involved in such networks.
- Explain the cooperative base station techniques.
- Explain the relay based cooperative techniques.
- Explain green radio networks.
- Understand the multiple access techniques in green radio networks.

PRE-REQUISITE:

Course Code: 20EC503
Course Name: Analog and digital communication

UNIT - I COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS **9**

Network architectures and research issues in cooperative cellular wireless networks – Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches – Fundamental trade-offs on the design of green radio networks – Green modulation and coding schemes – Cooperative techniques for energy efficiency.

UNIT - II COOPERATIVE BASE STATION TECHNIQUES **9**

Cooperative base station techniques for cellular wireless networks – Turbo base stations – Antenna architectures for cooperation – Cooperative communications in 3GPP and LTE Advanced – Partial information relaying and Coordinated multi-point transmission in LTE Advanced.

UNIT - III RELAY-BASED COOPERATIVE CELLULAR NETWORKS **9**

Distributed space-time block codes – Collaborative relaying in downlink cellular systems – Radio resource optimization – Adaptive resource allocation – Cross-layer scheduling design for cooperative wireless two-way relay networks – Network coding in relay-based networks.

UNIT - IV GREEN RADIO NETWORKS **9**

Base Station Power Management Techniques – Opportunistic spectrum and load management – Energy saving techniques in cellular wireless base stations – Power management for base stations in smart grid environment – Cooperative multicell processing techniques for energy efficient cellular wireless communications – Green communications in cellular networks with fixed relay nodes.

UNIT - V ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS **9**

Cross layer design of adaptive packet scheduling for green radio networks – Energy efficient relaying for cooperative cellular wireless networks – Energy performance in TDD-CDMA multihop cellular networks – Resource allocation for green communication in relay based cellular networks – Green Radio Test Beds and Standardization Activities.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ekram Hossain, Dong In Kim and Vijay K. Bhargava, “Cooperative Cellular Wireless Networks”, Cambridge University Press, 2011.
2. Ekram Hossain, Vijay K. Bhargava and Gerhard P. Fettweis, “Green Radio Communication Networks”, Cambridge University Press, 2012.

REFERENCES:

1. K.J. Ray Liu, Ahamed K. Sadek, Weifeng Su and Andres Kwasinski, “Cooperative Communications and Networking”, Cambridge University Press, 2009.
2. Y-W. Peter Hong, Wan-Jen Huang and C-C. Jay Kuo, “Cooperative Communications and Networking: Technologies and System Design”, Springer, 2010.
3. Tracey Ho and Desmond S. Lun, “Network Coding: An introduction”, Cambridge University Press, 2008.
4. Christina Fragouli and Emina Soljanin, “Network Coding Fundamentals”, Now Publishers Inc., 2007.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Cooperative Communication Systems		**Course Code :** 20EC8B2			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C421.1	Discuss network architectures, issues in cooperative cellular wireless networks, trade-offs involved in such networks.	1	K2	1,2,8,10	2
C421.2	Explain the cooperative base station techniques.	2	K2	1,2,8,10	2
C421.3	Illustrate the relay based cooperative techniques.	3	K3	1,2,3,8,10	2
C421.4	Illustrate green radio networks concepts in co-operative multicell.	4	K2	1,2,8,9,10	2
C421.5	Classify the multiple access techniques.	5	K3	1,2,3,8,10	2
C421.6	Apply the access techniques in green radio networks.	5	K3	1,2,3,8,10	2

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C421.1	2	1						2		2				1	
C421.2	2	1						2		2				1	
C421.3	3	2	1					2		2				2	
C421.4	2	1						2	2	2				1	
C421.5	3	2	1					2		2				2	
C421.6	3	2	1					2		2				2	

20EC8B3	C-BASED VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the overall HLS flow.
- To understand how a C-code will be converted to its equivalent hardware.
- To understand how to write C-code for efficient hardware generation.
- To understand how the common software compiler optimization can help to improve the circuit performance.
- To know about FPGA targets, Security, optimizations and verification challenges of HLS.

PRE-REQUISITE:

Course Code: 20EC402, 20EC504, 20EC505

Course Name: Computer Architecture and Organization, Microprocessors and Microcontrollers, Digital VLSI Design and FPGA Implementation

UNIT - I INTRODUCTION **9**

Introduction to Electronic Design Automation – C-Based VLSI Design: An Overview and Problem Formulation – Hardware-Software Co-Specification – System Partitioning – Co-simulation – Co-synthesis – Accelerators – Die Area and Cost – Power – Area-time-Power Tradeoffs and Chip Reliability.

