

SECA5106	FUNDAMENTALS OF IOT	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To discuss in detail about C language and its uses in IoT devices.
- To discuss in brief about concepts of Data Structure such as Linked List, Sorting Techniques, Searching Techniques etc.
- To study in detail the basic and advanced concepts of Python Language.
- To study the various IoT terminologies.
- To discuss in detail about IoT standards, IoT architecture, challenges in IoT, gateways, sensor and actuators.

UNIT1 C PROGRAMMING**9Hrs.**

Overview of C in the view of IoT devices, Functions, Arrays, Pointers, Strings, Structures and Unions, Files, Memory Allocations, Bitwise Operations, Pre-Processors, Introduction to Data Structures- Linked Lists, Stacks and Queues, Sorting & Searching Techniques.

UNIT2 PYTHON PROGRAMMING**9Hrs.**

Overview of Python-Applications over IoT & Advantages of Python, Introduction to Python concepts-Scope, Data Types, Files, Functions, Modules and Packages, Standard Libraries, Data Structures programming in Python.

UNIT3 INTRODUCTION TO IoT**9Hrs.**

Overview of IoT, Terminology of Internet of Things (IoT), History of IoT, Applications, Requirements for and of IoT, **M2M/IoT Standards**, Components of IoT, IoT Enabling, Technologies-**Sensors, Actuators, Gateways**, Local & Global Connectivity, **IoT Cloud Platforms**, ThingSpeak, ThingWorx.

UNIT4 BUSINESS INFERENCES AND IoTDESIGN**9Hrs.**

Architecture, Sensing, Connectivity-**To Cloud Platforms & Other IoT Devices**, Processing Software, Power, Prototyping of IoT Devices-Introduction to Node Red, **Visual Prototyping with Arduino and Applications of IoT- Home Automation, Agriculture, Smart Cities, Health Care and Education**.

UNIT5 IoT REFERENCE ARCHITECTURE AND CHALLENGES**9Hrs.**

Overview of Reference Architecture, **Business Models**, Introduction to **Challenges in IoT Implementation- Security, Privacy, Ethical Constraints**, Denial of Service (DoS), and Resource Constraints, Introduction of Solutions to the challenges.

Max.45Hrs.**COURSE OUTCOMES**

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

- CO1 - Articulate the key features of C and Python programming language with examples.
- CO2 - Attain broad understanding of the technologies related to emerging domain of IoT.
- CO3 - Demonstrate the role of Gateways and Cloud platforms for providing global connectivity in IoT.
- CO4 - Demonstrate the interfacing of different sensors with different microprocessors and microcontrollers under Windows and Linux environment.
- CO5 - Illustrate the application of IoT in Industrial Automation and identify Real World Design Constraints.
- CO6 - Design and implement real time IoT applications.

TEXT / REFERENCE BOOKS

1. Adrian McEwen and Hakim Cassimally, "Designing Internet of Things", Wiley, 1st Edition, 2013.
2. DeepaliSrivastava, S. K.Srivastava, "C in depth", BPB Publications, 3rd Edition, 2013.
3. Martin C Brown, "Python: The Complete Reference", McGrawHill, 2nd Edition, 2018.
4. ArsheepBahga, Vij1ay Madiseti, "Internet of Things: A Hands-On Approach", VPT, 2nd Edition, 2014.
5. Zed A. Shaw, "Learn Python the Hard Way" O'Reilly, 1st Edition, 2013.
6. Brian W. Kernighan, Dennis Ritchie, "C Programming Language", 2nd Edition, 1988.

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**

SECA5107	MICROCONTROLLERS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Discuss in brief about Microprocessors and Microcontrollers.
- Study in detail the internal architecture of ARM CortexM3/M4.
- Discuss in detail about various Communication protocols.
- Discuss in detail about ADC, PWM and GPIOs and its interfacing with MCUs.
- Demonstrate STM32cubeMX in view of ARM CortexM3/M4.
- Hands on at API level Coding with STM32fxxxBoards.

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

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

UNIT 2 INTRODUCTION TO ARM CORTEX-M**9Hrs.**

Introduction to ARM Cortex M Series-Introduction to various versions of ARM Cortex-Comparison of Various Versions- Machine Cycle-Harvard Architecture vs. Von-Neuman Architecture -Debugging Features-Thumb Instruction Set- Memory Management - Comparison of various Microcontrollers-8051,LPC2148,ARM cortex..

UNIT 3 CORTEX M3 CORE**9Hrs.**

Cortex M3 Architecture - Features - Oscillators - Pipelining and its Hazards-CPU Registers-CPU Operating Modes-Instruction set - Addressing modes - I/O Programming-Vector Table.

UNIT 4 TIMERS AND INTERRUPTS**9Hrs.**

Timers and Counters - Interrupts /Exception Handling -Tail Chaining & Late Arrival - Phase Locked Loops - Structure Padding - Serial Peripheral Interface – Master – Slave-Active Nodes, Passive Nodes.

UNIT 5 PROTOCOLS AND PROGRAMMING**9Hrs.**

Protocols-I2C,SPI,USB,CAN,LIN - Cortex M3 development boards-Programming on LPC2148-EEPROM,SPI Interfacing - Introduction to STM32 DISCOVERYF407 Board - Introduction and Installation of STMCUBEMX - Introduction ECLIPSE Environment -Introduction to GPIO-Programming on Led Blinking, I2C,ADC,UART/USART, PWM, Interrupts and Timers

Max.45Hrs.**COURSE OUTCOMES**

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

- CO1 - Understand the recent trends, challenges and design issues in Embedded Systems.
- CO2 - Describe Assemblers, Compilers, Linkers, Loaders, Debuggers and JTAG.
- CO3 - Explain Host/Target Development environment using build tools for Embedded Systems.
- CO4 - Explain various microprocessor architectures and hardware peripherals.
- CO5 - Develop Embedded System based application using Embedded C Programming.
- CO6 - Demonstrate ARM Cortex M architecture with Embedded C Programming for application 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. Lyla B. Das, "Architecture, Programming and Interfacing of Low-power ProcessorsARM 7, Cortex-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**

SECA5108	NETWORK PROGRAMMING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Study in detail the Linux internals.
- Study in detail the TCP/IP reference model and networking protocols.
- Study basics and advanced techniques of socket based client server programming.
- Demonstrate the packet sniffing tools.

UNIT1 INTRODUCTION TO COMPUTER NETWORKS**9Hrs.**

Introduction of Networks- Types of Networks- Network resources and its technology- Network Topology- Types of Network Topology- Wireless Network- Ad-Hoc Wireless Network- Infra structure Wireless Network.

UNIT2 INTERNETPROTOCOLS**9Hrs.**

Introduction to IP address and MAC address, Distinguished class in IP, IPv4- Subnet mask- Masking via host and networks – FLISM – VLSM- Advantages and Disadvantages of Sub-netting - Super-netting- IPv6- Port numbers- Multicast(Class-D).

UNIT 3 OSI MODEL AND ITS APPLICATIONS**9Hrs.**

Basics of Operating Systems- Introduction to OSI model-layers in OSI models- TCP/UDP protocol- ARP protocol- DHCP protocol- Network Protocol Applications.

