

SECA2101	ELECTRONIC DEVICES LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To give a basic introduction to electronic components.
- To provide students knowledge about semiconductor diodes.
- To determine the V-I characteristics of transistor configurations.
- To determine the characteristics of thyristor circuits.
- To explain the importance of transistors as switch.

SUGGESTED LIST OF EXPERIMENTS

1. Study of circuit components and equipments (Component identification, color coding, checking diode, BJT, FET, study of CRO, Audio Oscillator, Multimeter, LCR meter).
2. Characteristics of Semiconductor diode and Zener diode.
3. Characteristics of CE and CB configuration.
4. Characteristics of JFET.
5. Characteristics of SCR & UJT.
6. Characteristics of DIAC & LDR.
7. Clippers and Clampers.
8. Voltage multipliers.
9. Switching Characteristic of BJT.
10. Characteristics of CC configuration.

COURSE OUTCOMES

On completion of the course, students are able to

- CO1 - Understand the basic circuit concepts.
- CO2 - Explain the functioning of transistor configurations.
- CO3 - Demonstrate the understanding of special semiconductor diodes and its applications.
- CO4 - Analyze the V-I characteristics of thyristors.
- CO5 - Determine the performance of switching characteristics of BJT.
- CO6 - Evaluate the various parameters by utilizing oscilloscopes and other modern test equipments.



Employability



Entrepreneurship



Skill Development

SECA1303	ANALOG COMMUNICATION SYSTEMS (For ECE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To discuss and understand fundamental concepts of amplitude modulation and demodulation techniques.
- To understand the concepts of Frequency Modulation and De-Modulation techniques and compare with AM and PM.
- To understand the concepts of Analog Pulse modulation and De-Modulation techniques (PAM, PDM/PWM and PPM) & Multiplexing techniques and classifications.
- To apply different multiplexing techniques for AM, FM, PAM, PWM and PPM systems.
- To understand the various noises and their effect on Analog modulation systems.
- To discuss the working of Analog Communication Receivers and Telephone and Television Systems.

UNIT 1 AMPLITUDE MODULATION AND DEMODULATION**9 Hrs.**

Need for modulation -Model of communication system and classification, Representation of AM Modulation index and power calculation Types of AM: DSB-FC: Collector and base modulation circuits, square law modulator- DSB-SC: Balanced modulator circuit using FET SSB: Filter method and phase shift method VSB, Comparison of various AM schemes-AM transmitter: Low level and high level Modulation. Demodulation Envelope detector, Significance of RC time constant- Square law detector.

UNIT 2 ANGLE (FM AND PM) MODULATION AND DEMODULATION**9 Hrs.**

Single tone FM: Mathematical representation, frequency spectrum and bandwidth- Multi-tone FM - NBFM and WBFM - Phase modulation (PM): Mathematical representation - Conversion: FM to PM and PM to FM Comparison of AM, FM and PM- FM Generation: Direct method using Varactor diode and indirect method (Armstrong modulator) - Pre-emphasis - FM transmitter. FM Detector: Balanced slope detector, Foster seeley frequency discriminator and Ratio detector - De-emphasis.

UNIT 3 ANALOG PULSE MODULATION AND MULTIPLEXING**9 Hrs.**

Sampling theorem Types of sampling-Concepts of PAM, PWM, PPM and PCM- Modulators and demodulators. Types of Multiplexing- Frequency Division Multiplexing, Time Division Multiplexing and Quadrature Multiplexing - Comparison of multiplexing.

UNIT 4 ANALOG RECEIVERS AND NOISE**9 Hrs.**

AM Receivers: TRF receivers -Super heterodyne receivers - FM Receivers: FM stereo broadcast receivers - AFC - Capture effect, FM threshold effect. Communication Receivers: Sensitivity, fidelity and selectivity - Squelch circuit - Beat frequency Oscillator- Types of Noise- Noise factor and noise temperature for cascaded amplifier (Friis formula)- Noise in AM and FM systems.

UNIT 5 COMMUNICATION SYSTEMS**9 Hrs.**

Telephone Systems-Electronics Telephone and cellular Telephone System - Fax-Television Systems-Scanning-camera tube and Transmitter, Picture tube and Receiver, CCTV and Set top box.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

CO1-Analyze the performance of continuous wave modulation techniques

CO2-Design modulator and the demodulator circuits for different analog modulation techniques

CO3-Develop system level model of transceivers for analog communication systems

CO4-Evaluate the impact of noise in AM and FM systems communication receivers

CO5-Develop appropriate modulation techniques for a transmission of real time signals

CO6-Develop suitable multiplexing techniques for spectrum Optimization in communication systems

TEXT/REFERENCE BOOKS

1. R.P Singh Sanjay Sharma, "Analog Communication Systems", 2009.
2. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd Edition, Oxford University Press, 2007.
3. Deshpande, N.D, "Communication Electronics", Tata McGraw Hill Publishers, 1989.
4. Louis. E. Frenzel, "Communication Electronics Principles and applications", 3rd Edition, Tata McGraw Hill, 2002.
5. Dennis Reddy and John Coolen, "Electronic Communications", 4th Edition, Prentice Hall Publishers, 1995.
6. Kennedy, "Electronic Communications Systems", 4th Edition, McGraw-Hill Publishers, 1992.
7. R.Gulati, "Monochrome and colour television", 2nd Edition, New age international 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

Employability



Entrepreneurship



Skill Development; 2019



Employability



Entrepreneurship



Skill Development

S13ADPROJ	Design Thinking	L	T	P	Credits	Total Marks
		0	0	4	2	100

Course Objectives

- To introduce the concept of Design thinking to solve Real World Problems
- To understand the process of design thinking
- To identify and analyze societal issues
- To provide solution to the identified Real World Problem

UNIT I INTRODUCTION AND COGITATION

9 Hrs

Introduction to design thinking- Johari Window– Persona - DCAF and VAL. Theory of prioritization Brain storming - 25 brainstorming techniques, Case Study - Identification of Real-World Problems using brain storming and assigning priorities. Discussion on case study. Activities: Formation of team Brain storming Case study –

UNIT II DESIGN THINKING PROCESS

9 Hrs

Elements of great design - Human element of design thinking Lateral thinking HOTS - Out of-box thinking - case study Problem Identification Identification of a specific Real Word Problem after brain storming Team Presentation on identified problem. Activities: Specific Problem selection to proceed with the work Team presentation on identified problems and various possible solutions.

UNIT III ENGINEERING DESIGN - PHASE 1

9 Hrs

Identification of stake holders Roles and responsibilities Conduct of surveys and interviews for addressing Real World Problems Literature Surveys - Data collection. Surveys: Stake holder Survey Literature Survey Presentation on Stake holder's survey and Literature survey. Activities: SWOT Analysis Finalize the identified problem

UNIT IV ENGINEERING DESIGN - PHASE 2

9 Hrs

Difference between Creativity and Innovation Examples of innovation Overcoming obstacles Decision making on implementation of identified problem Identifying evaluation criteria - Functional decomposition. Documentation: Functional decomposition diagram, Decision on implementation, Evaluation criteria. Activities: Documentation

UNIT V ENGINEERING DESIGN - PHASE 3

9 Hrs

Brain storming alternate solutions- Developing proof of concept Project: Poster presentation and Proof of concept display Activities: Development of POC

Course Outcomes

On completion of the course, the student will be able to

- CO 1 Comprehend the various types of thinking skills.
- CO 2 - Explain the innovative and creative ideas.
- CO 3 Apply engineering design process for the identified problem
- CO 4 - Analyze a suitable solution for socially relevant issues
- CO 5 Develop working structure and concepts for the identified problem
- CO 6 - Design solutions for Real World Problem.

Text/Reference Books

- How to have Creative Ideas, Edward de Bono, Vermilion publication, UK, 2007
- The Art of Innovation, Tom Kelley & Jonathan Littman, Profile Books Ltd, UK, 2008
- G.Pahl and W.Beitz (Translated by Ken Wallace et al.) „Engineering Design: A Systematic Approach. Second Edition, Springer, 2005.
- George E. Dieter and Linda C. Schmidt, "Engineering Design", Fourth Edition, McGraw Hill Higher Education, 2009.
- Power Point Presentation material by Prof.D.K.Subramanian in the Workshop on Engineering Design at TCE, Madurai. Foundation Skills in Integrated Product Development, NASSCOM, Edition 2015.



Employability



Entrepreneurship



Skill Development



Employability



Entrepreneurship



Skill Development

SECA1402	TRANSMISSION LINES AND WAVE GUIDES	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To understand the concept of transmission lines types, various line parameters, waveguide types and resonators.
- To Characterize and analyze the transmission line parameters and Acquire knowledge about the waveguides and resonators.
- To analyze transmission lines for various frequencies and also smith-charts.

UNIT 1 TRANSMISSION LINE THEORY**9 Hrs.**

Introduction - Types of transmission lines - General theory of transmission line - Line constants - Transmission line equation - Physical significance of the equations - The Infinite line - Distortion in a line - Distortionless line - Telephone cables - Loading of lines - Types of loading - Campbell's formula - General equation for line with any termination - Input impedance - Open and Short circuited line. Numerical problems.

UNIT 2 RADIO FREQUENCY TRANSMISSION LINES**9 Hrs.**

Line approximations - Parameters of open wire line at radio frequency, parameters of coaxial lines at radio frequencies, constants for the line of zero dissipation - Voltages and Currents on the dissipation-less lines - input impedance of a lossless line - Wavelength and velocity of propagation - Reflection phenomena - Line losses - Return loss - reflection loss- insertion loss- Reflection coefficient, Reflection factor, Standing wave ratio, Input impedance in terms of reflection coefficient - Practical types - Microwave Transmission line, Super Conducting transmission line, Characteristics of different printed transmission lines.

UNIT 3 MATCHING, MEASUREMENTS AND INTERFERENCES**9 Hrs.**

Types of transmission line sections - Half wave line - One eighth wave line - Quarter wave line - Properties of quarter wave transformer - Location of Vmax and Vmin - Impedance matching - Single and double stub matching- **Smith chart - Solutions of problems using smith chart - Applications of smith chart - Measurement of line parameters- Measurement of VSWR, Wavelength, Impedance and Power - Phenomenon of corona, Methods of reducing corona and interference.**

UNIT 4 ELECTROMAGNETIC WAVES**9 Hrs.**

Waves between parallel planes - Transverse electric waves - Transverse magnetic waves - Characteristics of TE and TM waves - Transverse electromagnetic waves - Velocities of propagation - Attenuation in parallel plane waves - Wave impedance.

UNIT 5 GUIDED WAVES AND WAVE GUIDE THEORY (QUALITATIVE TREATMENT ONLY).**9 Hrs.**

Rectangular wave guides - TE and TM waves in rectangular wave guides - Dominant mode - Cut off frequency in wave guides - Impossibility of TEM waves in wave guides - Circular wave guides- TE and TM waves in circular wave guides - Attenuation factor and Q of wave guides- Microwave resonators introduction - rectangular cavity resonator - Q-factor of micro wave cavities.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1-Apply the knowledge of fundamental concepts of wave propagation in Transmission Lines and Wave Guides CO2- Analyze the line parameters and various losses in transmission lines
CO3-Design line parameter and impedance calculations using smith chart CO4- Evaluate the characteristics of parallel plane and rectangular wave guide s CO5-Evaluate the characteristics of Circular waveguides and prioritize their usage CO6-Correlate the characteristics of resonators

TEXT / REFERENCE BOOKS

1. Edward Jordan and K.G.Balmain, "Electromagnetic waves and radiating system", 4th Edition, PHI, 2016.
2. Umeshsinha, "Transmission lines and networks", 8th Edition, Sathya Prakashan Publishers, 2010
3. John D. Ryder, "Network lines and fields", 4th Edition, Prentice Hall of India, 2010.
4. Samuel Y. Liao, "Microwave devices and circuits", 3rd Edition, Prentice Hall of India, 2003.
5. David M. Pozar, "Microwave Engineering", 3rd Edition, John Wiley, 2011.
6. Seth S.P., "Elements of Electromagnetic Fields", 2nd Edition, Dhanpat Rai and Sons, 2007.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each -No choice**20 Marks.****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks.**
 **Employability**
 **Entrepreneurship**
 **Skill Development**
 **Employability**
 **Entrepreneurship**
 **Skill Development**

SAIC4001	INDUSTRY 4.0	L	T	P	Credits	Total Marks
		2	0	0	2	100

UNIT 1 ADVANCED TECHNOLOGY AND MATERIALS**7 Hrs.**

Advanced electro-optical sensing technology-active, passive multi-spectral and hyper spectral imaging; electronic beam steering; vacuum technology, surface and coating technology, health care technology, Nanotechnology-Nanomechanics, Nano optoelectronics; energy storage technology-next generation Li-based Batteries, Hydrogen storage, solar photovoltaic's, Flexible electronics. Intellectual Property Rights - case studies governing/pertaining to Materials/Technology.

UNIT 2 TRANSFORMING TECHNOLOGIES IN BIOENGINEERING**7 Hrs.**

Establishment of smart biotechnology factory, Artificial intelligence in Bioprocess technology, Omics Big data analysis through automation, 3D bio printing for tissue engineering. Simulation tools, RSM and Box model. Cyber physical system based telemedicine, diagnosis and therapeutics through real time biosensors. Bionanotechnology. Case studies Intellectual Property rights infringement in Biology.

UNIT 3 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT**7 Hrs.**

Introduction Technological developments in Architectural, Engineering and Construction (AEC) - Building Information Modelling (BIM) using Cloud computing technology and Internet of things (IoT) Unmanned Aerial Vehicles, sensors Additive manufacturing in construction Concrete-3D printing - Materials used - Lightweight and functionally graded structures - Net Zero Energy buildings, Bioswales, Biofiltration pond, Ecosan systems- Recent developments in Waste water Management, Air pollution control, waste disposal, public health issues-improving water management in surface and overhead irrigation- Integration of energy, water and environmental systems for a sustainable development.

UNIT 4 SMART MANUFACTURING**8 Hrs.**

Smart factories and interconnection, Smart Manufacturing automation systems, Additive Manufacturing, Smart grids, Micro Electro Mechanical Systems (MEMS), Stealth technology, Metal Finishing, Self propelled vehicles, e mobility, Green fuels, drones - unmanned aerial vehicles(UAVs), aerodynamics. Robotic Automation and Collaborative Robots Augmented reality and haptics, engineering cybernetics and artificial intelligence (AI), Disruptive Technologies Frugal Innovations Intellectual Property Rights (IPR): Case Studies.

UNIT 5 SMART WORLD**8 Hrs.**

Smart Sensors and IIOT, Smart grid, Hybrid renewable energy systems, Electronics in Smart city, Integration of Sensors in Robots and Artificial Intelligence, 5G Technology, Communication protocols, Human-Machine Interaction, Virtual Reality, Quantum Computing, Changing trends in transistor technology: Processor, Intellectual Property Rights- Case Studies.

UNIT 6 CYBER PHYSICAL SYSTEMS**8 Hrs.**

Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, healthcare and human computer interactions, Industrial Artificial Intelligence, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Transportation, Intellectual Property Rights (IPR) : Case Studies.

Max. 45 Hrs.**TEXT / REFERENCE BOOKS**

1. William D. Callister, "Materials Science and Engineering, An Introduction", John Wiley and Sons Inc. Singapore, 2001.
2. V. Raghavan, "Physical Metallurgy: Principle and Practice", Prentice Hall India Pvt Ltd, 2006.
3. Flavio Craveiro, Jose Pinto Duarte, Helena Bartolo and Paulo Jorge Bartolo, "Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0", Automation in Construction, Vol. 103, pp. 251 - 267, 2019.
3. Klaus Schwab, "Fourth Industrial Revolution", Random House USA Inc, New York, USA, 2017.
4. Oliver Grunow, "SMART FACTORY AND INDUSTRY 4.0. The current state of Application Technologies", Studylab Publications, 2016.
5. Alasdair Gilchrist, "INDUSTRY4.0: Industrial Internet of Things", Apress, 2016.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 11 Questions of 2 marks each-No choice**22 Marks****PART B:** 2 Questions from each unit with internal choice; each carrying 13 marks**78 Marks**

SECA1406
(NEW)

INDUSTRY 5.0 FOR ELECTRONICS ENGINEERS

L	T	P	Credit s	Total marks
2	0	0	2	100

Pre requisite: NIL

Co Requisite: NIL

Course Objectives

- To acquaint with the digital transformation of Industry 5.0
- To recognize the power of industry to achieve societal goals beyond jobs and growth
- To understand the design of personalized electronics products
- To focus on methods of interaction between humans and machines
- To develop the concept of electronics manufacturing beyond automation and optimization

UNIT	CONTENTS	HOURS
	INDUSTRY 4.0	
1	Introduction to Industry 4.0, Industry 4.0: The Fourth Industrial Revolution, History of Industry 4.0, Industry 4.0 by definition, Component of Industry 4.0, The opportunities in Industry 4.0, Industrial Internet, Smart Factory, Smart Buildings, Smart Manufacturing, Smart Farming.	9
	INDUSTRY 5.0	
2	Evolution from Industry 1.0 to 5.0, Introduction to Industry 5.0, Globalization and Emerging Issues, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Healthcare and Human computer interactions, Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Big Data and Advanced Analysis.	9
	DIGITAL TRANSFORMATION TO SOCIETY 5.0	
3	Digital Transformation, Introduction to Digital Transformation, Digital business transformation, Causes of disruption and transformation, Digital transformation myths and realities, Digital transformation across various industries, Retail industry, Urban Development, e-Governance and the public sector, Insurance industry, Healthcare, Food, Manufacturing, Disaster Control, Elements of Society 5.0, Data Driven to Society, Humanity Vs Society 5.0.	9
	SMART WORLD	
4	Introduction: Sensing & actuation, Communication, Electronics in Smart city, 5G Technology, Communication protocols, Integration of Sensors in Robots and Artificial Intelligence, Human-Machine Interaction, Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management., Intellectual Property Rights- Case Studies - Milk Processing and Packaging Industries.	9



Employability



Entrepreneurship



Skill Development

CYBER SECURITY IN INDUSTRY 5.0

5	Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Intellectual Property Rights (IPR) : Case Studies- Augmented Reality Virtual Reality	9
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Maximum Hours: 4

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Identify the digital transformation power of Industry 5.0 to achieve societal goals beyond jobs and growth

CO2– Analyze enhanced new production models in electronics

CO3– Implement various electronics manufacturing technologies beyond automation and optimization CO4 – Design suitable sensors for smart world real time applications

CO5– Evaluate the performance of various cyber physical systems

CO6– Create personalized electronics products combining the various industry 5.0 Applications with deep knowledge on Intellectual Property Rights

TEXT / REFERENCE BOOKS

- 1.S. Misra, A. Mukherjee, and A. Roy: “Introduction to IoT” (2020).
2. S. Misra, C. Roy, and A. Mukherjee: “Introduction to Industrial Internet of Things and Industry 4.0” (2020).
3. Klaus Schwab: “The Fourth Industrial Revolution” (2017).
4. Oliver Grunow: “Smart Factory and Industry 4.0: The Current State of Application Technologies” (2016).
5. Alasdair Gilchrist: “Industry 4.0: Industrial Internet of Things” (2016).



Employability



Entrepreneurship



Skill Development

SECA1503	CMOS VLSI DESIGN	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To focus on basics of semiconductor physics, Predominant CMOS technology.
- To study challenges of digital VLSI design.
- To get an idea about combinational logic circuit using CMOS logic style.
- To acquire the knowledge about sequential logic circuit and subsystem design.
- To extract the backend VLSI algorithms for ASIC.

UNIT 1 MOS TRANSISTOR THEORY**9 Hrs.**

The MOS transistor-Current Voltage Relations-Threshold Voltage-Second order effects-Capacitances in MOSFET - Scaling of MOS circuits -Review of CMOS - DC characteristics - Dynamic behavior- Power consumption.

UNIT 2 COMBINATIONAL LOGIC DESIGN**9 Hrs.**

nMOS depletion load and Static CMOS design - Determination of Pull-up and Pull-down ratio-Design of Logic gates- Sizing of transistors -Stick diagrams-Lay out diagram for static CMOS - Pass transistor logic - Dynamic CMOS design - Noise considerations - Domino logic, np CMOS logic - Power consumption in CMOS gates - Multiplexers - Transmission gates design.

UNIT 3 SEQUENTIAL LOGIC DESIGN**9 Hrs.**

Introduction - Static sequential circuits- CMOS static flip-flop - Dynamic sequential circuits -Pseudo static latch- Dynamic two phase flip-flop - clocked CMOS logic - Pipelining - NORA CMOS logic -True single phase clocked logic - Realization of D-FF in TSPC logic.

UNIT 4 SUBSYSTEM DESIGN**9 Hrs.**

Introduction-Designing Static and Dynamic Adder circuits - The Array Multiplier - Multiplier structures-Baugh-Wooly - Booth Multiplier - Barrel shifter - Memory structures - SRAM and DRAM design - Design approach of Programmable logic devices - PLA,PAL and FPGA.

UNIT 5 BASIC CONSTRUCTION**9 Hrs.**

Physical design - Goals and Objectives - Partitioning methods - Kernighan Lin algorithm - Hierarchical Floor planning - Floor planning tools -input, output and power planning -Min-cut placement, Force directed placement algorithm -Placement using simulated annealing - Greedy channel routing.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, students are able to

- CO1-Apply voltage and current relationship of MOS transistors for obtaining DC characteristics and AC small signal models of CMOS inverter
- CO2-Analyze the different styles of CMOS logic for combinational logic circuit design
- CO3-Design the CMOS static and dynamic sequential logic circuits
- CO4-Evaluate the CMOS subsystems and memory structure designs
- CO5-Construct logic circuits for realization of Boolean expressions using programmable logic devices
- CO6-Develop suitable algorithms for backend VLSI design.

