

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

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

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

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

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

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

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

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

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

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

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

UNIT 5 NANO DEVICES**12 Hrs.**

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

Max. 60 Hrs.**COURSE OUTCOMES**

On completion of the course, student will be able to

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



Employability



Entrepreneurship



Skill Development

CO6 Select suitable sensors for automation.

TEXT / REFERENCE BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A MCQ Questions

20 Marks

PART B Laboratory Practical

80 Marks

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

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

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

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

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

UNIT 2 DESIGN OF COMBINATIONAL LOGIC
12 Hrs.

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

UNIT 3 COMBINATIONAL CIRCUITS
12 Hrs.

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

UNIT 4 SEQUENTIAL CIRCUITS
12 Hrs.

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

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

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

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 Minimize Boolean functions for computationally less complex implementations.

CO2 Apply K map and tabulation method for minimization of Boolean functions.

CO3

Implement combinational logic circuits for Real World Problems.



Employability



Entrepreneurship



Skill Development



Employability



Entrepreneurship



Skill Development

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

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

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

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

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

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

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

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

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

UNIT 4 OPERATIONAL AMPLIFIERS**9 Hrs.**

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

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

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

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1** - Analyze the characteristics of various small signal models of BJT and MOSFETs.
- CO2** - Analyze the performance of single stage and multistage amplifiers.
- CO3** - Design current mirrors circuits for given specifications.
- CO4** - Analyze the performance of Operational amplifiers in closed loop and open loop configurations.
- CO5** - Design analog multiplier circuits using BJT and MOSFETs.
- CO6** - Design various filters using switched capacitor circuit techniques.

TEXT / REFERENCE BOOKS

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

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

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

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

UNIT 1 EMBEDDED PROGRAMMING**9 Hrs.**

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

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

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

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

Adding Structure to '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 behavior - UML state charts - Role of scenarios in the definition of behavior - Timing diagrams - Sequence diagrams - Event hierarchies - types and strategies of operations - Architectural design in UML - threads in UML- Develop UML model for Real World Problems.

UNIT 5 EMBEDDED JAVA**9 Hrs.**

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

Max. 45Hrs.**COURSE OUTCOMES**

On completion of the course, students will be able to

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
 Employability

 Entrepreneurship

 Skill Development

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 20 Questions - MCQs

20 Marks

PART B: Practical Laboratory

80 Marks

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

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

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

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

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

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

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

UNIT 3 CORTEX M4 CORE**9 Hrs.**

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

UNIT 4 Cortex M4 MICROCONTROLLER**9 Hrs.**

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

UNIT 5 STM32F3/4 SERIES PROGRAMMING**9 Hrs.**

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

Max. 45 Hrs.**COURSE OUTCOMES**

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

- 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**

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

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

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

UNIT 1 INTRODUCTION**9 Hrs.**

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

Practice Programs

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

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

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

Practice Programs

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

Sample Output:	Sample Output:
Original string:	Original string:
Python Exercises	Python Exercises
Python Exercise	Python Exercises

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

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

Practice Programs

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

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

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

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

UNIT 4 FILES AND REGULAR EXPRESSIONS

9 Hrs.

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

Practice Programs

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

UNIT 5 CREATING GUI FORM, CLASSES AND OBJECTS

9 Hrs.

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

Practice Programs

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

COURSE OUTCOMES

Max.45 Hrs.

On completion of the course, student will be able to

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

TEXT / REFERENCE BOOKS

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

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

PART A MCQ Questions
PART B Laboratory Practical

20 Marks
80 Marks

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

Pre requisite: Nil

Co requisite: Nil

COURSE OBJECTIVES

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

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

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

UNIT 2 PROBLEM IDENTIFICATION**9 Hrs.**

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

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

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

UNIT 4 KNOWLEDGE REPRESENTATION**9 Hrs.**

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

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

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

COURSE OUTCOMES**Max.45 Hrs.**

On completion of the course, student will be able to

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

TEXT / REFERENCE BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A** 10 Questions of 2 marks each-No choice**20 Marks****PART B** 2 Questions from each unit of internal choice; each carrying 16 marks**80 Marks****8****0 Marks**

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, 1st Edition, 2018.
5. Richard Barry, "Mastering the Free RTOS: Real Time Kernel", Real Time Engineers Ltd, 1st Edition, 2016.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks



Employability



Entrepreneurship



Skill Development

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.



Employability



Entrepreneurship



Skill Development

TEXT / REFERENCE BOOKS

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

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