UNIT - II SCHEDULING **9**

Introduction – ILP formulation of Scheduling – ILP formulation of MRLC and MLRC Scheduling – Multiprocessor Scheduling – Hu's algorithm for Multiprocessor Scheduling – List based Scheduling of MLRC – Forced Directed Scheduling – MRLC Scheduling Algorithm – Path Based Scheduling.

UNIT - III RESOURCE ALLOCATION **9**

Resource Allocation and Binding Problem Formulation – Left Edge Algorithm – ILP Formulation and Hierarchical Graph – Register Allocation and Binding – Multi-port Binding Problem – Datapath and Controller Synthesis.

UNIT - IV HIGH-LEVEL SYNTHESIS **9**

HLS for Arrays – HLS for Loops – Pipeline using HLS – Hardware Efficient C Coding – Dataflow Optimization in HLS – Frontend Optimizations in C – HLS for Security – Simulation based Verification – RTL to C Reverse Engineering – Phase-wise Verification of HLS – Equivalence between C and RTL.

UNIT - V PHYSICAL IMPLEMENTATION **9**

Introduction to Hardware Security **–** Attacks on RTL Logic locking **–** Introduction to Logic Synthesis **–** FPGA Technology Mapping **–** Introduction to Physical Synthesis **–** Introduction to Circuit optimizations **–** Recent Advances in C-Based VLSI Design.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. David C. Black, Jack Donovan, Bill Bunton and Anna Keist, "SystemC: From the Ground Up", Springer, Second Edition, 2010.
2. Frank Ghenassia, "Transaction-level modeling with SystemC: TLM Concepts and Applications for Embedded Systems", Springer, First Edition, 2005.

REFERENCES:

1. Thorsten Grötker, Stan Liao, Grant Martin and Stuart Swan, "System design with SystemC", Springer, 2002.
2. Michael Fingeroff, "High-Level Synthesis Blue Book", Mentor Graphics Corporation, Xlibris Us, 2010.
3. Michael J. Flynn and Wayne Luk, "Computer System Design: System on Chip", John Wiley and Sons Inc., First Edition, 2011.
4. Sudeep Pasricha and Nikil Dutt, "On-Chip Communication Architectures: System on Chip Interconnect", Morgan Kaufmann, 2008.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : C-Based VLSI Design		**Course Code :** 20EC8B3			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C422.1	Formulate the manual and automatic design space exploration with co-verify the legacy RTL descriptions and new C-based behavioral descriptions.	1	K4	1,2,3,4,8,10	3
C422.2	Apply C-based hierarchical design methods, including functions, multiple processes and bus structures to synthesize complete HW systems.	2	K3	1,2,3,8,10	3
C422.3	Convert behavioral Software descriptions into synthesizable ANSI-C descriptions.	3	K2	1,2,8,10	3
C422.4	Synthesize ANSI-C descriptions using state of the art commercial high-level synthesis tools.	4	K4	1,2,3,4,8,10	3
C422.5	Differentiate between different scheduling modes in order to be able to synthesize different types of applications.	4	K2	1.2.8,9,10	3
C422.6	Derive the ANSI-C coding into an FPGA board.	5	K3	1,2,3,8,10	3

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C422.1	3	3	2	1				2		2					3
C422.2	3	2	1					2		2					2
C422.3	2	1						2		2					1
C422.4	3	3	2	1				2		2					3
C422.5	2	1						2	2	2					1
C422.6	3	2	1					2		2					2

20CS701	DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of data analytic.
- To handle missing data in the real world data sets by choosing appropriate methods.
- To learn data analysis methods.
- To learn stream computing.
- To understand and apply data analysis techniques.
- To gain knowledge on Hadoop related tools.

PRE-REQUISITE:
Course Code: 20CS604
Course Name: Machine Learning

UNIT - I INTRODUCTION **9**

Knowledge domains of Data Analysis – Understanding structured and unstructured data – data analytic tools – applications of data analytics – various phases of data analytics lifecycle: discovery, data preparation, model planning, model building, communicating results, operationalization.

UNIT - II DATA PREPROCESSING **9**

Data Preprocessing: Data Cleaning – Data Integration – Data Reduction – Data Transformation. Handling Missing Data: Introduction to Missing data – Traditional methods for dealing with missing data. Maximum Likelihood Estimation – Basics, Missing data handling, improving the accuracy of analysis.