TEXT / REFERENCE BOOKS

1. Jan M.Rabaey, "Digital Integrated Circuits", 2nd Edition, September, PHI Ltd.2000.
2. M.J.S.Smith, "Application Specific Integrated Circuits", 1st Edition, Pearson education.1997.
3. Douglas A.Pucknell, "Basic VLSI design", PHI Limited, 1998.
4. E.Fabricious, "Introduction to VLSI design", McGraw Hill Limited, 1990.
5. Neil Weste, "Principles of CMOS VLSI design", Addison Wesley 1998.
6. Wayne Wolf, "Modern VLSI design", 2nd Edition, Pearson education.2003.
7. Sung-Mo Kang and Yusuf, "CMOS Digital Integrated Circuits- Analysis and Design", 2nd Edition, MGH.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each-No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 12 marks**80 Marks**
 **Employability**
 **Entrepreneurship**
 **Skill Development**

SECA1505	ANTENNAS AND WAVE PROPAGATION	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To understand the radiation mechanism of different antennas, their parameters and design aspects.
- To learn about antenna arrays and their radiation pattern.
- To learn about travelling wave and broadband antennas.
- To understand electromagnetic wave propagation over ground and through different layers of atmosphere.
- To learn about Smart Antennas

UNIT 1 ANTENNA FUNDAMENTALS AND WIRE ANTENNAS**9 Hrs.**

Antenna Radiation Mechanism - Isotropic radiator- Antenna parameters : Radiation Intensity, Radiation pattern, Gain and Directivity, FBR, Effective Length, Radiation Resistance, Antenna Impedance, Polarization, Beam width, Bandwidth, Antenna temperature- Friis transmission formula. Retarded Potential - Wire Antennas: Short Electric Dipole, Radiation from an alternating current element, Half - wave Dipole, quarter wave monopole - Fields, Power radiated and Radiation Resistance

UNIT 2 ANTENNA ARRAYS**9 Hrs.**

Types of arrays - Broad side, End fire, Collinear, Parasitic arrays. -Arrays of two point sources - N-element of uniform linear arrays Array of N elements with equal spacing and currents equal in magnitude and spacing (broad side array) - Array of N elements with equal spacing and currents equal in magnitude but with progressive phase shift (end fire array)- Hansen- Woodyard array - Pattern Multiplication - Binomial arrays.

UNIT 3 TRAVELLING WAVE AND BROADBAND ANTENNAS**9 Hrs.**

Travelling wave radiators: basic concepts, Long wire antennas - field strength calculations and patterns - V-antennas, Rhombic Antennas, Small Loop antennas- Concept of short magnetic dipole, Helical Antennas, Folded Dipole Yagi-Uda Arrays, Log periodic antennas. Reflector Antennas: Huygens' principle - Flat Sheet and Corner Reflectors, Paraboloid Reflectors, Cassegrain Feeds. Slot antennas - Babinet's principle, Horn antennas, Lens antennas, Microstrip antennas..

UNIT 4 WAVE PROPAGATION**9 Hrs.**

Factors involved in the propagation of Radio Waves - Ground wave propagation, Structure of Ionosphere and its effects on radio waves- Refraction and Reflection of sky wave by the ionosphere, Ray paths-Measures of Ionosphere propagation: critical frequency, skip distance, virtual height, Maximum usable frequency, Fading of signals: Selective fading - Diversity reception, Space wave propagation-Considerations in space wave propagation, Atmospheric effects in space wave propagation, Super Refraction - Duct Wave Propagation.

UNIT 5 SMART ANTENNAS**9 Hrs.**

Concepts and Benefits of Smart antennas - Fixed weight beamforming- Adaptive beamforming Design of Planar array antennas for Beamforming applications Feed techniques for Planar arrays - Role of Smart Antennas in Green Communications and 5G wireless communications Software Tools for Antenna Design and Analysis

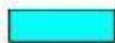
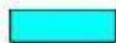
Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Define the antenna basic parameters.
- CO2 - Explain the radiation mechanism from the dipole elements.
- CO3 - Classify antenna arrays and infer their significance.
- CO4 - Analyze the characteristics of low and high frequency antennas.
- CO5 - Compare the properties and measures of various radio wave propagation.
- CO6 - Perform antenna measurements and analyze the parameters and develop the basic skills for designing practical antennas.

TEXT / REFERENCE BOOKS

1. John D. Kraus, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation", 5th Edition, McGraw Hill, 2017.
2. Balanis, C.A., "Antenna Theory and Design", 4th Edition, John Wiley and Sons, 2016.
3. Mohammad Abdul Matin, "Wideband, Multiband and Smart Antenna Systems, 1st Edition, Springer, 2021.
4. R.L. Yadava, "Antennas and Wave Propagation", 2nd Edition, PHI Learning Private Limited, New Delhi, 2011.
5. Jordan, E.C and Balmain K.G, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Prentice Hall of India, 2006.
6. K.D.Prasad and Satya Prakasan, "Antennas and Wave Propagation", 3rd Edition, Tech India, New Delhi, 2003

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each -No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks****Employability****Entrepreneurship****Skill Development****Employability****Entrepreneurship****Skill Development**

SECA1605	PROGRAMMING IN HDL	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To focus on the basic concept of VHDL and Verilog HDL
- To introduce the style of modeling in VHDL and Verilog HDL
- To focus advanced features of Verilog HDL
- To outline the formal procedures for testing and verification of HDL
- To introduce the design of switch level modeling and high level architecture

UNIT 1 CONCEPTS IN VHDL**9 Hrs.**

Introduction to VHDL - Language elements of VHDL -Concurrent and Sequential assignments -Data flow modeling - Concurrent Signal Assignment statements- Structural modeling - Component declaration - Component Instantiation - Behavioral modeling - Process statement - Examples for VHDL modeling.

UNIT 2 INTRODUCTION TO VERILOG HDL**9 Hrs.**

Basic concepts - Levels for design description - Module - Delays - Language elements - Compiler directives - value set - data types - Parameters - Expressions - Operands - operators in verilog HDL.

UNIT 3 STYLES OF MODELING**9 Hrs.**

Gate level modeling -Primitive Gates- Multiple input and multiple output gates User Defined Primitives - Combination UDP - Sequential UDP- Data flow modeling Behavioral modeling - procedural constructs procedural assignments - conditional and loop statements - Structural Modeling - Examples for modeling.

UNIT 4 FEATURES IN VERILOG HDL**9 Hrs.**

Tasks- Functions -systems tasks and functions - Verification - Modeling a test bench-timing and delays - Switch level modeling - state machine modeling - Moore FSM - Melay FSM - Design of RAM, ROM.

UNIT 5 REALIZING APPLICATIONS IN FPGA**9 Hrs.**

FPGA Design Flow - Architecture of Xilinx Artix7 FPGA - Configurable Logic Blocks (CLB)- Slice Description- LUT - Storage element - Programmable Interconnect - Internal Hard macros - Realizing applications in FPGA - combinational functions - N-bit functions, Encoder, Decoders - Sequential functions - N-bit register, shift registers, up/down counters- N-bit processor. Case Study: study of protocols I2C, SPI and UART.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Infer the needs of VHDL and Verilog HDL design flow.
- CO2 - Interpret the Verilog language elements and its relevance to digital design
- CO3 - Articulate different Modelling in HDL for Simulation, Synthesis and Test Bench Creation. CO4 Categorize the characteristics of Combinational and Sequential logic design using HDL. CO5 Evaluate and validate the digital logic circuits by State Machines.
- CO6 Design and verify the digital logic circuits in FPGA's

TEXT / REFERENCE BOOKS

1. J.Bhaskar, "A VHDL Primer", Prentice Hall of India Limited. 3rd edition 2004
2. Stephen Brown, "Fundamental of Digital logic with Verilog Design", 3rd edition, Tata McGraw Hill, 2008
3. J.Bhaskar, "A Verilog HDL Primer", Prentice Hall of India Limited. 3rd edition 2004
4. Samir Palnitkar "Verilog HDL: A Guide to Digital Design and Synthesis", Star Galaxy Publishing; 3rd edition, 2005
5. Michael D Ciletti - Advanced Digital Design with VERILOG HDL, 2nd Edition, PHI, 2009.
6. Z Navabi - Verilog Digital System Design, 2nd Edition, McGraw Hill, 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each -No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SECA3021	DIGITAL SYSTEM DESIGN AND VERIFICATION USING SYSTEM VERILOG	L	T	P	Credits	Total Marks
		2	0	2	3	100

Course Objectives

- To explore the fundamental concepts of verilog
- To understand system Verilog data types and capabilities
- To enumerate system Verilog RTL and abstraction
- To analyze dynamic types and arrays for behavioral modeling
- To evaluate System Verilog Assertions for design and verification

UNIT I DIGITAL DESIGN USING VERILOG HDL**9 Hrs**

Hardware modeling with the Verilog HDL: Encapsulation, modeling primitives, Types of Modelling. Logic system, Data types and operators. Behavioral descriptions in verilog HDL. Styles for Synthesis of combinational logic and sequential logic. HDL based Synthesis Technology independent design

UNIT II INTRODUCTION TO SYSTEM VERILOG**9 Hrs**

SystemVerilog standards, Key SystemVerilog enhancements for hardware design. Advantages of System Verilog over Verilog, Data Types: Verilog data types, System Verilog data types, 2 - State Data types, Bit, byte, shortint, int, longint. 4 - State data types. Logic, Enumerated data types, User Defined data types, Struct data types, Strings, Packages, Type Conversion: Dynamic casting, Static Casting, Memories: Arrays, Dynamic Arrays, Multidimensional Arrays, Packed Arrays, Associative Arrays, Queues, Array Methods, Tasks and Functions: Verilog Tasks and Functions

UNIT III CONNECTING THE TEST BENCH AND DESIGN**9 Hrs**

Verilog interface signals - Limitations of Verilog interface signals, SystemVerilog interfaces, SystemVerilog port connections, Interface instantiation, Interfaces Arguments, Interface Modports, Interface References, Tasks and functions in interface, Verilog Event Scheduler, SystemVerilog Event Scheduler, Clocking Block, Input and Output Skews, Typical Testbench Environment, Verification plan

UNIT IV CONSTRAINED RANDOMIZATION**9 Hrs**

Random Variables - rand and randc, Randomize() Method - Pre/Post Randomize() methods, Constraints in the class, Rand_mode and constraint_mode, Constraint and Inheritance, Constraint Overriding, Set Membership, Distribution Constraints, Conditional Constraints - .implication (->), if/else, Inline Constraints

UNIT V FUNCTIONAL COVERAGE AND ASSERTION BASED VERIFICATION**9 Hrs**

Coverage Definition, Code Coverage, Functional Coverage: Cover Group, Creating Cover Group Instances, Coverpoints, Bins - implicit bins, . Explicit bins, Bin creation, Vector and Scalar bins, Cross products, Intersect, Select Expressions, Conditional Expression (iff), Illegal bins, Ignore bins, Coverage Analysis, Covergroup Built-in Methods - .Sample(), .get_coverage(), .get_instance_coverage(), .set_instance_name(string), .start(), . stop()

COURSE OUTCOMES

On completion of the course the student will be able to

CO1: Understand the digital system designs skills using VERILOG HDL based on IEEE-1364 standards and managed by Open Verilog International (OVI)

CO2: Model digital systems in Verilog HDL at different levels of abstraction

CO3: Know the simulation techniques and test bench creation.

CO4: Demonstrate the skill on writing test-benches for design of digital systems and connecting them with the design.

CO5 Analyze the complete systems through robust verification methods such as assertion based verification.

CO6 Design the digital systems such as FIFOs, memories, ATM interfaces, etc. using the learnt methods and demonstrate the skills.

TEXT/REFERENCE BOOKS

1. Advanced Digital Design With the Verilog HDL, Michael D. Ciletti, 2nd Edition, PHI, ISBN: 978 0 -07 338054 4 2015.
2. Digital Systems Design Using Verilog, Charles Roth, Lizy K. John, Byeong KilLee, Cengage Learning, ISBN-10: 1285051076, 2015.
3. Fundamentals of Digital Logic with Verilog Design, Stephen Brown and Zvonko Vranesic, 6th Edition, McGraw Hill publication, ISBN: 978-0-07-338054-4, 2014.
4. System Verilog for Design - A Guide to Using System Verilog for Hardware Design and Modeling, Stuart Sutherland, Simon David mann and Peter Flake, 2E, Springer Science, ISBN-13: 978-0387-3339-91, 2006.
5. System Verilog for Verification-A Guide to Learning the Testbench Language Features, C Spear, Springer Science, IEEE press, ISBN-13: 978-0387-2703-64, 2006.
6. SystemVerilog golden reference guide-A concise guide to System Verilog Doulos ,IEEE Standard-1800- 2009, Version 5.0, ISBN: 0-9547345-9-9, 2012.
7. Step-by-Step Functional Verification with System Verilog and OVM, SasanIman, Hansen Brown Publishing Company, ISBN-13: 978-0-9816-5621-2, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A: 10 Questions of 2 marks each - No choice****20 Marks**

SECA3017	OPTICAL NETWORKS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To acquaint the students with basic optical communication components, topologies and types of networks.
- To familiarize on the principle of optical amplification and coupling.
- To make the students knowledgeable of various optical network topologies operations, limitations and its practical applications.
- To understand the choice of networks in optical communication.

UNIT 1 INTRODUCTION TO OPTICAL FIBRE**9 Hrs.**

Ray diagram, different types of optical fibre, step index, graded index. Mode Cut -Off wavelength, Mode-field Diameter, Equivalent Step-Index (ESI) Profile, Dispersion Measurements, Mechanical Strength of Optical Fibre. WDM network evolution, WDM network construction, broadcast and select optical WDM network, wavelength routed optical WDM network, Challenges of optical WDM network, OFDM.

UNIT 2 OPTICAL NETWORKING COMPONENTS / BUILDING BLOCKS**9 Hrs.**

Advantages of optical network, telecom network overview and architecture, WDM optical networks, WDM network evolution, WDM network construction, broadcast and select optical WDM network, wavelength routed optical WDM network, Challenges of optical WDM network. Optical transmitters, semiconductor laser diode, tunable and fixed laser, laser characteristics, photodetectors, tunable and fixed optical filters, channel equalizers, optical amplifiers and its characteristics, semiconductor laser amplifier, Raman amplifier, doped fiber amplifier, various Switching elements, OADM, OXC, CLOS architecture, MEMS, wavelength convertors.

UNIT 3 NETWORK TOPOLOGIES**9 Hrs.**

Robust networks, Line and path protection switching, Types of topology, Point to point topology, bi-directional line-switched ring (BLSR), meshed topology, Passive optical networks, Metro optical networks 28 MPLS and Optical Networks: IS label switching, Forwarding equivalence class (FEC), Types of MPLS nodes, Label distribution and binding, label swapping and traffic forwarding, MPLS support of Virtual Private Networks (VPN), MPLS traffic engineering, Multi -protocol Lambda switching (MPIS).

UNIT 4 SINGLE AND MULTIHOP NETWORKS**9 Hrs.**

Introduction to single and multi-hop networks, Characteristics of single and multi-hop networks, Experimental single hop networks: LAMBDANET, STARNET, SONATA, Rainbow, experimental multi-hop networks: Shuffle net, De Bruijn Graph, Hypercube.

UNIT 5 OPTICAL ACCESS AND METRO NETWORK**9 Hrs.**

Introduction to access network, PON, EPON and WDM EPON: overview, principal of operation, architecture; dynamic wavelength allocation, STARGATE: overview, need, architecture, operation and application, gigabit Ethernet, radio over fiber network. Introduction to metro network, overview of traffic grooming in SONET ring, traffic grooming in WDM ring, Interconnected WDM networks, packet communication using tunable WADM, RINGOSTAR: architecture, proxy stripping, protection and network lifetime.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1-Analyze the various causes for signal degradation and estimate the different types of losses occurring in transmission of energy
- CO2-Illustrate the necessity of using couplers and connectors in energy transmission
- CO3-Apply the principles of Wavelength Division Multiplexing on advanced devices
- CO4-Analyze the optical communication link using various types of network topologies
- CO5-Evaluate the dynamic wavelength allocation for Access networks
- CO6-Analyze the characteristics of optical access and metro networks

TEXT/REFERENCE BOOKS

1. Olivier Bouchet, HerveSizun, Christian Boisrobert and Frederique De Forne, "Free-Space Optics: Propagation and Communication", John Wiley and Sons, 2010.
2. Rajiv Ramaswami and Kumar Sivarajan, "Optical Networks - Practical Perspective", 3rd Edition, Morgan - Kaufmann Publishers.
3. Larry Peterson and Bruce Davie, "Computer Networks, A Systems Approach", 5th Edition, 2011, Morgan Kaufmann.
4. B. Mukherjee, "Optical WDM Networks", Springer, 2006.
5. R. C. Sivamurthy, G. Mohan, "WDM Optical Networks: Concepts, Design And Algorithms", PHI Learning Pvt Ltd, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2marks each-No choice**20 Marks****PARTB:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SEIA3004	SOFT COMPUTING TECHNIQUES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To learn the key aspects of Neural networks, Fuzzy logic components and building block hypothesis of Genetic algorithm.
- To adopt these techniques in solving problems in the real world.

UNIT 1 INTRODUCTION TO SOFT COMPUTING AND ARTIFICIAL NEURAL NETWORKS**9 Hrs.**

Evolution of Computing - Soft Computing Constituents - From Conventional AI to Computational Intelligence - Machine Learning Basics, Fundamentals of ANN - Biological Neurons and Their Artificial Models - Types of ANN - Properties - Different Learning Rules - Types of Activation Functions - Training of ANN - Hebb learning - Perceptron Model (Both Single and Multi Layer) - Training Algorithm - Problems Solving Using Learning Rules and Algorithms - Linear Separability Limitation. -

UNIT 2 DETERMINISTIC AND STATISTICAL NETWORKS**9 Hrs.**

Back Propagation Training Algorithm - Practical Difficulties - Counter Propagation Network - Structure & Operation - Training of Kohonen and Grossberg Layer - Applications of BPN & CPN - Statistical Method Training Application - Boltzman Training - Cauchy Training - Hop Field Network and Boltzman Machine - Speed Energy Function - Network Capacity - RBF Network, BAM, Architecture of SOM, ANN based water level controller.

UNIT 3 FUZZY LOGIC**9 Hrs.**

Introduction to Fuzzy Set Theory - Basic Concepts of Fuzzy Sets - Classical Set Vs Fuzzy Set - Properties of Fuzzy Set - Fuzzy Logic Operation on Fuzzy Sets - Fuzzy Logic Control Principles - Fuzzy Relations - Fuzzy Rules - Defuzzification - Fuzzy Inference Systems - Fuzzy Expert Systems - Fuzzy Decision Making.

UNIT 4 FUZZY LOGIC CONTROLLER & ITS APPLICATION**9 Hrs.**

Fuzzy Logic Controller - Fuzzification Interface - Knowledge Base- Decision Making Logic Defuzzification Interface- Application of Fuzzy Logic to Water Level Controller - Temperature Controller - Control of Blood Pressure during Anaesthesia. Introduction to Neuro - Fuzzy Systems - Fuzzy System Design Procedures - Fuzzy Sets and Logic Background - Fuzzy / ANN Design and Implementation.

UNIT 5 GENETIC ALGORITHMS**9 Hrs.**

Introduction - Robustness of Traditional Optimization and Search Techniques - The goals of optimization - Survival of the Fittest - Fitness Computations - Cross over - Mutation -Reproduction- Rank method- Rank space method.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of this course, student will be able to

- CO1-Analyze both supervised and unsupervised learning techniques in ANN
- CO2-Develop solution to real world problems using BPN, CPN, RBF, SOM and Boltzman machine
- CO3- Apply mathematical equations for developing fuzzy based systems
- CO4-Develop FLC for Real World Problems
- CO5-Analyze various techniques used for optimization in Fuzzy and neural networks
- CO6- Develop GA based solutions for Real World Problems

TEXT / REFERENCE BOOKS

- Laurene Fausett, " Fundamentals of Neural Networks: Architectures, Algorithms and Applications" 2008.
- Timothy J. Ross , "Fuzzy Logic with Engineering Applications", McGraw - Hill International Editions, 2004.
- Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and soft computing", Pearson Education, 2003.
- Rajasekaran. S, Pai. G.A.V. "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice Hall of India, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each-No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SECA3023	AUGMENTED REALITY AND VIRTUAL REALITY	L	T	P	Credits	Total Marks
		2	0	2	3	100

Course Objectives

- To explore the basic of AR/VR technology and devices
- To understand the various elements and components used in AR/VR Hardware and Software
- To explore the industrial application of AR/VR technology
- To analyze the difference between AR and VR
- To enable working on real life projects using AR/VR technology

UNIT I AUGMENTED REALITY**9 Hrs**

Introduction to Augmented Reality, Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems

UNIT II DEVELOPMENT OF AR MODELS**9 Hrs**

Unity, Basics of Unity, Understanding different panels in Unity, Moving, rotating & scaling Game objects in Unity, Game Panel in Unity, Physics in Unity, Increasing the light intensity, Adding colors to Game object, Adding textures to Game object, Parent and child Game objects in Unity, Local/Global and Pivot/Center tools in Unity, Prefabs in Unity, Scripts, Rotating the spheres, Revolving the spheres

UNIT III AUGMENTED REALITY ONE SECTION(ARONE) INTRODUCTION**9 Hrs**

Augmented Reality One (AROne) Section Introduction, Importing Vuforia package inside Unity, Importing Vuforia package via Vuforia Core Samples, Web Camera output and creating the ARONE License Key, Capturing an Image, Creating a Vuforia Database and uploading Image Targets, Projecting Barbarian 3D Model on Image Target, Testing the output on an Android smartphone, Testing the output on iPhone or iPad.

UNIT IV VIRTUAL REALITY**9 Hrs**

Introduction of Virtual Reality, Fundamental Concept and Components of Virtual Reality, Difference between AR and VR, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark, Primary Features and Present Development on Virtual Reality, Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection

UNIT V AR / VR APPLICATIONS**9 Hrs**

Engineering, Entertainment Movies, Game development, Science, Medical applications, military applications, robotics application, Case study - CRO based experiment, Building Electronic circuit using AR/VR.