UNIT 4 FUNDAMENTALS OF ETHERNET**9Hrs.**

CSMA/CD - CSMA/CA – Collision – Reflection – Absorption- Scattering of networks- Range of Ethernet in Wired and Wireless communication.

UNIT 5 SOCKET PROGRAMMING**9Hrs.**

Introduction to Sockets- Components of Socket- Server and its types- simple server- concurrent server - Client- System Calls for Server and Client- Socket programming using TCP and UDP protocols and its system calls- Network Address Topology and its uses- Inter Process Communication- tcpdump- WireShark interfaces.

Max.45Hrs.**COURSE OUTCOMES**

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

- CO1 - Describe the topologies and architecture of Local area network and wireless computer networks.
- CO2 - Describe major technologies and protocols used in network communications.
- CO3 - Demonstrate the key protocols that support internetworking.
- CO4 - Apply TCP/UDP sockets for network communication.
- CO5 - Apply knowledge of Linux operating systems to build robust client and server applications.
- CO6 - Implement a networking solution according to the need and requirements.

TEXT / REFERENCE BOOKS

1. Richard Stevens, "Unix Network Programming", Volume I and II, 2nd Edition, 1998.
2. Forouzan B A, "Data Communications and Networking", McGraw Hill, 4th Edition, 2006.
3. Kurose James F and Keith W. Ross, "Computer Networking: A Top-Down Approach", Pearson India, 5th Edition, 2012.
4. E R Harold, "Java network programming", O'Reilly Media, 4th Edition, 2013.
5. L. Peterson and B. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan-Kaufmann, 2012.

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**

SECA5109	DESIGN OF EMBEDDED SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To provide a clear understanding on the basic concepts, Building Blocks of Embedded Systems.
- To teach the fundamentals of Embedded processor Modeling, Bus Communication in processors, Input/output interfacing.
- To introduce processor-scheduling algorithms, Basics of Real time operating systems.
- To discuss on aspects required in developing a new embedded processor, different Phases & Modeling of embedded system.

UNIT 1 INTRODUCTION TO EMBEDDED SYSTEMS**9Hrs.**

Introduction to Embedded Systems – Structural units in Embedded processor, DMA, Memory management methods-memory mapping, cache replacement concept, Timer and Counting devices, Watchdog Timer, Real Time Clock.

UNIT 2 COMMUNICATION PROTOCOLS AND ISR**9Hrs.**

I/O Device Ports & Buses - Serial Bus communication protocols-RS232 standard - RS485 - USB - Inter Integrated Circuits (I2C) - interrupt sources, Programmed-I/O busy-wait approach without interrupt service mechanism- ISR concept - multiple interrupts -context and periods for context switching, interrupt latency and deadline.

UNIT 3 RTOS BASED EMBEDDED SYSTEM DESIGN**9Hrs.**

Introduction to basic concepts of RTOS-Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication-shared memory, message passing- Inter process Communication - synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance-comparison of commercial RTOS features

UNIT 4 SOFTWARE DEVELOPMENT TOOLS**9Hrs.**

Software Development environment-IDE, assembler, compiler, linker, simulator, debugger, In-circuit emulator, Target Hardware Debugging, Overview of UML, Scope of UML modeling, Conceptual model of UML, UML basic elements

UNIT 5 EMBEDDED SYSTEM APPLICATION DEVELOPMENT**9Hrs.**

Case studies-Smart card-Adaptive Cruise control in a Car – Robotics-Home automation-Industrial process monitoring and control.

Max. 45Hrs.**COURSE OUTCOMES**

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

- CO1 - Describe the components of embedded system and different communication protocols.
- CO2 - Describe the differences between the general computing system and embedded system, also recognize the classification of embedded systems.
- CO3 - Attain expertise with embedded system development and debugging tools.
- CO4 - Apply the interrupt service mechanism in the design of embedded system.
- CO5 - Design of real time embedded systems using the concepts of RTOS.
- CO6 - Articulate the role of embedded systems in industry and provide feasible design solutions for given problem statement.

TEXT / REFERENCE BOOKS

1. Rajkamal, "Embedded system-Architecture, Programming, Design", TMH, 2nd Edition, 2011.
2. Peckol, "Embedded system Design", John Wiley & Sons, 2nd Edition, 2010.
3. Elicia White, "Making Embedded Systems", O'Reilly Series, 1st Edition, 2011.
4. Shibu.K.V, "Introduction to Embedded Systems", Tata McGraw Hill, 1st Edition 2009.
5. Lyla B Das, "Embedded Systems-An Integrated Approach", Pearson, 1st Edition, 2013.
6. Bruce Powel Douglass, "Real-Time UML Workshop for Embedded Systems", Elsevier, 1st Edition, 2011.
7. Jonathan W. Valvano, "Embedded Microcomputer Systems, Real Time Interfacing", Cengage Learning, 3rd Edition, 2012.

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**

SECA5208	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	Credits	Total Marks
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COURSE OBJECTIVES

- To necessitate students understand the basic principles of random signal processing, spectral estimation methods, adaptive filter algorithms and their applications.
- To facilitate the student to comprehend the different signal detection and estimation methods used in communications system.
- To facilitate the students with some of the most important advanced signal processing techniques.
- To facilitate the students with time-frequency analysis techniques.

UNIT 1 DISCRETE RANDOM SIGNAL PROCESSING**9 Hrs.**

Weiner Khitchine relation - Power spectral density - filtering random process, Spectral Factorization Theorem, special types of random process - Signal modeling-Least Squares method, Pade approximation, Prony's method, iterative Prefiltering, Finite Data records.

UNIT 2 SPECTRUM ESTIMATION**9 Hrs.**

Non-Parametric Methods-Correlation Method - Co-Variance Estimator- Performance Analysis of Estimators - Unbiased, Consistent Estimators-Periodogram Estimator-Barlett Spectrum Estimation-Welch Estimation-Model based Approach - AR, MA, and ARMA Signal Modeling-Parameter Estimation using Yule-Walker Method

UNIT 3 ESTIMATION AND PREDICTION**9 Hrs.**

Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion - Wiener filter - Discrete Wiener Hof equations - Recursive estimators - Kalman filter - Linear prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equations.

UNIT 4 ADAPTIVE FILTERS**9 Hrs.**

FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Windrow Hof LMS Adaptive algorithm - Adaptive channel equalization - Adaptive echo canceller - Adaptive noise cancellation - RLS Adaptive filters.

UNIT 5 MULTIRATE SIGNAL PROCESSING**9 Hrs.**

Mathematical description of change of sampling rate - Interpolation and Decimation, Decimation by an integer factor Interpolation by an integer factor, Sampling rate conversion by a rational factor, Filter implementation for sampling rate conversion- Direct form FIR structures, Polyphase filter structures, time-variant structures.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Study the modern digital signal processing algorithms and applications.
- CO2 - Implement Spectrum estimation techniques.
- CO3 - Understand the filter design and realize it.
- CO4 - Have an in-depth knowledge of use Adaptive filters in real time applications.
- CO5 - Familiar with multi-rate processing and time-frequency analysis techniques.
- CO6 - Implement Direct form structures.