UNIT - III CLASSIFICATION AND CLUSTERING **9**

Statistical Methods: Regression modelling – Multivariate Analysis – Classification: SVM & Kernel Methods – Rule Mining – Cluster Analysis – Types of Data in Cluster Analysis – Partitioning Methods – Hierarchical Methods – Density Based Methods – Grid Based Methods – Model Based Clustering Methods – Clustering High Dimensional Data – Predictive Analytics.

UNIT - IV INTELLIGENT DATA ANALYSIS **9**

Analysis of Time Series : Linear and Non Linear Systems Analysis, Neural Networks : Fundamentals – Back Propagation Neural Network – Fuzzy Logic : Basics of Fuzzy Sets and Fuzzy Logic - Genetic Algorithms

UNIT - V HADOOP FRAMEWORKS **9**

HADOOP: HDFS concepts, Algorithms using MapReduce. Introduction to NoSQL, Cassandra, Pig – Hive.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. EMC Education Services (Editor), “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, John Wiley & Sons, 2015.
2. Craig K. Enders, “Applied Missing Data Analysis”, The Guilford Press, 2010.
3. Michael Berthold and David J. Hand, “Intelligent Data Analysis”, Springer, Second Edition, 2007.

REFERENCES:

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, Wiley, 2012.
2. Michael Minelli, Michelle Chambers and Ambiga Dhiraj, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses”, Wiley, 2013.
3. P.J. Sadalage and M. Fowler, “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Addison-Wesley Professional, 2012.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Data analytics		**Course Code :** 20CS701			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C423.1	Explain the basic concepts of Data Analytic	1	K2	1,2,8,9	2
C423.2	Describe the Data Analysis preprocessing Techniques.	2	K2	1,2,8,9	2
C423.3	Explain about how missing data will be handled during preprocessing	2	K2	1,2,8,9	2
C423.4	Apply the Classification and Clustering algorithms for real time applications	3	K3	1,2,3,8,9	2
C423.5	Apply intelligent analytics techniques like neural networks, fuzzy and genetic algorithms for real time analytics applications	4	K3	1,2,3,8,9	2
C423.6	Explain the Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics	5	K2	1,2,8,9	2

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C423.1	2	1						1	1					1	
C423.2	2	1						1	1	1				1	
C423.3	2	1						1	1	1				1	
C423.4	3	2	1					1	1			1		2	
C423.5	3	2	1					1	1			1		2	
C423.6	2	1			1			1	1			1		1	

20CS8B3 VIRTUAL REALITY AND AUGMENTED REALITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn rapidly evolving and commercially viable field of computer science.
- To become familiar with geometric modeling and computer graphics.
- To learn various types of Hardware and Software in virtual Reality systems.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO VIRTUAL REALITY **9**

Virtual Reality and Virtual Environment: Introduction – Computer graphics – Real time computer graphics – Flight Simulation – Virtual environment requirement – benefits of virtual reality – Historical development of VR – Scientific Landmark.

UNIT - II AUGMENTED REALITY **9**

Taxonomy – technology and features of augmented reality – difference between AR and VR – Challenges with AR – AR systems and functionality – Augmented reality method – visualization techniques for augmented reality – enhancing interactivity in AR environments – evaluating AR systems.

UNIT - III COMPUTER GRAPHICS AND GEOMETRIC MODELING **9**

Introduction – The Virtual world space – positioning the virtual observer – The perspective projection – Human vision – Stereo perspective projection – Colour theory. Geometrical Transformations: Introduction – frames of reference – Modeling transformations – scaling the VE – Collision detection.

UNIT - IV DEVELOPMENT TOOLS AND FRAMEWORK **9**

Human factors – Hardware – Software – The somatic senses – Sensor hardware – Head coupled displays – Acoustic hardware – Integrated VR systems – Modeling virtual world – Physical simulation.

UNIT - V AUGMENTED AND VIRTUAL REALITY APPLICATION **9**

Virtual Reality Applications: Introduction – Engineering – Entertainment – Education. The Future: Introduction – Virtual environments – modes of interaction. Case study on Oculus Rift – Head mounted display.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jernej Barbic, Mirabelle D'Cruz, Marc Erich Latoschik, Mel Slater and Patrick Bourdot, “Virtual Reality and Augmented Reality”, 14th EuroVR International Conference, EuroVR 2017, Laval, France, December 12–14, 2017, Proceedings: 10700 (Lecture Notes in Computer Science).
2. Timothy Jung and M. Claudia tom Diek, “Augmented Reality and Virtual Reality”, Progress in IS (PROIS), 2018.