Course Outcomes

On completion of the course, the student will be able to

CO1-Apply mathematical concepts for understanding Augmented reality and Virtual Reality

CO2-Analyze the development of AR models

CO3-Analyze various Vuforia package inside Unity

CO4-Develop a Virtual reality Model

CO5-Implement AR/VR in game development

CO6-Build any Electronic circuit using AR/VR

TEXT / REFERENCE BOOKS

1. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
2. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009
3. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, Wiley 2016
4. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA, ... 2015.
5. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg & Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016.
6. Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O'Reilly Media; 1 edition, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 12 marks**80 Marks**

SECA4007**REAL-TIME SYSTEM DESIGN**

L	T	P	Credits	Total marks
2	0	2	3	100

Pre requisite: NIL**Co Requisite:** NIL**Course Objectives**

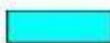
- To explain the features of real-time applications.
- To learn different task scheduling algorithms for real-time systems.
- To discuss various fault-tolerance techniques available for real-time systems.
- To learn about real-time operating systems and their characteristics.
- To study about various software tools for development of real-time embedded systems

UNIT	CONTENTS	HOURS
I	INTRODUCTION TO REAL-TIME SYSTEMS Real-time system characteristics-Hard real-time and soft real-time systems -Timing Constraints- Modelling Timing Constraints of typical real-time systems- Safety airbag - Aircraft Flight controller.	9
II	REAL-TIME TASK SCHEDULING Task Modelling -Types of Schedulers – Preemptive and Non-Preemptive scheduling - Cyclic schedulers- Rate Monotonic Algorithm (RMA-Earliest Deadline First Algorithm (EDFA)- Handling Resource sharing among real-time tasks – Priority Inversion – Priority Inheritance and Priority Ceiling Protocol for Deadlock prevention.	9
III	REAL-TIME OPERATING SYSTEMS Introduction to RTOS –Survey of real-time OS:Vxworks, QNX, Micrium OS, RT Linux and freeRTOS – Creating Tasks –Multitasking using RTOS - Interprocess Communication using mailbox, message queues – Task Synchronisation and Resource management using semaphores–Timers and Interrupts in RTOS-Memory Management in RTOS	9
IV	REAL-TIME SYSTEM MODELLING Model based system design frameworks - Petrinets and applications in real-time modeling, Vending Machine - Air traffic controller system – Distributed air defense system– Evaluation of system performance - In the loop Testing - Hardware in the loop testing-Software in loop testing	9
V	CASE STUDY OF REAL-TIME SYSTEMS Real-time PID controller-Real-time Multimedia communication-Real-time Databases-Aircraft Avionics-ECU in Automobiles	9

Maximum Hours: 45**Course Outcomes**

On completion of this course, students are able to

- CO1- Identify timing constraints of real-time systems
- CO2- Apply appropriate scheduling algorithms for timely execution of real-time tasks
- CO3- Develop real-time applications using RTOS
- CO4- Apply model based design approach for given real-time application



Employability



Entrepreneurship



Skill Development

CO5- Apply fault tolerant design techniques in developing real-time systems.

CO6- Evaluate performance of real-time systems using model based design frameworks.

TEXT / REFERENCE BOOKS

1. Philip. A Laplante, "Real Time System Design and Analysis", Prentice Hall of India, 4th Edition.2012.
2. Jane W. S Liu, "Real Time Systems" Pearson Higher Education, 4th Edition, 2014.
3. Richard Barry, "Mastering the Free RTOS: Real Time Kernel", Real Time Engineers Ltd, 1st Edition, 2016.
4. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2nd Edition, 2014.
5. Warren Gay, "Beginning STM32: Developing with Free RTOS",Apress, 1st Edition, 2018.
6. Li Q, Yao C, "Real-Time Concepts for Embedded Systems", CMP Books, 1st Edition, 2003.



Employability



Entrepreneurship



Skill Development

SEC1626	System Programming	L	T	P	Credits	Total Marks
		4	0	0	4	100

COURSE OBJECTIVES

This course is meant to give them a broad exposure to the understanding of various concepts of System Programming.

The course will provide the students with

- (i) the concept of advanced Embedded C Language,
- (ii) the knowledge of microcontroller architecture,
- (iii) the methodology to write Program for chosen microcontroller, and
- (iv) the skill to use basic technique for debugging in Linux environment and
- (v) basic understanding of system programming.

Experiments will run in synchronism with the lectures to support the methods and techniques taught in the lectures. Through the experiments, the students will

- (i) learn how to use Linux commands and programming environment,
- (ii) gain confidence to do system programming in Linux environment, and learn how to test and debug the developed programs.

Learning Outcome of students are

- (i) Perform advanced C programming using linked list, Function pointers, arrays, sorting, etc.,
- (ii) Basic scripting in Linux environment
- (iii) Demonstrate programming using Linux System calls
- (iv) Demonstrate various debugging techniques when the program throws error
- (v) Plan and execute projects simple system programming projects.

UNIT 1 EMBEDDED C PROGRAMMING

9Hrs.

Essential C Programming Concepts, Variables and Constants, IO operation, Memory Layouts, Operators and Expression, Control Statements, Functions, Arrays, Pointer, Structure and Union, Debugging Methods.

Lab work

1. Programs to understand the various C memory layouts and variable storage locations.
2. Programs to understand the control and conditional statements extensively.
3. Programs to understand the passing of 1-D, 2-D arrays to functions as argument.
4. Programs to understand the pointer usage and passing argument by reference.
5. Programs to understand the structure, union, enum, typedef and bitwise logical operations.

Project

1. Projects based on the modular programming design.
2. Projects based on event handlers
3. Projects based on finite state machine

UNIT 2 EMBEDDED SYSTEM SOFTWARE

9Hrs.

Assembly and C Microcontroller Programming, IO Port Programming, Timer Programming, Handling Interrupts, Interfacing with external peripherals and memory, ADC Programming, LCD & Keypad Programming, Interfacing with Sensors.

Lab work

1. Programs to understand the GPIO input, output and alternate functionalities.



Employability



Entrepreneurship



Skill Development

2. Programs to understand the timer functionalities in the microcontroller.
3. Programs to understand various interrupts and interrupt service handler and interrupt service routines.
4. Programs to understand the external interrupts and external peripheral interface with the microcontroller.
5. Programs to understand the ADC and DAC interfaces with the microcontroller.
6. Programs to understand the display and keypad interfaces with the microcontroller.
7. Programs to understand the external sensor signal handling in the microcontroller.

Project

1. Constructing the circuit in the breadboard to execute the lab work exercises in the actual hardware.
2. Developing programs for microcontroller with modular programming using state machines approaches.

UNIT3 EMBEDDED LINUX SYSTEM PROGRAMMING**9Hrs.**

System Programming Concepts, File Operation Programming, IO Operation Programming, Advance Process Management Programming and Thread Programming and Mutex.

Lab work

1. Programs to understand the file management in Linux C.
2. Programs to understand the process handling in Linux C.
3. Programs to understand the threads and mutex in Linux C.

Project

1. Developing multi processes project in Linux C.
2. Developing project using threads and mutex.

UNIT 4 EMBEDDED LINUX SYSTEM PROGRAMMING IPCs**9Hrs.**

Essential Inter Process Communication and Synchronization, Pipes, Signals, Timers, Shared Memory, Message Queues and Semaphores.

1. Programs to understand the Pipes in Linux C.
2. Programs to understand the Signals and Timers in Linux C.
3. Programs to understand the Shared Memory and Semaphores in Linux C.
4. Programs to understand the Message Queues in Linux C.

Project

1. Developing event-based project using Linux IPC and synchronization mechanism.
2. Developing message queue-based project using message queue and synchronization mechanism.

UNIT 5 ADVANCE MICROCONTROLLER PROGRAMMING**9Hrs.**

Introduction of Advanced Microcontroller Architectures, Buses, Memory, Clock Tree, Reset, Interrupts Management, IOs, Timers, and external interfaces.

Lab work

1. Programs to understand the various clock configurations.
2. Programs to understand the timer configurations and event handlers.
3. Programs to understand various interrupts and interrupt service handler and interrupt service routines.
4. Programs to understand the external interrupts and external peripheral interface with the microcontroller.
5. Programs to understand the handling of external signals.



Employability



Entrepreneurship



Skill Development

TEXT BOOK/ REFERENCE BOOKS**Text Books:**

Advanced Embedded C Programming
The C Language Programming, Brian W. Kernighan , Dennis M. Ritchie, 1998.
Linux System Programming
Linux System Programming, Robert Love, 2013.
Advanced Microcontroller Programming
Discovering the STM32 Microcontroller, Geoffrey Brown, 2012.

Reference Books:**Advanced Embedded C Programming**

1. THE FIRMWARE HANDBOOK, Jack Ganssle, 2004..
2. C Programming for Embedded Systems, Kirk Zurell, 2000.
3. Making Embedded Systems, Elecia White, 2011.

Linux System Programming

1. Beginning Linux Programming, Neil Matthew & Richard Stones, 2008.
2. Hands-On System Programming with Linux, Kaiwan N Billimoria, 2018.

Advanced Microcontroller Programming

1. Mastering STM32, Carmine Noviello, 2016.
2. ARM Cortex M4 Cookbook, Dr. Mark Fisher, 2016.
3. RM0090, Reference manual, STM32F405/415, STM32F407/417, STM32F427/437 and STM32F429/439 advanced Arm®-based 32-bit MCUs.
4. PM0214 Programming manual STM32 Cortex-M4 MCUs and MPUs programming manual.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3Hrs.****Employability****Entrepreneurship****Skill Development**

SECA704	ARTIFICIAL INTELLIGENCE FOR INDUSTRIAL APPLICATIONS	L	T	P	Credit s	Total marks
		2	0	2	3	100

Pre requisite: NIL

Co Requisite: NIL

Course Objectives

- To explore the fundamental concepts of Artificial Intelligence (AI)
- To assess the applicability, strengths, and weaknesses of the basic knowledge representation
- To impart machine learning techniques
- To understand various CNNs
- To develop the solutions for real world problems using AI

UNIT	CONTENTS	HOURS
I	OVERVIEW OF AI	9
	Evolution of AI, Applications of AI, Classification of AI systems, Knowledge Inferring systems and Planning, Uncertainty and towards Learning Systems, Problem solving by Search, Problem space, State space, Blind Search, Types, Performance measurement.	
II	KNOWLEDGE REPRESENTATION	9
	First Order Predicate Logic, Prolog Programming, Unification, Forward Chaining, Backward Chaining, Resolution, Knowledge Representation, Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.	
III	FOUNDATIONS FOR MACHINE LEARNING	9
	ML Techniques overview, Dimensionality Reduction, Clustering, Regression, Classification Naïve Bayes; K-nearest Neighbours; SVM; Decision Trees, Ensemble methods	
IV	UNDERSTANDING DEEP LEARNING	9
	Perceptron, Activation Functions, Artificial Neural Networks, Training Neural Networks, Convolutional Neural Networks, Evolution of CNN Architectures: AlexNet, VGG, ResNets, DenseNets, Recurrent Neural Networks.	
V	APPLICATIONS	9
	AI applications, Information Retrieval, Machine Translation, Classification, Object Detection, Artificial Intelligence Techniques for Cyber-Physical, Digital Twin Systems and Engineering Applications	

Maximum Hours: 45

Course Outcomes

On completion of the course, the student will be able to CO1-
Evaluate Artificial Intelligence methods.

CO2- Demonstrate knowledge of reasoning and knowledge representation for solving real world problems CO3-
Analyze various machine learning techniques

CO4-Identify suitable deep learning techniques for real world problems



Employability



Entrepreneurship



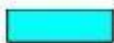
Skill Development

CO5-Implement image classification and object detection systems CO6-

Solve real world problems in cyber physical systems using AI

TEXT / REFERENCE BOOKS

1. Phil Kim. "MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress, 2017.
2. Jan Erik Solem, "Programming Computer Vision with Python", Creative Commons, 2012.
3. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall, 3rd Edition, 2015.
4. Alpaydin, E., "Introduction to Machine Learning", 2nd edition, MIT Press, 2010.
5. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.
6. M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc.; 1st Edition, 2008.
7. William F. Clocksin and Christopher S. Mellish, "Programming in Prolog: Using the ISO Standard", 5th Edition, Springer, 2003



Employability



Entrepreneurship



Skill Development

SEC1627	EMBEDDED LINUX BSP & PERFORMANCE TUNING	L	T	P	Credits	Total Marks
		2	1	0	3	100

COURSE OBJECTIVES

This course focusses on applying the topics learned in 6th and 7th semester for a real-world application, expands the understanding of the components that make up an embedded system.

The course will provide the students with

- (i) Advanced C skills and exposure to C++
- (ii) The core concepts of boot loader, BSP and performance tuning
- (iii) Substantiate the previous learnings of C programming and device drivers,
- (iv) The methodologies for debugging and performance tuning

UNIT 1 APPLICATIONS of 'C' & C++ BASIC 9Hrs.

Advanced C: Compiler - linker - loader, ELF, Static and Dynamic Libraries, Structure, Union and Bit field Structure, Pointers, Arrays, Multi-dimensional Arrays, Double pointers, Function Pointers, Memory Allocation, linked list, Queue and Stack, Hash table, Data structure algorithms, Makefiles. C++ basic: Classes & Objects, C++ Pointers & Arrays, Constructors & Destructors, Overloading, Inheritance, Virtual functions, Polymorphism, Exception handling, Templates, CMAKE.

UNIT 2 APPLICATIONS of LINUX SYSTEM PROGRAMMING 9Hrs.

Industrial Protocols Overview: CAN, Modbus, Profibus, EtherCAT, CoAP, Advanced Process Management: Scheduler Types, Priorities, Affinity, Hard Vs Soft Real-time Systems, Advanced Thread Management: Revisiting Thread Models, Patterns, Concurrency, Parallelism, Races, Synchronization and Pthread.

UNIT 3 APPLICATIONS of DEVICE DRIVERS 9Hrs.

PCI: PCI Vs PCI-X Vs PCIe, PCI Architecture, Memory and IO map, Configuration Space, Enumeration, Block drivers, DAS/NAS/SAN Overview, Storage Architecture. Ethernet Driver: Ethernet boot loader driver, Ethernet Linux driver, Ethernet tools & tests, Raw socket, General Device Drivers1: Memory, RTC, Sensors, Power rails, General Device Drivers2: Timers, ADC, IOs using PINCTRL, Waveforms using PWM, High level tests for Audio & Video

UNIT 4 EMBEDDED LINUX BSP 9Hrs.

Boot Loader: Introduction, Device tree, Arguments, Boot sequence, Drivers, Optimizations, U-boot commands, Accessing boot environments from user space. Board Support Package: of a BSP, Toolchain, build system, Booting Linux locally and from remote, Booting Ubuntu with a new Kernel, Booting with plain vanilla Kernel, Core dumps, Busy box.

UNIT 5 DEBUGGING & PERFORMANCE TUNING 9Hrs.

Introduction, Methods and Concepts, Boot parameters, /proc, /Sys and Sysctl, System Monitoring, Timer counter, Memory Management (swap, page, defragmentation), Tuning - memory/Network/Device usage, Controlling Process - Threads, Profiling and Benchmarking methods, Debugging Methods and Techniques – CRO and Logic Analyzers, JTAG, Problem Reproduction, Dumps, Break point, Single Step, variables and history analysis, Print statement, Interrupt, I/O points, Instrumenting code, Code Tracing & Coverage.



Employability



Entrepreneurship



Skill Development

COURSE OUTCOMES

On completion of the course the student will be able to

Learning Outcome of students are

- CO1: Become well versed in C and exposed to C++
- CO2: Applying PCI device driver knowledge for a Storage use case
- CO3: Understanding of Bootloader and BSP components
- CO4: Understanding of build systems
- CO5: Demonstrate building a custom Linux distribution
- CO6: Demonstrate various debugging and performance tuning techniques

TEXTBOOK/ REFERENCE BOOKS**Textbooks:**

1. Peter D Hipson, Advanced C, Sams Publishing, 1982
2. John Perry, Advanced C programming by Example, PWS, 1982
3. Andrew and Barbara, Accelerated C++ Practical Programming by Example, Addison-Wesley, 2000.
4. Robert Love, Linux System Programming, 2nd Edition, O'Reilly Media, Inc.2013
5. Michael Kerrisk, The Linux Programming Interface: A Linux and UNIX System Programming Handbook, No Starch Press, 2010



Employability



Entrepreneurship



Skill Development

SECA3036

MEDICAL INSTRUMENTATION AND IMAGING TECHNIQUE

L	T	P	Cred its	Total marks
2	0	2	3	100

Pre requisite: Electronics Circuits**Co Requisite:** NIL**Course Objectives**

- To explore the characteristics of biomedical signals and systems.
- To analyze the various electronics circuits used for medical signals conditioning
- To study and understand various assistive devices and monitors used in medical instrumentation
- To analysis the operation of various imaging equipments
- To implement various imaging techniques for real time medical applications

UNIT	CONTENTS	HOURS
I	BIOPOTENTIAL MEASUREMENTS Sources of biomedical signals, Basic medical instrumentation system, Bio signals characteristics frequency and amplitude ranges. ECG – Einthoven's triangle, Standard lead system, Principles of vector cardiography. EEG 10-20 electrode system, unipolar, bipolar and average mode. EMG- unipolar and bipolar mode. Recording of ERG and EOG.	9
II	SIGNAL CONDITIONING CIRCUITS Need for bio-amplifier _ single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers _ transformer and optical isolation _ isolated DC amplifier and AC carrier amplifier, Power line interference, Right leg driven ECG amplifier, Band pass filtering.	9
III	ASSISTIVE DEVICES AND MONITORS Cardiac Pacemakers, Heart lung machine- Oxygenators - Pumps, Monitoring Process. Hemodialyzer- Principle of Haemodialysis, Membranes, Dialysate, Different types of hemodialyzer's, Wearable Artificial Kidney, Defibrillators, Implantable defibrillators, Functional electrical stimulator (FES)	9
IV	IMAGING EQUIPMENTS X-Ray machine, CT - Scanning system, processing unit, viewing part & storage unit. MRI - The magnet, RF transmitter system, Gradient system, imager system, Advantages. Ultrasonic imaging systems - A Scan, B Scan, TM Mode Scan, Echocardiography.	9



Employability



Entrepreneurship



Skill Development

Biomedical Applications Thermographic Equipment, Mobile units of Computer Radiography & Digital Radiography system, 3D/4D Sonography systems, Mammography, Angiography, Endoscopy, Capsule Endoscopy, Laparoscopy. Foetal Monitoring System.

Maximum Hours: 45

Course Outcomes

On completion of the course, the student will be able to

CO1- Apply Suitable biomedical signals for medical instruments

CO2-Analyze suitable signal conditioning circuits for the medical instruments

CO3-Analyze Various assistive devices and monitors used for medical instrumentation

CO4-Identify the techniques used in various imaging systems

CO5-Implement various imaging techniques for real time medical applications on real time imaging system

CO6-Design an instrument for real time medical application

TEXT / REFERENCE BOOKS

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson, Second Edition, 2004
2. John G. Webster, Medical Instrumentation Application and Design, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
3. Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education, 2004.
4. Myer Kutz, Standard Handbook of Biomedical Engineering and Design, McGraw Hill Publisher, 2003.
5. Khandpur R.S, Handbook of Biomedical Instrumentation, 3rd edition, Tata McGrawHill New Delhi, 2014
6. Step by Step CT; Step by Step MRI and MRI made Easy for beginners – Govind B. Chavhan – Jaypee brothers and Medical Publishers (p) Ltd, New Delhi CT & MRI protocol – Satish K. Bhargava, CBS publishers.
7. R. Ananda Natarajan, Biomedical Instrumentation and Measurements, 2nd Edition, PHI, 2016.

SCS1622	Linux Kernel & Device Drivers	L	T	P	Credits	Total Marks
		4	0	0	4	100

COURSE OBJECTIVES

This course is meant to give them a broad exposure to the understanding of various concepts of Linux Kernel and Device Driver Programming.

The course will provide the students with

- The core concepts of operating systems
- The knowledge of Linux Kernel architecture and device driver framework,
- The methodology to write Programs for chosen embedded devices, and
- The skill to use basic techniques for debugging in Linux device drivers and
- Basic understanding of Linux based embedded system design.

UNIT 1 INTRODUCTION TO THE LINUX KERNEL

9 Hrs.

Preliminaries - UNIX Vs Linux, Types of Kernels, Versions, Kernel repository, Object-Oriented approach in Linux Kernel, Important Kernel tasks, User-Space and Kernel-Space. Programming Preview - Error numbers and Getting Kernel output, Task structure, Memory allocations, Kernel data structures, Jiffies Kernel Architecture Preview - Processes Vs Threads Vs Tasks, Process address space and Process context, Process limits and capabilities, Kernel Preemption, Real Time Preemption Patch, Dynamic Kernel Patching, Porting to a New Platform Kernel Initialization - System initialization, Systemboot, U-Boot, Kernel Configuration - Layout of the Kernel source, Kernel configuration files, Kernel Building and Makefiles, initrd and initramfs Kernel style & general considerations - Coding style, kernel-doc, Using generic Kernel routines and methods, sparse, Using likely() and unlikely(), Writing portable code (CPU, 32/64-bit, Endianness), Writing for SMP, Writing for high memory systems, Power management, Keeping security in mind, Mixing user and Kernel space headers, Modules - What are modules? Compiling modules, modules vs built-in, Module utilities, Automatic loading/unloading of modules, Module usage count, the module struct, Module licensing, exporting symbols, Resolving symbols

UNIT 2 DEVICE DRIVERS I

9 Hrs.

Device Driver Overview - Types of devices, Mechanism vs. Policy, avoiding binary blobs, Power management, How applications use device drivers, Walking through a system call accessing a device, Error numbers, printk(), devres: Managed device resources, Device driver binding Platform Drivers - Platform devices, I2C subsystem, Device trees, Pin-muxing, Memory management overview, I/O memory and ports, Character Drivers - Character devices, Interaction of user space applications with the kernel, ioctl's, Memory addressing - Virtual memory management, Systems with and without MMU and the TLB, Memory addresses, High and low memory, Memory zones, Special device nodes, NUMA, Paging, Page tables, page structure, Kernel Samepage Merging (KSM), Huge page support, libhugetlbfs, Transparent huge pages, Memory allocation - Requesting and releasing pages, Buddy system, Slabs and cache allocations, Memory pools, kmalloc(), vmalloc(), Early allocations and bootmem(), Memory defragmentation

UNIT3 KERNEL FRAMEWORK I

9Hrs.

