



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited "A" Grade by NAAC | 12B Status by UGC | Approved by AICTE

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SCHOOL OF SCIENCE AND HUMANITIES

DEPARTMENT OF COMPUTER SCIENCE

1.2.1 New Courses introduced in 2022 -2023

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15	SBSA2401	Database Management Systems Lab	B.Sc.CS with Specialization in AI	20

16	SBSA2402	Robotics Lab	B.Sc.CS with Specialization in AI	21
17	S734ADPROJ	Design Thinking and Innovations	M.Sc CS	22

SBSA1301	OPERATING SYSTEMS	L	T	P	Credits	TotalMarks
		3	0	0	3	100

COURSE OBJECTIVES:

- To learn how computers work and to learn about system design (performance vs .simplicity, HWvs.SW,etc.)
- To have a view of different types of operating systems.
- To learn and implement the concept of process management.
- To observe the concept of storage management.
- To understand the concept of I/O and file systems.
- To learn the basics of Linux Programming

UNIT 1

9Hrs.

Introduction: Operating system –Views and Goals - Types of System- OS Structure - Components - Services – System Structure - Layered Approach - Process Management: Process - Process Scheduling - Cooperating Process - Threads - Inter-process Communication.

UNIT 2

9Hrs.

CPU Scheduling: CPU Schedulers - Scheduling Criteria - Scheduling Algorithms. Process Synchronization: Critical-Section Problem-Synchronization Hardware-Semaphores Classical Problems of Synchronization-Critical Region-Monitors.

UNIT 3

9Hrs.

Deadlocks: Characterization-Methods for Handling Deadlocks-Deadlock Prevention-Avoidance-Detection-Recovery.

UNIT 4

9Hrs.

Memory Management: Address Binding - Dynamic Loading and Linking - Overlays - Logical and Physical Address Space – Contiguous Allocation-Non-Contiguous Allocation.

UNIT 5

9Hrs.

File System: File Concepts - Access Methods - Directory Structures - Protection Consistency Semantics - File System Structures- Allocation Methods-Free Space Management.

Max.45hours

COURSE OUTCOMES:

- CO1 Understand the fundamental components of a computer operating system and how computing resources are managed by the operating system.
- CO2 Apply the concepts of CPU scheduling, synchronization and deadlocks in real computing problems.
- CO3 Demonstrate the different memory and I/O management techniques used in Operating Systems.
- CO4 Have practical exposure to the concepts of semaphores and monitors for process synchronization.
- CO5 Create design and construct the following OS components: Schedulers, Memory management systems in the modern operating system.
- CO6 Understand file system structure and implement a file system such as FAT.

TEXT /REFERENCE BOOKS:

1. A.Silberschatz P.B.Galvin ,Gange.,Operating System Concepts,6thEdition.,Addison-WesleyPublishingCo.,2002.
2. William Stallings ,Operating Systems,FourthEdition,PHI.
3. AndrewS Tanenbaum ,Operating Systems:Design and Implementation,ThirdEdition,

SBSA1302	JAVA PROGRAMMING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES:

- To understand and apply the fundamentals core java, packages, database connectivity for computing
- To provide knowledge on advanced features like Swing, JavaBeans, Sockets
- To understand the principles and concepts of object oriented programming
- To Store and retrieve the information from Files.
- To learn multithreading concepts

UNIT 1

9 Hrs.

An Overview of Java - Features of Java - Object oriented concepts - Lexical Issues - Data Types - Variables - Type Conversions and Casting - Arrays - Operators - Control Statements.

UNIT 2

9 Hrs.

Introduction to Classes and Objects - Declaring Objects and Methods - Constructors - this keyword - finalize() method- Overloading Methods - Overloading Constructors - Recursion - Access Control - Static and Final methods and variables - Nested and Inner class - String class - String Handling

UNIT 3

9 Hrs.

Inheritance - Using super - Overriding Methods - Abstract classes - Final with Inheritance – Multi Threaded programming

UNIT 4

9 Hrs.

Packages - Access Protection – Importing Packages – Interfaces – Exception Handling – throw and throws. – Sting tokenizer – Date – Calendar- Random.

UNIT 5

9 Hrs.

Applet - AWT Controls - Layout Managers and Menus- -Swing - JDBC/ODBC Connection

Max. 45 hours

COURSE OUTCOME :

CO1 - To understand the principles and concepts of object oriented programming

CO2 - To Store and retrieve the information from Files.

CO3 - To learn multithreading concepts

C04- Implement the interface, package and multithread concepts

C05- Implement various built in package and its applications

C06- Develop web based applications using applet programming

TEXT /REFERENCE BOOKS:

1. Herbert Schildt, The Complete Reference JAVA2, 7th Edition, McGraw-Hill/Osborne Media.
2. Bruce Eckel, Thinking in Java, 4th edition, Prentice Hall
3. Michael Morrison, Java Unleashed, 3rd edition, SAMS Publishing
4. Clayton Walnum, Java By Example, QUE Publications, 2000.
5. K. Arnold and J. Gosling, The JAVA programming language, Third edition, Pearson Education, 2000

SBSA1303	COMPUTER ARCHITECTURE	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on various types of Registers and Microinstructions.
- To discuss about the Data path design and Processor design in detail.
- To understand the types of memory organizations.
- To discuss about the registers, interface and communication in I/O devices.
- To analyze about the characteristics, structure communication and synchronization of multiprocessors.