REFERENCES:

1. Grigore C. Burdea and Philippe Coiffet, “Virtual Reality Technology”, Wiley-IEEE Press, Second Edition, 2017.
2. Alan B. Craig, “Understanding Augmented Reality, Concepts and Applications”, Morgan Kaufmann, First Edition, 2013.
3. Alan B. Craig Dr., William R. Sherman Dr. and Jeffrey D. Will, “Developing Virtual Reality Applications: Foundations of Effective Design”, Morgan Kaufmann, 2009.
4. John Vince, “Virtual Reality Systems”, Pearson Education Asia, 2007.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Virtual Reality and Augmented Reality		**Course Code :** 20CS8B3			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C424.1	Explain the virtual reality and environment, virtual reality requirements and benefits.	1	K2	1,2,8,9	3
C424.2	Illustrate the visualization techniques for augmented reality.	2	K2	1,2,8,9,10	3
C424.3	Discuss the concept of computer graphics and geometric modeling.	3	K2	1,2,8,9	3
C424.4	Use various types of hardware and software in virtual reality systems.	4	K3	1,2,3,8,9,12	3
C424.5	Apply development tools and framework for virtual reality.	4	K3	1,2,3, 5,6,8,9,12	3
C424.6	Analyze and design a system or process to meet given specifications with realistic engineering constraints.	5	K4	1,2,3,4, 5,6,8,9,10, 12	3

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C424.1	2	1						1	**1**						1
C424.2	2	1						1	**1**	1					1
C424.3	2	1						1	**1**						1
C424.4	3	2	1					1	**1**			1			2
C424.5	3	2	1		2	1		2	**2**			1			2
C424.6	3	3	2	1	1	1		2	**2**	1		1			3

20HS8B1	INTRODUCTION TO NGO MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the Non-Governmental Organizations (NGO's) role in various developmental issues across the states in India.
- To understand the role of voluntary sector in the developmental process and policy-making issues.
- To emphasis the management education process hitherto, had been limited to the private sector and or large public sector undertakings.
- To understand the effort of the capacity building for the voluntary sector and to organizing workshops and training programmes.
- To provide a formal platform to volunteers and community workers in the field of community service to understand the nuances of management at different levels.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO NGO MANAGEMENT **9**

Non-Governmental Organisations' relevance and rationale – definitions – nomenclature – characteristics – classification of NGOs – evolution of NGOs along different developmental frameworks and approaches – NGOs in developing countries.

UNIT - II LEGAL REQUIREMENTS IN SETTING-UP NGOS **9**

Registration of NGOs – legal options available to register NGOs in India – fiscal regime in India with respect to NGOs – additional information on tax laws – differing legal frameworks for NGOs in south Asian countries – processes and essentials of registration.

UNIT - III PLANNING PROGRAMMES AND WORKING WITH THE COMMUNITY **9**

Programme planning – programme documentation – stakeholder – stakeholder analysis – government as a stakeholder – media as a stakeholder – private business as a stakeholder.

UNIT - IV MANAGING RESOURCES AND PROPOSAL WRITING **9**

Human resource management – staff development – resource mobilisation – proposal writing – financial management – case studies on proposal writing.

UNIT - V PROCESS DOCUMENTATION, MONITORING AND EVALUATION **9**

Process documentation – monitoring – features of monitoring – evaluation – difference between monitoring and evaluation – differing approaches to monitoring and evaluation – elements of a monitoring and evaluation plan.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. David Lewis, Nazneen Kanji and Nuno S. Themudo, "Non-Governmental Organizations, Management and Development", Routledge, 2014.
2. Manoj Fogla, Suresh Kumar Kejriwal and Tarun Kumar, "Trusts & NGOs Ready Reckoner", Taxmann Publications Pvt. Ltd., 2020.

REFERENCES:

1. Alan Fowler and Chiku Malunga, “NGO Management: The Earthscan Companion”, Routledge, First Edition, 2010.
2. Abraham Anita, “Formation And Management Of NGOs (Non Governmental Organisations)”, Universal Law Publishing - An imprint of LexisNexis, Fourth Edition, 2015.
3. Patrick Kilby, “NGOs in India: The challenges of women's empowerment and accountability”, Routledge, 2011.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Introduction to NGO Management		**Course Code :** 20HS8B1			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C425.1	Summarise the development of the NGO sector.	1	K2	6,8,9,10,11	
C425.2	Structure the framework for setting up NGOs.	2	K3	6,8,9,10,11	
C425.3	Plan programmes to work with Stake holders.	3	K3	6,8,9,10,11	
C425.4	Discuss about human resource management and financial management.	4	K2	6,8,9,10,11	
C425.5	Make use of resources to write a proposal.	4	K3	6,8,9,10,11	
C425.6	Identify the process for documentation, monitoring and evaluation.	5	K3	6,8,9,10,11	