Race conditions & synchronization - Concurrency and synchronization Methods, Atomic operations, Bit operations, Spinlocks, Seqlocks, Disabling preemption, Mutexes, Semaphores, Completion functions, RCU, Reference counts SMP and Threads - SMP Kernels and modules, Processor affinity, CPUSETS, SMP algorithms (Scheduling, Locking, etc.), Per-CPU variable, Scheduling - Main scheduling tasks, SMP, Scheduling priorities, Scheduling system calls, the schedule() function, O(1) Scheduler, Time slices and priorities, Load balancing, Priority inversion and priority inheritance, The CFS scheduler, Calculating priorities and fair times, Scheduling classes, CFS Scheduler Details, Disk caches and swapping - Caches, Page cache basics, what is swapping, Swap areas, swapping pages In and Out, Controlling swappiness, The swap cache, Reverse mapping, OOM Killer, Signals - What are Signals? Available signals, System calls for signals, Sigaction, Signals and threads, How the Kernel installs signal handlers, How the Kernel sends signals, How the Kernel invokes signal handlers, Real time signals

B.E /B.Tech REGULAR



Employability



Entrepreneurship



Skill Development

UNIT 4 DEVICE DRIVERS II**9Hrs.**

Input Subsystem – Principles of Kernel Input subsystem, API offered to kernel drivers to expose input devices capabilities to user space applications, User space API offered by the input subsystem, the misc Subsystem - What the misc kernel subsystem is useful for? API of the misc kernel subsystem (both the kernel side and user space side), GPIO Subsystem -API of the GPIO kernel subsystem (both the kernel side and user space side), PCI Drivers - What is PCI? Locating PCI Devices, Accessing Configuration Space, Accessing I/O and Memory Spaces, PCI Express Sleeping and Interrupts, Locking Monitoring & debugging

UNIT 5 KERNEL FRAMEWORK II**9Hrs.**

DMA - What is DMA? DMA directly to user, DMA and Interrupts, DMA memory constraints, DMA masks, DMA API, DMA pools, Scatter/Gather mappings, Memory Technology Devices - What are MTD Devices? NAND vs. NOR vs. eMMC, Flash filesystems, Block Drivers - What are Block Drivers? Buffering, Registering a block driver, gendisk structure, Request handling, Power Management - ACPI and APM, System power states, Callback functions, Network Drivers - Network Layers and Data Encapsulation, Datalink Layer, Network Device Drivers, Loading/Unloading, Opening and Closing, net_device, sk_buff, Tx/Rx, ioctls, NAPI

COURSE OUTCOMES :

On completion of the course the student will be able to

- CO1: Understanding of complex Linux Kernel framework and extending this knowledge to understand any type of operating system
- CO2: Writing device drivers for simple embedded devices
- CO3: Basic scripting to building the Linux Kernel and Device Drivers
- CO4: Demonstrate end-end data flow from device to application
- CO5: Demonstrate various debugging techniques when the system crashes due to a malfunctioning Kernel or Device Driver
- CO6: Plan and execute simple device driver development projects.

TEXTBOOK/ REFERENCE BOOKS

1. Robert Love, Linux System Programming, 2nd Edition, O'Reilly Media, Inc. 2013
2. Michael Kerrisk, The Linux Programming Interface: A Linux and UNIX System Programming Handbook, No Starch Press, 2010

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3Hrs**

B.E /B.Tech REGULAR



Employability



Entrepreneurship



Skill Development

SECA1406 (NEW)	INDUSTRY 5.0 FOR ELECTRONICS ENGINEERS	L	T	P	Credits	Total marks
		2	0	0	2	100

Pre requisite: NIL

Co Requisite: NIL

Course Objectives

- To acquaint with the digital transformation of Industry 5.0
- To recognize the power of industry to achieve societal goals beyond jobs and growth
- To understand the design of personalized electronics products
- To focus on methods of interaction between humans and machines
- To develop the concept of electronics manufacturing beyond automation and optimization

UNIT	CONTENTS	HOURS
	INDUSTRY 4.0	
1	Introduction to Industry 4.0, Industry 4.0: The Fourth Industrial Revolution, History of Industry 4.0, Industry 4.0 by definition, Component of Industry 4.0, The opportunities in Industry 4.0, Industrial Internet, Smart Factory, Smart Buildings, Smart Manufacturing, Smart Farming.	9
	INDUSTRY 5.0	
2	Evolution from Industry 1.0 to 5.0, Introduction to Industry 5.0, Globalization and Emerging Issues, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Healthcare and Human computer interactions, Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Big Data and Advanced Analysis.	9
	DIGITAL TRANSFORMATION TO SOCIETY 5.0	
3	Digital Transformation, Introduction to Digital Transformation, Digital business transformation, Causes of disruption and transformation, Digital transformation myths and realities, Digital transformation across various industries, Retail industry, Urban Development, e-Governance and the public sector, Insurance industry, Healthcare, Food, Manufacturing, Disaster Control, Elements of Society 5.0, Data Driven to Society, Humanity Vs Society 5.0.	9
	SMART WORLD	
4	Introduction: Sensing & actuation, Communication, Electronics in Smart city, 5G Technology, Communication protocols, Integration of Sensors in Robots and Artificial Intelligence, Human-Machine Interaction, Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management., Intellectual Property Rights- Case Studies - Milk Processing and Packaging Industries.	9

CYBER SECURITY IN INDUSTRY 5.0

5	Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Intellectual Property Rights (IPR) : Case Studies- Augmented Reality Virtual Reality	9
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Maximum Hours: 45

COURSE OUTCOMES

On completion of the course, student will be able to

CO1– Identify the digital transformation power of Industry 5.0 to achieve societal goals beyond jobs and growth

CO2– Analyze enhanced new production models in electronics

CO3– Implement various electronics manufacturing technologies beyond automation and optimization CO4 – Design suitable sensors for smart world real time applications

CO5– Evaluate the performance of various cyber physical systems

CO6– Create personalized electronics products combining the various industry 5.0

Applications with deep knowledge on Intellectual Property Rights

TEXT / REFERENCE BOOKS

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press. Availability: https://www.amazon.in/Introduction-IoT-Sudip-Misra/dp/1108959741/ref=sr_1_1?dchild=1&keywords=sudip+misra&qid=1627359928&sr=8-1.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
availability:https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3
3. Klaus Schwab, “Fourth Industrial Revolution”, Random House USA Inc, New York, USA, 2017.
4. Oliver Grunow, ”SMART FACTORY AND INDUSTRY 4.0. The current state of ApplicationTechnologies”, Studylab Publications, 2016.
5. Alasdair Gilchrist, “INDUSTRY 4.0: Industrial Internet of Things”, Apress, 2016.



Employability



Entrepreneurship



Skill Development

SECA5209

STRATEGIES IN INDUSTRY 5.0

L	T	P	Credit	Total
			s	marks
2	0	0	2	100

Pre requisite: INDUSTRY 4.0**Co Requisite:** NIL**Course Objectives**

To acquaint with the digital transformation of Industry 5.0

To recognize the power of industry to achieve societal goals beyond jobs and growth

To understand the design of personalized electronics products

To focus on methods of interaction between humans and machines in virtual reality

To develop the concept of augmented reality in electronics manufacturing beyond automation and optimization

UNIT	CONTENTS	HOURS
T		S
	INDUSTRY 5.0	
1	Evolution from Industry 1.0 to 5.0, Introduction to Industry 5.0, Globalization and Emerging Issues, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Healthcare and Human computer interactions, Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Big Data and Advanced Analysis.	9
	DIGITAL TRANSFORMATION TO INDUSTRY 5.0	
2	Digital Transformation, Introduction to Digital Transformation, Digital business transformation, Causes of disruption and transformation, Digital transformation myths and realities, Digital transformation across various industries, Retail industry, Urban Development, e-Governance and the public sector, Insurance industry, Healthcare, Food, Manufacturing, Disaster Control, Elements of Society 5.0, Data Driven to Society, Humanity Vs Society 5.0.	9
	SMART WORLD	
3	Introduction: Sensing & actuation, Communication, Electronics in Smart city, 5G Technology, Communication protocols, Integration of Sensors in Robots and Artificial Intelligence, Human-Machine Interaction, Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management., Intellectual Property Rights- Case Studies - Milk Processing and Packaging Industries.	9
	CYBER SECURITY IN INDUSTRY 5.0	
4	Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Intellectual Property Rights (IPR).	9

AR/VR IN INDUSTRY 5.0

5	Unity, Basics of Unity, Understanding different panels in Unity, Moving, rotating & scaling Gameobjects in Unity, Game Panel in Unity, Physics in Unity, Increasing the light intensity, Adding colors to Gameobject, Adding textures to Gameobject, Parent and child Gameobjects in Unity. Case Studies- Development of AR/VR Models in Unity.	9
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Maximum Hours: 45

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 – Identify the digital transformation power of Industry 5.0 to achieve societal goals beyond jobs and growth
- CO2 – Analyze enhanced new production models in electronics
- CO3 – Implement various electronics manufacturing technologies of augmented reality beyond automation and optimization
- CO4 – Design suitable sensors for smart world real time applications with virtual reality experience
- CO5 – Evaluate the performance of various cyber physical systems
- CO6 – Create personalized electronics products combining the various industry 5.0 Applications with deep knowledge on Intellectual Property Rights

TEXT / REFERENCE BOOKS

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press. Availability:https://www.amazon.in/Introduction-IoT-Sudip-Misra/dp/1108959741/ref=sr_1_1?dchild=1&keywords=sudip+misra&qid=1627359928&sr=8-1.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press. Availability:https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3
3. Klaus Schwab, “Fourth Industrial Revolution”, Random House USA Inc, New York, USA, 2017.
4. Oliver Grunow, ”SMART FACTORY AND INDUSTRY 4.0. The current state of Application Technologies”, Studylab Publications, 2016..
5. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
6. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.
7. Grigore C. Burdea, Philippe Coiffet , Virtual Reality Technology, Wiley 2016

SECA1101	ELECTRONIC DEVICES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field effect Transistors, Power control devices, LED, LCD and other Opto- electronic devices.
- To understand the mechanisms of current flow in semi-conductors.
- To familiarize on the principle of operation, capabilities and limitation of various advanced semiconductor devices and its practical application.
- To design practical circuits with alternate electronic devices.
- To study about the display devices and power semiconductors.

UNIT 1 SEMICONDUCTOR DIODE**9 Hrs.**

PN junction diode- construction and operation, Current equations, Diffusion and drift current densities, forward and reverse bias characteristics, Breakdown in PN Junction Diodes. Applications- Rectifiers, Limiting and Clamping Circuits, Zener diode- construction and VI characteristics.

UNIT 2 BIPOLAR JUNCTION TRANSISTOR**9 Hrs.**

Bipolar junction transistors, NPN -PNP, construction, forward and reverse bias characteristics -Early effect, current equations- Input and Output characteristics of CE, CB CC- Ebers Moll Model- Multi Emitter Transistor, Gummel Poon-model.

UNIT 3 FIELD EFFECT TRANSISTORS**9 Hrs.**

JFETs Drain and Transfer characteristics, -Current Equations-Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET- Characteristics Comparison of MOSFET with JFET, DUAL GATE MOSFET.

UNIT 4 SPECIAL SEMICONDUCTOR DEVICES**9 Hrs.**

Schottky barrier diode-SCR, DIAC, TRIAC, Varactor diode, Tunnel diode, UJT, LDR, Photo transistor, Gallium Arsenide device.

UNIT 5 POWER DEVICES AND DISPLAY DEVICES**9 Hrs.**

Power BJT- Power MOSFET- DMOS-VMOS, CRO, LASER diode, Operation of LCDs, Plasma, LED, Opto-Coupler, Solar cell, CCD.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Apply the knowledge of basic semiconductor materials and understand fabrication processes.
- CO2 - Analyse the characteristics of various electronic devices like diode, transistor etc.
- CO3 - Classify and analyse the various circuit configurations of Transistor and MOSFETs.
- CO4 - Illustrate the qualitative knowledge of Power electronic Devices.
- CO5 - Become Aware of the latest technological changes in Display Devices.
- CO6 - Apply the knowledge of basic semiconductor materials and understand fabrication processes.

TEXT / REFERENCE BOOKS

1. Donald A Neaman, "Semiconductor Physics and Devices", 4th Edition, Tata McGraw Hill Inc. 2012.
2. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, "Electronic Devices and circuits", 3rd Edition, Tata McGraw Hill, 2008.
3. David Bell, "Fundamentals of Electronic Devices and Circuits", 5th Edition, Oxford University Press 2012.
4. Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory" Pearson Prentice Hall, 10th Edition, 2008.
5. R.S.Sedha, "A Text Book of Applied Electronics", S.Chand Publications, 2006.
6. Edward S.Yang, "Fundamentals of Semiconductor devices", McGraw Hill International Edition, 1978.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 mark each -No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SECA1307	ELECTRONIC CIRCUITS - I	L	T	P	Credits	Total Marks
		3	*	0	3	100

Course Objectives

- To understand the method of biasing transistors.
- To acquire the knowledge of equivalent circuits.
- To understand the frequency response of amplifiers.
- To provide foundation and confidence to the students to troubleshoot and fault analysis of power supplies and power amplifiers.
- To develop current mirrors and differential operations

UNIT I BIASING OF BJT AND FET**9 Hrs.**

BJT-Need for biasing -Various biasing methods of BJT- Bias Circuit Design- DC Load Line -DC analysis of Transistor circuits-AC Load Line- AC analysis of Transistor Circuits- Quiescent Point-Thermal stability - Stability factors - Biasing of JFET - Various biasing methods of JFET - JFET Bias Circuit Design - MOSFET Biasing-Two port network.

UNIT II EQUIVALENT MODELS OF BJT AND FET AMPLIFIERS**9 Hrs.**

Hybrid model- Analysis of CE, CC and CB amplifiers using Hybrid equivalent circuits to obtain gain, input impedance and output impedance- Small Signal Amplifiers Analysis of CE, CC and CB amplifiers using small signal equivalent circuits to obtain gain, input impedance and output impedance. Small Signal equivalent circuit of FET and MOSFET - Analysis of CS, CD and CG JFET amplifiers using small signal equivalent circuits- Analysis of CS, CD and CG MOSFET amplifiers using small signal equivalent circuits

UNIT III MULTISTAGE AMPLIFIERS AND FREQUENCY RESPONSE OF BJT AND FET AMPLIFIERS**9 Hrs.**

Multistage Amplifiers- Methods of Coupling- RC Coupled- Transformer Coupled Direct Coupled Amplifiers- Amplifier frequency response Miller effect- Frequency response of transistor amplifiers with circuit capacitors BJT frequency response Low and High frequency analysis of CE, CB, CC -Frequency response of FET Low and High frequency analysis of CS, CG, CD JFET & MOSFET.

UNIT IV POWER SUPPLIES AND POWER AMPLIFIERS**9 Hrs.**

Linear mode power supply - Rectifiers - Half-Wave Rectifier - Full-Wave Rectifier - Filters-L, C, LC, CLC Filter- Regulators - Zener Diode regulator- Linear series, shunt voltage Regulators - Switched mode power supply (SMPS) Large Signal Amplifiers - Class A, Class B, Class C, Class D- Distortion in power amplifiers.

UNIT V CURRENT MIRRORS AND DIFFERENTIAL AMPLIFIERS**9 Hrs.**

Current sources for biasing -Current steering circuits -Current mirror with improved performance (Cascode mirror, Wilson, Widlar). Large and small signal operation of Differential pair circuit Differential pair with active load - Frequency response of the Differential amplifier

Max. Hours: 45**Course Outcomes**

On completion of the course, the student should be able to

CO1 -Design biasing circuits for BJT and FET.

CO2 -Analyze BJT and FET amplifiers using equivalent circuit models.

CO3 -Evaluate frequency response of BJT and FET amplifiers in different configurations.

CO4-Design multistage amplifiers using BJT

CO5 -Analyze the performance of power supplies and power amplifiers.

CO6 -Design current mirrors and differential amplifiers

TEXT / REFERENCE BOOKS

1. Millman J and Halkias C., "Integrated Electronics", TMH, 2nd Edition, 2017.
2. S. Salivahanan, N. Suresh Kumar and A. Vallavaraj, "Electronic Devices and Circuits", TMH, 2nd Edition, 2017.
3. Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits", Oxford University Press, Sixth Edition, 2009.
4. Behzad Razavi, "Fundamentals of Microelectronics", 1st edition, Wiley publication, 2008.
5. Donald A. Neamen, "Electronic Circuits Analysis and Design", McGraw Hill Education (India) Private Ltd., 3rd Edition, 2010.
6. Robert L. Boylestad and Louis Nashersky, "Electronic Devices and Circuit Theory", Pearson Education, 11th Edition, 2013.
7. Floyd, "Electronic Devices", Pearson Education, 9th Edition, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2marks each-No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks****Employability****Entrepreneurship****Skill Development**

SECA2301	CIRCUITS AND NETWORKS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To construct a KCL & KVL circuits.
- To design the Constant K filters and M-Derived filters.
- To design the Attenuators and equalizer circuits.
- To verify the twin T network circuits.
- To verify reciprocity theorem and compensation theorem.

SUGGESTED LIST OF EXPERIMENTS

1. Verification of KCL & KVL.
2. Verification of Reciprocity & Compensation Theorem.
3. Series and Parallel Resonance.
4. Constant K filters (both LPF & HPF).
5. M-Derived filters (both LPF & HPF).
6. Attenuators.
7. Equalizers.
8. Matching Networks.
9. Twin T Network as Notch filter.
10. Verification of reciprocity theorem.
11. Verification of compensation theorem.
12. Study of composite m-derived filters.

COURSE OUTCOMES

On completion of the course, students are able to

- CO1-Apply the basic Electrical Laws for verifying them by feeding different excitation for the circuit. CO2-Design the different filter circuits.
- CO3-Determine the performance of Attenuators and equalizer circuits. CO4-Analyze the twin T network circuits.
- CO5-Determine the bandwidth, selectivity, Q-factor for a series and parallel resonance circuits CO6-Solve the electrical networks by implementing network theorems



Employability



Entrepreneurship



Skill Development

SECA2302	ELECTRONIC CIRCUITS - I LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To construct a biasing circuits.
- To design the rectifier circuits.
- To design the voltage regulator circuits.
- To design the digital circuits.
- To design the circuits using PSPICE.

SUGGESTED LIST OF EXPERIMENTS

1. Transistor Biasing Circuits.
2. Half wave Rectifier With and Without Filter.
3. Voltage Regulator.
4. Fullwave Rectifier With and Without Filter, Flipflops using PSPICE.
5. Adders.
6. Subtractors.
7. Shift Register.
8. Counters.
9. Code Converters.
10. Common Source JFET, Common Emitter BJT using PSPICE.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1-Determine the biasing circuits of transistors.
 CO2-Design the different rectifier circuits.
 CO3-Experiment with the voltage regulator circuits.
 CO4-Analyze the digital circuit's performance.
 CO5-Assess the digital circuits using PSPICE.
 CO6-Evaluate the analog circuits using PSPICE.



Employability



Entrepreneurship



Skill Development

SECA1401	ELECTRONIC CIRCUITS - II	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To understand the concepts of Feedback amplifiers.
- To identify the design and analysis of Oscillators.
- Be familiar with the performance of Tuned Amplifiers.
- Learn the types of Multivibrators.
- To focus on Time Based Generator and Blocking Oscillator.

UNIT 1 FEEDBACK AMPLIFIERS**9 Hrs.**

General feedback structure-Types of feedback-Properties of negative feedback-Basic feedback Topologies - Feedback amplifiers - effect of feedback amplifier on noise, distortion, gain, input and output impedance, analysis of voltage and current feedback amplifier.

UNIT 2 OSCILLATORS**9 Hrs.**

Barkhausen Criterion for Oscillator General form of Oscillator -Classification of Oscillator - Sinusoidal Oscillator RC Phase Shift Oscillator and Wein Bridge Oscillator Analysis of LC Oscillator- Hartley- Colpitts- Clapp- Armstrong-Crystal Oscillator.

UNIT 3 TUNED AMPLIFIERS**9 Hrs.**

Resonance Circuits, Unloaded and Loaded Q of Tank Circuit Bandwidth Types of Tuned Amplifiers Analysis of Single Tuned Amplifier - Double Tuned Amplifier-Stagger Tuned Amplifier - Instability of Tuned Amplifier - Stabilization Techniques, Neutralization and Unilateralization Class C Tuned Amplifiers.

UNIT 4 WAVE SHAPING AND MULTIVIBRATOR CIRCUITS**9 Hrs.**

High Pass and Low Pass RC Circuits and their Response for Sine, Step, Pulse, Square, Ramp and Exponential Input - Multivibrators Astable Multivibrators Emitter and Collector Coupled Monostable Multivibrators, Bistable Multivibrators, and Schmitt Trigger Circuits.

UNIT 5 TIME BASED GENERATOR AND BLOCKING OSCILLATORS**9 Hrs.**

Principle of Time Based Generator Types of Time Based Generator Voltage Time Based Generator Bootstrapped and Miller Saw Tooth Generator Current time Based Generator Blocking Oscillator - Monostable and Astable Blocking Oscillator using Emitter and base Timing Push-Pull Operation of Blocking Oscillator.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1-Analyze the types of feedback Amplifiers
- CO2-Analyze the frequency of oscillation of oscillators
- CO3-Analyze the performance of Tuned Amplifiers by measuring the gain and bandwidth
- CO4-Analyze the wave shaping and multivibrator circuits
- CO5-Examine the Time Based Generator
- CO6-Examine the different types of Blocking Oscillators

TEXT / REFERENCE BOOKS

- Christos C. Halkias, Satyabrata Jit, Jacob Millman Millmans, "Electronic Devices and Circuits" 4th Edition 2015.
- Sedra and Smith, "Microelectronic Circuits", Oxford University Press, 6th Edition, 2010,
- BOGART, "Electronic Devices and Circuits", Pearson - 2011,
- Milman and Halkias, "Integrated Electronics", TMH, 2017.
- Balbir Kumar and Shail B. Jain, "Electronic Devices and Circuits", Kindle eBook 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each -No choice**20 Marks.****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks.****Employability****Entrepreneurship****Skill Development**

SECA1403	DIGITAL COMMUNICATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To know the principles of sampling & quantization.
- To understand the various Base Band signaling schemes.
- To introduce the basic concepts of digital modulation of baseband signals.
- To get introduced to the basics of source and channel coding/decoding.
- To understand the basics of spread spectrum modulation schemes.