TEXT / REFERENCE BOOKS

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc., Singapore, 2002.
2. Dimitris G. Manolakis, "Statistical and adaptive signal processing", McGraw Hill, New York, 2000.
3. Glenn Zelinkar, Fred J. Taylor, "Advanced digital Signal processing, Theory and Applications", McGraw Hill, 2000.
4. Ifeakor. E.C., Jarvis. B.W., "Digital Signal Processing: A Practical Approach", Prentice Hall, 2nd Edition, 2002.
5. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson Education, 2002
6. John G. Proakis, "Algorithms for Statistical Signal Processing", Pearson Education, 2002.

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**

SECA6102	MICROCONTROLLER AND IOT LAB	L	T	P	Credits	Total Marks
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COURSE OBJECTIVES

- To understand the fundamentals of C and Python programming languages.
- To learn C programming of Microcontrollers.
- To understand the principles of Internet of Things (IoT)

SUGGESTED LIST OF EXPERIMENTS

1. C programming (pointers, arrays, strings, structures, files, memory allocations, stack, queues etc.).
2. Python programming (data types, loops, functions, string, list, tuple, dictionary, sets, classes, modules, packages, file handling, regular expressions modules like OS etc.).
3. Embedded C Programming of 8 bit Microcontroller.
4. Client server socket programming using TCP and UDP socket.
5. GPIO Programming of ARM processor (LED blinking, Potentiometer, Switch).
6. Timer/Counter, ADC (Polling and Interrupt).
7. Controlling GPIO using PWM.
8. UART, SPI, I2C protocols.
9. Interfacing with Wi-Fi, Bluetooth and BLE Modems.
10. Prototyping using NodeRed, Arduino (blinking led, serial communication, sensor interfacing).
11. IoT Cloud platform e.g. ThingSpeak, connectivity of Arduino to IoT cloud platform.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Acquainted with Assemblers, Compilers, Linkers, Loaders and Debuggers.
- CO2 - Develop Host/Target Development environment using build tools for Embedded Systems.
- CO3 - Demonstrate C and Python programming through examples.
- CO4 - Design and development of 8bit/16bit microcontroller based applications.
- CO5 - Design and development of ARM processor based applications.
- CO6 - Implement IoT applications.

SECA5203	WIRELESS SENSOR NETWORKS FOR IoT	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Study in detail about various wireless technologies.
- Study in detail about Bluetooth and Bluetooth Low Energy Beacons.
- Discuss in detail about cellular technologies.
- Hands on at Wi-Fi and BLE enabled board and devices.
- Discuss in brief about Communication Protocols and demonstration.

UNIT 1 INTRODUCTION TO WIRELESS COMMUNICATION**9Hrs.**

Introduction to Wireless Technologies, Wireless LAN, IEEE 802.11 standards, Frequency bands, Sub Standards (a,b,g,n), Network Topology, Terminology, Client-Server Network Management for WLAN

UNIT 2 FUNDAMENTALS OF BLUETOOTH**9 Hrs.**

Bluetooth Basics, Classic Bluetooth Profiles - L2CAP, RFCOMM, Bluetooth Smart/Low Energy, BLE Profiles - GATT, GAP, BLE Motes, Beacons- Protocols, Implementation support, frame support, Advertising, discovering, data Transmission, Bluetooth 5/ Bluetooth Mesh protocols

UNIT 3 STUDY AND DEPLOYMENT OF IEEE 802.15.4 STANDARDS & RPL**9Hrs.**

Wireless PAN, IEEE 802.15.4 standards, Implementation of ZigBee, Thread etc., Linux support for WPAN, 6LoWPAN standard, IPv6 Routing Protocol for Low-Power (RPL) and Lossy Networks, RPL Border Router, Use cases of MQTT and Rest Services for Cloud Connectivity

UNIT 4 CELLULAR TECHNOLOGIES**9Hrs.**

Introduction to Cellular Technologies, Frequency Reuse Concepts Global System for Mobile Communications (GSM), General Radio Packet Radio Services (GPRS), Code Division Multiple Access (CDMA), 3G/UMTS, 4G/LTE, Introduction to 5G and its challenges

UNIT 5 OVERVIEW OF RECENT IoT WIRELESS TECHNOLOGIES**9Hrs.**

Introduction to Short range communication, RFID, IrDA, NFC, GPS, Sigfox, NB-IoT, LoRA-WAN Protocol- Terminology, Classes of LoRA Devices, Frequency Bands, Addressing Schemes, Message/Frame Formats, Use Case and Examples, Introduction to Firmware over the Air (FOTA)

Max. 45Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Have the basic concepts of wireless sensor networks, sensing, computing and communication tasks.
- CO2 - Describe and explain radio standards and communication protocols adopted in wireless sensor networks.
- CO3 - Analyze the hardware, software and communication for wireless sensor network nodes.
- CO4 - Explain the architectures, features, and performance for wireless sensor network systems and platforms.
- CO5 - Describe and analyze the specific requirements of applications in wireless sensor networks for energy efficiency, computing, storage and transmission.
- CO6 - Able to adapt the wireless sensor network with sensor nodes which have limitations in power consumption, processing power and bandwidth and able to apply appropriate algorithms to develop new wireless sensor network applications.

TEXT / REFERENCES BOOKS

1. Jun Zheng, Abbas Jamalipour, "Wireless Sensor Networks: A Networking Perspective", Wiley India, 1st Edition, 2014.
2. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", John Wiley & Sons, 1st Edition, 2010.
3. Edgar H. Callaway, "Wireless Sensor Networks: Architectures and Protocols", CRC Press, 1st Edition, August 2003.
4. Jose A. Gutierrez, Edgar H. Callaway, Raymond Barrett, "IEEE 802.15.4 Low-Rate Wireless Personal Area Networks: Enabling Wireless Sensor Networks", Standards Information Network, 3rd Edition, 2011.
5. Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks: Technology, Protocols, and Applications", John Wiley & Sons, 1st Edition, 2007.

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**

SECA5204	EMBEDDED OS AND DEVICE DRIVERS	L	T	P	Credits	Total Marks
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COURSE OBJECTIVES

- To learn embedded system architecture.
- Study in detail process management and memory management.
- To learn Real Time Operating system principles and its components.
- Study in detail Linux kernel and Linux file systems.
- Study in detail device drivers.

UNIT1 OVERVIEW OF EMBEDDED SYSTEMS**9Hrs.**

Embedded System Architecture fundamentals. Hardware and Software abstraction models.

UNIT2 OPERATING SYSTEMS OVERVIEW**9Hrs.**

Operating Systems fundamentals- Process Creation – Scheduling-Memory Management-Inter Process Synchronization – Inter Process Communication.

UNIT3 EMBEDDED OPERATING SYSTEMS**9Hrs.**

Embedded OS overview, Study of Embedded OS principles and requirements. Internal components of Embedded operating systems - Compare and contrast various Embedded OS platforms.

UNIT 4 INTRODUCTION TO DEVICE DRIVERS**9Hrs.**

Unix/Linux kernel fundamentals-Process Scheduling-Kernel Synchronization, I/O devices - Architecture-Character, Block Device handling, file systems- The Ext2 file System-The Virtual File System and peripheral devices.

UNIT5 DEVICE DRIVER INTERNALS**9Hrs.**

Fundamentals of device drivers-Character and Block Devices -Polling and Interrupts-The Hardware, device enumeration and configuration, Data transfer and management mechanisms.

