

SCSA1307	EMBEDDED SYSTEM	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the technologies behind the embedded computing systems.
- To acquire knowledge about microcontrollers embedded processors and their applications.
- To analyze and develop software programs for embedded systems
- To have knowledge about the working of a microcontroller system and its programming in assembly language.
- To provide experience to integrate hardware and software for microcontroller applications systems.

UNIT 1 INTRODUCTION AND REVIEW OF EMBEDDED HARDWARE**9 Hrs.**

Terminology – Gates – Timing diagram – Memory – Microprocessor buses – Direct memory access – Interrupts – Built interrupts – Interrupts basis – Shared data problems – Interrupt latency – Embedded system evolution trends – Round-Robin – Round Robin with interrupt function – Rescheduling architecture – algorithm.

UNIT 2 REAL TIME OPERATING SYSTEM**9 Hrs.**

Task and Task states – Task and data – Semaphore and shared data operating system services – Message queues timing functions – Events – Memory management – Interrupt routines in an RTOS environment – Basic design using RTOS.

UNIT 3 EMBEDDED HARDWARE, SOFTWARE AND PERIPHERAL**9 Hrs.**

Custom single purpose processors: Hardware – Combination Sequence – Processor design – RT level design – optimizing software: Basic Architecture – Operation – Programmers view – Development Environment – ASIP – Processor Design – Peripherals – Timers, counters and watch dog timers – UART – Pulse width modulator – LCD controllers – Key pad controllers – Stepper motor controllers – A/D converters – Real time clock.

UNIT 4 MEMORY AND INTERFACING**9 Hrs.**

Memory write ability and storage performance – Memory types – composing memory – Advance RAM interfacing communication basic – Microprocessor interfacing I/O addressing – Interrupts – Direct memory access – Arbitration multilevel bus architecture – Serial protocol – Parallel protocols – Wireless protocols – Digital camera example.

UNIT 5 PROCESS MODELS AND HARDWARE SOFTWARE CO-DESIGN**9 Hrs.**

Modes of operation – Finite state machine– HCFSL and state charts language – state machine models – Concurrent process model – Concurrent process – Communication among process –Synchronization among process – Implementation - Data Flow model - Design technology- Automation synthesis – Hardware & software co-simulation – IP cores – Design Process Model.

MAX. 45 Hours**Course Outcomes:**

On completion of the course, student will be able to

- CO1:** Understand basic concepts of embedded systems hardware.
- CO2:** Implement the RTOS development tools in building real time embedded systems.
- CO3:** Develop the hardware for embedded system applications based on the processors.
- CO4:** Develop prototype circuit on breadboard including micro processor interfacing.
- CO5:** Design Hardware and Software using process models.
- CO6:** Develop and implement embedded based applications.

TEXT / REFERENCE BOOKS

1. David. E.Simon, "An Embedded Software Primer", Pearson Education, 2001.
2. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons, 2002.
3. Steve Heath, "Embedded System Design", Elsevier, Second Edition, 2004.
4. Shibu K.V, "Introduction to Embedded Systems", Mc Graw Hill.
5. Raj Kamal, "Embedded Systems", TMH.
6. Lyla, "Embedded Systems", Pearson, 2013.
7. Peter Marwadel, "Embedded System Design: Embedded Systems, Foundations of Cyber-Physical Systems, and the Internet of Things", Springer, Third Edition, 2018.

SCSA1319	DESIGN THINKING AND INNOVATIONS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce the idea of Human-centered design and design thinking
- To understand the concept of empathy and its technique
- To understand observation phase and insight concepts in design thinking
- To leverage the use of prototype in design thinking
- To design business models using the design thinking innovations

UNIT 1 Human-centered Design**9 Hrs.**

Introduction to Human-centered Design – Applications of Human-centered Design – Design Process – Mindsets of Human-centered designer – Principles and process of Design Thinking – Planning a Design Thinking Project

UNIT 2 Interviewing & Empathy-building Techniques**9 Hrs.**

Introduction to Empathy – Practicing Empathy – Empathy vs. Sympathy – Methods for Empathetic design – Tips for Interviews – Empathy Interviews – Understanding and defining the problem

UNIT 3 Making Sense of Observations & Insights**9 Hrs.**

Observation Phase – Tips for observing – Insights definition – Problems with Insights – Case study: Insight problems in the history of aviation – Creativity process, principles and techniques – Evaluation of ideas

UNIT 4 Developing and Testing Prototypes**9 Hrs.**

Role of Prototype in design thinking – Types of prototyping – Guidelines for prototyping – Lean Startup Method for Prototype Development – Visualization and presentation techniques – Testing prototypes: Feedbacks and Maximize learning