UNIT 1 SAMPLING AND QUANTIZATION**9 Hrs.**

Digital communication systems: performance metrics and specifications-Review of Sampling process -Natural Sampling-Flat Sampling - Aliasing - Signal Reconstruction-Quantization- Uniform & non-uniform quantization - quantization noise - PCM- Noise considerations in PCM- differential pulse code modulation - Delta modulation - - Adaptive Delta Modulation.

UNIT 2 BASEBAND PULSE TRANSMISSION**9 Hrs.**

Base band transmission - Wave form representation of binary digits -Matched Filter- Error Rate due to noise - Nyquist's criterion for Distortion less Base band Binary Transmission- Inter symbol Interference - Ideal Nyquist channel - Raised cosine channels- Correlative level coding - Equalization- Adaptive Equalization Eye patterns- Companding - correlation receiver.

UNIT 3 DIGITAL MODULATION TECHNIQUES**9 Hrs.**

Introduction - ASK- FSK - PSK- coherent modulation techniques-BFSK-BPSK-signal space diagram-probability of error- Coherent Quadrature modulation techniques- QPSK-signal space diagram-probability of error- Non coherent modulation techniques-DPSK-M-ary modulation techniques - Vectorial view of MPSK.

UNIT 4 ERROR CONTROL CODING**9 Hrs.**

Discrete memoryless channels Linear block codes - Cyclic codes - Convolutional codes Maximum likelihood decoding of convolutional codes-Viterbi Algorithm, Trellis coded Modulation, Turbo codes.

UNIT 5 SPREAD SPECTRUM MODULATION**9 Hrs.**

Pseudo- noise sequences - a notion of spread spectrum - Direct sequence spread spectrum with coherent binary phase shift keying - Signal space Dimensionality and processing gain -Probability of error - Frequency hop spread spectrum- Synchronization and its types.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

CO1-Apply the knowledge of signals and systems to compute noise levels and bandwidth requirements for different binary encoding schemes.

CO2-Evaluate the performance of baseband communication systems in the presence of noise and inter-symbol interference

CO3-Analyze bit-error rate and spectral requirements of different band-pass signaling schemes.

CO4-Design encoder and decoder architecture for error control codes like Hamming code, Convolutional Code, etc.

CO5-Analyze the performance of digital communication systems with spread spectrum techniques.

CO6-Examine the theoretical concepts through application of modern software tools.

TEXT/REFERENCE BOOKS

1. Simon Haykins, "Communication Systems" John Wiley, 5th Edition, March 2009.
2. Taub. HDL Schilling, G Saha, "Principles of Communication", 5th Edition, 2009.
3. John G. Proakis, Masoud Salehi, "Digital Communication", McGraw Hill, 5th Edition, 2007.
4. Bernard Sklar, "Digital Communication, Fundamentals and Application", Pearson Education Asia, 2nd Edition, 2009

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****PART A:** 10 Questions of 2 marks each -No choice**PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**Exam Duration: 3 Hrs.****20 Marks.****80 Marks.****Employability****Entrepreneurship****Skill Development**

SECA2401	ELECTRONIC CIRCUITS - II LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To construct the amplifier circuits.
- To design the oscillator circuits.
- To design the feedback amplifier circuits.
- To design the importance of digital circuits.
- To design the importance of PSPICE.

SUGGESTED LIST OF EXPERIMENTS

- 1 Class C Power Amplifier using PSPICE.
- 2 Cascode Amplifier.
- 3 Single tuned Amplifier.
- 4 Feed back Amplifier using PSPICE.
- 5 Hartley Oscillator.
- 6 Colpitts Oscillator.
- 7 Waveform generation using CMOS gates.
- 8 PRBS generator.
- 9 Encoders.
- 10 Decoders using PSPICE.
- 11 Multiplexers.
- 12 Demultiplexers using PSPICE.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1-Design the different types of amplifier circuits.
- CO2-Design the oscillator circuits.
- CO3-Analyze the frequency response of feedback amplifier circuits.
- CO4-Design digital logic circuits for given applications
- CO5-Analyze the digital circuits using PSPICE.
- CO6-Evaluate the analog circuits using PSPICE.



Employability



Entrepreneurship



Skill Development

SECA1506	DIGITAL SIGNAL PROCESSING	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To introduce the fundamental operations of Digital signal processor and its advantages over Analog signal processor.
- To analyze the discrete system using Discrete Fourier Transform and Fast Fourier Transform.
- To design the digital IIR and FIR filter circuit using various techniques.
- To analyze the effect of finite word length register used in the signal processing equipment.
- To introduce the multirate signal processing techniques and its applications.

UNIT 1 DISCRETE FOURIER TRANSFORM (DFT) AND FAST FOURIER TRANSFORM (FFT) 9 Hrs.

Review of Signals and Systems, DFT and its properties, Relation between DTFT and DFT, FFT computations using Decimation in time (DIT) algorithms and Decimation in frequency (DIF) algorithms, Auto correlation, Cross correlation, and their properties. Realization of Discrete Time System: introduction, Basic Realization block diagram and the signal flow graph, Realization of recursive and nonrecursive systems - Direct Form I and Form II - Cascade and parallel realization

UNIT 2 DIGITAL FILTER DESIGN 9 Hrs.

Design of Digital Filters: General considerations: causality and its implications, characteristics of practical frequency selective filter. Design of FIR filter using window method - Rectangular, Hanning and Hamming Windows. Design of IIR filters using Impulse invariant and Bilinear transformation method. Review of Butterworth and Chebyshev approximations, Frequency selective filters: Ideal filter characteristics, low pass, high pass and band pass filters, Properties of IIR and FIR filters

UNIT 3 FINITE WORD LENGTH EFFECTS 9 Hrs.

Fixed point and floating point number representations - Comparison - Truncation and Rounding errors - Quantization noise - derivation for quantization noise power - coefficient quantization error - Product quantization error - Overflow error - Round off noise power - limit cycle oscillations due to product round off and overflow errors - signal scaling

UNIT 4 MULTIRATE SIGNAL PROCESSING 9 Hrs.

Introduction to Multirate signal processing-Decimation-Interpolation-Polyphase implementation of FIR filters for interpolator and decimator -Multistage implementation of sampling rate conversion - Applications of Multirate signal processing, Speech compression, Adaptive filter, Musical sound processing, Image enhancement.

UNIT 5 REAL TIME DIGITAL SIGNAL PROCESSING 9 Hrs.

Real Time DSP System Architecture and Functional Blocks, Analog Interface, Signal Conditioning, generation and detection for real time applications, - DSP Hardwares (Digital Signal Processor, FPGA, ARM Processor with DSP Extension) & its applications- Speech Signal Processing, Enhancements, Coding & Transcoding Techniques (A-Law, U-Law, G.711, G.723, G.729, GSM) for IP and Mobile Telephone applications - High Definition Audio Signal Processing, Audio Coding Techniques and Comparison Analysis, Transcoding. Case Study: A study of an intelligent ECG Monitor.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Analyze LTI Discrete Time Systems using DFT and FFT
- CO2 - Design of digital filters like FIR and IIR Filter
- CO3 - Evaluate the effect of finite word length while designing a digital filter
- CO4 - Employ signal processing strategies in multirate signal processing
- CO5 - Apply the signal processing technique in speech signal and image processing
- CO6 - Build filter design algorithm in DSP processor

TEXT / REFERENCE BOOKS

- John C. Proakis & Dimitrios G. Manolakis, "Digital Signal Processing, Algorithm and Applications", 4th Edition, PHI, 2014.
- Ramesh Babu, "Digital Signal Processing", 6th Edition, SciTech Publications (India) Pvt Ltd, 2014.
- Salivahanan, "Digital Signal Processing", 3rd Edition, McGraw Hill Education, 2017.
- Richard G. Lyons, "Understanding Digital Signal Processing". Second Edition, Pearson Education, 3rd Edition, 2011.
- A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", Pearson Education India; 3rd Edition, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****PART A:** 10 Questions of 2 marks each -No choice

B.E. / B.Tech. - Regular

Exam Duration: 3 Hrs.**20 Marks**

REGULATIONS 2019



SECA1502	ANALOG INTEGRATED CIRCUITS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To have thorough understanding of Op-Amp.
- To be able to design circuits using op amp for various applications.
- To acquire knowledge about ADC and DAC.
- To study the basic principles of PLL and Timer Circuit.
- To understand the concept of Special function ICs.

UNIT 1 INTRODUCTION TO OP- AMP AND ITS APPLICATIONS.**9 Hrs.**

OP-AMP- DC and AC Characteristics- Input offset voltage- Input bias current-Input offset current- Total output offset voltage- Thermal drift- Slew rate- CMRR -Inverting amplifier- Non-inverting amplifier- Voltage follower- Summing and differential amplifier- Integrator- Differentiator- Logarithmic and Anti logarithmic amplifiers-Comparator and Schmitt trigger.

UNIT 2 FILTERS AND SIGNAL GENERATORS**9 Hrs.**

First order and Second order Butterworth filters- low pass, high pass, band pass and band reject filters -RC phase shift, Wein's bridge oscillator- Astable and Monostable multivibrator-Precision half wave and full wave rectifiers.

UNIT 3 A/D AND D/A CONVERTERS**9 Hrs.**

Sample and Hold circuit - Digital to analog converters: R-2R ladder network and Binary weighted - Characteristics of D/A converters - Analog to digital converters: Flash converter - Successive approximation converter - Dual slope ADC-Weighted-Capacitor DACs- Oversampling Converters.

UNIT 4 PLL AND TIMER CIRCUITS.**9 Hrs.**

Phase Locked Loop IC 565- Block schematic - Applications of PLL: FM demodulator and Frequency synthesizers Demodulator- VCO IC LM 566 - Timer IC LM 555 and its applications: Astable and Monostable multivibrator.

UNIT 5 SPECIAL FUNCTION ICs**9 Hrs.**

Integrated circuit Tuned amplifier, Instrumentation Amplifier, Monolithic voltage regulators 78XX,79XX Series ,Opto coupler, CMOS Operational Amplifier- Dc analysis- small signal analysis- specifications of IC MC 14573.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1-Analyze the impact of DC and AC characteristics of operational amplifiers on output and their compensation techniques.
- CO2- Design the linear and non-linear circuits with op-amp for specific applications
- CO3-Design filters and various amplifiers circuits for Real World Problems
- CO4- Evaluate the performance of op-amp and IC 555 multivibrators
- CO5-Design data converters for interfacing sensors with electronic circuits
- CO6-Develop op-amp based circuits for resolving problems in communication adhering to standards

TEXT / REFERENCE BOOKS

1. Ramakant A.Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015.
2. D.RoyChoudary, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2000.
3. Grey and Meyer, "Analysis and Design of Analog Integrated Circuits", 4th Edition, Wiley International, 2001.
4. Michael Jacob, "Applications and Design with Analog Integrated Circuits", 2nd Edition, Prentice Hall of India, 1993.
5. S. Salivahanan, V.S. Kanchana Bhaaskaran, "Linear integrated circuits", 3rd Edition, McGraw-Hill, 2011.
6. William D.Stanely, "Operational Amplifiers with Linear Integrated Circuits", 4th Edition, Pearson Education, 2004.
6. Sergio Franco "Design With Operational Amplifiers and Analog Integrated Circuits" 4th Edition, McGraw-Hill Education, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each -No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks****Employability****Entrepreneurship****Skill Development**

SECA 2501	DIGITAL SIGNAL PROCESSING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To provide knowledge for understanding of digital signal processing through hands-on experience that is sufficient to enable them to apply DSP to real-world problems.
- To understand the process of convolution, correlation, DFT, IDFT, Signal smoothing, filtering of long duration signals, and Spectral analysis of signals.

SUGGESTED LIST OF EXPERIMENTS

1. Study of ADSP 21XX & TMS 320 C XX processor.
2. Generation of Periodic Signals.
3. Generation of Non Periodic Signals.
4. Sampling.
5. Modulation and Demodulation using Matlab.
6. Computation of Z Transform & Inverse Z transform.
7. Computation of Impulse & System Response.
8. Design of FIR filters using Windowing Techniques.
9. Design of IIR filters using Bilinear Transformation.
10. Spectral Analysis using Matlab.
11. Implementation of FFT using DIT and DIF algorithm.
12. Convolution (Linear and Circular).
13. Correlation (Auto & Cross).
14. Frequency response of first and second order systems.
15. Fast Fourier Transform (FFT), Inverse Fast Fourier Transform(IFFT).

COURSE OUTCOMES

On completion of the course, student will be able to

CO1-Construct periodic and aperiodic discrete/digital signals using MATLAB

CO2-Analyze the Frequency response of first and second order systems.

CO3-Evaluate the basic operations of Signal processing such as convolution and correlation.

CO4-Determine transfer function and predict frequency response of discrete-time systems by applying various techniques like Z-transform, DFT and FFT using MATLAB

CO5-Employ signal processing strategies in modulation and demodulation technique

CO6-Design digital filters such as FIR and IIR Filter and observe the magnitude and phase response



Employability



Entrepreneurship



Skill Development

SECA2502	ANALOG INTEGRATED CIRCUITS LAB (For ECE)	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To enable the students to design and testing of analog integrated circuits.
- To expose the students to a variety of practical circuits using various analog ICs.

SUGGESTED LIST OF EXPERIMENTS

- 1 Study of IC 741.
- 2 Measurement of Op amp parameters.
- 3 Inverting, Non Inverting amplifier, Integrator and Differentiator.
- 4 Precision Rectifiers (HW & FW).
- 5 Filters (LPF & HPF).
- 6 A/D & D/Converters.
- 7 RC Phase Shift Oscillator.
- 8 Astable Multivibrator Using IC 741.
- 9 Schmitt Trigger.
- 10 PLL as voltage multiplier.
- 11 Astable Multivibrator using IC 555.
- 12 Comparators.
- 13 Bridge Oscillator.
- 14 Instrumentation Amplifier.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1-Apply mathematical concepts for understanding the behavior of Operational amplifier
CO2-Analyze the functioning of various analog circuits
CO3-Design filter circuits using Op Amp for Real World applications
CO4-Implement oscillator circuits using IC741
CO5-Evaluate the performance of various waveform generator circuits.
CO6-Design analog circuits for various applications



Employability



Entrepreneurship



Skill Development

SECA1604	COMPUTER NETWORKS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To acquire the knowledge about the basics of computer networking.
- To understand the various IEEE networking standards.
- To familiarize with error detection and correction techniques for data communication.
- To know about the design issues of various layers in ISO-OSI and TCP/IP model.

UNIT 1 DATA COMMUNICATION BASICS**9 Hrs.**

Digital data - digital signals - Bit rate - Bit length - Data rate limits - noise less channels - Noisy channel - Shannon capacity - Performance - Bandwidth - throughput - latency - Bandwidth delay product - jitters. Circuit switched networks - Datagram networks - virtual circuit networks - connection oriented and connection less services- Network Hardware, Network Software, OSI reference model - TCP/IP reference model - comparison of both models.

UNIT 2 NETWORKING**9 Hrs.**

Network Topologies - mesh, star, bus, and ring - hybrid topology - Network Standardization - De facto and De jure standards of networks -MAC Layer- Aloha, CSMA, CSMA/CD, CSMA/CA protocols, Different IEEE802 working groups - internet- Architecture of the internet - Third generation mobile networks - UMTS Architecture - Wired Ethernet - Wireless LANs IEEE 802.11 - RFID - Different types - sensor networks - Multi hop topology of sensor network.

UNIT 3 PHYSICAL LAYER AND DATALINK LAYER**9 Hrs.**

The Physical layer - Media - Twisted pair - coaxial cable-infrared - millimetre wave - PSTN - The local loop modem - ADSL - Switching - Internet over cable - cable modems. Data Link Layer and Logical Link Control (LLC) sub-layer: Framing; Error control including Bit-parity, CRC and Hamming Codes; **Reliable transmission and Automatic Repeat Request (ARQ) protocols including Stop-and-Wait, Go-back-N, and Selective Repeat. Performance analysis of ARQ protocols. Example protocols such as HDLC and PPP.**

UNIT 4 MAC SUB LAYER AND NETWORK LAYER**9 Hrs.**

MAC sub layer for Standard Ethernet, Fast Ethernet, Wireless LAN and broadband wireless. Design issues of network layer - **Routing algorithm - shortest path routing - Distance vector routing - Broadcast routing Inter domain routing, Congestion control algorithm - Congestion control in virtual circuit and datagram switches - The network layer in the internet - The IP protocol-IP Addresses - IPv6, ARP,DHCP,ICMP, Classless Addressing, Network Address Translation.**

UNIT 5 TRANSPORT LAYER AND APPLICATION LAYER**9 Hrs.**

The transport layer - service provided to the upper layer - Elements of transport protocols - Addressing - connection establishment - connection release - UDP TCP. Application Layer-Introduction ,providing services, Applications layer paradigms, Client server model, Standard client-server application, E mail - The user agent - Message transfer agent-SMTP - Message access agent: POP and IMAP - File Transfer Protocol - HTTP - SNMP - VOIP.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1-Analyze the basic concepts and the parameters used in computer networks
- CO2-Evaluate the behavior of various topologies in computer Networks adhering to IEEE standards
- CO3- Analyze the behavior of physical layer and data link layer in ISO OSI reference model
- CO4-Evaluate different routing and congestion control algorithms
- CO5-Implement reliable and unreliable transfer protocols for Real World Problems
- CO6-Develop addressing, error detection and address translation mechanisms for TCP/IP.

TEXT / REFERENCE BOOKS

1. Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks", 5th Edition, Prentice Hall, 2011.
2. Michael A.Gallo, William Hancock.M, Brooks/Cole "Computer Communications and Networking Technologies", 2001.
3. Richard Lai and Jirachief pattana, "Communication Protocol Specification and Verification", Kluwer Publishers, Boston,1998.
4. Pallapa Venkataram and Sunilkumar S.Manvi, "Communication protocol Engineering", PHI Learning, 2014.
5. Behrouz A. Foruzan, "Data Communication and Networking", 5th Edition, Science Engineering and Math Publications, 2012.
6. W. Stallings, "Data and Computer Communication", 8th Edition, Pearson Education, 2016.
7. L.L.Peterson and B.S.Davie, "Computer Networks", 5th Edition, ELSEVIER, 2011.
8. James F.Kurose, K.W.Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", 6th Edition, Pearson Education, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each -No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

SECA2601	MICROPROCESSOR AND MICROCONTROLLER LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To understand the operation of Microprocessor & Microcontroller.
- To develop algorithms and write assembly language programs.
- To provide knowledge to solve real time issues using Microprocessor and Microcontroller.

MICROPROCESSOR- 8085

1. Programs using Arithmetic operations.
2. Programs for Code conversions.
3. Largest, smallest and Sorting of an array.

MICROCONTROLLER- 8051

1. Data Transfer Programs.
2. Programs Using Logical Instructions.
3. Programs using Bit manipulation Instructions.
4. Reading and Writing on Parallel port.
5. Stepper Motor controller.
6. Timer Operations.
7. Serial communication Implementation.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1-Develop assembly language programs to perform array operations using 8085 Microprocessor CO2- Develop assembly language programs to perform data transfer using 8051 microcontroller
CO3-Develop assembly language programs to perform Logical and Bit manipulation operations using 8051 microcontroller CO4- Develop assembly language programs to interface 7 segment LED, CRO, Traffic light controller and Timer using 8051 microcontroller
CO5-Develop assembly language programs to interface and control stepper motor using 8051 microcontroller CO6- Develop assembly language programs to solve Real World Problems using 8051 microcontroller



Employability



Entrepreneurship



Skill Development

SECA2602	VLSI DESIGN LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To Give a Introduction on Digital logic systems.
- To explain how combinational circuits are being used.
- To explain how Sequential circuits are being used.
- To explain the importance of memories.

SUGGESTED LIST OF EXPERIMENTS**HDL Design, Simulation, Synthesis and FPGA Implementation of**

- 1 Logic gates.
- 2 Adders and Subtractors.
- 3 4-bit multiplier.
- 4 ALU.
- 5 Flip Flops.
- 6 Shift registers.
- 7 Synchronous and Asynchronous Counters.
- 8 Moore and Mealy FSM.
- 9 RAM and ROM memories.
- 10 MAC unit.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1-Develop various logic gates using different modeling styles
- CO2-Develop digital system design in combinational and sequential circuits using various modeling styles
- CO3-Develop digital system design in memory elements using various modeling styles
- CO4-Analyze the Synthesis report acquired for digital system design
- CO5-Develop RTL schematic and analyze the parameters
- CO6-Develop a FPGA System for Real World Problems



Employability



Entrepreneurship



Skill Development

SECA3001	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Understand OSI security architecture and classical encryption techniques.
- Acquire fundamental knowledge on the concepts of finite fields and number theory.
- Understand various block cipher and stream cipher models.
- Describe the principles of public key cryptosystems, hash functions and digital signature.
- To provide basic concept of network and security system.

UNIT 1 FUNDAMENTALS**9 Hrs.**

The OSI security architecture-Network security model-Principles of Security - Confidentiality, Authentication, Integrity, Nonrepudiation, Access Control, Availability: Types of Attacks - Active and Passive: Classical Encryption Techniques: Substitution Cipher - Caesar Cipher, Play Fair Cipher, Hill cipher, One Time Pad: Transposition Cipher - Rail Fence and Simple Columnar Techniques.