UNIT1

9 Hrs.

Number systems - Conversion from one number system to another - Compliments - Binary codes - Binary logic - Binary Arithmetic - Logic gates - Truth tables. Boolean Algebra - Axioms - Truth table simplification of Boolean function - Map method- Mc-Clausky tabulation method.

UNIT 2

9 Hrs.

Combinational Logic: Adders - Subtractors - Decoders - Encoders - Multiplexer – Demultiplexer Sequential logic: RS, JK, D and T Flip flops - Registers -Shift Registers Counters - Design of Counters.

UNIT 3

9 Hrs.

Associative Memory – Cache Memory – Virtual Memory – Auxiliary Memory Memory Management Hardware. Peripheral Devices – Input-Output Interface – Asynchronous Data Transfer: Handshaking – Serial Transfer – Communication Interface – Modes of Transfer – Priority Interrupt – DMA –Serial Communication-

UNIT 4

9 Hrs.

Introduction to micro computers, Microprocessors and Assembly languages - Microprocessor architecture and its operations - 8085 MPU - 8085 instruction set and Classifications.

UNIT 5

9 Hrs.

Central Processing unit: General register and stack organizations, instruction formats - Addressing modes, Data transfer and manipulation - program control, RISC – Pipelining – Arithmetic and instruction, RISC pipeline – vector processing and array processors.

Max. 45 hours

COURSE OUTCOMES

- CO1 - Classify the various types of registers, microinstructions and addressing modes.
CO2 - Design the data path for processor
CO3 - Demonstrate the usage of Memory Organization.
CO4 - Describe about the I/O devices.
CO5 - Explain the characteristics, structure, communication and synchronization of multiprocessor.
CO6 - State the inter processor communication and synchronization.

TEXT /REFERENCE BOOKS:

1. M.Moris Mano, Computer system Architecture. PHI (Third edition, 1993)
2. M.M. Mano, Digital Logic and Computer Design, Prentice Hall of India, 1994.
3. Carl Hamacher, uonko G.Vranesic, Safwat G.Zaky – Computer Organisation, McGraw hill ISE 1987.
4. John, P.Hayes., Computer System architecture, McGraw Hill, ISE,1988.
5. Hwang.K.Briggs .F.A -Computer Architecture and parallel Processing, McGraw Hill ISE, 1988.
6. T.C.Bartee, Computer Architecture and logical Design, McGraw Hill, 1991.

SBSA1306	BLOCKCHAIN TECHNOLOGY	L	T	P	Credits	TotalMarks
		3	0	0	4	100

COURSE OBJECTIVES

- To introduce Bit coin and other crypto currencies.
- To study the algorithms and techniques in block chain.
- To understand the practical aspects in the design of crypto currency.
- To understand the function of Block chains as a method of securing distributed ledgers.
- To design, code, deploy and execute a smart contract.

UNIT 1

12 Hrs.

Basics of blockchain-Public Ledgers-Block Chain as Public Ledgers-Types of Block chains- Pillars of Block chain- Government Initiatives of BlockChain – Bitcoin – Smart Contracts.

UNIT 2

12 Hrs.

Block in a Block chain-find Transactions-Distributed Consensus-Proof of work, Stake, Space-Attacks on POW- Ethereum Pos/POW Hybrids-Crypto currency to block chain 2.0, Model of Blockchain-Algorand.

UNIT 3

12 Hrs.

Hash Function and Merle Tree-Security Properties-Security Considerations for block chain-Digital Signature-Public Key Cryptography-Bit coin block chain incentive structures- Nash Equilibriums- evolutionary stable strategies,-and Pareto efficiency (game theory) Weaknesses and news Points of Failure - Mitigation Methods -Redundancies and fall-back methods.

UNIT 4

12 Hrs.

Mining – Pools – Impact of CPU and GPU – Transaction in Bit coin Network – Block Mining – Block Propagation and block relay

UNIT 5

12 Hrs.

Industry applications of Blockchain-Blockchain in Government-Government use cases-Preventing Cybercrime through block chain- Block Chain in defense, tax payments.

Max. 60Hours

COURSE OUTCOMES:

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

CO1 - Explain the structure of a block chain.

CO2 - Analyze the incentive structure in a blockchain based system.

CO3 - Judge the scenario where “smart” contract is most appropriate.

CO4 - Identify Basic knowledge of Bitcoin, Ethereum.

CO5 - Apply Blockchain in future use cases for security.

CO6 - Understand the various Block Chain applications.

