SECB5101	TRANSFORMS AND RANDOM PROCESS FOR ELECTRONICS ENGINEERING (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 reinforce the mathematical foundation with advanced topics.
- To enable the student to appreciate the engineering aspect of mathematics.
- To equip the student with tools to confront continual mathematical.
- To understand probabilistic models and their applications.
- To expose the students to different Transform techniques.

UNIT 1 2D TRANSFORMS 9 Hrs.

Need for transform – Review of 1D Transform – 2D DFT – IDFT – properties – Image transforms–2D Orthogonal and Unitary transform and its properties–Separable transforms– Walsh, Hadamard, Haar, DST, DCT, Slant, SVD and KL transforms.

UNIT 2 WAVELET TRANSFORMS & ITS APPLICATIONS 9 Hrs.

Wavelet transforms – 1D & 2D Wavelet transform – basis and orthogonal basis – Time and frequency decompositions – STFT – CWT, DWT, Haar wavelet and Shannon wavelet – MRA – Orthonormal Wavelets – Fast Wavelet transform – Wavelet Packets – Bi-Orthogonal Wavelet Bases – SPIHT Algorithm – Wavelet Denoising – Wavelet based Signal Processing – Signal & Image compression.

UNIT 3 PROBABILITY & RANDOM VARIABLES 9 Hrs.

Probability concepts – Random variable – moment generating function – discrete types, continues types – Distributions - Binomial, Poisson, Geometric, Uniform, Normal and Exponential – Transformation of random variables – 2D random variables – marginal, conditional, joint probability – Correlation – Regression – Lindberg-Levy and Demoivre theorem- Sampling Distributions of chi square - Central Limit Theorem.

UNIT 4 RANDOM PROCESS 9 Hrs.

Notion of Stochastic processes – Stationary and Independence; WSS &Ergodicity – Correlation Functions; Auto Correlation, Cross Correlation & its properties – expectations – variance, co variance – Power Spectral Density – properties – Energy spectral density – Parseval's theorem – Wiener Khintchine relation –Renewal process-Linear systems with Random inputs – response of linear systems to white noise.

UNIT 5 QUEUING THEORY 9 Hrs.

Introduction to queuing theory – Characteristics of Queuing Systems – Little's Law – Markovian Queues –Single server models – Multiple server models – Non-Markovian Queues– Pollaczek-Khinchine formula – Machine interference model – steady state analysis – self-service queue – Priority Queues – Open and Closed Networks – queuing applications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Asses random variables as an intrinsic need for the analysis of random phenomena
CO2 - Apply time domain and frequency domain transform techniques for different applications.
CO3 - Apply the regression model in practical applications
CO4 - Evaluate covariance and spectral density of stationary random processes.
CO5 - Demonstrate the specific applications of Poisson and Gaussian processes.
CO6 - Acquire skills in analyzing queuing models.

TEXT / REFERENCE BOOKS

1. Rafael C.Gonzalez & Richard E Woods, "Digital Image Processing", 5thEdition, Pearson Prentice Hall, 2018
2. Peyton Z.Peebles, "Probability, Random Variables and random signal principles", 4thEdition, TMH Publication, 2010.
3. Anil K Jain, "Fundaentals of Digital Image Processing", Prentice Hall, 2015.
4. Raghuveer M. Rao&Ajit S. Bopardikar, "Wavelet Transform: Introduction to Theory & Applications", Pearson Education, 4th 2018.
5. Donald Gross, John F. Shortle, James M. Thompson and Carl W. Harris, "Fundamentals of Queuing Theory", 6thEdition, Wiley, 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**

SECB5102	ADVANCED DIGITAL SYSTEM DESIGN (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 know about the functioning of combinational and sequential logic circuits in detail.
- To analyse the behaviour of CSSN using different tables and diagrams.
- To model a CSSN and to understand its behaviour.
- To understand about Algorithmic State Machines (ASM) and to design digital circuits with the aid of ASM chart.
- To analyse the behaviour of Asynchronous Sequential Circuit (ASN) using different tables and diagrams.
- To implement the digital design using PLDs and FPGAs.

UNIT 1 INTRODUCTION TO COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUITS 9 Hrs.

Combinational: Introduction; General Approach to Combinational Logic Design; Introduction to Digital Integrated Circuits; Decoders; Encoders; Digital Multiplexers; Binary Comparators; Array Multipliers; Tristate Buffers. Sequential: Latches; Flip- Flops; Counters-Ring counter and Johnson Counter.

UNIT 2 SYNCHRONOUS SEQUENTIAL NETWORKS 9 Hrs.

Structure and Operation of Synchronous Sequential Networks: Moore model, Mealy model-Analysis of Clocked Synchronous Sequential Networks (CSSN); Transition equations, Transition tables, Excitation tables, State Tables, State diagrams - Modelling of CSSN behaviour: Serial binary adder as a mealy and Moore network, Sequence recogniser.

UNIT 3 CSSN TABLE REDUCTION TECHNIQUES AND ASM 9 Hrs.

State Table Reduction–Implication Table for determining equivalent states of the table, Obtaining Equivalence Classes of states, Constructing the minimum state table –State Assignment, Unused states Algorithmic state Machines– ASM Charts - ASM blocks, ASM chart for mod-N binary counter – Relationship between state diagram and ASM charts - ASM Chart for a sequence recogniser- ASM Chart for binary multiplier.

UNIT 4 ASYNCHRONOUS SEQUENTIAL NETWORKS 9 Hrs.

Structure and Operation of Asynchronous Sequential Networks (Fundamental and Pulse Mode); Analysis of Asynchronous Sequential Networks (ASN); Design of ASN; Primitive Flow Table; Flow Table Reduction; Races in ASC–Static and Dynamic Hazards; Essential Hazards.

UNIT 5 PROGRAMMABLE LOGIC DEVICES AND FPGA 9 Hrs.

Programmable Logic Array (PLA), Programmable Array Logic (PAL), Structure of standard PLD's; Complex PLD's (CPLD) -System Design using PLD's; Design of Combinational and Sequential Circuits using PLD's; Introduction to Field Programmable Gate Arrays - FPGA Programming.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Design combinational digital circuits for given specifications.
CO2 - Design Sequential digital circuits for given specifications.
CO3 - Apply state table reduction techniques for optimization of digital circuits.
CO4 - Apply ASM chart for designing sequential logic systems.
CO5 - Implement digital circuits using PLDs.
CO6 - Implement digital circuits using FPGAs.

TEXT / REFERENCE BOOKS

1. Donald G.Givone, Digital principles and Design, Tata McGraw Hill, 2nd Edition, reprint, 2012.
2. John M Yarbrough, Digital Logic applications and Design, Thomson Learning, 2010 reprint.
3. Charles H. Roth, Jr. and Larry L. Kinney, "Fundamentals of Logic Design", 6th Edition, Cengage Learning, 2012.
4. Richard F. Tinder, "Engineering Digital Design", 2nd Edition Revised, Academic Press, 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**

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

CO1 - Choose appropriate microcontrollers or processor core for different applications
CO2 - Demonstrate Host/Target Development build tools for Embedded System development
CO3 - Design circuits with ARM cortex-M family microcontrollers
CO4 - Analyze the performance of various communication protocols.
CO5 - Develop Embedded System applications using STM microcontrollers
CO6 - Demonstrate Hardware Abstraction Layer based microcontroller peripheral programming

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 Processors-ARM 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**

S104PB11	NETWORK PROGRAMMING	L	T	P	EL	Credits	Total Marks
		2	0	2	0	3	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVES

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

UNIT 1 INTRODUCTION TO COMPUTER NETWORKS 9 Hrs.