Max.45Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Gain adequate understanding of the software architecture of the Embedded OS.
- CO2 - Develop simple applications for Process Management, Synchronization Techniques, Message Passing, POSIX based application development.
- CO3 - Describe the Linux Kernel environment; build system, kernel configuration, customization and compilation.
- CO4 - Set up a Linux environment with basic understanding of kernel programming concepts like Module Programming and Device Drivers.
- CO5 - Develop a character driver on x86 PCs and ARM based Linux Environments.
- CO6 - Understand cross tooling environments and be exposed to development of device drivers for a target hardware platform.

TEXT / REFERENCE BOOKS

1. Charles Crowley, "Operating Systems: A Design-Oriented Approach", MGH, 1st Edition, 2001.
2. Christopher Hallinan, "Embedded Linux Primer: A practical Real-World approach", Prentice Hall, 2nd Edition, 2011.
3. Daniel P. Bovet and Marco Cesati, "Understanding the Linux Kernel, O'Reilly, 3rd Edition, 2005.
4. John Madiou, "Linux Device Drivers Development: Develop customized drivers for embedded Linux", Packt Publishing, 1st Edition, 2017.
5. Jonathan Corbet, Alessandro Rubini, Greg Kroah, "Linux Device Drivers", O'Reilly, 3rd Edition, 2005.

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**

SECA6202	EMBEDDED OS AND DEVICEDRIVERS LAB	L	T	P	Credits	Total Marks
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COURSE OBJECTIVES

- To understand the fundamentals of Embedded OS and device drivers.
- To learn device driver development for different I/O modules.
- To understand the principles operating system elements

SUGGESTED LIST OF EXPERIMENTS

- 1 Task management and Software timers.
- 2 Real-time message queues, semaphores, and mutexs.
- 3 Process management and Thread management.
- 4 Scheduling policies and preemptions.
- 5 Embedded Linux Development environment set-up.
- 6 Linux Kernel configuration.
- 7 Building Embedded Linux Device Trees.
- 8 Linux Kernel Modules and Device model.
- 9 Sysfs, Char device / drivers.
- 10 Platform device/driver.

COURSE OUTCOMES

On completion of the course the students will be able to

- CO1 - Gain adequate understanding of the software architecture of the Embedded OS
- CO2 - Develop simple applications for Process Management, Synchronization Techniques, Message Passing, Mutex, etc.,
- CO3 - Describe the Linux Kernel environment; build system, kernel configuration and customization and compilation.
- CO4 - Set up a Linux environment with basic understanding of kernel programming concepts like Module Programming and Device Drivers.
- CO5 - Develop a character driver on ARM based Linux Environments.
- CO6 - Design and development of device drivers for a target hardware platform.

SCCA9501	INDUSTRY 4.0	L	T	P	Credits	Total Marks
		2	0	0	2	100

UNIT 1 ADVANCED TECHNOLOGY AND MATERIALS**9 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 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT**9 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 3 SMART MANUFACTURING**9 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 4 SMART WORLD**9 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 5 CYBER PHYSICAL SYSTEMS**9 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) : CaseStudies.

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. FlavioCraveiro, 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.
4. Klaus Schwab, "Fourth Industrial Revolution", Random House USA Inc, New York, USA, 2017.
5. Oliver Grunow, "SMART FACTORY AND INDUSTRY 4.0. The current state of Application Technologies", Studylab Publications, 2016
6. Alasdair Gilchrist, "INDUSTRY 4.0: Industrial Internet of Things", Apress, 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**

SECA5205	MOBILE APPLICATION DEVELOPMENT	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Discuss in detail the survey of prominent mobile platforms.
- Study in detail the android mobile application development.
- Study in detail the connectivity methods to other mobile applications and IoT devices.

UNIT1 INTRODUCTION TO VARIOUS MOBILE PLATFORMS**9Hrs.**

Introduction: Survey of prominent mobile platforms - Android -iOS- Windows Mobile.

UNIT 2 ANDROID ACTIVITIES: STUDY AND CREATION**9Hrs.**

Introduction to Android, Why develop for android OS, Android SDK features, Creating android activities.

UNIT 3 ANDROID INTENT, THREAD AND SERVICES**9Hrs.**

Fundamental Android UI design, Android Application Basis - Activities and Intents, Threads, Services.

UNIT 4 RECEIVERS AND MULTIMEDIA TECHNIQUES IN ANDROID**9Hrs.**

Receiver and Alerts, User Interface Layout, User Interface Events, Multimedia Techniques, Hardware Interfaces.

UNIT 5 CONNECTIVITY IN ANDROID**9Hrs.**

Connecting Gyro Sensor and Accelerometer -Wi-Fi and Bluetooth Connectivity with Mobile applications.

Max.45Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Explain the differences between Android and other mobile development environments.
- CO2 - Describe the working of Android applications, their life cycle, manifest, Intents, and using external resources.
- CO3 - Exploit Android's APIs for data storage, retrieval, user preferences, files, databases, and content providers.
- CO4 - Develop or create rich map based applications using location based services, geo-coder and compass sensors.
- CO5 - Apply the power of background services, threads, and notifications in Android for securing and optimizing applications.
- CO6 - Utilize Android's communication APIs for SMS, telephony, network management and internet resources.

TEXT / REFERENCE BOOKS

1. Erica Sadun, "The iOS 5 Developer's Cookbook: Core Concepts and Essential Recipes for iOS Programmers", AddisonWesley, 3rd Edition, 2011.
2. G. Blake Meike, ZigurdMednieks, John Lombardo, Rick Rogers, "Android Application Development", O'reilly, 1st Edition, 2009.
3. R. NageswaraRao, "Core JAVA: An Integrated Approach", Dreamtech Press, Wiley India, 1st Edition, 2015.
4. Herbert Schildt, "Java: The Complete Reference", 9th Edition, 2014.
5. Gary Cornell, Cay S. Horstmann, "Core Java Volume I - Fundamentals", Prentice Hall, 9th Edition, 2012.
6. Cay S. Horstmann, "Core Java, Volume II - Advanced Features", Prentice Hall, 11th Edition, 2019.

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**70 Marks**

SECA5302	RTOS PROGRAMMING	L	T	P	Credits	TotalMarks
		3	0	0	3	100

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**9Hrs.**

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**9Hrs.**

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**9Hrs.**

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 FreeRTOS

UNIT 4 APPLICATION PROGRAMMING USING RTOS**9Hrs.**

Task synchronization using semaphores, Intertask 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**9Hrs.**

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 - Explain types of real time systems and summarize the issues in real time computing
- CO2 - Demonstrate real-time scheduling and schedulability analysis, including clock-driven and priority-driven scheduling algorithms.
- CO3 - Analyze the situation of fault occurrence and will be able to apply solutions accordingly.
- CO4 - Demonstrate porting of RTOS to embedded hardware target platforms.
- CO5 - Develop and implement real time applications using RTOS software.
- CO6 - Attain improved employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

TEXT / REFERENCE BOOKS

1. Jane W. S Liu, "Real Time Systems" Pearson Higher Education, 3rd Edition, 2000.
2. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2nd Edition, 2014.
3. Jean J. Labrosse, "Micro C/OS-II: The real time kernel" CMP Books, 2nd Edition, 2015.
4. Warren Gay, "Beginning STM32: Developing with FreeRTOS", Apress, 1st Edition, 2018.
5. Richard Barry, "Mastering the FreeRTOS: Real Time Kernel", Real Time Engineers Ltd, 1st Edition, 2016.
6. David E. Simon, "An Embedded Software Primer", Pearson Education Asia Publication,
7. Philip. A Laplante, "Real Time System Design and Analysis", Prentice Hall of India, 3rd Edition, 2006.
8. Li Q, Yao C, "Real-Time Concepts for Embedded Systems", CMP Books, 1st Edition, 2003.
9. Doug Abbott, "Linux for Embedded and Real-time Applications", Newnes, 3rd Edition, 2006.