UNIT 5 Defining & Testing Business Models & Business Cases**9 Hrs.**

Business Model Definition – Design thinking to design business model – Innovation in Business Model – Pursuing innovation in business – Business model innovations cases – Kano Model – Desirability Testing

Max. 45Hours.**COURSE OUTCOMES:**

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

- CO1:** Understand and apply human-centered design process and planning of design thinking project
- CO2:** Use empathetic design in the interview process
- CO3:** Identify need for observations and insights problems and come up with creative ideas in design thinking
- CO4:** Understand, build and test the prototypes
- CO5:** Use design thinking concepts to build successful business models
- CO6:** Implement innovation techniques in business models

TEXT / REFERENCE BOOKS

1. Mueller-Roterberg, Christian. "Handbook of Design Thinking." Hochschule Ruhr West (2018).
2. Design Kit by IDEO.org. "The field guide to human centered design." (2015), ISBN: 978-0-9914063-1-9.
3. <https://www.interaction-design.org/literature/article/design-thinking-getting-started-with-empathy>
4. <https://www.interaction-design.org/literature/article/stage-4-in-the-design-thinking-process-prototype>
5. <https://www.interaction-design.org/literature/article/test-your-prototypes-how-to-gather-feedback-and-maximise-learning>
6. <https://uxplanet.org/what-are-insights-aa1f2d1b3b9c>
7. <https://labs.sogeti.com/using-design-thinking-to-design-business-models/>
8. <https://www.northeastern.edu/graduate/blog/implementing-business-model-innovation/>

SCSA2304	EMBEDDED PROGRAMMING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- Design complex electronic systems interfacing multiple integrated circuits.
- Design and conduct experiments, as well as analyze and interpret data.
- Design a system, component, or process to meet desired needs. .
- Identify, formulate, and solve engineering problems. .
- Use the techniques, skills, and modern engineering tools necessary for engineering practice

LIST OF EXPERIMENTS

1. Study of ARM evaluation system
2. Interfacing ADC and DAC.
3. Interfacing LED and PWM.
4. Interfacing real time clock and serial port.
5. Interfacing keyboard and LCD.
6. Interfacing EPROM and interrupt.
7. Mailbox.
8. Interrupt performance characteristics of ARM and FPGA.
9. Flashing of LEDS.
10. Interfacing stepper motor and temperature sensor.
11. Implementing zigbee protocol with ARM.

COURSE OUTCOMES

On completion of the course the student will be able to

- CO1:** Write programs in ARM for a specific Application
CO2: Interface memory and Write programs related to memory operations
CO3: Interface A/D and D/A converters with ARM system
CO4: Analyse the performance of interrupt
CO5: Write programmes for interfacing keyboard, display, motor and sensor.
CO6: Formulate a mini project using embedded system

SCSA2302	CODE OPTIMIZATION AND DEBUGGING - I	L	T	P	Credits	Total Marks
		0	0	2	1	50

COURSE OBJECTIVES

- To improve the intermediate code by making it consume fewer resources
- To get the faster running machine code
- To improve the consistency of the code
- To enhance the readability of the code and easier code maintenance
- To improve the work flow of the code

LIST OF EXPERIMENTS

1. Implement Built In Function and Libraries using python
2. Implement Optimizing loop using python
3. Profiling CPU usage using python
4. Profiling memory usage using python
5. Implement query optimization in DBMS
6. Implement heuristics in query optimization in DBMS
7. Implement factorial of given number using memorization in data structure
8. Implement Divide and conquer method in data structure
9. Implement hybrid stable sorting algorithm in data structure
10. Implement linked list with improving the time complexity in data structure

COURSE OUTCOMES

On completion of the course the student will be able to

- CO1:** Understand importance of code optimization
CO2: Apply time complexity and space complexity of the algorithm for improving optimization.
CO3: Analyse and appreciate variety of performance measures for various optimization problems
CO4: Learn efficient computational procedures to solve optimization problems
CO5: Be able to use programming languages to implement optimization algorithms
CO6: Be able reduce the execution time of code by applying proper coding technique.

SCSA1407	ARDUINO PROGRAMMING FOR IoT BOARDS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To program Arduino to control lights, motors, and other devices.
- To learn Arduino's architecture, including inputs and connectors for add-on devices.
- To add third-party components such as LCDs, accelerometers, gyroscopes, and GPS trackers to extend Arduino's functionality.
- To understand various options in programming languages, from C to drag-and-drop languages.
- To test, debug, and deploy the Arduino to solve real world problems.

UNIT 1: Introduction to sensors**9 Hrs.**

Transducers, Classification, Roles of sensors in IOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IOT sensors, Role of actuators, types of actuators.