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.

UNIT 2 INTERNETPROTOCOLS 9 Hrs.

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

UNIT 3 OSI MODEL AND ITS APPLICATIONS 9 Hrs.

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 9 Hrs.

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

UNIT 5 SOCKET PROGRAMMING 9 Hrs.

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- TCP dump- Wire Shark interfaces.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Choose appropriate network topologies for given industrial scenario
CO2 - Analyze the different IEEE standards used in computer communication.
CO3 - Demonstrate the key protocols that support internetworking
CO4 - Apply TCP/UDP sockets for network communication
CO5 - Apply knowledge of operating systems and packet sniffing tools to build robust client and server applications.
CO6 - Implement a networking solutions for real world problems.

TEXT/ REFERENCE BOOKS

1. Richard Stevens, “Unix Network Programming: Volume I and II, 4thEdition, 2012.
2. Forouzan B A, “Data Communications and Networking”, McGraw Hill, 6th Edition, 2014.
3. Kurose James F and Keith W. Ross: Computer Networking: A Top-Down Approach, Pearson India, 6thEdition, 2017.
4. E R Harold, “Java network programming”, O’Reilly Media, 5th Edition, 2019.
5. L. Peterson and B. Davie, Computer Networks: A Systems Approach, 7th Edition, Morgan-Kaufmann, 2018.

S35BLH11	SOFTWARE FOR EMBEDDED SYSTEMS (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

- 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 'C' 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 behaviour - UML state charts - Role of scenarios in the definition of behaviour - 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 Java card tool chain.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Develop Assembly and C programs for 8-bit microcontrollers.
CO2 - Analyze Embedded C programs and debug the software faults.
CO3 - Apply embedded C programming tool chain available in Linux platforms.
CO4 - Develop applications with sEOS embedded operating system.
CO5 - Apply UML based modeling in design of embedded applications.
CO6 - Develop embedded applications with Embedded Java and J2ME tool chain.

TEXT / REFERENCE BOOKS

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. Zhiqun 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**

SISB9101	**RESEARCH METHODOLOGY AND IPR (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 understand the concepts of research.
- To provide an insight into the techniques of research.
- To learn the requisites of writing a research report.
- To impart knowledge on formulation of research problem, research methodology, and ethics involved in doing research and importance of IPR protection.

UNIT 1 RESEARCH PREPARATION AND PLANNING 9 Hrs.

Objectives of research – Understanding research and its goals, Critical thinking, Techniques for generating research topics. Topic selection and justification. Techniques involved in designing a questionnaire – Methods of scientific enquiry – Formulation of hypotheses and testing of the same – Development of a research proposal.

UNIT 2 RESEARCH RESOURCES 9 Hrs.

Sources of information. Literature search. World Wide Web, Online data bases – search tools. Citation in dices – Principles underlying impact factor – Literature review – Case studies, review articles and Meta-analysis – Role of the librarian. Ethical and moral issues in Research, Plagiarism, tools to avoid plagiarism.

UNIT 3 ACADEMIC WRITING AND PRESENTATION 9 Hrs.

Proposal submission for funding agencies, Elements of Style. Organization of proposals, Basic knowledge of funding agencies, Research report writing, Communication skills, Tailoring the presentation to the target audience – Oral presentations, Poster preparations, Submission of research articles for Publication in Reputed journal, Thesis writing and Research report writing. Elements of excellent presentation: preparation, visual and delivery, oral communication skills and oral defense.

UNIT 4 DATA COLLECTION, ANALYSIS AND INFERENCE 9 Hrs.

Basic statistical distributions and their applications. Sample size determination and sampling techniques. Large sample tests and small sample tests.

UNIT 5 INTELLECTUAL PROPERTY RIGHTS 9 Hrs.

Nature of Intellectual Property: Patents, Designs, Trade Mark and Copyright. Process of Patenting and Development: technological research, innovation, patenting & development. Procedure for grants of patents, Patenting under PCT. Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the important basics of research and Intellectual Property Rights
CO2 - Write research problem formulations through various methods of literature survey
CO3 - Analyze research related information and Follow research ethics
CO4 - Correlate the results of any research article with other published results. Write a review article in the field of engineering
CO5- Differentiate patents, copyrights, trademark and designs.
CO6 - Apply the process for IPR protection

TEXT / REFERENCE BOOKS

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.
5. James C. Van Horne, Standford University, Financial Management and Policy, Prentice Hall,
6. James R. McGuigan, R. Charles Moyer, Frederick H. deB. Harris, Managerial economics – applications, strategy and Tactics, Cengage learning, India.
7. Philip Kotler, Marketing management Pearson Education, India.
8. Modern Production / Operations Management, Elwood S. Buffa&RakeshSarin, Wiley India.
9. Ronald R. Sims, Organizational success through effective human resources Management, Quorum books, London.
10. Ganesan R, Research Methodology for Engineers, MJP Publishers, Chennai. 2011.

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**

SECB6101	MICROCONTROLLER PROGRAMMING LAB (For AE and Embedded & IoT)	L	T	P	EL	Credits	Total Marks
		0	0	6	0	2	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVES

- To learn C programming of Microcontrollers
- To understand the basics of STM32cube IDE and Eclipse IDE
- To learn interfacing of ARM Cortex-M series microcontrollers with Peripherals

SUGGESTED LIST OF EXPERIMENTS

1. GPIO Programming of 8-bit and 16-bit Microcontrollers
2. GPIO Programming of Cortex-M Microcontrollers (LED blinking, Potentiometer, Switch),
3. Timer/Counter Programming.
4. ADC Interface (Polling and Interrupt).
5. Interfacing with DC, Stepper and Servo Motors.
6. PWM Interfacing.
7. UART, SPI,I2C protocols.
8. USB and CAN protocols.
9. Interfacing with Wi-Fi, Bluetooth and BLE Modems.
10. Interfacing with TFT and LED displays.

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1 - Apply Assemblers, Compilers and Debuggers tool chain for programming Microcontrollers.
CO2 - Develop Host/Target Development environment using build tools for Embedded Systems.
CO3 - Design 8-bit and 16-bit microcontroller based circuits.
CO4 - Demonstrate Embedded C programming through examples.
CO5 - Design ARM Cortex-M microcontroller based circuits.
CO6 - Develop programs for ARM microcontroller based applications.

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

1. Jane W. S Liu, “Real Time Systems” Pearson Higher Education,3rd Edition, 2010.
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 Free RTOS”,Apress, 1stEdition, 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**

SECB5203	IoT COMMUNICATION	L	T	P	EL	Credits	Total Marks
		3	0	0	1	3	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVES

- To Understand the Architectural Overview of IoT
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To Understand the various IoT Protocols

UNIT 1 OVERVIEW OF IoT 9 Hrs.