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C425.1						2		2	2	2	2				
C425.2						3		3	3	3	3				
C425.3						3		3	3	3	3				
C425.4						2		2	2	2	2				
C425.5						3		3	3	3	3				
C425.6						3		3	3	3	3				

20HS7A2	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand TQM concepts.
- To know about TQM principles.
- To understand Six Sigma, Traditional tools, New tools, Benchmarking and FMEA.
- To understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
- To apply QMS and EMS in any organization.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION **9**

Quality - Need, Evolution, Definitions, Dimensions of product and service quality. TQM - Basic concepts, Framework, Contributions of Deming, Juran and Crosby, Barriers. Quality statements, Customer satisfaction, Customer complaints, Customer retention, Costs of quality.

UNIT - II TQM PRINCIPLES **9**

Strategic quality planning, Quality Councils, Employee involvement, Motivation, Empowerment, Teamwork, Quality circles, Recognition and Reward, Performance appraisal, Continuous process improvement - PDCA cycle, 5S, Kaizen, Supplier partnership, Supplier selection, Supplier Rating.

UNIT - III TQM TOOLS AND TECHNIQUES I **9**

Traditional tools of quality, New management tools. Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT, Bench marking, Reason to bench mark, Bench marking process, FMEA - Stages, Types.

UNIT - IV TQM TOOLS AND TECHNIQUES II **9**

Control Charts, Process Capability, Quality Function Development (QFD), Taguchi quality loss function, TPM - Concepts, improvement needs, Performance measures.

UNIT - V QUALITY SYSTEMS **9**

Need for ISO 9000, ISO 9001-2008 Quality System, Elements, Documentation, Quality Auditing, QS 9000 - ISO 14000, Concepts, Requirements and Benefits, TQM Implementation in manufacturing and service sectors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. H.Besterfield Dale, Besterfield Carol, H.Besterfield Glen, Besterfield Mary, Urdhwareshe Hemant and Urdhwareshe Rashmi, “Total quality Management”, Pearson Education Asia, Fifth Edition, 2018.
2. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, Cengage Learning, Eight Edition, 2012.
3. L.Suganthi and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., Second Edition, 2006.

REFERENCES:

1. Joel E. Ross, “Total Quality Management – Text and Cases”, CRC Press, Fifth Edition, 2017.
2. D.R.Kiran, “Total Quality Management: Key concepts and case studies”, Butterworth – Heinemann Ltd, First Edition, 2016.
3. J.S.Oakland, “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition, 2012.
4. B.Janakiraman and R.K.Gopal, “Total Quality Management - Text and Cases”, Prentice Hall (India) Pvt. Ltd., First Edition, 2006.
5. G.Brue, “Six Sigma for Managers”, Tata-McGraw Hill, Second Edition, 2002.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Total Quality Management		**Course Code :** 20HS7A2			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C426.1	Explain basic concepts, TQM framework, Barriers and Benefits of TQM.	1	K2	6,8,9,10,11	
C426.2	Explain the TQM Principles for application.	2	K2	6,8,9,10,11	
C426.3	Define the basics of Six Sigma and Traditional tools, New tools, Benchmarking and FMEA.	3	K2	6,8,9,10,11	
C426.4	Apply Techniques like QFD, TPM, COQ and BPR to demonstrate performance measures	4	K3	6,8,9,10,11	
C426.5	Illustrate and apply QMS and EMS in any organization.	5	K3	6,8,9,10,11	
C426.6	Explain the process of implementation of ISO 9000/9001-2008/14000 for given manufacturing, service sector.	5	K2	1,2,3,5,11,12	

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C426.1						2		2	2	2	2				
C426.2						2		2	2	2	2				
C426.3						2		2	2	2	2				
C426.4						2		2	2	2	2				
C426.5						2		2	2	2	2				
C426.6						2		2	2	2	2				

20OE305 FUNDAMENTALS OF IMAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression methods.

PRE-REQUISITE: NIL

UNIT - I DIGITAL IMAGE FUNDAMENTALS **9**

Steps in Digital Image Processing - Elements of Visual Perception - Image Sensing and Acquisition - Image Sampling and Quantization - Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT - II IMAGE ENHANCEMENT **9**

Spatial Domain: Gray level transformations - Histogram processing - Basics of Spatial Filtering - Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform - Smoothing and Sharpening frequency domain filters - Ideal, Butterworth and Gaussian filters, Homomorphic filtering.