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**

SECA5303	CLOUD COMPUTING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Study in detail the cloud computing concepts and IAAS, PAAS, SAAS.
- Discuss some scenarios of clouds in organizations.
- Study in detail about application deployment over cloud.
- Study different IoT cloud platforms.

UNIT 1 INTRODUCTION TO CLOUD COMPUTING**9Hrs.**

Introduction to Cloud Computing-Definition, Characteristics, Components,

UNIT 2 CLOUD COMPUTING SERVICES**9Hrs.**

Cloud provider, SAAS, PAAS, IAAS and other Organizational scenarios of clouds.

UNIT3 CLOUD ADMINISTRATION AND MANAGEMENT**9Hrs.**

Administering & Monitoring cloud services, benefits and limitations,

UNIT4 CLOUD DEPLOYMENT**9Hrs.**

Deploy application over cloud. Comparison among SAAS, PAAS, IAAS

UNIT5 INTRODUCTION TO OPEN SOURCE IOT CLOUD PLATFORMS**9Hrs.**

Introduction to IoT cloud platforms like OpenShift, Kaa etc.

Max.45Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Articulate the main concepts, key technologies, strengths, and limitations of cloud computing.
- CO2 - Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, etc.
- CO3 - Demonstrate how storage and virtualization are used in the cloud platform and apply this in practice
- CO4 - Analyze the core issues of cloud computing such as security, privacy, and interoperability and evaluate various cloud computing solutions.
- CO5 - Suggest relevant cloud computing solutions according to the applications.
- CO6 - Apply the fundamental principles of multi-tier web applications and services in a cloud environment.

TEXT / REFERENCE BOOKS

1. Barrie Sosinsky, "Cloud Computing Bible", Wiley-India, 1st Edition, 2011.
2. Toby Velte, Anthony Velte, Robert C. Elsenpeter, "Cloud Computing: A Practical Approach", Tata McGraw Hill, 1st Edition, 2009.
3. Kumar Saurabh, "Cloud Computing", Wiley India, 1st Edition, 2016.
4. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud", O'reilly, 1st Edition, 2009.
5. John W. Rittinghouse, James F. Ransome, "Cloud Computing Implementation, Management, and Security", CRC Press, 1st Edition, 2009.

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**

SECA7020	HIGH PERFORMANCE COMPUTING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the basics of organizational and architectural issues related to high performance computing.
- Demonstrate the basic structure and operation of a high performance computing.
- To explore the fundamental concepts of HPC Administration, Application porting, execution and scalability analysis.

UNIT 1 BASICS OF HIGH PERFORMANCE COMPUTING**9Hrs.**

Basics of Organizational and Architectural issues related to High Performance Computing, **Demonstrate the Basic Structure and Operation of a HPC**, Explore the Fundamental Concepts of HPC Administration.

UNIT 2 APPLICATION PORTING**9 Hrs.**

Application Porting, Execution and Scalability Analysis: Compiler Flags, Vectorization, Memory Alignment of Data, **Porting of Application on Linux, Measurement of Application Execution time and Memory consumption with small, medium and large datasets.**

UNIT 3 SCALABILITY ANALYSIS AND SECURITY**9Hrs.**

Scalability Analysis and Identification of Performance Bottlenecks, Profiling of Applications to find opportunities for Performance Optimization. Security Fundamentals, Firewalls, Types of Firewalls, Limitations of firewall.

UNIT 4 INTRUSION DETECTION**9Hrs.**

Intrusion Detection and Prevention, Intrusion Risks, Security Policy, Monitoring and Reporting of Traffics, Traffic Shaping, **Investigating and Verifying Detected Intrusions, Reporting and Documenting Intrusions.**

UNIT 5 INTRUSION PREVENTION**9Hrs.**

Define the Types of Intrusion Prevention Systems, **Intrusion Prevention System** Basics, and Limitations of Intrusion Prevention System, Spoof Prevention, Denial of Service (DoS), and Quality of Service (QoS) Policy, Web Application Firewall, Packet Signature and Analysis.

Max. 45Hrs.**COURSE OUTCOMES**

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

- CO1 - Articulate HPC Clustering, Parallel file system, Data Center Design and HPC Solutions & their applications.
- CO2 - Understand the cloud privacy and security concepts to create secure cloud environment.
- CO3 - Attain in-depth knowledge and understanding of the HPC System Administration domain.
- CO4 - Manage the HPC infrastructure like (Network, Storage, Resource and Backup Management)
- CO5 - Design and develop an efficient data center.
- CO6 - Undertake industrial research projects for the development of future solutions in the domain of HPC Administration

TEXT / REFERENCE BOOKS

1. Dave Knifton, "Enterprise Data Architecture: How to navigate its landscape", Paragon, 3rd Edition, 2014.
2. W.H. Inmon Daniel Linstedt, "Data Architecture: A Primer for the Data Scientist: Big Data, Data Warehouse and Data Vault", MorganKauffman, 1st Edition, 2014.
3. Martin Oberhofer, EberhardHechler, Mario Godinez, Klaus Koenig, Michael Schroeck, Steve Lockwood, "The Art of Enterprise Information Architecture: A Systems-Based Approach for Unlocking Business Insight", IBM Press, 1st Edition, 2010.

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**

SECA7022	ADVANCED DIGITAL IMAGE PROCESSING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To develop a theoretical foundation of image processing techniques.
- To understand techniques and algorithms to segment / classify/ represent the image.
- To provide analytic skills to process the images with applications.

UNIT 1 DIGITAL IMAGE FUNDAMENTALS**9 Hrs.**

Elements of Visual Perception; Image Sensing and Acquisition; Image Sampling and Quantization; Basic Relationships between Pixels; Monochromatic Vision Models; Colour Vision Models; Colour Fundamentals; Colour Models; Conversion of Colour Models; Colour Transformations.

UNIT 2 ENHANCEMENT AND RESTORATION**9 Hrs.**

Introduction; Point Processing - Image Negatives, Log transformations, Power Law Transformations, Piecewise-Linear Transformation Functions; Arithmetic/Logic Operations - Image Subtraction, Image Averaging; Histogram Processing - Histogram Equalization, Histogram Matching; Spatial filtering - Smoothing, Sharpening; Smoothing Frequency Domain Filters - Ideal Low Pass, Butterworth Low Pass, Gaussian Low Pass; Sharpening Frequency Domain Filters - Ideal High Pass, Butterworth High Pass, Gaussian High Pass; Model of Image Degradation/Restoration Process; Noise Models; Inverse Filtering; Geometric Transformations.