IoT Architectural Overview– Standards considerations - IoT Technology Fundamentals - Devices and gateways - Business processes in IoT - Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.

UNIT 2 REFERENCE ARCHITECTURE 9 Hrs.

IoT Reference Architecture- Functional View, Information View, Deployment and Operational View- Real-World Design Constraints - Data representation and visualization, Interaction and remote control.

UNIT 3 IoT DATA LINK LAYER & NETWORK LAYER PROTOCOLS 9 Hrs.

PHY/MAC Layer- 3GPP MTC, IEEE 802.11, IEEE 802.15 - Wireless HART, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4,IPv6, 6LoWPAN, DHCP, ICMP, RPL, CORPL and CARP.

UNIT 4 TRANSPORT & SESSION LAYER PROTOCOLS 9 Hrs.

Transport Layer - TCP, MPTCP, UDP, DCCP, SCTP, TLS - Session Layer-HTTP, CoAP, XMPP, AMQP and MQTT.

UNIT 5 SERVICE LAYER PROTOCOLS & SECURITY 9 Hrs.

Service Layer – one M2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4, 6LoWPAN and RPL –Overview of Application Layer.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Choose appropriate hardware components for implementation of IoT applications.
CO2 - Analyze various IoT Application layer Protocols.
CO3 - Implement IoT-based systems for real-world problem
CO4 - Demonstrate state of the art methodologies in data representation and analysis.
CO5 - Apply appropriate IP based protocols and Authentication Protocols for IoT communication.
CO6 - Analyze security issues in IoT Communication.

TEXT / REFERENCE BOOKS

1. David Hanes, Patrick Grossetete , Robert Barton , Jerome Henry,"IoT Fundamental Networking Technologies, Protocols, and Use Cases for the Internet of Things", First Edition, Pearson Education,2017
2. Rolando Herrero,"Fundamentals of IoT Communication Technologies"Springer,2022
3. Simone Cirani ,Gianluigi Ferrari, Marco Picone, Luca Veltri,"Internet of Things: Architectures, Protocols and Standards",Wiley,2018
4. Adrian McEwen and Hakim Cassimally, “Designing Internet of Things”, Wiley, 1st Edition, 2013.

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

CO1 - Apply optimum filters appropriately for a given communication application.
CO2 - Design appropriate adaptive algorithm for processing non-stationary signals.
CO3 - Analyse wavelet transforms for signal and image processing based applications.
CO4 - Demonstrate filtering of color images.
CO5 - Perform vector operations on color images.
CO6 - Develop code for 3D image processing.

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**

S35BPB21	STRATEGIES IN INDUSTRY 5.0 (For AE and Embedded Systems & IoT)	L	T	P	EL	Credits	Total Marks
		2	0	2	0	3	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 in virtual reality
- To develop the concept of augmented reality in electronics manufacturing beyond automation and optimization

UNIT 1 INDUSTRY 5.0 9 Hrs.

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.

UNIT 2 DIGITAL TRANSFORMATION TO INDUSTRY 5.0 9 Hrs.

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.

UNIT 3 SMART WORLD 9 Hrs.

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.

UNIT 4 CYBER SECURITY IN INDUSTRY 5.0 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, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Intellectual Property Rights (IPR).

UNIT 5 AR/VR IN INDUSTRY 5.0 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. Case Studies- Development of AR/VR Models in Unity.

Max. 45 Hrs.

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 the effectiveness of various enhanced 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, Introduction to IoT, Cambridge University Press, 2020.
2. S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry, CRC Press, 2020.
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 Coiffed, Virtual Reality Technology, Wiley 2016.

SECB6202	RTOS PROGRAMMING LAB	L	T	P	EL	Credits	Total Marks
		0	0	6	0	2	100

Pre requisite: Nil **Co requisite: Nil**

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, student will be able to

CO1 - Analyze the software architecture of real time embedded systems.
CO2 - Develop RTOS program for Process Management, Synchronization Techniques, Message Passing, Mutex, etc.
CO3 - Demonstrate the concept of real-time programming using tasks and context switching.
CO4 - Develop free RTOS programs for given task specifications.
CO5 - Develop relevant cloud computing solutions for various real world applications.
CO6 - Apply the fundamental principles of multi-tier web applications and services in a cloud environment.

SECB5302	DEVICE DRIVER PROGRAMMING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVES

- To learn about embedded processor architectures that support OS.
- Study in detail features and functions of Embedded operating systems.
- Study in detail Linux kernel and Linux files systems.
- Learn about device drivers in Linux.

UNIT 1 EMBEDDED OPERATING SYSTEMS 9 Hrs.

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

UNIT 2 LINUX KERNEL AND FILE 9 Hrs.

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.

UNIT 3 BOARD SUPPORT PACKAGES 9 Hrs.

Inserting BSP in Kernel Build Procedure, Boot loader Interface, Memory Map, Interrupt Management, PCI Subsystem: Timers - UART- Power Management. Embedded Storage: MTD – MTD Architecture - MTD Driver for NOR Flash - Flash Mapping Driver.

UNIT 4 DEVICE DRIVER INTERNALS 9 Hrs.

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

UNIT 5 DEVICE DRIVER DEVELOPMENT 9 Hrs.

Embedded device Drivers: Linux Serial Driver - Ethernet Driver - I2C Subsystem on Linux - USB Gadgets and Watchdog Timer.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Choose right embedded OS for given applications.
CO2 - Demonstrate programming skill in Linux and Linux shell scripting.
CO3 - Develop loadable kernel modules in Linux.
CO4 - Develop a character driver on ARM based Linux Environments.
CO5 - Develop device drivers for a given target hardware platform.
CO6 - Demonstrate debugging techniques in device drivers.

TEXT/ REFERENCE BOOKS

1. John Madieu, "Linux Device Drivers Development: Develop customized drivers for embedded Linux, Packt Publishing, 1st Edition, 2017.
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. 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**

S35BPB31	Graphical Programming Languages (For AE and Embedded Systems & IoT)	L	T	P	EL	Credits	Total Marks
		2	0	2	0	3	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVES

- Become familiar with the main features of the Python for Data Science applications.
- To enable the student on how to approach for solving Engineering problems using simulation tools.
- To prepare the students to use Python and LabVIEW in their project works.
- To provide a foundation in use of this softwares for real time applications.

UNIT 1 PYTHON FOR DATA SCIENCE 9 Hrs.

Introduction to Python, Datatypes in Python- Primitive Data Types, Core Type- LIST, Tuple, Dictionary, Array, Sets, Loops in Python, Conditional Statements in Python, Function.

UNIT 2 NUMPY AND PANDAS 9 Hrs.

Numpy- Introduction to Numpy, Creating different arrays using Numpy, Array Functions and Methods, Different Mathematical Functions, Different Matrix Operations, Random Numbers, Generate Numbers between a range.