UNIT 2: Hardware**9 Hrs.**

Physical device – Arduino Interfaces, Hardware requirement for Arduino, Connecting remotely over the network using VNC, GPIO Basics, Controlling GPIO Outputs Using a Web Interface, – Programming, APIs / Packages- Quark SOC processor, programming, Arduino Boards using GPIO (LED, LCD, Keypad, Motor control and sensor)

UNIT 3: Platforms**9 Hrs.**

History - Creative Coding Platforms - Open Source Platforms – PIC - Arduino, Sketch, Iterative coding methodology – Python Programming - Mobile phones and similar devices - Arm Devices - Basic Electronics (circuit theory, measurements, parts identification) Sensors and Software: Understanding Processing Code Structure, variables and flow control, Interfacing to the Real World

Unit 4: Programming an Arduino IoT Device**9 Hrs.**

Preparing the development environment (Arduino IDE), Exploring the Arduino language (C/C++) syntax, Coding, compiling, and uploading to the microcontroller, Working with Arduino Communication Modules: Bluetooth Modules, WiFi Modules and I2C and SPI, Interfacing arduino and Blynk via USB ; LED Blinking, Controlling a Servomotor.

Unit 5: Programming ESP 8266 Module**9 Hrs.**

ESP8266 WiFi Serial Module: Overview, Setting Up the Hardware, Interfacing with Arduino, Creating an IoT Temperature and Humidity Sensor System, Overview of DHT-22 Sensor, Interfacing the Hardware: Arduino, ESP8266 WiFi Module, and DHT-22 Sensor, Checking Your Data via ThingSpeak, Connecting Your Arduino Set-up to Blynk via WiFi

Max 45 Hours**COURSE OUTCOMES:**

- CO1:** Recall the basics of sensors, its functioning.
- CO2:** Execute basic and advanced assembly language programs.
- CO3:** Learn the ways to interface I/O devices with processor for task sharing.
- CO4:** Recall the basics of co-processor and its ways to handle float values by its instruction set.
- CO5:** Recognize the functionality of micro controller, latest version processors and its applications.
- CO6:** Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyze the results.

TEXT / REFERENCES BOOKS

1. "Practical Electronics for Inventors, Third Edition," by Paul Scherz and Simon Monk. 2016
2. Intel Galileo and Intel Galileo Gen 2 API Features and Arduino Projects for Linux Programmers, Ramon, Manoel 2014 (Open Access)
3. Making Sense of Sensors: End-to-End Algorithms and Infrastructure Design By Omesh Tickoo, Ravi Iyer 2016
4. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.
5. Programming Interactivity, Second Edition By Joshua Noble, 2012
6. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.

SCSA1408	IoT ARCHITECTURE AND ITS PROTOCOLS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES:

- To learn the fundamentals of IoT
- To understand the various models and architecture of IoT
- To understand the protocols in data link and network layers
- To analyze the different transport and session layer protocols
- To analyze various service layer protocols and security

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

Introduction - IoT and digitization – IoT impact – Convergence of Information Technology and Operational Technology – Ancestors without IP – IoT enabled applications - IoT challenges

UNIT 2 IoT REFERENCE ARCHITECTURE**9 Hrs.**

IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, 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), WirelessHART,ZWave,Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP

UNIT 4 TRANSPORT & SESSION LAYER PROTOCOLS**9 Hrs.**

Transport Layer: TCP, MPTCP, UDP, DCCP, SCTP-TLS, DTLS – Session Layer: HTTP, CoAP, XMPP, AMQP, 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, RPL, Application Layer

MAX. 45 Hours**COURSE OUTCOMES:**

On completion of the course, student will be able to

- CO1:** Understand the need of digitization and IoT challenges
- CO2:** Describe the various IoT reference models and architecture
- CO3:** Analyze the data link and network layer protocols
- CO4:** Recognize the transport and session layer protocols required for IoT.
- CO5:** Describe the service layer protocols and security
- CO6:** Implement an application based on understanding of architecture and protocols

SCSA2403	MACHINE LEARNING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To understand the fundamental concepts of Machine Learning.
- To develop logics and employ statistics for various Machine Learning algorithms.
- To gain practical knowledge of machine learning algorithms and methods
- Identify and apply the appropriate machine learning technique for classification, pattern recognition, and decision problems.
- To recognize the characteristics of ML and employ them to cater real-world problems.

LIST OF EXPERIMENTS:

1. Analysis and implementation using Python /Jupyter Notebook/Colab

- Compute the distance travelled by the robot from current position after a sequence of movement and original point.
- Creation of scatter plot using sepal length and petal width to separate the Species classes

2. Computation of Statistical details and Complexity

- Calculate the Five Number Summary(Quartiles, IQR) for the attribute(age) of each employee at a Tea Factory.
- Analyze the complexity of Heap sort, applied over different sized random lists.