UNIT 2 SYMMETRIC KEY CRYPTOGRAPHY**9 Hrs.**

Symmetric Key Cryptosystems: Comparison of Stream Ciphers and Block Ciphers: Feistel Block Cipher: Block Cipher Modes of Operation: Data Encryption Standard - Details of one round in DES: Advanced Encryption Standard.

UNIT 3 PUBLIC KEY CRYPTOGRAPHY**9 Hrs.**

Modular Arithmetic: Euclidean Algorithm: Fermat's and Euler's Theorem; Chinese Remainder Theorem: Principles of Public Key Cryptosystems; Key Management - Distribution of Public Keys, Use of Public Key Encryption to Distribute Secret Keys: RSA Algorithm, Diffie-Hellman Key Exchange; Concepts of Elliptic Curve Cryptography.

UNIT 4 SECURITY FUNCTIONS AND APPLICATIONS**9 Hrs.**

Authentication Requirements: Message Authentication Codes - Requirements for MAC, Basic Uses of MAC: Hash Functions HMAC - Requirements for a Hash function, MD-5 SHA 1 Kerberos: X.509 Authentication Service Certificate: E-Mail Security - Pretty good Privacy, S/MIME.

UNIT 5 NETWORK AND SYSTEM SECURITY**9 Hrs.**

IP Security - IP Security Architecture, Authentication Header, Encapsulating Security Payload, Benefits, Applications; Web Security - Secure Socket Layer, Secure Electronic Transaction SSL Vs SET, Firewalls - Design Principles, Characteristics, Types of Firewalls: Virus and Antivirus approaches.

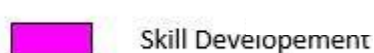
Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1-Analyze the vulnerabilities in any computing system
- CO2-Estimate the various security threats during data communication in the network.
- CO3-Evaluate security mechanisms using rigorous approaches, including theoretical mechanisms. CO4-Apply different IEEE standards in electronic mail security.
- CO5-Develop symmetric key cryptographic techniques for real-time application. CO6-Construct the various cryptographic algorithm for emails and web security

TEXT / REFERENCE BOOKS

- Atul Kahate, "Cryptography and Network Security", 2nd Edition, Tata McGraw-Hill Education Pvt.Ltd., New Delhi, 2011.
- William Stallings, "Cryptography and Network Security - Principles and Practices", 4th Edition, Prentice-Hall of India Pvt.Ltd., New Delhi, 2006.
- Behrouz A. Forouzan, "Cryptography & Network Security", Tata Mc Graw Hill, 2007.
- Niels Ferguson and Bruce Schneier, "Practical Cryptography", John Wiley and Sons, 2003.
- Niels Ferguson, Bruce Schneier, Tadayoshi Kohno, "Cryptography Engineering- Design Principles and Practical Applications", Wiley Publishing, Inc, Indiana, 2010.
- Douglas R Simson "Cryptography - Theory and practice", 1st Edition, CRC Press, 1995.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****PART A:** 10 Questions of 2 marks each -No choice**PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**Exam Duration: 3 Hrs.****20 Marks****80 Marks****Employability****Entrepreneurship****Skill Development**

SECA3007	MEMS AND ITS APPLICATIONS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To have adequate knowledge in MEMS and Microsystems.
- To understand the fabrication procedures and have knowledge on MEMS sensors and actuators and their applications.
- To be made aware of the MEMS design procedures and RFMEMS.
- To investigate various applications of MEMS.

UNIT 1 OVERVIEW OF MEMS AND MICROSYSTEMS**9 Hrs.**

Definition - historical development - Fundamentals - Properties, Introduction to Design of MEMS and NEMS, MEMS ,Microsystems microelectronics, miniaturization, Working principle of micro system - Micro sensors, Micro actuators, Micro accelerometers and Micro fluidics, MEMS materials: Silicon, silicon compounds, polymers, metals.

UNIT 2 MEMS FABRICATION**9 Hrs.**

Micro-system fabrication processes: Photolithography, Ion Implantation, Diffusion, and Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology.

UNIT 3 MICROSENSORS AND ACTUATORS**9 Hrs.**

Micro-sensing for MEMS: Piezo-resistive Pressure Sensor, Capacitive sensor, Piezoelectric sensing, Resonant sensing, Surface Acoustic Wave sensors Vibratory gyroscope, Electromechanical transducers: Piezoelectric transducers, Electrostrictive transducers, Magnetostrictive transducers, Electrostatic actuators, Electromagnetic transducers, Electro- dynamic transducers, Case study-Piezo-resistive pressure sensor, Comb drive actuators.

UNIT 4 MEMS DESIGN AND INTRODUCTION TO OPTICAL RF MEMS**9 Hrs.**

Micro system Design - Design consideration, process design, Mechanical design, Mechanical design using MEMS. Optical MEMS,- System design basics - Gaussian optics, Matrix operations, Resolution. MEMS scanners and retinal scanning display, Digital Micro mirror devices. RF Memes - Design basics, case study - Capacitive RF MEMS switch, Performance issues.

UNIT 5 MEMS PACKAGING AND APPLICATIONS**9 Hrs.**

MEMS packaging: Role of MEMS packaging, Types of MEMS packaging, selection of packaging materials, flip -chip and multichip Unit packaging, RF MEMS packaging issues. Micro-machined transmission line and components, micro-machined RF Filters, Micromachined Phase shifters, and Micro-machined antenna, Gyros and Bio-MEMS. Recent trends in MEMS.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1-Identify right choice of MEMS materials and processing techniques for given application requirement
- CO2- Design micro devices and micro systems for given specifications.
- CO3- Analyze the characteristics of MEMS devices
- CO4-Design MEMS based sensors and actuators for given requirement
- CO5-Design micro-machined RF components and devices such as Switches, phase shifters, antennas, etc for given specifications
- CO6- Investigate various applications of MEMS devices

TEXT / REFERENCE BOOKS

- Vijay K. Varadan, K. J. Vinoy and K. A. Jose , "RF MEMS & Their Applications", John Wiley & Sons, 2003.
- Tai - Rai Hsu, "MEMS and Microsystems Design and Manufacturing", Tata MC Graw Hill, New Delhi, Edition 2002.
- Gabriel M Rebeiz, "RF MEMS - Theory Design and Technology", John Wiley and Sons, 2003.
- Nadim Maluf, "An introduction to Micro electro mechanical system design", Artech House ,2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each -No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks**

COURSE OBJECTIVES

- To acquaint the students with the behaviour of passive and active electronic components at Radio frequencies.
- To familiarize on the principle of operation of various building blocks of RF transceivers.
- To understand the functional design aspects of LNAs, Mixers and VCO and Cadence simulation tools.

UNIT 1 RF BEHAVIOUR OF PASSIVE ELECTRONIC COMPONENTS**9 Hrs.**

Introduction to Radio frequency models of resistors, capacitors and Inductors. Integrated inductors, resistors, Capacitors, tunable inductors and transformers. Design of RF lumped element lowpass and high pass filters -Introduction to Richards Transformations and Kuroda Identities (definition only)-Design of stepped impedance distributed element lowpass and high pass filters.

UNIT 2 BJT AND MOSFET BEHAVIOR AT RF FREQUENCIES**9 Hrs.**

BJT and MOSFET modeling at low frequency and radio frequencies. Radio frequency SPICE models of BJT and MOSFETs. Noise performance and limitations of MOSFETs-Introduction to Cadence Simulation tool.

UNIT 3 INTRODUCTION TO TRANSCEIVER ARCHITECTURES**9 Hrs.**

RF Receiver (front end) Architectures- Basic and Modern Heterodyne Receiver - Direct-Conversion Receiver - Low-IF Receiver - Transmitter Architectures - Direct-Conversion Transmitters and Heterodyne Transmitters.

UNIT 4 RF CMOS AMPLIFIERS**9 Hrs.**

RF Amplifier Parameters-Low noise Amplifier (LNA) topologies- Design aspects of Common gate (CG) and Common Source CMOS LNA- Introduction to CMOS RF Power Amplifier Design.

UNIT 5 RF CMOS MIXERS AND VCOs**9 Hrs.**

Introduction to Frequency Mixer and its parameters-single balanced and double balanced active Mixer- Gilbert Mixer Circuit- Basics of Voltage Controlled Oscillators(VCO)- VCO using MOS varactors- Design of LC VCOs. Introduction to Frequency Mixer and its parameters-single balanced and double balanced active Mixer- Gilbert Mixer Circuit- Basics of Voltage Controlled Oscillators(VCO)- VCO using MOS varactors- Design of LC VCOs.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1-Analyze the frequency range of technologies used for passive and active RF circuit implementation
- CO2-Analyze the behavior of RF frequency signals in transistor environment
- CO3-Evaluate the operations of Transceiver architecture noise, linearity, etc
- CO4-Analyze the behavior of CMOS low noise amplifiers and RF Power Amplifiers in noisy and noiseless environment
- CO5-Design voltage controlled oscillators for Real World problems
- CO6-Develop RF circuits for specific applications using Cadence simulation tools

TEXT / REFERENCE BOOKS

1. B.Razavi, "RF Microelectronics", 2nd Edition, Prentice-Hall, 2011.
2. Bosco H Leung "VLSI for Wireless Communication", 2nd Edition, Springer, 2011.
3. Behzad Razavi, "Design of Analog CMOS Integrated Circuits" 2nd Edition, McGraw-Hill, 2017.
4. Jia-sheng Hong, "Microstrip filters for RF/Microwave applications", Wiley, 2nd Edition, 2011.
5. Thomas H.Lee, "The Design of CMOS Radio -Frequency Integrated Circuits", 2nd Edition, Cambridge University Press, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 marks each - No choice**20 Marks****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks****Employability****Entrepreneurship****Skill Development**

COURSE OBJECTIVES

- To understand the various characteristics of Intelligent agents.
- To learn the different search strategies in AI.
- To learn to represent knowledge in solving AI problems.
- To know about the various applications of AI.

UNIT 1 INTRODUCTION TO ARTIFICIAL INTELLIGENCE**9 Hrs.**

Introduction-Definition - Future of Artificial Intelligence - Characteristics of Intelligent Agents-Typical Intelligent Agents - Problem Solving Approach to Typical AI problems.

UNIT 2 PROBLEM SOLVING METHODS**9 Hrs.**

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems - Constraint Propagation - Backtracking Search - Game Playing - Optimal Decisions in Games - Alpha - Beta Pruning - Stochastic Games.

UNIT 3 KNOWLEDGE REPRESENTATION**9 Hrs.**

First Order Predicate Logic - Prolog Programming - Unification - Forward Chaining-Backward Chaining - Resolution - Knowledge Representation - Ontological Engineering-Categories and Objects - Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information.

UNIT 4 SOFTWARE AGENTS**9 Hrs.**

Architecture for Intelligent Agents - Agent communication - Negotiation and Bargaining - Argumentation among Agents - Trust and Reputation in Multi-agent systems.

UNIT 5 APPLICATIONS**9 Hrs.**

AI applications - Language Models - Information Retrieval- Information Extraction - Natural Language Processing - Machine Translation - Speech Recognition.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1-Apply Mathematical equations for developing learning Techniques in AI
- CO2-Analyze various searching techniques for solving Real World Problems
- CO3-Apply predicate logic, ontology and reasoning for knowledge representation in artificial Intelligence
- CO4-Analyze various techniques involved in intelligent agents for communication in AI systems
- CO5-Develop AI based techniques for Real world Applications
- CO6-Evaluate the performance of AI based systems for NLP, Machine translation and speech recognition

TEXT / REFERENCE BOOKS

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall, 3rd Edition, 2009.
2. M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc.; 1st Edition, 2008.
3. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.
4. William F. Clocksin and Christopher S. Mellish, "Programming in Prolog: Using the ISO Standard", 5th Edition, Springer, 2003.
5. Gerhard Weiss, "Multi Agent Systems", 2nd Edition, MIT Press, 2013.
6. David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A :** 10 Questions of 2 marks each - No choice**20 Marks.****PART B:** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks.****Employability****Entrepreneurship****Skill Development**

SECA4004	e-Health	L	T	P	Credits	Total marks
		3	1	0	3	100

Course Objectives

- To introduce the concepts of eHealth
- To have an in-depth knowledge on medical data analytics and wearable devices used in e-Health systems
- To assess the advantages of eHealth
- To explore the usage of AI in eHealth
- To design and develop applications for e-Health

UNIT I INTRODUCTION TO e-Health

9 Hrs

Overview and introduction to eHealth and flow of health information- International regulations in e-Health-Advantages, Challenges and future of e-Health.

UNIT II MEDICAL DATA ANALYTICS AND WEARABLE DEVICES

9 Hrs

Health care data and Electronic Health Records (EHR) systems- Medical data bases -Wearable devices-Data collection from wearable devices- Clinical use of personal health data- Big data in the field of Medicine.

UNIT III DIGITAL HEALTH

9 Hrs

Introduction to health care digital transformation- Digital health: Tools, Strategies of digital health-Technologies in digital health-Implementation of Digital health- Advantages and challenges of Digital health

UNIT IV ARTIFICIAL INTELLIGENCE IN e-Health

9 Hrs

History of AI in health care-Impacts and Aspects of AI in health care- Current research in AI in e-Health-Regulations and Ethical concerns in using AI in e-Health

UNIT V APPLICATION DEVELOPMENT FOR e-Health

9 Hrs

Introduction to Android, Creating Android Activities, Android User interface design, Access Wi-fi and Bluetooth with mobile applications-Web based App for eHealth applications.

Max: 45 Hrs

Course Outcomes

- On Completion of The Course, Student Should Be Able To
- CO1 - Articulate e-Health and Its Regulations
- CO2 - Explore Medical Data Analytics and Records
- CO3 - Appraise Digital Transformation in The Field of Medicine
- CO4 - Analyse AI in Health Care Systems
- CO5 - Design System Level Architecture for Health Information Systems
- CO6 - Deploy Android Application on Devices

TEXT / REFERENCE BOOKS

1. Shortliffe, Edward H and Cimino James J. Biomedical Informatics, Computer Applications in Health Care and Biomedicine, Springer-Verlag London 2014.
2. Lavis, JN (ed). Ontario's Health System: Key Insights for Engaged Citizens, Professionals and Policymakers. 2016.
3. Hoyt RE, Yoshihashi A, Bailey N. Health informatics: Practical guide for healthcare and information technology professionals. Lulu Press. 2014 Seventh edition.
4. Gaddi A, Capello F, Manca M. eHealth, Care and Quality of Life. 2014 electronic library holding in the Health Science Library

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 12 marks

80 Marks

SECA3027	IoT FOR REAL TIME APPLICATIONS	L	T	P	Cred its	Total Marks
		2	0	2	3	100

Course Objectives

- To design products related to IoT based Health care applications
- To design IoT enable smart cities considering various energy harvesting techniques
- To develop IoT based system for supporting farmers and agriculture
- To develop IoT based system for industrial automation
- To analyze various IoT based system considering societal benefits
- To develop an IoT based wearable device for measuring physiological parameters and physical movements

UNIT I IoT FOR HEALTHCARE**9 Hrs.**

Architecture of IoT for Healthcare , IoT based Health Monitoring System using Arduino, Healthcare monitoring Technique for Diabetes Patients, Remote Patient Monitoring- IoT Heart Rate Monitoring, remote monitoring of physiological parameters, ECG, EEG, and BP.

UNIT II IoT ENABLED SMART CITIES**9 Hrs**

Smart Energy meters, , , Smart home powered by IoT, Smart Lightning, Smart Traffic Control , Smart Grid and Solar Energy Harvesting, Intelligent Parking System.

UNIT III IoT FOR SMART AGRICULTURE**9 Hrs.**

Smart Agriculture, IoT Based Agriculture, Animal Intrusion detection in farms, soil moisture detection and Irrigation system, Livestock monitoring system, IoT based Greenhouse Environment Monitoring and controlling

UNIT IV IoT BASED INDUSTRIAL AUTOMATION**9 Hrs.**

IoT based gas leakage monitoring system, Temperature and liquid level monitoring in boilers, Wireless video surveillance robot, Automatic Solar Tracker, IoT in Logistics Sector

UNIT V IoT FOR SOCIETY**9 Hrs.**

Medical Waste Management, Weather update system with IoT, Women security system, wearable glove to enable sign to speech conversation, IoT based air pollution meter, Improved productivity of staff and reduced human labor

Maximum Hours: 45**Course Outcomes**

On completion of the course, the student should be able to

- CO1**-Develop MATLAB programs for solving basic mathematical problems
- CO2**-Develop MATLAB programs for solving Real World Problems
- CO3**-Develop GUI and MATLAB programs for Plotting various types of Graphs
- CO4**-Develop MATLAB programs for Advanced Mathematical applications
- CO5**-Develop Simulink based systems for solving Real World Problems
- CO6**- Develop Simulink programs for resolving specialized engineering related issues

TEXT / REFERENCE BOOKS

1. Fadi Al-Turjman, Intelligence in IoT- enabled Smart Cities, 2019, 1st edition, CRC Press, ISBN-10: 1138316849
2. Giacomo Veneri, and Antonio Capasso, Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0, 2018, Packt Publishing.
3. Krishna P. Venkata, Sasikumar Gurumoorthy, Mohammad S.Obaidat, Internet of Things and Personalized Healthcare Systems , Springer-2019.
4. Pattnaik, Prasant Kumar, Mohanty, Suneeta, Mohanty, Satarupa, Smart Healthcare Analytics in IoT Enabled Environment, Springer-2020.
5. Avijit Mathur, Thomas Newe, Walid Elgenaidi, Muzaffar Rao, Elfed Lewis and Daniel Toal, Medical IoT systems: architecture and security by Wearable Sensors, 2017.
6. Verónica Saiz-Rubio , Francisco Rovira-Mas ,From Smart Farming towards Agriculture 5.0: A Review on Crop Data Management, Agronomy 2020, 10, 207; doi:10.3390/ agronomy 10020207

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100**ExamDuration:3 Hrs.****PART A: 10** Questions of 2 marks each-No choice**20 Marks****PART B: 2** Questions From each unit of internal Choice; each carrying 16 marks**80 Marks**

SECA1704	CONTEMPORARY WIRELESS COMMUNICATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on evolution of mobile communication and standards.
- To understand current trends in wireless LAN protocols.
- To study about personal area network and M2M communication standards.
- To impart knowledge on role of satellites in mobile and internet services.
- To study about underwater wireless communication techniques.

UNIT 1 EVOLUTION OF CELLULAR MOBILE NETWORKS

9hrs

UMTS and CDMA 2000 (3G) - Wideband CDMA (WCDMA) - LTE and LTE advanced (4G) - Network architecture

– Modulation–Coding schemes– 5G systems: specifications and applications.

UNIT 2 WIRELESS LAN STANDARDS

9 hrs

IEEE 802 Standards – IEEE 802.11 WLAN Standards – Comparison of IEEE 802.11 a, b and g standards, WiFi- 5 and WiGig - Concepts of MIMO, Massive MIMO and MU MIMO -Principle of Li-Fi based WLAN.

UNIT 3 PERSONAL AREA NETWORK PROTOCOLS

9 hrs

Bluetooth -Piconet, Scatternet- Bluetooth Low Energy(BLE) - Zig-Bee- Z-wave UWB- LoRA Wireless Standards, LoRA WAN Gateway, LORA Applications.

UNIT 4 SATELLITE MOBILE AND SPECIALIZED SERVICES

9 hrs

Types of Satellites LEO, MEO and GEO Satellite services in Cellular Mobile communication - Satellite Phones

– Satellite IoT services - Satellite Internet Service: Starlink and Viasat GPS Services: GLONASS, IRNSS and NAVIC.

UNIT 5 UNDERWATER WIRELESS COMMUNICATION

9 hrs

Underwater Communication: IEEE Standards, Modulation techniques, Frequency Spectrum, Modulation Techniques - Underwater Channel models for wireless Communication -Role of Digital signal processing in Underwater Communication- Underwater localization

Max. 45 hrs

COURSE OUTCOMES:

On completion of this course, students are able to

- CO1 Classify various generations of wireless communication and standards
- CO2 Demonstrate the applications of different international standards in wireless LAN and PAN
- CO3 Develop an energy efficient system level model for IoT applications
- CO4 Appraise and report on advances in higher generations of wireless communication systems.
- CO5 Design conceptually a mobile communication system according to the required standard.
- CO6 Develop system level models for underwater communication.

TEXT / REFERENCE BOOKS:

- [1] William C.Y. Lee., "Wireless and Cellular Telecommunications", 3rd Edition revised reprint McGraw Hill.2011.
- [2] Iti saha Mishra , "Wireless Communications and Networks: 3G and Beyond" 2nd Edition McGraw Hill 2013.
- [3] Nishith D. Tripathi and Jeffrey H. Reed,"Cellular Communications A Comprehensive and Practical Guide" Wiley 2014.
- [4] Rajpandya " Mobile and Personal Communication Services and Systems", IEEE Inc., New York, 2014.
- [5] Nitin Goyal, Luxmi Sapra, Jasminder Kaur Sandhu," Energy-Efficient Underwater Wireless Communications and Networking", 1st Edition, Business Science Reference , 2020

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 hrs

Part A: 10 questions of 2 marks each -No choice

20 Marks

Part B: 5 questions from each unit with internal choice, each carrying 16 marks

80 Marks

S13AEPICS	ENGINEERING PROJECTS IN COMMUNITY SERVICE	I	T	P	Credits	Total marks
						100

Course Objectives

To Properly define and scope a problem; To Identify and analyze relevant factors;

To apply appropriate industrial engineering methodologies and computational tools; To Generate and evaluate alternative solutions;

To Improve skills in

- Technical writing, ▪ Public speaking, ▪ Working within a team (when applicable), and ▪ Project and time management.