Pandas-Introduction to Pandas (Series), Creating Series using Pandas, Different Series Attributes, Series vs List, Series Operations, Series from CSV File, Different Functions in Series, Different Sorting Algorithms in Series, Extracting Values from Series, value_counts() method, apply() methods.

UNIT 3 DATAFRAME AND DATA VISUALIZATION 9 Hrs.

Data frame: Creating Data frame, Data frame different functions, Data frame manipulation, Dropping with Null Values, Filling Null Values, Different Sorting Algorithms in Data frame, Filtering Data in Data frame, Retrieve Row Values using loc and iloc in Pandas, Delete Rows or Columns in Pandas.

Data Visualization-Introduction to Matplotlib, Installing Matplotlib in Python, Drawing 2D Graphs, Line Plot Graph, Bar Plot Graph, Scatter Plot Graph, Drawing Sub plot.

UNIT 4 INTRODUCTION TO LABVIEW 9 Hrs.

Introduction to Virtual Instrumentation- advantages- architecture of a Virtual Instrument-block diagram-front panel-VIs, loading and saving Vis-debugging techniques- creating sub Vis- loops and Charts-arrays-clusters and graphs.

UNIT 5 STRUCTURES, GRAPHS, FILE I/O AND DATA ACQUISITION 9 Hrs.

Shift registers-Case structure- Sequence structures-Formula node- Expression node – Math Script –Data Acquisition using LabVIEW - Case study: myDAQ Audio Equalizer

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students are able to

CO1 - Apply Panda and NumPy libraries for data processing applications.
CO2 - Develop python code for different data handling and storage methods..
CO3 - Create VI models in LabVIEW for arithmetic and logic operations.
CO4 - Develop VI programs using various data structures.
CO5 - Perform real-time data acquisition using NI DAQ Modules.
CO6 - Create LabVIEW programs for audio and signal processing applications.

TEXT / REFERENCE BOOKS

1. Jake Vander Plas, " Python Data Science Handbook: Essential Tools for Working with Data" 2016.
2. Andreas Muller, " Introduction to Machine Learning with Python: A Guide for Data Scientists" 2016.
3. Jeffrey Travis, Jim Kring, " Labview for Everyone: Graphical Programming Made Easy and Fun", 3rd Edition, 2009
4. www.ni.com.

SECB6302	DEVICE DRIVER PROGRAMMING LAB	L	T	P	EL	Credits	Total Marks
		0	0	6	0	2	100

Pre requisite: Nil **Co requisite: Nil**

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 Embedded Linux Development environment set-up,
2 Linux Kernel configuration
3 Building Embedded Linux Device Trees.
4 Creating Linux Kernel Modules and Device models
5 Building Cross-Compilation Tool chain
6 Implementing GPIO driver Initialization function and Entry Point function
7 Implementing GPIO driver Exit function and Interrupt function
8 Testing GPIO device driver
9 I2C driver for cortex-M devices
10 Bluetooth Driver
11 USB device driver

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 - Set-up Linux environment for embedded system development
CO2 - Develop loadable kernel modules in Linux
CO3 - Demonstrate kernel configuration, customization and compilation.
CO4 - Develop a character driver on ARM based Linux Environments
CO5 - Development of device drivers for GPIO interface in ARM cortex core
CO6 - Development of device drivers for serial communication in ARM cortex core

SECB5301	ARTIFICIAL INTELLIGENCE AND DATA SCIENCE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVES

- To understand the basic principles and concepts of Artificial Intelligence and Data Science.
- To gain knowledge of various machine learning algorithms and their applications.
- To develop skills in data preprocessing, feature engineering, and model evaluation.
- To explore ethical considerations and challenges associated with AI and Data Science applications.

UNIT 1 INTRODUCTION TO AI AND DATA SCIENCE 9 Hrs.

Overview of AI and Data Science - Historical perspective and key milestones - AI Agents and Environments - Structure of Agents - Searching for solutions - Parameters to evaluate performance of problem solving - Heuristic functions - Data Acquisition - Sources of acquiring the data - Internal systems and External systems.

UNIT 2 PROBABILITY, STATISTICS, AND DATA PREPROCESSING 9 Hrs.

Probability theory - Probability Space - Events - Axiomatic approach to Probability - Conditional Probability - Independent Events - Descriptive statistics - Statistical inference - Population, sample - parameter and statistic - characteristics of a good estimator – Consistency - Invariance property of Consistent estimator, Sufficient condition for consistency Data preprocessing - Data cleaning - Data integration - Data Reduction - Feature Generation and Feature Selection - Wrappers.

UNIT 3 SUPERVISED LEARNING ALGORITHMS 9 Hrs.

Linear regression - Logistic regression - Decision trees and ensemble methods - Support Vector Machines (SVM) - Neural networks - Training and its types - Single layer Perceptron - Back Propagation Networks - Introduction to Deep learning Networks - Convolution Neural Networks.

UNIT 4 UNSUPERVISED LEARNING AND EVALUATION 9 Hrs.

Clustering algorithms - k-means, hierarchical clustering - Dimensionality reduction techniques - PCA, t-SNE - Model evaluation metrics – Cross validation techniques.

UNIT 5 ADVANCED TOPICS AND ETHICAL CONSIDERATIONS 9 Hrs.

Natural Language Processing (NLP) - Time Series Analysis and Forecasting - Multivariate Data Analysis - Reinforcement Learning - Ethical considerations in AI and Data Science - privacy, bias and responsible AI.

Max. 45 Hrs.

COURSE OUTCOMES

On **co**mpletion of the course, student will be able to

CO1 - Analyze the software and hardware requirements to work with AI Algorithms.
CO2 - Simulate given problem scenario using appropriate AI libraries.
CO3 - Develop AI programming solutions for given problem scenario.
CO4 - Implement deep learning algorithms and solve real-world problems
CO5 - Implement AI based edge computing solutions using GPUs.
CO6 - Analyze the performance of various ML algorithms for a specific application.

TEXT / REFERENCE BOOKS

1. Norvig, P., Russell, S. J., Artificial Intelligence: A Modern Approach. United Kingdom, Pearson, 2021.
2. Géron A. , Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, Inc., 2022.
3. CosmaRohillaShalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
4. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press, 2016.
5. Marc S. Paolella, Fundamental statistical inference: A computational approach, Wiley, 2018.
6. Andreas Muller, Introduction to Machine Learning with Python: A Guide for Data Scientists, Shroff/O'Reilly;1st Edition, 2016.
7. AndriyBurkov, The Hundred-Page Machine Learning Book, Publisher: AndriyBurkov, 1st 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**

SECB7004	ADVANCED ROBOTICS AND AUTOMATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

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 analyse 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 APPLICATONS 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 UNDERWATER ROBOTICS AND HUMANOIDS 9 Hrs.

Robotics in Water - Basics Representation of Underwater Robot - Types and Classification of Underwater Robotics - Underwater Manipulators - Introduction to Hydraulics on Underwater Vehicles - Applications of Underwater Vehicles. Humanoids **-** Wheeled and legged, 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 - Analyse the performance of different arm configurations.
CO2 - Apply kinematics techniques to control the movement of robotic arm.
CO3 - Evaluate different robot models based on manipulator Dynamics.
CO4 - Develop robotic manipulator for given real life problems.
CO5 - Choose appropriate type of actuator for the design of robots to solve real world problems.
CO6 - Assess different robot sensor systems for underwater and humanoid robots.