UNIT - III IMAGE RESTORATION **9**

Image Restoration - degradation model, Properties, Noise models - Mean Filters - Order Statistics - Adaptive filters - Band reject Filters - Band pass Filters - Notch Filters - Optimum Notch Filtering - Inverse Filtering - Wiener filtering.

UNIT - IV IMAGE SEGMENTATION **9**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing-erosion and dilation, Segmentation by morphological watersheds.

UNIT - V IMAGE COMPRESSION **9**

Fundamentals of image compression - Compression methods - Huffman Coding, Arithmetic Coding, LZW Coding, Run-Length coding, Symbol-Based Coding, Bit-Plane Coding, Block Transform Coding, Predictive Coding, Wavelet Coding.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson, Third Edition, 2010.

2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson, 2002.

REFERENCES:

1. Kenneth R. Castleman, “Digital Image Processing”, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods and Steven Eddins, “Digital Image Processing using MATLAB”, Pearson Education, Inc., 2011.
3. D.E. Dudgeon and R.M. Mersereau, “Multidimensional Digital Signal Processing”, Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, “Digital Image Processing”, John Wiley, New York, 2002.
5. Milan Sonka, “Image processing, analysis and machine vision”, Brookes/Cole, Vikas Publishing House, Second Edition, 1999.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Fundamentals of Image Processing		**Course Code :** 20OE305			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
1	Explain the fundamentals of digital image processing techniques.	1	K2	1,2,8,10	
2	Apply the various transforms and its properties for 2D signals.	2	K3	1,2,3,8,10	
3	Describe the various image enhancement technique used in digital image processing.	2	K2	1,2,8,9,10	
4	Apply the various filters for image restoration.	3	K3	1,2,3,8,10	
5	Examine feature extraction methods for segmentation.	4	K3	1,2,3,8,10	
6	Apply the different coding methods for image compression.	5	K3	1,2,3,8,10	

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	2	1						2		2					
2	3	2	1					2		2					
3	2	1						2	2	2					
4	3	2	1					2		2					
5	3	2	1					2		2					
6	3	2	1					2		2					

20OE306	CONSUMER ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give students an in depth knowledge of various electronic audio and video devices and systems.
- To introduce the consumer electronic gadgets/goods/devices like audio-systems, CD systems.
- To give organization structure and principles of working of various other components like visual display, keyboard drives and printers.
- To find employment in computer industry, repair and maintenance field.

PRE-REQUISITE: NIL

UNIT - I AUDIO SYSTEMS **9**

Microphones, their types: Carbon, velocity, crystal, condenser, cordless etc. Loud Speaker: Direct radiating, horn loaded woofer, tweeter, mid-range, multi-speaker system, baffles and enclosures. Sound recording on magnetic tape, its principles, block diagram and tape transport mechanism, Digital sound recording on tape and disc, CD system, Hi- Fi system, pre-amplifier, amplifier and equalizer system, stereo amplifiers, public address systems, Graphics Equalizer, speed Synthesizer, Electronic tuning.

UNIT - II VIDEO SYSTEMS **9**

B&W TV, color TV and HD TV systems, LCD, LED, PLASMA Systems, Electronic cameras, VCR, VCP, CD systems, Memory diskettes, Discs and drums. Dolby noise reduction digital and analog recording. Digital projection systems (LCD, DLP, SVGA to UXGA system) Block diagram and principles of working of cable TV and DTH, cable TV using internet.

UNIT - III COMPUTER SYSTEM **9**

Different types of mother boards - Single Board Based System - Different types of Buses PCI, ISA, SCSI & Serial and Parallel Ports, USB - Hard Disk Device (HDD) - Computer Monitor - Video Display Adopters - Keyboard - Mouse - Scanner - Printer - digitizer.

UNIT - IV MOBILE PHONE **9**

Architecture - Connectivity - RF Transceiver - Antennas - Tx/Rx switch - Baseband part - System-on-chip - ADC/DAC - Memory and storage - Camera - Sensors - Operating system - Microphone and Speaker - Display and Keypad - Battery.

UNIT - V HOUSEHOLD APPLIANCES **9**

Microwaves: Microwave Oven Block Diagram, LCD Timer with Alarm, Types of Microwave Ovens Washing Machines: Electronic controller for Washing Machines, Washing Machine Hardware, Air Conditioning: Components of Air Conditioning Systems, Remote Control-buttons, Unitary and Central Air Conditioning Systems, Split Air Conditioners. Refrigeration: Refrigerants, Refrigeration Systems, Dish Washers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jim Ledin, “Modern Computer Architecture and Organization: Learn x86, ARM, and RISC-V architectures and the design of Smartphones, PCs, and cloud servers”, Packt Publishing, Illustrated Edition, 2020.
2. S.P.Bali, “Consumer Electronics”, Pearson Education, 2007.