Unit I	Multidisciplinary Design: Learn how to be better designers, gain design knowledge and skills; learn how to apply disciplinary knowledge to real and possibly ill-defined problems; learn how to identify and acquire new knowledge; learn to collaborate with people from other disciplines and develop an appreciation for cross-disciplinary contributions in design.	9hrs
Unit II	Professional Preparation: Develop the broad set of skills needed to be successful in the changing global workplace and world:	9hrs
Unit III	Service-Learning: Provide significant service to the community while learning; gain an understanding of the role that engineering (and their discipline) can play in society and the broader issues related to the needs we are addressing.	9hrs
Unit IV	Case studies on community service	9hrs
Unit V	Identification of engineering solutions to a real world problem	9hrs

The students will be able

- CO1: To investigate the real -world problems
- CO 2: To illustrate the real -world problems with community service
- CO 3: To demonstrate design the solutions using multi- disciplinary approach
- CO 4: To investigate the processes
- CO 5: To analyze the solutions given
- CO 6: To develop empathy

SECA5304	INTELLIGENT COMPUTING TECHNIQUES (For VLSI & AE)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To study the basic principles of fuzzy logic and fuzzy operators.
- To understand the concept of fuzzy logic controller and its applications.
- To comprehend the concepts of biological neuron and the learning algorithms.
- To study and analyse various methodologies for training multi-layer network.
- To acquire knowledge about SOM and special networks.
- To illustrate the concepts of Genetic Algorithms & Evolutionary strategies.

UNIT 1 INTRODUCTION TO FUZZY LOGIC

9 Hrs.

Classical set- operations and properties -Fuzzy Set-operations and properties-problems ,Classical Relations-Operations and Properties, Fuzzy Relations-Operations and Properties -Compositions-Max-min, Max-Product-Problems, Membership function-features of membership functions-types, α cuts, Linguistic Hedges.

UNIT 2 FUZZY LOGIC CONTROL SYSTEM

9 Hrs.

FLCS- Fuzzy logic control system-Need for FLCs-Assumptions in FLC design. Fuzzification – Defuzzification. Fuzzy decision making, Fuzzy Rule Based System- Knowledge Base System. Mamdani and sugeno FLC architectures, Introduction to ANFIS-Architecture. Fuzzy cognitive maps. Applications - speed control of induction motor, automatic train control.

UNIT 3 FUNDAMENTALS OF ANN

9 Hrs.

Fundamentals of ANN - - Features of ANN, Biological Neural Network – structure, Features ,Functions of Synaptic junction ,Comparison of BNN & ANN, Topology, Models of ANN - McCulloch – Pitts model, Adeline , Madeline. Basic learning laws, Activation Functions - Types , Learning strategy - Learning Rules, Perception Model– Training Algorithm –Limitation of single layer network, Multi Layer Perception n/w – Algorithm, Problems in perception N/W.

UNIT 4 MULTILAYER AND ADAPTIVE ARCHITECTURES

9 Hrs

BPN-Algorithm, Application, CPN-Training, Applications, Mexican Hat, Kohonan SOM, vector quantization, - Associate memory - Bidirectional Associative Memory (BAM) - Architecture – Hopfield – Discrete & Continuous types, AlgorithmEnergy function, Adaptive Resonance Theory - ART1 ,ART2-



training. Probabilistic neural network, Applications - Fault diagnosis, Motion control in robotics. Pattern Recognition.

UNIT 5 GENETIC ALGORITHMS AND EVOLUTIONARY STRATEGIES

9

Hrs.

Introduction – Robustness of Traditional Optimization and Search Techniques – The goals of optimization - Evolutionary computation versus Classical optimization –Fitness function, Reproduction Selection - Selective pressure, Random selection, Proportional, Tournament, Rank based, Boltzmann, Elitism, Hall of Fame – Stopping conditions - Cross over – Binary & Floating point representation, Mutation - Binary & Floating point representation & headless chicken method. Generic Evolution Strategy Algorithm, Strategy Parameters and Self-Adaptation, Evolution Strategy Variants, Applications of Evolution Strategies

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Recall and recollect the concepts of Fuzzy logic properties and operations
- CO2 - Understands design and development of various fuzzy based control applications
- CO3 - Evaluate different artificial neural network techniques.
- CO4 - Analyze different multilayer and adaptive networks
- CO5 - Identify the need for evolutionary computation.
- CO6 - Formulate algorithms based on Evolutionary computational strategies.

TEXT / REFERENCE BOOKS

1. James A Freeman and Davis Skapura, "Neural Networks", Pearson, 2017 reprint.
2. Jacek M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 2012 reprint.
3. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", MacGraw Hill. 3rd Edition, 2010.
4. Jang J.S.R., Sun C.T., Mizutani E., "Neuro-Fuzzy and Soft Computing", PHI, 2017 reprint.
5. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley, reprint 2017.
6. Rajasekharan and Rai, "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications", PHI Publication, 2nd Edition 2017.
7. Andries P. Engelbrecht, "Computational intelligence An Introduction", 2nd Edition, 2010.
8. Laurene Fausett, "Fundamentals of Neural Networks: Architecture, Algorithms and Applications", Pearson Education, 2017.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 5 Questions of 6 marks each - No choice

30 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 14 marks

70 Marks

3



Employability



Entrepreneurship



Skill Development

SECA6303	LABVIEW PROGRAMMING LAB	L	T	P	Credits	Total Marks
		0	0	6	2	100

COURSE OBJECTIVES

- To Apply knowledge of Mathematics, Science and Engineering to solve the complex engineering problems in Electronics and Communication Engineering.
- To Demonstrates the knowledge of theoretical & practical aspects of signal and systems to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety.
- To Test, measure and provide valid conclusions on energy saving design using modern engineering tools and softwares for environmental sustainability.
- To Model and simulate communication systems and analyze the performance using modern tools.
- To Investigate, design and conduct experiments, analyze and interpret data, make inferences from the resulting data and apply the research skills to solve complex engineering problems in analog and digital systems.
- To Design systems for applications based on the acquired knowledge to solve real time requirements.

SUGGESTED LIST OF EXPERIMENTS

1. Experiments using arrays
2. Experiments using loops
3. Experiments using structures
4. Sub VI
5. Thermometer
6. Random number generation and matching
7. Formula node & expression node Sampling,
8. Aliasing and quantization Signal
9. Transformation
10. Filters Signal Denoising
11. Image processing application
12. Automotive applications
13. Biomedical Imaging

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Apply the concepts of virtual instrumentation concept and dataflow programming.

CO2 - Illustrate various functions available in Lab VIEW for engineering applications.



CO3 - Design of projects for various application.

CO4 - Anayze the performance of DAQ devices and customized hardware using Lab VIEW.

CO5 - Design a biomedical imaging based application.

CO6 - Develop an application using Lab view.

SECA7043	AUTONOMOUS DRONE TECHNOLOGY	L	T	P	Credits	Total Marks
		3	1	0	3	100

COURSE OBJECTIVES

- To introduce anatomy of Drones and their types.
- To Familiarize the Student's with aerodynamics of drones.
- To Understand the configuration of flight controllers and other systems in drones
- To understand the fundamentals of autonomous navigation
- To learn the applications of computer vision and AI in autonomous drones.

UNIT I ANATOMY OF DRONE**9 Hrs**

Drones-Definition and Classifications--Anatomy of Drone - Mechanical Structures, Flight Controller, Sensors and Actuators, Electronic Speed Controller, Brushless Motors-Communication Systems- Batteries and Power supply unit

UNIT II AERODYNAMICS AND STABILITY**9 Hrs**

Forces of flight, Principal axes and rotation of aerial systems - Longitudinal axis, Lateral(transverse) axis and Perpendicular axis, Equilibrium, Stability - Stable system, Unstable system and Neutrally stable system, Control — Roll, Pitch, Yaw and Throttle.

UNIT III DESIGN OF GROUND CONTROLLED DRONES**9 Hrs**

Standards and Legal Restrictions for Drones - Frame type selection - Configuring Drones Compass calibration, Access calibration, Radio calibration, Flight mode calibration and Failsafe calibration –Case study- Drones for Aerial photography, Mapping and Surveying.

UNIT IV AUTONOMOUS NAVIGATION AND POSITIONING**9 Hrs**

GPS/GNSS receivers, Inertial Navigation Systems (INS), LiDAR scanners, Ultrasonic sensors and visual camera - Simultaneous Location and Mapping-(SLAM)- Mission Planner.

UNIT V COMPUTER VISION AND AI FOR AUTONOMOUS DRONES**9 Hrs**

Computer Vision and Multi-View Stereo Vision – 3D Vision System Development— Case study-object detection, classification,Image Annotation, Data Annotationand airborne tracking using OpenCV and Pytorch

Max. 45 hrs**COURSE OUTCOMES:**

On completion of the course, student will be able to

CO1— Apply the mathematical/engineering concepts in building drones

C02 —Analyze the mathematical relation between force, equilibrium, stability and the movement ofdrones C03 — Select appropriate sensors and actuators for specific application requirements.

CO4 — Develop navigational systems for autonomous drones.

C05 — Appraise the performance of computer vision in drones

C06 — Design an autonomous drone for mission control application.

TEXT / REFERENCE BOOKS

1. Syed Omar FarukTowaha, "Building Smart Drones with ESP8266 and Arduino: Build exciting drones by leveraging the capabilities of Arduino and ESP8266" Packt Publishing, 2018
2. Aaron Asadi, "Drones The Complete Manual. The essential handbook for drone enthusiasts", Imagine Publishing Limited, 2016
3. Neeraj Kumar Singh, PorselvanMuthukrishnan, Satyanarayana Sanpini, "Industrial System Engineering for Drones: A Guide with Best Practices for Designing", Apress, 2019
4. V Kishore Ayyadevara, Yeshwanth Reddy, "Modern Computer Vision with PyTorch",Packt, 2020.
5. K R Krishna, "Agricultural Drones: A Peaceful Pursuit", Apple Academic Press; CRC Press, 2018

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 5 Questions of 6 Marks each – No choice

30 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 14 Marks

70 Marks

SECA7018	BIG DATA TECHNOLOGIES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Provide the basics of organization of big data, architectural issues of big datatools.
- Study on Modern databases which currently exist in the field of computerscience.

UNIT 1 OVERVIEW OF BIG DATA**9Hrs.**

Fundamentals of Big-data analytics, Overview & analytics life cycle, Need, Structured and multi-structured data analysis, Big-data analytics major components, Analytical models and approaches, Big data challenges.

UNIT 2 ARCHITECTURES IN BIG DATA**9Hrs.**

Designing and building big data applications, Big data architecture, Distributed Computing platforms and Data Storage, Security and Data Privacy, Application Areas, Application Tools and Platforms.

UNIT 3 HADOOP& HDFS**9Hrs.**

Clustered Hadoop environment, HDFS and data managements using HDFS, Analytics Using Map Reduce and programming, Map Reduce design patterns.

UNIT 4 MODERN DATABASES**9Hrs.**

Introduction to Modern databases-NoSQL, NewSQL, NoSQLVs RDBMS databases Tradeoffs, Working with MongoDB, Data warehouse system for Hadoop.

UNIT5 PIG AND HIVE IN BIG DATA**9 Hrs.**

Introduction to Pig and HIVE- Programming Pig: Engine for executing data flows in parallel on Hadoop, Programming with Hive.

Max. 45Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Attain in-depth knowledge and understanding of the big data technologies.
- CO2 - Understand the various search methods and visualization techniques for big data analytics.
- CO3 - Demonstrate the principles of bi data analytics using Big Data tools, Big Data Querying Tools, such as Pig, Hive and Impala.
- CO4 - Design and build big data applications and analyze issues in data storage, data privacy and security.
- CO5 - Demonstrate various techniques for mining data stream and applications using Map Reduce Concepts.
- CO6 - Use advanced analytical tools/ decision-making tools/ operation research techniques to analyze the complex problems.

TEXT / REFERENCE BOOKS

1. Dean Wampler, Jason Rutherglen, Edward Capriolo, "Programming Hive" O'Reilly Media, 1st Edition, 2012.
2. Sawant, Nitin, Shah, Himanshu, "Big Data Application Architecture Q &A: A Problem-Solution Approach", Apress, 1st Edition, 2013.
3. Tom White, "Hadoop the Definitive Guide", Yahoo Press, 3rd Edition, 2012.
4. Alex Holmes, "Hadoop In Practice ", Manning, 1st Edition, 2012.
5. JasonVenner, "Pro Hadoop", Apress, 1st Edition, 2009.
6. Donald Miner, Zach Radtka, "Hadoop with python", O'Reilly Media, 1st Edition, 2015.
7. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann, 1st Edition, 2013.
8. Jonathan R. Owens, Jon Lentz, Brian Femiano, "Hadoop Real, World Solutions Cookbook", Packt, 2nd Edition, 2016.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 5 Questions of 6 Marks each – No choice**30 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 14 Marks**70 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 14 Marks

SECA7014	LOW POWER VLSI DESIGN (For AE & VLSI)	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- This course will focus on sources of power dissipation, types of analysis, Low power VLSI design Techniques and methodologies.

UNIT 1 INTRODUCTION TO LOW POWER VLSI DESIGN

9 Hrs.

Introduction- Need for Low power VLSI design- Charging and Discharging Capacitance- Short circuit current in CMOS- CMOS leakage current- Static current- Principles of Low power design- Low power figure of Merits.

UNIT 2 POWER ANALYSIS METHODS

9 Hrs.

Simulation power analysis - SPICE circuit analysis - Discrete Transistor Modeling and analysis-Gate Level Logic simulation- Architecture level analysis - Data Correlation analysis in DSP systems - Monte Carlo Simulation – Random Logic signal- Probability Power analysis techniques- Signal entropy.

UNIT 3 GATING AND ENCODING TECHNIQUES

9 Hrs.

Transistor and gate sizing-Network Restructuring and Reorganization- special latches and Flip flops-Low power digital cell library-Gate Reorganization-Signal Gating-Logic Encoding-State Machine encoding- Precomputation Logic.

UNIT 4 SPECIAL TECHNIQUES

9 Hrs.

Special Techniques- Power reduction in clock networks- CMOS floating node -Low power Bus -Delay Balancing- Low power techniques for SRAM- Architecture and system- Power and performance management - Switching activity reduction-Parallel Architecture –Flow graph transformation.

UNIT 5 ADVANCED TECHNIQUES

9 Hrs.

Advanced techniques- Adiabatic Computation- Pass transistor Logic synthesis -Asynchronous circuits – Software Design for Low power- Sources of software power dissipation- Software power optimization.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Illustrate the basic concepts of Low power Designs
- CO2 - Compare the Parameters such Power, Delay and Power Delay product
- CO3 - Categorize understanding of Gating and Encoding Techniques
- CO4 - Identity the features of Special Low Power Techniques
- CO5 - Assess the Advanced Low Power Techniques
- CO6 - Design about the Low Power VLSI applications



TEXT / REFERENCE BOOKS

1. Gary Yeap, "Practical Low Power Digital VLSI design", Kluwer Academic Publishers, 1998 Edition.
2. Sharat Prasad and Koushik Roy, "Low power CMOS VLSI Circuit design", John Wiley Publications", 2000 Edition.
3. Kiat Seng Yeo & Kaushik Roy, "Low voltage, Low power VLSI subsystems", McGraw HillM 2009.
4. Meloberti Franco, "Analog design for CMOS VLSI systems", Kluwer Academic Publishers, 2001.
5. Abdellatif Bellaouar, "Low Power Digital VLSI Design: Circuits and Systems", Kluwer Academic Publishers, 1995.
6. Saraju P. Mohanty, Nagarajan Ranganathan, Elias Kougiannos, Priyardarsan Patra, "Low-Power High- Level Synthesis for Nanoscale CMOS Circuits", Springer, 2008.



S13BLH11	ELECTRONIC DEVICES	L	T	P	EL	Credits	Total Marks
		2	0	4	0	4	100

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

- To acquaint the students with the construction, theory and operation of the basic electronic devices.
- To understand the mechanisms of current flow in semi-conductors.
- To familiarize on the principle of operation, capabilities and limitation of various advanced semiconductor devices and its practical application.
- To design practical circuits with alternate electronic devices.
- To study Nano devices.

UNIT 1 BASIC SEMICONDUCTOR DEVICES**12 Hrs.**

PN junction diode- construction and operation, Current equations, Diffusion and drift current densities, forward and reverse bias characteristics, Breakdown in PN Junction Diodes. Applications - Rectifiers, Limiting and Clamping Circuits, Zener diode-construction and VI characteristics. Design and Experimental Verification of Diode Characteristics (PN and Zener) and applications (Rectifiers and Voltage Regulators).

UNIT 2 BIPOLAR JUNCTION TRANSISTORS**12 Hrs.**

Bipolar junction transistors, NPN -PNP, construction, forward and reverse bias characteristics -Early effect, current equations-Input and Output characteristics of CE,CB,CC-Ebers Moll Model-Multi Emitter Transistor, Gummel Poon-model- Verification of Transistor Characteristics (CE,CB,CC).

UNIT 3 FIELD EFFECT TRANSISTORS**12 Hrs.**

JFETs-Drain and Transfer characteristics,-Current Equations-Pinch off voltage and its significance-MOSFET-Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET-Characteristics-Comparison of MOSFET with JFET,DUALGATEMOSFET- Non- Theoretical Comparison of JFET and MOSFET Characteristics.

UNIT 4 SPECIAL SEMICONDUCTOR DEVICES**12 Hrs.**

Schottky barrier diode-SCR, DIAC, TRIAC, Varactor diode, Tunnel diode, UJT, LDR, Phototransistor, Gallium Arsenide device- Heuristics approach to Special semiconductor devices, VI characteristics of special semiconductor devices.

UNIT 5 NANO DEVICES**12 Hrs.**

Nano Sensors for measurement of temperature, humidity, pressure- Bio Sensors for measurement of blood pressure, heart rate, glucose level, SPO₂ Chemical Sensors for pH, gas measurement-sensors for automation, Linearity characteristics of sensors.

Max. 60 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** Apply the knowledge of basic semiconductor materials by understanding fabrication processes.
- CO2** Analyze the characteristics of various electronic devices
- CO3** Analyze the various circuit configurations and its classifications of BJT and MOSFETs.
- CO4** Analyze the characteristics of special semiconductor devices.
- CO5** Analyze the performance characteristics of various sensors.



Employability



Entrepreneurship



Skill Development

CO6 Select suitable sensors for automation.

TEXT / REFERENCE BOOKS

1. Donald A Neaman, "Semiconductor Physics and Devices", 4th Edition, Tata McGraw Hill Inc. 2012.
2. Wolfgang Fritzsche (Editor), Jürgen Popp (Editor) "Optical Nano- and Microsystems for Bio-analytics (Springer Series on Chemical Sensors and Biosensors Book 10)" 2012th Edition
3. Juin J. Liou (Editor), Shien-Kuei Liaw (Editor), Yung-Hui Chung (Editor), "Nano Devices and Sensors Hardcover – Import, 25 April 2016"
4. David Bell, "Fundamentals of Electronic Devices and Circuits", 5th Edition, Oxford University Press 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A MCQ Questions

20 Marks

PART B Laboratory Practical

80 Marks

S13BLH21	DIGITAL LOGIC CIRCUITS	L	T	P	EL	Credits	Total Marks
		2	0	4	0	4	100

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

- To impart knowledge on various types of Binary logics.
- To design a binary logic circuit for an arithmetic expression.
- To understand the usage of registers and counters used in various digital circuits.
- To understand the design of memory devices used
- To get an exposure about the electronics behind design of Basic digital logical elements.

UNIT 1 NUMBER SYSTEMS, LOGIC FUNCTIONS AND BOOLEAN ALGEBRA
12 Hrs.

Number systems Number systems conversions - Binary arithmetic Binary codes Logic functions- Universal gate functions - Boolean algebra Functionally complete operation sets, Reduction of switching equations using Boolean algebra, Realization of switching function, Experimental verification of Logic gates.

UNIT 2 DESIGN OF COMBINATIONAL LOGIC
12 Hrs.

Design procedure of Combinational Logic Design of two level gate networks - Sum of Products (SOP) - Product of Sums(POS) - Canonical SOP - Canonical POS - Karnaugh Map - Simplifications of Boolean functions using Karnaugh Map and implementation using Logic function Advantages and limitations of K-Map Tabulation method, Design and Experimental verification of Boolean function.

UNIT 3 COMBINATIONAL CIRCUITS
12 Hrs.

Introduction to Combinational circuits-Half Adder, Full Adder - Half Subtractor, Full Subtractor-Parallel binary Adder, Parallel binary Subtractor - Carry look ahead Adder- BCD Adder- Decoders- Encoders - Multiplexers- Demultiplexers- Code convertors- Magnitude Comparator, Design and experimental verification of Adders, Subtractors, Encoders, Decoders, Multiplexers, Demultiplexers and Code convertors.

UNIT 4 SEQUENTIAL CIRCUITS
12 Hrs.

Introduction to Sequential circuits – Flip flops – SR, JK, D and T flip flops, Master-Slave flip flop, Characteristic and excitation table –Registers – Shift registers – Counters– Synchronous and Asynchronous counters – Modulus counters –State diagram, State table, State minimization – Hazards, Design and experimental verification of Flip flops, Shift registers and Counters.

UNIT 5 DIGITAL LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES
12 Hrs.

Classification and characteristics of logic family – Bipolar logic family – Saturated logic family – Non saturated family – Unipolar family – TTL, MOS and CMOS logic families. Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA), Implementation of logic circuits in FPGA.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 Minimize Boolean functions for computationally less complex implementations.**CO2** Apply K map and tabulation method for minimization of Boolean functions.**CO3**

Implement combinational logic circuits for Real World

Employability Entrepreneurship Skill Development

Problems.

S35PB11	ANALOG INTEGRATED CIRCUIT DESIGN	L	T	P	EL	Credits	Total Marks
		2	0	2	0	3	100

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

- To understand the concepts of small signal models of BJTs and MOSFETs. To
- identify the design and analysis of single stage and multistage amplifier. Be
- familiar the performance of operational amplifier.
- To focus on analog multiplier.
- Be familiar with the Analog Design.

UNIT 1 INTEGRATED CIRCUIT BJT AND MOSFET MODELING**9 Hrs.**

Small signal models of BJTs and MOSFETs, short channel effects and scaling, and its impact on small signal parameters, biasing and operating regimes, parasitic elements, Frequency response of BJTs and MOSFETs.