TEXT / REFERENCE BOOKS

1. John J. Craig, "Introduction to Robotics Mechanics and Control", 3rdEdition, Pearson Education, 2015.
2. AshitavaGhoshal, "Robotics-Fundamental Concepts and Analysis", Oxford University Press, 6th Edition, 2015.
3. Deb S R. and Deb S., "Robotics Technology and Flexible Automation", Tata McGraw Hill Education Pvt. Ltd., 2014.
4. Saha S.K., "Introduction to Robotics", Tata McGraw Hill Education Pvt. Ltd., 2018.
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, 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**

SECB7005	AUTOMOTIVE EMBEDDED SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVE

- To introduce the potential of automotive systems in industries.
- To understand Automotive Sensory Systems.
- To analyze the importance of Automotive control in system design.

UNIT 1 INTRODUCTION 9 Hrs.

Automotive Systems Overview :Automotive Vehicle Technology, Overview of Vehicle Categories, Various Vehicle Sub Systems like Chassis, Body, Driveline, Engine technology, Fuelling technology, vehicle Emission, Brakes, Suspension, Emission, Doors, Dashboard instruments, Wiring Harness, Safety & Security , Comfort &Infotainment, Communication & Lighting, Future Trends in Automotive Embedded Systems : Hybrid Vehicles, Electric Vehicles.

UNIT 2 AUTOMOTIVE PROTOCOLS 9 Hrs.

Need for Protocol, Automotive Protocols : LIN, CAN, KWP2000 & J1939, FlexRay, Protocol- Calibration and Diagnostics tools for networking of electronic systems like ECU Software and Testing Tools , ECU Calibration Tools , Vehicle Network Simulation. Advanced Trends in Automotive Electronics: AUTOSAR Architecture.

UNIT 3 EMBEDDED COMMUNICATION 9 Hrs.

Automotive Communication Systems: Characteristics and Constraints - In-Car Embedded Networks- Middleware Layer- Open Issues for Automotive Communication Systems.

UNIT 4 AUTOMOTIVE ARCHITECTURE DESCRIPTION LANGUAGE 9 Hrs.

Engineering Information Challenges - State of Practice - ADL as a Solution- Existing ADL Approaches

UNIT 5 TESTING, AND TIMING ANALYSIS 9 Hrs.

Testing Automotive Control Software- Testing and Monitoring of FlexRay-Based Applications- Timing Analysis of CAN-Based Automotive Communication Systems

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze the market potential in automotive systems.
CO2 - Analyze the various automotive protocols for given application
CO3 - Demonstrate embedded communication with CAN Networks.
CO4 - Develop automotive description language for various existing ADL approaches
CO5 - Development testing and timing analysis for CAN based communication system
CO6 - Develop automotive embedded system for real time applications.

TEXT BOOKS / REFERENCES

1. Nicolas Navet, Francoise Simonot -Lion ”Automotive Embedded system”, CRC Press, Taylor and Francis group, 2013.
2. Robert Bosch GmbH, “Bosch Automotive Electrics and Automotive Electronics – Systems and Components, Networking and Hybrid Drive”, 5th Edition, Springer Vieweg, 2017.
3. WilliamRibbens, “Understanding Automotive Electronics – An Engineering Perspective”, 7th Edition, Butterworth Heinemann, 2012.
4. V.A.W. Hillier and David R. Rogers, “Hillier’s Fundamentals of Motor Vehicle Technology”, Book 3 –Chassis and Body Electronics, 5th Edition, Nelson Thornes Ltd, 2012.
5. Tom Denton, “Automobile Electrical and Electronic Systems”, 4th Edition, Routledge, 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**

SECB7006	CLOUD COMPUTING (AE and Embedded & IoT)	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVE

- To have a knowledge on basics of cloud
- To provide students basic understanding and virtualization.
- To discuss some scenarios of clouds in organizations

UNIT 1 CLOUD COMPUTING OVERVIEW 9 Hrs.

Origins of Cloud computing – Cloud components - Essential characteristics – On-demand self- service, Broad network access, Location independent resource pooling ,Rapid elasticity , Measured service, Comparing cloud providers with traditional IT service providers, Roots of cloud computing.

UNIT 2 CLOUD INSIGHTS 9 Hrs.

Architectural influences – High-performance computing, Utility and Enterprise grid computing, Cloud scenarios – Benefits: scalability ,simplicity ,vendors ,security, Limitations – Sensitive information - Application development- security level of third party - security benefits, Regularity issues: Government policies.

UNIT 3 CLOUD ARCHITECTURE- LAYERS AND MODELS 9 Hrs.

Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption.

Cloud deployment model: Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing.

UNIT 4 CLOUD SIMULATORS- CLOUDSIM AND GREENCLOUD 9 Hrs.

Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture(User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to Green Cloud.

UNIT 5 INTRODUCTION TO VMWARE SIMULATOR 9 Hrs.

Basics of VMWare, advantages of VMware virtualization, using Vmware workstation, creating virtual machines-understanding virtual machines, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.

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 -** Analyze the core issues of cloud computing such as security, privacy, and interoperability.
- **CO3 -** Develop applications based on public cloud and private cloud architectures.
- **CO4 -** Demonstrate how storage and virtualization is carried out in the cloud platform.
- **CO5 -** Create virtual machine based applications for real world problems.
- **CO6 -** Apply the fundamental principles of multi-tier web applications and services in a cloud environment.

TEXT / REFERENCE BOOKS

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, JohnW., and James F. Ransome, “Cloud Computing: Implementation, Management and Security”, CRC Press, 2017.
3. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata McGraw Hill, 2013.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing -A Practical Approach”, Tata Mcgraw Hill, 2015.
5. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)”, O'Reilly, 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**

SECB7007	COMPUTER VISION AND DEEP LEARNING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVES

- To review image processing techniques for computer vision.
- To understand shape and region analysis, Hough Transform and its applications to detect lines, circles, ellipses.
- To understand Visualization and Convolution Neural Networks for computer vision.
- To understand the concept of Recurrent Neural Networks.
- To understand the concept of Attention and Deep Generative Models.

UNIT 1 Introduction to Computer Vision 9 Hrs.

Introduction to Image Formation, Capture and Representation; Linear Filtering, Thresholding, Correlation, Convolution, Edge, Blobs, Corner Detection; Scale Space and Scale Selection; SIFT, SURF; HoG, LBP.

UNIT 2 Visual Matching 8 Hrs.

Bag-of-words, VLAD; RANSAC, Hough transform; Pyramid Matching; Optical Flow.

UNIT 3 Visualization and Convolution Neural Networks (CNNs) 10 Hrs.

Review of Deep Learning, Multi-layer Perceptrons, Backpropagation, Introduction to CNNs; Evolution of CNN Architectures: AlexNet, ZFNet, VGG, InceptionNets, ResNets, DenseNets, Visualization of Kernels; Backprop-to-image/Deconvolution Methods; Deep Dream, Hallucination, Neural Style Transfer; CAM, and Grad-CAM.