UNIT 3 IMAGE ANALYSIS AND REPRESENTATION**9 Hrs.**

Introduction; Image Segmentation - Point, Line, Edge, Boundary Detection; Colour Image Segmentation; Thresholding- Basic Global Thresholding, Multiple Thresholding, Variable Thresholding; Region Based Segmentation; Representation: Chain codes, Signatures, Boundary segments, Skeletons, Description: Boundary Descriptors, Regional Descriptors.

UNIT 4 MORPHOLOGICAL PROCESSING AND COMPRESSION**9 Hrs.**

Morphological Image Processing - Logic Operations involving Binary Images; Dilation and Erosion; Opening and Closing; Hit or Miss Transform, Basic Morphological Algorithms - Boundary Extraction, Region Filling, Thickening, Thinning; Image Compression - Compression Model, Huffman Coding, Arithmetic Coding.

UNIT 5 CLASSIFICATION AND APPLICATIONS**9 Hrs.**

Object Recognition and Classification, Statistical classification, Structural /Syntactic Classification, 3D Image Processing, 3D Visualization; Surface rendering, Volume rendering; Applications: Motion Analysis, Image Fusion, Image Classification.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the fundamentals of Digital Image Processing.
- CO2 - Know the Image Enhancement in the Spatial & Frequency Domain and model the noises and restoration.
- CO3 - Analyze various segmentation and representation techniques.
- CO4 - Analyze various morphological algorithms and compression techniques.
- CO5 - Understand the various classification techniques.
- CO6 - Apply classification algorithms for various applications.

TEXT / REFERENCE BOOKS

- Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson, 3rd Edition, 2018.
- Anil K. Jain, "Fundamentals of Digital Image Processing", PHI Learning Private Limited, New Delhi, 2002.
- John C. Russ, "The Image Processing Handbook", CRC Press, Taylor & Francis Group, 6th Edition, 2011.
- Geoff Dougherty, "Digital Image Processing for Medical Applications", Cambridge University Press, 2009.
- William K. Pratt, "Digital Image Processing", John Wiley & Sons, 4th Edition, 2007.

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 data tools.
- 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**

SECA6302	RTOS PROGRAMMING LAB	L	T	P	Credits	Total Marks
		0	0	6	2	100

COURSE OBJECTIVES

- To understand the fundamentals of real time systems and its development.
- To acquire knowledge on real time operating systems.
- To understand the design methodologies of real time embedded systems
- To understand the basics of cloud computing technology.

SUGGESTED LIST OF EXPERIMENTS

- 1 Analysis of real time scheduling algorithms using Cheddar Tool.
- 2 Real-time message queues, semaphores, and mutexs.
- 3 Task management and Thread management in freeRTOS.
- 4 RTOS Porting for hardware platforms.
- 5 Development of simple real time embedded applications with freeRTOS.
- 6 Real time PID controller.
- 7 Electronic control unit (ECU).
- 8 Video accelerator.
- 9 Working with Cloud platforms.
- 10 Real time IoT applications using cloud platforms.

COURSE OUTCOMES

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

- CO1 - Gain adequate understanding of the software architecture of real time embedded systems.
- CO2 - Develop simple applications for Process Management, Synchronization Techniques, Message Passing, Mutex, etc., using FreeRTOS.
- CO3 - Demonstrate the concept of real-time programming using tasks and context switching.
- CO4 - Demonstrate how storage and virtualization are used in the cloud platform and apply this in practice.
- CO5 - Suggest relevant cloud computing solutions according to the applications.
- CO6 - Apply the fundamental principles of multi-tier web applications and services in a cloud environment.

SECA7017	AI AND SOFT COMPUTING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To provide a strong foundation of fundamental concepts in Artificial Intelligence.
- To provide a basic exposition to the goals and methods of Artificial Intelligence.
- To enable the student to apply these techniques in applications which involve perception reasoning and learning.

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

History and Definition of AI, Foundations Intelligent Agents - Agents and environments-Good behavior- the nature of environments, Structure of agents-Problem Solving agents, Searching for solutions -Uninformed search strategies- Breadth-first, depth-first, depth limited search, Uninformed search strategies - Iterative deepening DFS, Bi-directional search strategies, Avoiding repeated states, searching with partial information.

UNIT 2 SEARCHING TECHNIQUES**9Hrs.**

Informed search and exploration- Informed search strategies, greedy best-first, A* Algorithm, Memory-bounded heuristic search, heuristic functions, Local search algorithms and optimization problems, searching in continuous space, CSP - backtracking search for CSPs, Local search for CSP- structure of problems, Adversarial search.

UNIT 3 KNOWLEDGE REPRESENTATION**9Hrs.**

Introduction to Logic, Syntax and semantics of first order logic, Using first order logic, assertions and queries in first-order logic, kinship domain, Wumpus world problem, Knowledge engineering in first order logic, Inference in first order logic- Propositional vs. first-order inference, Unification and lifting, **Storage and retrieval, Forward chaining, Backward chaining, Resolution, Knowledge representation.**

UNIT 4 LEARNING**9Hrs.**

Introduction, Learning from observations, Inductive learning, Learning decision trees, Ensemble learning, logical formulation of learning, Knowledge in learning, explanation based learning, Learning using relevance information, inductive logic programming, **Statistics learning methods, learning with complete data, Learning with hidden variables** – EM algorithm, Instance based learning, Introduction to Neural networks, Neural networks, learning neural network structures, Reinforcement learning, passive reinforcement learning, Active reinforcement learning Generalization in reinforcement learning.

UNIT 5 APPLICATIONS**9Hrs.**

Communication - Communication as action, A formal grammar for a fragment of English, **Syntactic analysis** Augmented grammars, Semantic interpretation, Semantic interpretation, Ambiguity and disambiguation, Discourse understanding- Grammar induction, Probabilistic language processing - **Probabilistic language models, Information Retrieval and implementation, Information Extraction, Machine translation systems**

Max. 45Hrs.**COURSE OUTCOMES**

On completion of the course students will be able to

- CO1 - Understand the various searching techniques, constraint satisfaction problem and example problems- game playing techniques.
- CO2 - Apply these techniques in applications which involve perception, reasoning and learning.
- CO3 - Explain the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.
- CO4 - Acquire the knowledge of real world knowledge representation.
- CO5 - Analyze and design a real world problem for implementation and understand the dynamic behavior of a system.
- CO6 - Use different machine learning techniques to design AI machine and enveloping applications for real world problems.

TEXT / REFERENCE BOOKS

1. Stewart Russell and Peter Norvig, "Artificial Intelligence-A Modern Approach ", Pearson Education, 2nd Edition, 2012.
2. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2015.
3. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill, 2nd Edition, 2013.
4. George F. Luger, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving", Pearson Education, 1st Edition, 2002.

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**

SECA7025	NETWORK ORIENTED OS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce students to the state of the art in wireless sensor actuator networks.
- To provide hands on training in programming these networks and several applications such as environmental monitoring, perimeter security, structural control, asset tracking and personal health care systems.

UNIT 1 OVERVIEW OF IOTCONTIKI OS**9Hrs.**

Internet of Things: current solutions and an outlook on future evolutions of current technologies. Basic introduction to **Contiki OS: basic operations, proto-threads, timers, event management**.