UNIT 2 SINGLE AND MULTISTAGE AMPLIFIERS**9 Hrs.**

Small signal single stage amplifier such as Common Emitter stage, Common source stage, Source follower, Common gate stage, Cascode stage configurations and properties, multistage amplifier stages such as Darlington and cascade configurations, Small signal analysis of differential amplifiers, Balanced differential amplifiers.

UNIT 3 CURRENT MIRRORS AND LOADS**9 Hrs.**

Basic current mirrors, cascode current mirrors, active current mirrors, current mirror configurations, current matching considerations, active load configurations, Miller effect, voltage references, supply independent biasing, temperature independent references, input bias current.

UNIT 4 OPERATIONAL AMPLIFIERS**9 Hrs.**

Concept of negative feedback, Effect of loading in feedback networks, Operational amplifier performance parameters, analysis of the simple op amp, Two-stage Op Amps, Input range limitations, Gain boosting, slew rate, power supply rejection, design considerations of integrated op-amps, Statistical characteristics of noise, noise in single stage amplifiers, noise in differential amplifiers, noise figure and noise temperature.

UNIT 5 ANALOG MULTIPLIER AND IC DESIGN**9 Hrs.**

Bipolar analog multiplier, simple emitter coupled multiplier, a complete analog multiplier, Gilbert multiplier, Analysis of four quadrant and variable trans conductance multiplier, Low Power Analog Design, Introduction to Switched Capacitor Circuits, Analog Layout Considerations and Packaging Issues.

Max. 45 Hrs.

Employability



Entrepreneurship



Skill Development

COURSE OUTCOMES

On completion of the course, student will be able to

- C01** - Analyze the characteristics of various small signal models of BJT and MOSFETs.
- C02** - Analyze the performance of single stage and multistage amplifiers.
- C03** - Design current mirrors circuits for given specifications.
- C04** - Analyze the performance of Operational amplifiers in closed loop and open loop configurations.
- C05** - Design analog multiplier circuits using BJT and MOSFETs.
- C06** - Design various filters using switched capacitor circuit techniques.

TEXT / REFERENCE BOOKS

1. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", 5th Edition, Wiley, 2009.
2. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2012
3. Willey M.C. Sansen, "Analog designessentials", Springer, 2014.
4. Grebene, "Bipolar and MOS Analog Integrated circuit design", John Wiley & Sons, Inc., 2015.
5. Phillip E. Allen, Douglas R. Holberg, "CMOS Analog Circuit Design", 2nd Edition, Oxford University Press, 2012.
6. P.E. Allen and D.R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, 2011.



Employability



Entrepreneurship



Skill Development

S35BLH11	SOFTWARE FOR EMBEDDED SYSTEMS (For AE and Embedded & IoT)	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

- Introduce the students to the issues and challenges in developing software for embedded systems.
- Educate the students in formal modeling, design and development methodologies.
- Expose the students to software tools and techniques used in the development process.

UNIT 1 EMBEDDED PROGRAMMING**9 Hrs.**

C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Experiment Debugging and Optimization of C Programs.

UNIT 2 C PROGRAMMING TOOLCHAIN IN LINUX**9 Hrs.**

C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities - Profiling - using gprof - Memory Leak Detection with val grind - Introduction to GNU C Library Develop Embedded C programs in Linux platforms.

UNIT 3 EMBEDDED C AND EMBEDDED OS**9 Hrs.**

Adding Structure to Code: Object oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts. Basis of embedded OS, Introduction to sEOS, Using Timer 0 and Timer 1, Portability issue- Creating real-time applications using sEOS.

UNIT 4 MODEL BASED DESIGN OF EMBEDDED SYSTEMS**9 Hrs.**

System-level design methodologies - UML basics, Object state behavior - UML state charts - Role of scenarios in the definition of behavior - Timing diagrams - Sequence diagrams - Event hierarchies - types and strategies of operations - Architectural design in UML - threads in UML- Develop UML model for Real World Problems.

UNIT 5 EMBEDDED JAVA**9 Hrs.**

Introduction to Embedded Java and J2ME Smart Card basics Java card technology overview Java card objects Java-card applets working with APDUs Web Technology for Embedded Systems- Smart Programming using Javacard tool chain.

Max. 45Hrs.**COURSE OUTCOMES**

On completion of the course, students will be able to

- C01** - Develop Assembly and C programs for 8-bit microcontrollers.
- C02** - Analyze Embedded C programs and debug the software faults.
- C03** - Apply embedded C programming tool chain available in Linux platforms.
- C04** - Develop applications with sEOS embedded operating system.
- C05** - Apply UML based modeling in design of embedded applications.
- C06** - Develop embedded applications with Embedded Java and J2ME tool chain.

TEXT / REFERENCE BOOKS

Employability



Entrepreneurship



Skill Development

1. Steve Oualline, 'Practical C Programming 3rd Edition', O'Reilly Media, Inc, 2016.
2. Hassan Gomma, "Designing concurrent, distributed, and real time applications with UML", 2nd Edition, Pearson Education, 2012.
3. Michael J Pont, "Embedded C", Pearson Education, 2017.
4. Zhiquan Chen, 'Java Card Technology for Smart Cards: Architecture and Programmer's Guide', Addison-Wesley Professional, 2020.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 20 Questions - MCQs**20 Marks****PART B:** Practical Laboratory**80 Marks**

SECB5103	MICROCONTROLLERS (For AE and Embedded Systems & IoT)	L	T	P	EL	Credits	Total Marks
		3	0	0	1	3	100

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

- To learn the internal architecture of ARM Cortex M3/M4 core.
- To study about different communication protocols.
- Discuss in detail about peripheral interfacing with MCUs.
- To learn STM32 cube MX IDE for ARM Cortex M3 / M4 processors.
- To learn API level coding with STM32fxxxboards.

UNIT 1 INTRODUCTION TO MICROCONTROLLER 9 Hrs.

Microprocessors and Microcontrollers – CISC and RISC - Fundamentals of Assembly language Programming– Instruction to Assembler – C Programming for Microcontrollers – Compiler and IDE.

UNIT 2 INTRODUCTION TO ARM CORTEX-M 9 Hrs.

Introduction to various versions of ARM Cortex M series - Debugging Features -Thumb Instruction Set - Memory Management - Comparison of various Cortex-M microcontrollers: LPC2148, STM32 series.

UNIT 3 CORTEX M4 CORE 9 Hrs.

Cortex M4 Architecture – Features – CPU Registers, Operating Modes - Instruction set – Addressing modes – I/O Programming - Vector Table.

UNIT 4 Cortex M4 MICROCONTROLLER 9 Hrs.

STM32F3/4 Series Microcontrollers - Timers and Counters – Interrupts /Exception Handling - Phase Locked Loops – Communication Protocols - I2C, SPI, USB, CAN and LIN.

UNIT 5 STM32F3/4 SERIES PROGRAMMING 9 Hrs.

Introduction to Cortex M4 microcontroller boards – GPIO, Timers, EEPROM, ADC, PWM, SPI and I2C interface programming with STM32cube IDE.

Max. 45 Hrs.**COURSE OUTCOMES**

Upon completion of the course, the students will be able to

- C01** - Choose appropriate microcontrollers or processor core for different applications
- C02** - Demonstrate Host/Target Development build tools for Embedded System development
- C03** - Design circuits with ARM cortex-M family microcontrollers
- C04** - Analyze the performance of various communication protocols.
- C05** - Develop Embedded System applications using STM microcontrollers
- C06** - Demonstrate Hardware Abstraction Layer based microcontroller peripheral programming



Employability



Entrepreneurship



Skill Development

TEXT / REFERENCE BOOKS

1. Joseph Yiu, "The Definitive Guide to the ARM Cortex-M3", Newnes, 2nd Edition, 2009.
2. Mark Fisher, "ARM Cortex M4 Cookbook, Packt Publishing, 2016.
3. B. Das, "Architecture, Programming, and Interfacing of Low-power Processors-ARM 7, M", Cengage, 1st Edition, 2017.
4. Steve Furber, ARM System-on-Chip Architecture, Pearson, 2nd Edition, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 5 Questions of 6 marks each - No choice**30 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 14 marks**70 Marks**

S11BLH22	PYTHON PROGRAMMING	L	T	P	EL	Credits	Total Marks
		2	0	2	0	3	100

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

- To study the concept of data types
- To study basics of python programing
- To study GUI programming

UNIT 1 INTRODUCTION**9 Hrs.**

Introduction, History, Features of Python, Data types, Variables, Expressions, Conditional Statements, Operators, Looping, Control Statements

Practice Programs

1. Develop a python program to find the best of two test average marks out of three test's marks accepted from the user and compute the overall pass percentage for their placements.
2. Write a class Money with attributes Rupees and Paise. Overload operators +=, -=, and >= so that they may be used on two objects. Also write functions so that a desired amount of money can be either added or subtracted from Money.

UNIT 2 FUNCTIONS AND STRINGS**9 Hrs.**

Function Calls, Conversion of functions, Arguments, Fruitful Functions, Boolean functions, Strings, Looping and Counting, String Operations.

Practice Programs

1. Defined as a function F as $F_n = F_{n-1} + F_{n-2}$. Write a Python program which accepts a value for N (where $N > 0$) as input and pass this value to the function. Display suitable error message if the condition for input value is not followed.
2. Analyze the string similarity between two given strings using Python program

Sample Output:

Original string:

Python Exercises

Python Exercise

Sample Output:

Original string:

Python Exercises

Python Exercises

UNIT 3 LIST, TUPLES AND DICTIONARIES**9 Hrs.**

List, List Operations Built in List functions, Tuple, Tuple Operations, Dictionary, Operations in Dictionary, Built in Dictionary Methods.

Practice Programs

1. A hospital has received a set of lab reports. Totally five tests are conducted in the lab and the report is prepared in such a way that the 'nth' number correspond to value of test_n. Given the details of a test made for a patient, write an algorithm and the subsequent Python program to print if the test result is normal or not normal by referring the values in Table 1. Since the value is sensitive, provide a mechanism so that the values do not get altered.

Name of the Test	Minimum Value	Maximum Value
Test1	20	30
Test2	35.5	40
Test3	12	15
Test4	120	150
Test5	80	120

2. An University has published the results of the term end examination conducted in April. List of failures in physics, mathematics, chemistry and computer science is available. Write a program to find the number of failures in the examination. This includes the count of failures in one or more subjects.
3. Write a program to maintain a telephone directory of the employees of an organization. If the

employee has more than one number store all the numbers. Write a program to print the mobile numbers given full or part of the name of the employee. Eg: Given name of the employee as 'John' the program must print phone numbers of 'John Paul' and 'Michel John'.

UNIT 4 FILES AND REGULAR EXPRESSIONS

9 Hrs.

Files, File Handling Operations, User Defined Exceptions, Regular Expression, Types using Match function, Postfix, Infix, prefix conversion.

Practice Programs

1. A proctor of our university wants a student to write a program that calculates the average of marks scored by her wards in CAT1. She has the details such as name, register number, mark1, mark2 and mark3 of her proctees. The constraint given by the faculty is that any of the details must not be altered by mistake. Help the student to develop a Python program.
2. Consider the following scenario for finding the number of students who secured centum in mathematics in their examination. A total of 6 lakhs students appeared for the examinations and their results are generated automatically and updates to the portal using file.

UNIT 5 CREATING GUI FORM, CLASSES AND OBJECTS

9 Hrs.

Creating a GUI Window, Widgets, Buttons, Canvas, Layout Management, Designing GUI Applications using Tkinter module, Overview of OOP, class Definitions, Built in Class Attributes, Real time Examples using Classes and objects.

Practice Programs

1. A farmer with a fox, a goose, and a sack of corn needs to cross a river. Now he is on the east side of the river and wants to go to west side. The farmer has a rowboat, but there is room for only the farmer and one of his three items. Unfortunately, both the fox and the goose are hungry. The fox cannot be left alone with the goose, or the fox will eat the goose. Likewise, the goose cannot be left alone with the sack of corn, or the goose will eat the corn. Given a sequence of moves find if all the three items fox, goose and corn are safe. The input sequence indicate the item carried by the farmer along with him in the boat. 'F' – Fox, 'C' – Corn, 'G' – Goose, N-Nothing. As he is now on the eastern side the first move is to west and direction alternates for each step.
2. An university is setting up a new lab at their premises. Design an algorithm and write Python code to determine the approximate cost to be spent for setting up the lab. Cost for setting the lab is sum of cost of computers, cost of furnitures and labour cost. Use the following formulae for solving the problem:

COURSE OUTCOMES

Max.45 Hrs.

On completion of the course, student will be able to

- CO1** Apply the concept of Data types, conditional statements and looping in Python programming
- CO2** Apply functions in Python for real time problems.
- CO3** Analyze the use of List, Tuples and Dictionaries in Python programming
- CO4** Develop python programming for web applications using regular expression
- CO5** Design GUI in Python for various applications
- CO6** Develop solution in Python for any specific real time problem

TEXT / REFERENCE BOOKS

1. Introduction to Programming Using Python by Y. Daniel Liang (Pearson Publishing), ISBN 9780132747189
2. <http://www.pythontutor.com/visualize.html>
3. <https://docs.python.org/2/tutorial>
4. The Practice of Computing Using Python, by W. Punch and R. Enbody, 3-rd edition, Pearson Publishing, ISBN 978-0- 13-437976-0

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.**

PART A MCQ Questions
PART B Laboratory Practical

20 Marks
80 Marks

SECB3002	KNOWLEDGE ENGINEERING AND EXPERT SYSTEM	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

- To get introduced to the basic knowledge representation, problem solving, and learning methods of Artificial Intelligence.
- To solve problems in Artificial Intelligence using Python.
- To familiarize with Fuzzy Logic and knowledge processing in expert systems.

UNIT 1 INTRODUCTION TO PYTHON**9 Hrs.**

Python-Introduction to Python- Lists Dictionaries & Tuples in Python- Python implementation of Hill Climbing.

UNIT 2 PROBLEM IDENTIFICATION**9 Hrs.**

What is Artificial Intelligence, The AI Problems, Defining the Problem as a State Space Search, Problem Characteristics Searching strategies – Generate and Test.

UNIT 3 HEURISTIC SEARCH TECHNIQUES**9 Hrs.**

Heuristic Search Techniques- Breadth-First Search (BFS) and Depth First Search (DFS), Bidirectional Search, A* search Simulated Annealing, Hill climbing.

UNIT 4 KNOWLEDGE REPRESENTATION**9 Hrs.**

Using Predicate logic -representing facts in logic, functions and predicates, Conversion to clause form, Resolution in propositional logic, Resolution in predicate logic, Unification. Representing Knowledge Using Rules: Procedural Versus Declarative knowledge, Logic Programming, forward versus Backward Reasoning.

UNIT 5 CONNECTIONIST MODELS AND EXPERT SYSTEM**9 Hrs.**

Hopfield Networks, Learning in Neural Networks, Applications of Neural Networks, Recurrent Networks. Connectionist AI and Symbolic AI - Representing and using Domain Knowledge – Reasoning with knowledge– Expert System Shells –Support for explanation- examples Knowledge acquisition-examples.

COURSE OUTCOMES**Max.45 Hrs.**

On completion of the course, student will be able to

- CO1** - Develop Python programs for implementing AI algorithms
- CO2** - Analyze various searching Strategies in AI
- CO3** - Analyze the methods used for Knowledge representation
- CO4** - Analyze the knowledge processing in Expert System
- CO5** - Design and implement algorithms for Connectionist Models
- CO6** - Implement of Search methods using Python



Employability



Entrepreneurship



Skill Development

TEXT / REFERENCE BOOKS

1. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill Publishing Company Ltd., New Delhi, Third Edition, ISBN: 13:978-0-07-008770-5, 2010.
2. Stuart Russell, Peter Norvig, "Artificial Intelligence- A modern approach", Pearson Education Asia, Second Edition, ISBN:81-297-0041-7
3. Akshar Bharati, Vineet Chaitanya, Rajeev Sangal, "Natural Language Processing: A Paninian Perspective", Prentice Hall India Ltd., New Delhi, 1996, ISBN 10: 8120309219
4. Amit Konar, Artificial Intelligence and Soft Computing, CRC Press.
5. Dan W.Patterson, "Introduction to Artificial Intelligence and Expert Systems", Prentice Hall India Ltd., New Delhi, 2009, ISBN: 81-203-0777-1.
6. Rajendra Akerkar, Introduction to Artificial Intelligence, PHI Learning Pvt. Ltd., 2005, ISBN: 81-203- 2864-7.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.**

PART A 10 Questions of 2 marks each-No choice
PART B 2 Questions from each unit of internal choice; each carrying 16 marks

20 Marks**80 Marks****8****0 Marks**

Employability



Entrepreneurship



Skill Development

SECB5202	REAL TIME OPERATING SYSTEMS (For AE and Embedded Systems & IoT)	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

- To learn about the fundamental difference between general purpose and real time operating systems.
- To learn about the scheduling algorithms used in RTOS.
- To learn about the porting and configuration of RTOS to different hardware targets.
- To learn programming with RTOS.

UNIT 1 INTRODUCTION AND INTERNALS 9 Hrs.

Introduction to Real-Time Systems, Classification of real time systems, Difference between GPOS and RTOS- Real Time Kernels - RTOS Architecture- Features of RTOS- POSIX-RT standard

UNIT 2 PERFORMANCE METRICS AND SCHEDULING ALGORITHMS 9 Hrs.

Performance Metrics of RTOS, Task Specifications-Task state - Real Time Scheduling algorithms: Cyclic executive, Rate monotonic, IRIS and Least laxity scheduling- Schedulability Analysis.

UNIT 3 RESOURCE SHARING FOR REAL TIME TASKS 9 Hrs.

Resource sharing among tasks- Priority inversion Problem- Priority inheritance and Priority ceiling Protocols-Features of commercial and open source real time operating systems: Vxworks, QNX, Micrium OS, RT Linux and Free RTOS

UNIT 4 APPLICATION PROGRAMMING USING RTOS 9 Hrs.

Task synchronization using semaphores, Inter task communication: message queues and pipes, Remote procedure call- Timers and Interrupts-Memory management and I/O management.

UNIT 5 RTOS IMAGE BUILDING FOR DIFFERENT TARGET PLATFORMS 9 Hrs.

Porting of RTOS, Configuring RTOS for minimizing RAM consumption and increasing Throughput- Building RTOS Image for Target platforms

Max. 45 Hrs.

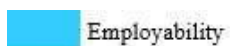
COURSE OUTCOMES

On completion of the course, student will be able to:

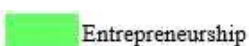
- CO1** - Analyze the hardware and software issues in real-time computing
- CO2** - Demonstrate real-time scheduling and schedulability analysis of priority-driven scheduling algorithms.
- CO3** - Analyze the situation of fault occurrence and provide feasible solutions accordingly.
- CO4** - Demonstrate porting of RTOS to embedded hardware target platforms.
- CO5** - Develop real-time applications using RTOS software.
- CO6** - Attain improved employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

TEXT/REFERENCE BOOKS

- Jane W. S Liu, "Real Time Systems" Pearson Higher Education, 3rd Edition, 2010.
- Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2nd Edition, 2014.
- Jean J. Labrosse, "Micro C/OS-II : The real time kernel" CMP Books, 2nd Edition, 2015.



Employability



Entrepreneurship



Skill Development

4. Warren Gay, "Beginning STM32: Developing with Free RTOS", Apress, 1st Edition, 2018.
5. Richard Barry, "Mastering the Free RTOS: Real Time Kernel", Real Time Engineers Ltd, 1st Edition, 2016.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 5 Questions of 6 marks each - No choice**30 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 14 marks**70 Marks**

S35BLH21	REAL TIME SIGNAL AND COLOR IMAGE PROCESSING (FOR AE and Embedded Systems & IoT)	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

- To introduce the principles of optimum filters such as Wiener and Kalman filters
- To introduce the principles of adaptive filters and their applications to communication engineering
- To introduce the concepts of multi-resolution analysis

UNIT 1 DESIGN OF OPTIMUM FILTERS**9 Hrs.**

Wiener filters - FIR Wiener filter - discrete Wiener Hopf equation, Applications - filtering, linear prediction. IIR Wiener filter - causal and non-causal filters. Recursive estimators - discrete Kalman filter applications.

UNIT 2 DESIGN OF ADAPTIVE FILTERS**9 Hrs.**

Principles and properties of adaptive filters - FIR adaptive filters. Adaptive algorithms - steepest descent algorithm, the LMS algorithm - convergence. Applications of adaptive filtering - noise cancellation, channel equalization.

UNIT 3 APPLICATIONS OF WAVELETS**9 Hrs.**

Short-time Fourier transform - Heisenberg uncertainty principle. Principles of multi-resolution analysis - sub-band coding, the continuous and discrete wavelet transform - properties. Applications of wavelet transform - noise reduction, image compression.

UNIT 4 COLOR IMAGE PROCESSING**9 Hrs.**

Colour Models and Spaces- RGB and CMYK Spaces, Scalar Processing of Colour Images-Vector Processing of Colour Images- Noise Removal using Vector Filters-Vector Edge Detection- Colour Filter Arrays and Demosaicking

UNIT 5 3D IMAGE VISUALIZATION**9 Hrs.**

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Image processing in 3D, Measurements on 3D images.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

C01 - Apply optimum filters appropriately for a given communication application.

C02 - Design appropriate adaptive algorithm for processing non-stationary signals.

C03 - Analyse wavelet transforms for signal and image processing based applications.

C04 - Demonstrate filtering of color images.

C05 - Perform vector operations on color images.

C06 - Develop code for 3D image processing.



Employability



Entrepreneurship



Skill Development

TEXT / REFERENCE BOOKS

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2018.
2. P. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 2009.
3. Andreas Koschan, MongiAbidi. Digital color image processing, John Wiley and Sons, 2008.
4. Gaurav Sharma (Ed). Digital colorimaging handbook, CRC Press, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A: 20 Questions MCQs****20 Marks****PART B: Practical Laboratory****80 Marks****Employability****Entrepreneurship****Skill Development**