UNIT 4 Recurrent Neural Networks (RNNs) 9 Hrs.

RNNs; CNN + RNN Models for Video Understanding: Spatio-temporal Models, Action/Activity Recognition.

UNIT 5 Attention and Deep Generative Models 9 Hrs.

Introduction to Attention Models in Vision; Vision and Language: Image Captioning, Visual QA, Visual Dialog; Spatial Transformers; Transformer Networks, Deep Generative Models: GANs, VAEs, PixelRNNs, NADE, Normalizing Flows.

Max. 45 Hrs.

COURSE OUTCOMES

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

- **CO1 -** Apply basic Image processing techniques to a specific image
- **CO2 -** Apply visual matching techniques to extract features from the image
- **CO3 -** Develop CNN architecture for computer vision applications
- **CO4 -** Develop RNN model for video processing
- **CO5 -** Develop Attention model for computer vision applications
- **CO6 -** Choose appropriate Deep generative model for a specific application

TEXT / REFERENCE BOOKS

1. E.R. Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press, 2012.
2. R. Szeliski, “Computer Vision: Algorithms and Applications”, Springer 2011.
3. Simon J.D. Prince, “Computer Vision: Models, Learning and Inference”, Cambridge University Press, 2012.
4. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, 3rd Edition, Academic Press, 2012.
5. Ian Goodfelllow, YoshuaBenjio, Aaron Courville, Deep Learning, The MIT Press,2016
6. S.Kevin Zhou, Hayit Greenspan, DinggangShen , Deep Learning for Medical Image Analysis, ELESVIER, Academic Press ,2017
7. Mark Jenkinson, Michael Chappell, “Introduction to Neuroimageing Analysis”, OXFORD University 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**

SECB7008	CONTEMPORARY WIRELESS AND MOBILE COMMUNICATIONS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVES

- To understand the basics of 5G and Beyond Wireless communication
- To study about the key technologies and enablers of 5G and beyond communication systems.
- To learn about channel models used in contemporary wireless communication system.
- To learn 5G techniques such as massive MIMO, mmWave, NOMA, etc.

UNIT 1 EVOLUTION OF MOBILE WIRELESS TECHNOLOGIES 9 Hrs.

Evolution of cellular systems- requirements, goals, and vision of the next generation wireless communication systems - Fading, digital modulations and performance metrics.

UNIT 2 5G TECHNOLOGIES 9 Hrs.

Small cells: capacity of small cell networks - Interference management, D2D architecture for Spectrum efficiency- Massive MIMO: Point-to-point MIMO, Virtual MIMO (relaying), MIMO Challenges and propagation channel model - mmWave: Applications and radiowave propagation.

UNIT 3 MULTIPLE ACCESS TECHNIQUES FOR 5G AND BEYOND 9 Hrs.

Orthogonal frequency division multiplexing (OFDM), filter banks, Generalized Frequency Division Multiplexing (GFDM), Orthogonal Time Frequency Space (OTFS), Non-orthogonal multiple access (NOMA) – Beam forming Techniques.

UNIT 4 6G ENABLING TECHNOLOGIES 9 Hrs.

Wireless energy harvesting: Energy-rate trade-off, Simultaneous wireless information and power transfer (SWIPT), time-switching, power splitting Wireless energy harvesting - Visible light communication - Intelligent reflecting surface (IRS) - Extremely Large Aperture Massive MIMO.

UNIT 5 MACHINE LEARNING IN WIRELESS COMMUNICATION 9 Hrs.

Channel modeling, Channel Estimation using Machine learning - Spectrum sensing, Spectrum Sharing and Resource allocation in NOMA, mmWave massive MIMO using Machine learning.

COURSE OUTCOMES

CO1 - Distinguish and understand the major cellular communication standards and wireless communications networks.
CO2 - Apply the 5G techniques e.g. massive MIMO. Mm Wave etc. for the design of communication systems.
CO3 - Evaluate performance of various modulation techniques used in wireless systems.
CO4 - Analyze different multiplexing techniques such as OFDM, NOMA etc.
CO5 - Apply machine learning techniques in wireless communications.
CO6 - Analyze the performance of Spectrum Sharing and Resource sharing Algorithms.

TEXT / REFERENCE BOOKS

1. R. Vannithamby and S. Talwar, Towards 5G: Applications, Requirements and Candidate Technologies., John Willey & Sons, West Sussex, 2017.
2. Manish, M., Devendra, G., Pattanayak, P., Ha, N., 5G and Beyond Wireless Systems PHY Layer Perspective, Springer Series in Wireless Technology.
3. T. S. Rappaport, R. W. Heath Jr., R. C. Daniels, and J. M. Murdock,, Millimeter Wave Wireless Communication., Pearson Education, 2015.

4. M. Vaezi, Z. Ding, and H. V. Poor, Multiple Access techniques for 5G Wireless Networks and Beyond., Springer Nature, Switzerland, 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**

SECB7009	CYBER PHYSICAL SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVES

- To study the basic concepts, requirements, principles, and techniques in emerging cyber physical systems.
- To provide students hands-on experience in prototyping a cyber-physical system.
- To address real-world problems through Cyber Physical Systems.
- To develop an exposition of the challenges in implementing a cyber-physical system from a computational perspective.
- To provide students of different disciplinary background with necessary knowledge to understand the fundamentals of cyber physical systems.

UNIT 1 COMPUTATIONAL FOUNDATION AND DESIGN OF CYBER PHYSICAL SYSTEM **9 Hrs.**

Cyber Physical Systems in Real world, Basic Principle of Cyber Physical Systems, Industry 4.0, IIoT, Cyber Physical Systems Design Recommendations, CPS system requirements, Cyber Physical System Applications Case study of Cyber Physical Systems.

UNIT 2 CYBER PHYSICAL SYSTEM PLATFORMS **9 Hrs.**

Hardware platforms for Cyber Physical Systems (Sensors/Actuators, Microprocessor/Microcontrollers), Wireless Technologies for Cyber Physical Systems.

UNIT 3 MODELS AND DYNAMICS BEHAVIOURS **9 Hrs.**

Continuous Dynamics, Discrete dynamics and Hybrid Systems.

UNIT 4 CONCURRENT MODELS OF COMPUTATION **9 Hrs.**

Structure of Models, Synchronous Reactive models, Dataflow models of computation, Timed models of computation.

UNIT 5 SECURITY AND PRIVACY IN CYBER PHYSICAL SYSTEMS **9 Hrs.**

Security and Privacy Issues in CPS, Local Network Security for CPS, Internet-Wide Secure Communication, Security and Privacy for Cloud-Interconnected CPSs, Case Study: Cyber security in Digital Manufacturing/Industry 4.0.

COURSE OUTCOMES **Max. 45 Hrs.**

On completion of the course, student will be able to

CO1 - Choose the necessary components for Cyber Physical Systems.
CO2 - Develop difference interface methods to interact with Cyber Physical System.
CO3 - Apply appropriate communication protocols for CPS for given application.
CO4 - Analyze the different architectures of Cyber Physical System.
CO5 - Develop different models for Cyber-physical systems.
CO6 - Analyze common methods used to secure cyber-physical systems.