REFERENCES:

1. R.G. Gupta, “Audio and Video Systems: Principles, Maintenance and Troubleshooting”, McGraw Hill Education, Second Edition, 2017.
2. Jacob Beckerman, “How to Build a Computer: Learn, Select Parts, Assemble, and Install: A Step by Step Guide to Your First Homebuilt”, JIBB Publishing, First Edition, 2014.
3. R.R. Gulati, “Modern Television Practice: Transmission, Reception and Applications”, New Age International Private Limited, 2015.
4. Nick Vandome, “Android Phones for Seniors in easy steps: Updated for Android v7 Nougat”, In Easy Steps Limited, Second Edition, 2019.
5. Sajid Umair and Muhammad Yousaf Shah, “Mobile Devices and Smart Gadgets in Human Rights”, IGI Global, 2018.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Consumer Electronics		**Course Code :** 20OE306			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
1	Describe the various audio system components and its functionalities.	1	K2	1,2,8,10	
2	Explain the concepts and techniques employed in the construction of televisions.	2	K2	1,2,8,10	
3	Analyse the construction of personal computers.	3	K3	1,2,3,8,10	
4	Illustrate the various blocks and components used in the construction of mobile phones.	4	K2	1,2,8,10	
5	Explain the various systems used in the residence.	5	K2	1,2,8,9,10	
6	Analyse the commonly used consumer electronic gadgets used in our residences.	5	K3	1,2,3,8,10	

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	2	1						2		2					
2	2	1						2		2					
3	3	2	1					2		2					
4	2	1						2		2					
5	2	1						2	2	2					
6	3	2	1					2		2					

20OE307	FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of discrete time systems.
- To learn Discrete Fourier Transform, its properties and its application to linear filtering.
- To understand the characteristics of digital filters, design of FIR and IIR filters and its realization.
- To understand the effects of finite precision representation on digital filters.

PRE-REQUISITE: NIL

UNIT - I DISCRETE TIME SYSTEM ANALYSIS **9**

Classification of discrete time systems - linear, causal, stability, time invariance, dynamic, recursive and non-recursive, Sampling, Nyquist rate, Aliasing effect, Quantization and its error - Discrete Time Fourier Transform, magnitude and phase representation.

UNIT - II DISCRETE FOURIER TRANSFORM **9**

Frequency - Domain sampling: The Discrete Fourier Transform - Properties of DFT - Linear filtering methods based on the DFT - Efficient computation of the DFT: FFT algorithms: radix 2 FFT algorithms.

UNIT - III FINITE IMPULSE RESPONSE FILTERS **9**

Characteristics of practical frequency selective filters - Design of FIR filters: symmetric and Anti-symmetric FIR filters - Design of linear phase FIR filters using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. Structures for FIR systems - linear phase structure, direct form realizations.

UNIT - IV INFINITE IMPULSE RESPONSE FILTERS **9**

Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters: Impulse invariance method, Bilinear transformation. Structure of IIR systems - Direct form structures, Cascade and parallel structures.

UNIT - V FINITE WORD LENGTH EFFECTS **9**

Representation of Numbers - Quantization of filter coefficients - Round-off effects in Digital filters: Limit cycle oscillations in recursive systems - scaling to prevent overflow.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. John G. Proakis and Dimitris G. Manolakis, “Digital Signal Processing – Principles, Algorithms & Applications”, Pearson Education / Prentics Hall, Fourth Edition, 2016.

2. Sanjay K. Mitra, “Digital Signal Processing: A Computer based approach”, Tata McGraw Hill, Fourth Edition, 2017.

REFERENCES:

1. Emmanuel C. Fleachor and Barrie W. Jervis, “Digital Signal Processing”, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. Vinay K. Ingle and John G. Proakis, “Digital Signal Processing using MATLAB”, Cengage Learning Custom Publications, Third Edition, 2011.
3. A.V. Oppenheim, R.W. Schafer and J.R. Buck, “Discrete – Time Signal Processing”, Indian Reprint, Pearson, Twenty Eight Edition, 2004.
4. Andreas Antoniou, “Digital Signal Processing”, Tata McGraw Hill, 2006.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Fundamentals of Digital Signal Processing		**Course Code :** 20OE307			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
1	Classify the discrete time systems and its frequency response.	1	K3	1,2,3,8,10	
2	Compute DFT and IDFT coefficients of a discrete time sequences using FFT algorithms and output of the discrete time system.	2	K3	1,2,3,8,10	
3	Determine the transfer function of FIR digital filters.	3	K3	1,2,3,8,10	
4	Determine the transfer function of IIR digital filters.	4	K3	1,2,3,8,10	
5	Construct the realization structures for digital filters.	4	K3	1,2,3,8,10	
6	Explain the fundamental concepts of number representation, quantization errors and limit cycle oscillations.	5	K2	1,2,8,9,10	