UNIT 2 COOJA SIMULATOR AND 6LOWPAN**9Hrs.**

Introduction to the Cooja emulator. Introduction to 6LoWPAN. 6LoWPAN architecture: simple, extended and ad-hoc networks. **Issues in determining IPv6 links in LLNs and illustration of the undetermined link addressing model-IPv6 addressing in 6LoWPAN. 6LoWPAN forwarding: route-over and mesh under approaches.**

UNIT 3 ROUTING IN LOSSY NETWORK**9Hrs.**

Routing in low power and Lossy networks: pros and cons of the mesh-under and route-over solutions.

UNIT 4 INTRODUCTION TO RPL**9Hrs.**

Introduction to RPL: the IPv6 Routing Protocol for LLNs. RPL: multi-point to point routing with destination oriented directed acyclic graphs.

UNIT 5 RPL CONSTRAINT AND CONFIGURATION**9Hrs.**

RPL instances, routing metrics and constraints. Introduce 6LBR. **RPL protocol configuration in Contiki.** Overview of the general configuration parameters.

Max. 45Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the fundamentals and the need for network oriented or constrained operating system.
- CO2 - Describe the functional architecture of IPv6 networking protocol and 6LoWPAN and its applications.
- CO3 - Understand the basic functions of an IoT operating system such as Contiki.
- CO4 - Design a Low power PAN and analyze its performance using Cooja emulator.
- CO5 - Analyze the performance of various protocols for low power and lossy wireless sensor networks.
- CO6 - Design, implement and analyze the performance metrics of LoWPAN using an IoT operating system.

TEXT / REFERENCE BOOKS

1. Andrew S. Tanenbaum, "Computer Networks", PHI, 5th Edition, 2015.
2. KazemSohraby, Daniel Minoli, TaiebZnati, "Wireless Sensor Network", Wiley, 1st Edition, 2007. ISBN:978-0-471-74300-2.
3. C.SivaRamMurthyandB.S.Manoj"AdHocWirelessNetworks:Architectures andProtocols",PrenticeHall, 1st Edition, 2004.
4. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Pearson Education, 6th Edition, 2016.
5. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", Wiley, 1st Edition, 2007.
6. Feng Zhao and Leonidas J. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Edition, 2004.

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**

SECA7024	SCADA SYSTEMS APPLICATIONS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To learn about the features and applications of SCADA systems.
- To learn the functional architecture of SCADA systems.
- To learn about various communication protocols used in SCADA systems.

UNIT 1 INTRODUCTION AND FEATURES OF SCADA SYSTEMS**9Hrs.**

Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system Architecture, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA.

UNIT 2 STUDY OF VARIOUS ARCHITECTURE OF SCADA SYSTEMS**9Hrs.**

SCADA Architectures - First generation - Monolithic, Second generation - Distributed, Third generation - Networked Architecture.

UNIT 3 OVERVIEW OF OSI AND IEC61850**9Hrs.**

Open systems interconnection (OSI) Model, TCP/IP protocol, DNP3 protocol, IEC61850 layered architecture.

UNIT 4 INDUSTRIAL AUTOMATION SPECIFIC PROTOCOLS**9Hrs.**

Control and Information Protocol (CIP), Device Net, Control Net, Ether Net/IP, Flexible Function Block process (FFB), Process Field bus (Profibus).

UNIT 5 CASE STUDY ON SCADA BASED APPLICATIONS**9Hrs.**

SCADA systems in operation and control of interconnected power system, Power System Automation (Automatic substation control and power distribution, Petroleum Refining Process, Water Purification System, Chemical Plant.

Max. 45Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Explain the various architecture of SCADA system and their merits and demerits.
- CO2 - Describe the network communication protocols used by SCADA systems for remotemonitoring and control.
- CO3 - Articulate industrial automation specific protocols and standards pertaining to SCADA systems.
- CO4 - Demonstrate the working principle of SCADA based industrial automation systems.
- CO5 - Design and develop SCADA/HMI interface for different applications.
- CO6 - Design and implementation of appropriate industrial automation systems to meet the requirements of an enterprise.

TEXT / REFERENCE BOOKS

1. Stuart G McCrady, "Designing SCADA Application Software: A Practical Approach", Elsevier; 1st Edition, 2013.
2. K S Manoj, "Industrial Automation with SCADA: Concepts, Communications and Security", Notion Press, 1st Edition, 2019.
3. PLCs & SCADA: Theory and Practice, University Science Press, 1st Edition, 2011.
4. Francis G.L, "SCADA: Beginner's Guide", 2016.
5. Stuart A. Boyer, "SCADA: Supervisory Control and Data Acquisition", ISA, 4th Edition, 2009.

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**

SECA7019	GATEWAY DESIGN FOR IOT DEVICES	L	T	P	Credits	Total Marks
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		3	0	0	3	100
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COURSE OBJECTIVES

- Demonstrate the basic terminology and standards of IoT communications.
- Study in detail the various communication models.
- Study in detail the various IoT communication protocols and their implementations.
- Study the gateway design and its significance and characteristics.
- Study the edge computing at devices and gateways.

UNIT 1 OVERVIEW OF M2M**9Hrs.**

Introduction to communication needs, Terminology- Machine to Machine to Communication (M2M), Internet of Things (IoT), Web of Things (WoT), M2M vs IoT, IoT vs. WoT, Communication Standards

UNIT 2 COMMUNICATION MODELS AND DATA EXCHANGE FORMATS**9Hrs.**

Communication Models- Request-Response, Publish Subscribe, Communication Patterns- Telemetry, Inquiry, Status, Notifications, Data exchange formats e.g. JSON

UNIT 3 MQTT AND COAP PROTOCOLS**9Hrs.**

IoT protocols, Introduction to MQTT, MQTT – packet format, broker, topics, QOS Levels, LWT, keep Alive and Client take over, security, Connectivity to IoT cloud Platform through MQTT, MQTT over Web sockets, CoAP overview, Client – server implementation through CoAP Protocol, Resource registration and discovery, Use case of CoAP, CoAP vs MQTT.

UNIT 4 HTTP REST AND WEBSOCKETS PROTOCOLS**9Hrs.**

Introduction to HTTP, HTTP REST model, CRUD operations, connectivity to IoT cloud platforms using HTTP REST Services, Introduction to WebSocket, use cases of WebSocket, Websocket vs. HTTP REST, Significance of gateway design, characteristics, Protocol bridging, implementation and case studies.

UNIT 5 EDGE AND FOG COMPUTING**9Hrs.**

Introduction to Edge Computing, Edge computing vs FOG computing, Edge Analytics at devices and Gateways, Down sampling of data, aggregations, filters, Threshold prediction, Detecting Anomalies.

Max.45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Identify the main challenges associated with machine-to-machine communications with respect to the status quo in networking today.
- CO2 - Describe the standards, protocols and algorithms that are used to address the challenges in M2M communications.
- CO3 - Develop an understanding of edge and fog computing for data aggregation, filtering and detecting anomalies
- CO4 - Design and build a network based on the client server, as well as how to publish/subscribe to connect, collect data, monitor and manage assets.
- CO5 - Develop device, gateway and server-side scripts and apps, enabling them to aggregate and analyze sensor data
- CO6 - Analyze and suggest suitable application-layer protocols and web services architectures for a seamless integration of various components within an IoT ecosystem.