TEXT / REFERENCE BOOKS

5. Principles of Cyber Physical Systems, Rajeev Alur, MIT Press, 2015.
6. E. A. Lee, Sanjit Seshia , "Introduction to Embedded Systems – A Cyber–Physical Systems Approach", Second Edition, MIT Press, 2017, ISBN: 978-0-262-53381-2.
7. Guido Dartmann, Houbing song, Ankeschmeink, “Big data analytics for Cyber Physical System”, Elsevier, 2019.
8. Houbing song, Danda B Rawat, Sabina Jeschke, Christian Brecher, “Cyber Physical Systems Foundations, Principles and Applications”, Elsevier, 2017.
9. Chong Li, Meikang Qiu, “Reinforcement Learning for Cyber Physical Systems with Cyber Securities Case Studies”, CRC press, 2019.
10. Houbing Song, Glenn A.Fink, Sabina Jesche, “Security and Privacy in Cyber-Physical Systems: Foundations, Principles and Solutions”, IEEE Press.

ENDS EMESTER 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**

SECB7010	CYBER SECURITY	L	T	P	EL	CREDITS	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite:** Nil

Course Objectives

- To analyze the basics of cyber security.
- To determine the cybercrimes and security.
- To examine the attacks and threats related to cyber security.
- To analyze the concepts of intrusion detection and prevention.
- To apply the concepts for various real time systems.
- To build cyber security system for real time applications.

UNIT 1 INTRODUCTION TO CYBER SECURITY 9 Hrs.

Introduction – Need for Security – Security Approaches – Principles of Security – Components – Balancing Security & Access – Cyber Security –Impact of Internet – CIA Triad;– Need for Cyber Security – Cybercriminals — A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

UNIT 2 CYBER CRIMES AND CYBER SECURITY 9 Hrs.

Cyber Crime and Information Security – History of Cyber Crime-classifications of Cyber Crimes – Reason for Cyber Crime -Tools and Methods –Password Cracking, Key loggers, Spywares, SQL Injection – Network Access Control – Cloud Security – Web Security – Wireless Security.

UNIT 3 ATTACKS AND COUNTERMEASURES 9 Hrs.

Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures.

UNIT 4 INTRUSION DETECTION AND PREVENTION 9 Hrs.

Host Based Intrusion Detection – Network Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots. Firewalls- Types of Firewalls- Firewall location and configuration- Intrusion Prevention systems- Example -Unified Threat Management Products.

UNIT 5 CYBER SECURITY-CASE STUDIES 9 Hrs.

Smartphone security- social media and basic Windows security- secure password and Wi-Fi security- Online Banking, Credit Card and UPI Security- Micro ATM, e-wallet and Point of Sale(POS) Security

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 Analyze the basics of cyber security concepts
CO2 Analyze various cybercrimes and cyber security.
CO3 Interpret threats, attacks and countermeasures of cyber security
CO4 Investigate Intrusion detection and prevention systems
CO 5 Apply the concepts for cyber security in IoT applications
CO 6 Develop real time applications for cyber security.

TEXT / REFERENCE BOOKS

1. Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021.
2. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley Publishers, 2011.
3. B. Sullivan, V. Liu, and M. Howard, “Web Application Security”, A B Guide. New York: McGraw-Hill Education, 2011.
4. Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther Press. Edition 2010.
5. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011).
6. Henry A. Oliver , Security in the Digital Age: Social Media Security Threats and Vulnerabilities, Create Space Independent Publishing Platform. (Pearson , 13th November, 2001).
7. B.B.Gupta, D.P.Agrawal,Haoxiang Wang,Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, 2018.

ENDS EMESTER 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**

SECB7012	HIGH PERFORMANCE NETWORKS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVES

- To develop a comprehensive understanding of high speed networks and multimedia networking.
- To study the concepts of applications related to high speed networks.
- To learn about different types of high speed Ethernet communication networks.
- To review about high performance wireless networks.
- To know about the high speed optical networks and the concepts of FTTH.

UNIT 1 BASICS OF HIGH SPEED NETWORKS AND APPLICATIONS 9 Hrs.

Traffic characteristics and QoS- Network services: connection oriented, connection less services – High performance network – Network elements – network mechanisms – high speed applications- peer to peer file distribution – scalability of p2p services-bit torrent- video streaming and content distribution networks – Internet video- HTTP Streaming - case study: Netflix, YouTube.

UNIT 2 DATA NETWORK AND COMMUNICATION PROTOCOLS 9 Hrs.

Switched communication networks- Circuit switching concepts-Packet Switch Networks – Frame Relay Networks – Congestion in data network and internets – Communication protocol architectures.

UNIT 3 HIGH SPEED ETHERNETS 9 Hrs.

Traditional Ethernet- High speed Ethernet: IEEE 802.3 (FAST ETHERNET)- Gigabit Ethernet- 10Gps Ethernet- configuration – 100 Gps Ethernet- Configuration for massive blade server site- Multilane distribution for 100Gps Ethernet- IEEE 802.1Q VLAN standard- configuration of VLAN.

UNIT 4 HIGH SPEED WLANS 9 Hrs.

Wireless LANs – Configuration – single cell, multiple cell- IEEE 802.11 standards- Terminology- Architecture- Services- MAC- Protocol architecture- MAC frame format- IEEE 802.11 a, b and g standards- comparison – Gigabit Wi-Fi.

UNIT 5 HIGH SPEED OPTICAL NETWORKS 9 Hrs.

Optical networks- Management and services- IP and optical integrated networks- Migration scenario- network configuration- resource allocation concepts- DOFSR- DOFSR network- Demands on high speed optical networks- packet switching in optical network- All optical packet switching- FTTH- Concepts- Architecture – Applications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Appraise the elements of high speed networks and their relevant applications.
CO2 - Analyze the functional metrics of high speed networks.
CO3 - Apprehend different types of switching related to high speed operations.
CO4 - Evaluate the performance of various types of high speed Ethernets.
CO5 - Analyze the IEEE standards pertaining to high speed wireless data communications.
CO6 - Evaluate the performance of optical networks.

TEXT / REFERENCE BOOKS

1. J.F.Kurose&K.W.Ross, "Computer Networking: A top down approach featuring the internet", 7th Edition, Pearson, 2017.

2. Walrand.J.Varatya, "High performance communication network", 2nd Edition, 2010, Morgan Kauffman Publishers Ltd., Reprint 2015.
3. William Stallings, "Data and Computer communications", 10th Edition, Pearson, 2014.
4. Hans W. Barz, Gregory A. Bassett, "Multimedia Networks Protocols, Design and Applications", Wiley, 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**

SECB7014	MACHINE LEARNING ALGORITHMS	L	T	P	EL	C	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVES

- To focus on the construction and study of algorithms that can learn from data.
- To emphasize on the logical, knowledge-based approach.
- To introduce students to the basic concepts and techniques of Machine Learning.
- To develop skills of using recent machine learning software for solving practical problems.
- To gain experience of doing independent study and research.