3. Preprocessing and construction of a quality dataset

- Preprocess the given data to build good training sets (80%) and test sets (20%) by removing the missing values and imputing them with the mean value.
- Examine the interrelations among the set of variables using Principal Component Analysis, display the PCA Components and generate Heatmap.

4. Analysis and Interpretation of data

- Manipulate the Twitter Data Set by removing the Punctuation, Numbers, Special Characters and word length<=3. Tokenize the Words and Stem.
- Generate a word cloud for the Twitter dataset and retrieve the top 15 positive and negative tags.

5. Build new models (Classification and Clustering)

- Find core samples of high density and expand clusters from them using DBSCAN Clustering.
- Split the iris dataset into train and test data(80%-20%) and train or fit the data into the model using K Nearest Neighbor Algorithm.

6. Evaluate the Performance of Machine Learning algorithms

- Evaluate the performance of Machine Learning algorithms using Confusion Matrix, Accuracy, Sensitivity, Specificity, Precision and Recall.
- Employ Linear Regression to check the linearity between the a)stock price and interest rate, b)stock price and unemployment rate.

COURSE OUTCOMES

- CO1** - Design and develop Python Program for simple Machine Learning tasks.
- CO2** - Explain Complexity, Implementation and limitations of Machine Learning.
- CO3** - Formulate the model for various Use cases by employing Supervised, Semi-Supervised and Unsupervised Machine learning algorithms.
- CO4** - Interpretation of data by analyzing the Data set.
- CO5** - Construct new models with efficient visualization techniques for real world problems.
- CO6** - Evaluate and assess the performance of Machine Learning systems.

SCSA2405	Programming for IoT Boards Lab	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To provide knowledge of Arduino board and its applications.
- To familiarize students with Arduino as IDE, programming language & platform.
- To provide knowledge of Arduino boards and basic components.
- To capable of developing various applications using raspberry pi projects.
- To provide the knowledge of developing application in waspmote boards.

LIST OF EXPERIMENTS:

1. Make your Arduino board blink an LED.
2. Create an application to find Motion detection using arduino board.
3. Create an application to measure Temperature and Humidity using arduino board.
4. Demonstrate Ultrasonic distance sensor in arduino board.
5. Create an application to learn to test the output & input of GPIO pins on Raspberry pi.
6. Develop an application to set up a Apache Tomcat web server on a Raspberry Pi.
7. Design an prototype which measures the amount the gas present inside the working environment using gas sensor in Raspberry pi.
8. Build the application to monitor the environment using temperature sensor in Raspberry pi board.
9. Implement smart cities Sensor Board v3.0 using Wasp mote platform for measuring temperature, humidity and pressure.
10. Measure the light intensity and pollution level using Wasp mote platform.

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Learn the basics of electronics and sensors.

CO2: Learn how to prototype circuits with a breadboard

CO3: Learn the Arduino programming language and and IDE

CO4: Learn the Raspberry pi pins and Raspbian OS

CO5: Build the prototype in washmote platform.

CO6: Build the projects for real world applications.

SCSA2402	CODE OPTIMIZATION AND DEBUGGING - II	L	T	P	Credits	Total Marks
		0	0	2	1	50

COURSE OBJECTIVES

- To analyze the programming logic and apply the appropriate design approach
- To optimize the speed of the program by using proper utilization of available memory
- To make use of performance tools for tracking the application.
- To have a capacity to analyze and design software systems, components to meet desired needs
- To have a working ability and grasping attitude to design and conduct object-oriented analysis

LIST OF EXPERIMENTS

1. Implement minimum heap allocation in java
2. Implement string builder in java
3. Implement concurrency control using java
4. Checking the current log level using java
5. Implement Garbage collection using java
6. Implement grid line in object oriented analysis and design
7. Implement grid with two sets of diagonal lines in object oriented analysis and design
8. Implement concurrency in object oriented analysis and design
9. Implement design optimization for removing non usable associations in object oriented analysis and design
10. Implement sparing and storing derived attributes associations in object oriented analysis and design

COURSE OUTCOMES

On completion of the course the student will be able to

- CO1:** Understand the impact of performance hits during application run time.
CO2: Implement optimal functions for improving the performance
CO3: Analyze the proper utilization of memory for code
CO4: Design experiments using UML, as well as to analyze and evaluate their models
CO5: Discussing and understanding analysis and design heuristics that are involved in the course
CO6: Students will learn and understand how to map one style of diagrammatic notations into another