TEXT / REFERENCE BOOKS

1. Mischa Dohler, Carles Anton-Haro, "Machine-to-machine (M2M) Communications", Woodhead Publishing, 1st Edition, 2014.
2. Perry Lea, "Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security", Packt, 1st Edition, 2018.
3. Maciej Kranz, "Building the Internet of Things", John Wiley & Sons, 1st Edition, 2017.
4. David Boswarthick, Omar Elloumi, Olivier Hersent, "M2M Communications: A Systems Approach", John Wiley & Sons, 1st Edition, 2012.
5. Anupama C. Raman and Pethuru Raj, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC press, 1st Edition, 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**

SECA7021	SECURITY IN IoT	L	T	P	Credits	Total Marks
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COURSE OBJECTIVES

- To learn about the security issues in IoT and cloud computing.
- To learn about the cryptography solutions and issues in IoT.
- To learn about the security measures taken in IoT and Cloud systems to improve security.

UNIT 1 FUNDAMENTALS OF IoT ECOSYSTEM**9Hrs.**

IoT security issues, how to design an IoT system, Hardware, software and network security related to IoT systems. Basics of cryptographic solutions to IoT systems.

UNIT 2 OVERVIEW OF CLOUD COMPUTING AND ITS SERVICES**9Hrs.**

Cloud Computing Fundamental: Cloud computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS.

UNIT 3 CHALLENGES IN CLOUD COMPUTING**9Hrs.**

Benefits and challenges of cloud computing, public vs. private clouds. Role of virtualization in enabling the cloud.

UNIT 4 SECURITY CONCEPTS IN CONTEXT TO IoT DEVICES**9Hrs.**

Security Concepts: Confidentiality, privacy, integrity, authentication, non-repudiation, Virtualization

UNIT 5 IoT SECURITY THREATS AND COUNTERMEASURES**9Hrs.**

System-Specific Attacks: Guest hopping, attacks on the VM (delete the VM, attack on the control of the VM, code or file injection into the virtualized file structure), VM migration attack, hyper jacking

Max.45Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the fundamental security issues in Internet of things.
- CO2 - Demonstrate different Frameworks and Hardware Architecture of IoT Device.
- CO3 - Analyze different IoT Protocols and Layer Functioning.
- CO4 - Protect and secure the network connecting IoT devices to back-end systems on the internet.
- CO5 - Demonstrate different authentication mechanism such as digital certificates, biometrics, etc.
- CO6 - Demonstrate collecting, aggregating, monitoring, and normalizing data from IoT devices and providing actionable reporting and alerting on specific activities or when activities fall outside established policies.

TEXT / REFERENCE BOOKS

- David Etter, "IoT Security: Practical guide book" CreateSpace, 1st Edition, 2016.
- Drew Van Duren, Brian Russell, "Practical Internet of Things Security", Packt, 1st Edition, 2016.
- Sean Smith, "The Internet of Risky Things", O'Reilly Media, 1st Edition, 2017.
- Brian Russell, Drew Van Duren, "Practical Internet of Things Security: Design a security framework for an Internet connected ecosystem", 2nd Edition, 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**

SECA7032	ADVANCED ROBOTICS AND AUTOMATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce the functional elements of a ROBOT.
- To understand the concept of kinematics.
- To comprehend the concepts of robot arm dynamics.
- To study and analyze various assembly and inspection procedures.
- To illustrate the applications of Robot in different fields.

UNIT 1 INTRODUCTION**9 Hrs.**

Geometric configuration of robots - Asimov's laws of robotics - work volume. Need for Automation - types of automation - fixed, programmable and flexible automation. Manipulators - drive systems - internal and external sensors - end effectors - control systems - robot programming languages and applications - Introduction to robotic vision system.

UNIT 2 ROBOT ARM KINEMATICS**9 Hrs.**

Direct and Inverse Kinematics - rotation matrices - composite rotation matrices - Euler angle representation -homogeneous transformation – DenavitHattenberg representation and various arm configurations.

UNIT 3 ROBOT ARM DYNAMICS**9 Hrs.**

Lagrange - Euler formulation, joint velocities - kinetic energy - potential energy and motion equations – generalized D'Alembert equations of motion.

UNIT 4 ROBOT APPLICATIONS**9 Hrs.**

Material Transfer & Machine Loading / Unloading. General Consideration in robot material handling transfer applications – Machine loading and unloading. Processing Operations, Spot welding – Continuous arc welding - spray coating – other processing operations using robots.

UNIT 5: ASSEMBLY AND INSPECTION: Assembly and robotic assembly automation – Parts presentation methods – assembly operation – Compliance and the Remote Centre Compliance(RCC) device – Assembly system Configurations – Adaptable, Programmable assembly system – Designing for robotic assembly – Inspection automation.

UNIT 5 UNDERWATER ROBOTICS AND HUMANOIDS**9 Hrs.**

Robotics in Water: Basics Representation of Underwater Robot - Types and Classification of Underwater Robotics. Control System and Types of Control Systems in Underwater Robotics - Sensors Connected with the Underwater Robotics - Introduction to Underwater Manipulators - Introduction to Hydraulics on Underwater Vehicles - Applications of Underwater Vehicles. Humanoids: Wheeled and legged, Legged locomotion and balance, Arm movement, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, sound and tactile sensing.

Max. 45 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Recall and recollect the basic concept of robotics.
- CO2 - Understand, develop different robot arm configurations based on kinematic techniques.
- CO3 - Evaluate different robot arm models based on manipulator Dynamics.
- CO4 - Analyze different industrial processing applications of Robots.
- CO5 - Identify the need for underwater and humanoid robots.
- CO6 - Assess different robot sensor systems for underwater autonomous and humanoid robots.

TEXT / REFERENCE BOOKS

1. John J.Craig, "Introduction to Robotics Mechanics and Control", 3rd edition, Pearson Education, 2009.
2. AshitavaGhoshal, "Robotics-Fundamental Concepts and Analysis', Oxford University Press, 6th impression, 2010.
3. Deb S R.andDebS., "Robotics Technology and Flexible Automation", Tata McGraw Hill Education Pvt. Ltd, 2010.
4. Saha S.K., "Introduction to Robotics", Tata McGraw Hill Education Pvt. Ltd, 2010.
5. K.S.Fu, R.C.Gonzalez, CSG. Lee, "Robotics control, sensing, vision and Intelligence", McGraw Hill Education Pvt. Ltd., 2013.
6. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering: An Integrated Approach, PHI Learning", New Delhi, 2009.
7. Mikell P Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", Pearson Education, 2015.
8. GianlucaAntonelli, – Underwater Robots]], Springer, 2014.
9. Roland Siegwart, Illah Reza Nourbakhsh, DavideScaramuzza," Introduction to Autonomous Mobile Robots", Bradford Company Scituate, USA, 2011.
10. RiadhSiaer, "The future of Humanoid Robots- Research and applications", Intech Publications, 2012.

SECA7043	AUTONOMOUS DRONE TECHNOLOGY	L	T	P	Credits	Total Marks
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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 Annotation and 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

CO2 —Analyze the mathematical relation between force, equilibrium, stability and the movement of drones

CO3 — Select appropriate sensors and actuators for specific application requirements.

CO4 — Develop navigational systems for autonomous drones.

CO5 — Appraise the performance of computer vision in drones

CO6 — 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**