UNIT 1 SUPERVISED LEARNING 9 Hrs.

Decision Trees: ID3, Classification and Regression Trees, Regression: Linear Regression, Multiple Linear Regression, Logistic Regression, Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions, K-Nearest Neighbours.

UNIT 2 ENSEMBLE LEARNING 9 Hrs.

Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost and Stacking

UNIT 3 UNSUPERVISED LEARNING 9 Hrs.

Introduction to clustering, Hierarchical: AGNES, DIANA, Partitional: K-means clustering, K-Mode Clustering, Expectation Maximization, Gaussian Mixture Models

UNIT 4 PROBABILISTIC LEARNING 9 Hrs.

Bayesian Learning, Bayes Optimal Classifier, Naıve Bayes Classifier, Bayesian Belief Networks Learning Association Rules: Mining Frequent Patterns - basic concepts -Apriori algorithm, FP- Growth algorithm, Association based Decision Trees.

UNIT 5 MACHINE LEARNING IN PRACTICE 9 Hrs.

Design, Analysis and Evaluation of Machine Learning Experiments, Other Issues: Handling imbalanced data sets.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Choose appropriate learning techniques for classification, regression and clustering problems.
CO2 – Analyze the strengths and weaknesses of popular machine learning approaches.
CO3 – Analyze validity of machine learning approaches for different scenarios.
CO4 – Apply suitable model parameters for different machine learning techniques to achieve optimum performance.
CO5 – Develop ML algorithms for real world problems
CO6 – Evaluate the performance of probalistic learning and deterministic learning.

TEXT / REFERENCEBOOKS

1. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, 2014.
2. Tom Mitchell, “Machine Learning”, McGraw Hill, 2013.
3. Shai Shalev-Shwartz and Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge University Press, 2014.

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	EL	C	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

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 **9 Hrs.**

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

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

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

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

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, CoAPvs MQTT.

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

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

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

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 - Analyze the main challenges associated with machine-to-machine communications with respect to the status quo in networking today.

CO2 - Apply 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 suitable application-layer protocols and web services architectures for a seamless integration of various components within an IoT ecosystem.

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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 EXAM QUESTION PAPER PATTERN

Max. Marks :100 **Exam Duration: 3 hrs.**

PART A:	5 Questions of 6 marks each without choice	**30 Marks**
PART B:	2 Questions from each unit of internal choice, each carrying 14 marks	**70 Marks**

SECB7020	REAL TIME DATA ANALYTICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

COURSE OBJECTIVES

- To Study in detail the Scala programming.
- To Study in detail the Spark programming and its various concepts.
- To learn the integration of various technologies with Spark to develop Big Data applications.

UNIT 1 INTRODUCTION TO SCALA AND SPARK 9 Hrs.

Introduction to Spark – Basics of Spark- Spark Philosophy - History of Spark -Programming in Scala- Functionally oriented framework for big data processing in Scala.

UNIT 2 SPARK ARCHITECTURE 9 Hrs.

Introduction to Spark- Spark architecture- Data Frames - Transformations - End to end example - Spark toolset-Spark run on cluster – Developing spark Applications - Deploying Spark - Spark Streaming- Programming in Spark.

UNIT 3 INTEGRATION OF SPARK WITH HADOOP ECOSYSTEM 9 Hrs.

Integration of Spark with the Hadoop ecosystem for developing Big Data applications- Dataset - Transformations_RDD - Creating RDD – Transformations – Actions - saving files - Advanced RDD - Key value RDD - Distributed shared variables - Accumulators..

UNIT 4 KAFKA AND SPARK 9 Hrs.

Introduction to Kafka, Integration of Kafka with Spark- Streaming: Streaming Fundamentals - Processing Design Points - Structure Streaming Basics - core concepts - Input and output.

UNIT 5 LATEST TECHNOLOGIES FOR REAL TIME DATA ANALYTICS 9 Hrs.

Introduction to influx dB, Grafana, Integration of Influx dB with Grafana- HiveQL: Indexes - Schema Design – Tuning – Functions - Customizing Hive File and Record formats - Case Studies.

Max. 45 Hrs.

COURSE OUTCOMES

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

CO1 - Perform data analysis using Scalaprogramming tool.
CO2 - Analyse the principles of Real time data collection and its processing techniques using Spark programming language.
CO3 - Demonstrate Real-time data streaming processes and operations with Spark Streaming tool kit.
CO4 - Implement high-velocity streaming and data processing use cases.
CO5 - Create machine-learning pipelines to combine multiple algorithms in a single workflow.
CO6 - Deploy contemporary real time data analytic technologies for big data application development.

TEXT / REFERENCE BOOKS

1. Byron Ellis, “Real-Time Analytics: Techniques to Analyze and Visualize Streaming Data”, Wiley, 1stEdition, 2014.
2. ShilpiSaxena, Sumit Gupta, “Real-Time Big Data Analytics”, Packt, 1stEdition, 2016.
3. Jonathan Leibiusky, Gabriel Eisbruch, Dario Simonassi, “Getting Started with Storm”, O’Reilly, 1stEdition, 2012.
4. ShilpiSaxena, Saurabh Gupta, “Practical Real-time Data Processing and Analytics”, Packt, 1stEdition, 2017.

5. SiamakAmirghodsi, Romeo Kienzler, “Apache Spark 2: Data Processing and Real-Time Analytics”, Packt, 1st Edition, 2008.

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**

SECB7021	SCADA SYSTEMS APPLICATIONS	L	T	P	EL	C	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

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.
- Knowledge of computer programming code, desirable: python programming, basic knowledge of Microprocessor and micro-controller.

UNIT 1 INTRODUCTION AND FEATURES OF SCADA SYSTEMS 9 Hrs.

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 9 Hrs.

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

UNIT 3 OVERVIEW OF OSI AND IEC61850 9 Hrs.

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

UNIT 4 INDUSTRIAL AUTOMATION SPECIFIC PROTOCOLS 9 Hrs.

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 9 Hrs.

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. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Evaluate the various architecture of SCADA system and their merits and demerits.
CO2 - Analyze different the network communication protocols used by SCADA systems for remote monitoring and control.
CO3 - Analyze 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 BOOK

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. Francis G.L, “SCADA: Beginner's Guide”, Kindle Edition, 2016.
4. Stuart A. Boyer,“SCADA: Supervisory Control and Data Acquisition”, ISA, 4thEdition, 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**

SECB7022	BIG DATA TECHNOLOGIES	L	T	P	EL	C	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite: Nil**

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 computer science.

UNIT 1 OVERVIEW OF BIG DATA 9 Hrs.

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 9 Hrs.

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 9 Hrs.

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

UNIT 4 MODERN DATABASES 9 Hrs.

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

UNIT 5 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. 45 Hrs.

COURSE OUTCOMES

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

CO1 - Apply in-depth knowledge and understanding of the big data technologies.
CO2 - Analyze 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 - Apply 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, "HadoopThe Definitive Guide", Yahoo Press, 3st Edition, 2012.
4. Alex Holmes, "HadoopIn 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**