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	2	1					2		2					
2	3	2	1					2		2					
3	3	2	1					2		2					
4	3	2	1					2		2					
5	3	2	1					2		2					
6	2	1						2	2	2					

20OE308	INTRODUCTION TO VLSI TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the VLSI era.
- To introduce the fundamental concepts relevant to VLSI fabrication.
- To enable the students to understand the various VLSI fabrication technique.

PRE-REQUISITE: NIL

UNIT - I LOGIC DESIGN WITH MOSFETS **9**

Ideal Switches and Boolean Operations - MOSFETs as Switches- Basic Logic Gates in CMOS - Complex Logic Gates in CMOS - Transmission Gate Circuits - Clocking and Dataflow Control.

UNIT - II PHYSICAL STRUCTURE OF CMOS INTEGRATED CIRCUITS **9**

Integrated Circuit Layers - Interconnect Resistance and capacitance – MOSFETs - Electrical Conduction in silicon - nFETs and pFETs - Current flow in a FET - driving the gate capacitance - CMOS Layers - Designing FET Arrays.

UNIT - III FABRICATION OF CMOS INTEGRATED CIRCUITS **9**

Overview of Silicon Processing - Material Growth and Deposition - Silicon dioxide - Silicon Nitride - polycrystal silicon – metals - doped silicon layers - chemical mechanical polishing – Lithography - The CMOS Process Flow - Design Rules.

UNIT - IV ELECTRICAL CHARACTERISTICS OF MOSFETS **9**

MOS Physics - derivation of threshold voltage - nFET Current - Voltage Equations - SPICE level 1 equation - body bias effects - derivation of the current flow equation - The FET RC Model - pFET Characteristics - Modeling of Small MOSFET.

UNIT - V ELECTRONIC ANALYSIS OF CMOS LOGIC GATES **9**

DC Characteristics of the CMOS Inverter - Inverter Switching Characteristics - Power Dissipation - DC Characteristics: NAND and NOR Gates - NAND and NOR Transient Response - Analysis of Complex Logic Gates - Gate Design for Transient Performance - Transmission Gates and Pass Transistors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. John P. Uyemura, “Introduction to VLSI Circuits and Systems”, John wiley & sons, 2001.
2. S.K. Gandhi, “VLSI Fabrication Principles”, John Willey & Sons, Second Edition, 2008.

REFERENCES:

1. Kamran Eshraghian, Douglas A. Pucknell and Sholeh Eshraghian, “Essentials of VLSI Circuits and Systems”, PHI, 2005.
2. Neil H.E. Weste and K. Eshraghian, “Principles of CMOS VLSI Design: A System Perspective”, McGraw Hill, 2010.
3. Sung-Mo Kang, Yusuf Lablebici and Chulwookim, “CMOS Digital Integrated Circuits, Analysis and Design”, McGraw Hill, Fourth Edition, 2019.
4. Partha Pratim Sahu, “VLSI Design”, McGraw Hill, 2013.
5. Neil H.E. Weste, “CMOS VLSI Design: A Circuit and System Perspective”, Pearson Education, 2011.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Introduction to VLSI Technology		**Course Code :** 20OE308			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
1	Explain the introduction of MOSFET as simple logic controlled switches and then concentrate on the design of CMOS static logic gates at the Boolean level.	1	K2	1,2,8,10	
2	Generalize the views of an integrated circuit as a set of patterned material layers that are used to control the flow of signals.	2	K3	1,2,3,8,10	
3	Discuss the switch level description down to the physical level.	2	K2	1,2,8,10	
4	Discuss the general and specific aspects of the manufacturing process of CMOS.	3	K2	1,2,8,10	
5	Derive the equations for RC switching model based on the square law equation.	4	K3	1,2,3,8,9	
6	Develop the electrical properties of CMOS logic circuits.	5	K3	1,2,3,8,9,10	

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	2	1						2		2					
2	3	2	1					2		2					
3	2	1						2		2					
4	2	1						2		2					
5	3	2	1					2		2					
6	3	2	1					2	2	2					