TEXT / REFERENCE BOOKS

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos O'Reilly, Second Edition, 2018.
2. Blockchain by Melanie Swa, O'Reilly Media 2015.
3. Zero to Block chain - An IBM Redbooks course, by Bob Dill, David Smits.

SBSA1307	COMPUTER COMMUNICATION	L	T	P	Credits	TotalMarks
		3	0	0	4	100

COURSE OBJECTIVES

- To understand the basics of communication
- To impart knowledge on basics of analog and digital communication.
- To analyze the data communication models and understand how to employ.
- To explore the various layers and its functionalities in data communication model

UNIT 1

9 Hrs.

Introduction to Communication systems – basic model, point to point, broadcast communication; modulation-need for modulation, types of modulation, Base band and Pass band transmission; Demodulation (detection) - Coherent and Noncoherent detection; Noise – types of noise; Analog to Digital Conversion (ADC) process– Sampling , Quantization and Coding; Sampling theorem, types of sampling – ideal, natural and flat –top sampling; nyquist rate, Signal reconstruction, types of quantization, Quantization noise, Aliasing.

UNIT 2

9 Hrs.

Amplitude modulation – types of amplitude modulation- Standard AM with Full Carrier ,Comparison of different amplitude modulations; Angle modulation (FM and PM), FM generation using PM, PM generation using FM, Comparison of Narrowband and Wideband FM, Comparison of AM,FM and PM. Analog pulse modulation – PAM,PWM,PPM; Digital pulse modulation – Pulse Code Modulation (PCM), Delta modulation (DM), Adaptive Delta modulation (ADM), Multiplexing – Frequency Division Multiplexing (FDM), Time Division Multiplexing.

UNIT 3

9 Hrs.

Introduction to computer communication: Transmission modes - Switching: circuit switching and packet switching, OSI model, Layers in OSI model, TCP/IP protocol suite. Physical Layer: Guided and unguided transmission media (Co-axial cable, UTP,STP, Fiber optic cable), Data Link Layer: Framing, Flow control (stop and wait , sliding window flow control) ,Error control, HDLC, Media access control: Ethernet (802.3), CSMA/CD, Logical link control, Wireless LAN (802.11), CSMA/CA.

UNIT 4

9 Hrs.

Network Layer Logical addressing: IPv4 & IPV6, Subnetting, DHCP, Virtual LAN, Networking devices (Hubs, Bridges & Switches), Network topologies. Routing: Routing and Forwarding, Static routing and Dynamic routing, Routing Algorithms: Distance vector routing algorithm, Link state routing (Dijkstra's algorithm), Routing Protocols: Routing Information protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol (BGP), MPLS.

UNIT 5

9 Hrs.

Transport Layer –UDP, TCP, Congestion Control & Quality of Service – Data traffic, Congestion, Congestion Control, QoS and Flow Characteristics, Application Layer – DNS, Remote Logging (Telnet), SMTP, FTP, WWW, HTTP, POP3, MIME, SNMP.

Max. 45 Hours

COURSEOUTCOMES

- CO1: Describe the essential basics of communication
- CO2: Classify different types of analog and digital modulation schemes
- CO3: Comprehend the need of data communication models
- CO4 : Identify the required network layer components and functions
- CO5 : Analyze the various protocols required in various layers
- CO6 : Acquire the needs for building a communication model

TEXT/REFERENCEBOOKS:

1. William Stallings, Data and Computer Communications, 10th Edition, Pearson, 2014.
2. Wayne Thomasi, "Advanced Electronic Communication Systems", 6th Edition, PHI Publishers, 2003.
3. Simon Haykins, "Communication Systems" John Wiley, 5th Edition, March 2009.
4. John G. Proakis, MasoudSalehi, "Digital Communication", McGraw Hill 5th edition November 6, 2007.

SBSA2301	JAVA PROGRAMMING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

LIST OF PROGRAMS

1. Substring removal from a String using StringBuffer class.
2. Determining the orders of the numbers generated randomly using Random class
3. Usage of Calendar class and manipulation
4. String manipulation using CharArray
5. Usage of Vector class
6. Implementing Thread based applications and exception handling
7. Application using synchronization such as Thread based, Class based and synchronized Statement Using Applets and swings
8. Working with frames and other controls
9. Working with Dialog and Menus
10. Working with Panel and Layout
11. Incorporating Graphics
12. Database creation for storing email addresses and manipulation using Swing

SBSA5301	CYBER PHYSICAL SYSTEM	L	T	P	Credits	TotalMarks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce basics of cyber-physical system and Industrial revolution 4.0 concepts
- To develop an exposition of the challenges in implementing a cyber-physical system
- To analyze the functional behaviour of CPS based on standard modeling formalisms.
- To design CPS requirements based on operating system and hardware architecture constraints.
- To understand the concepts involved in Cyber Physical Systems Security

UNIT1 INTRODUCTION TO INDUSTRY 4.0 & CYBER PHYSICAL SYSTEM

9Hrs.

Industry 4.0 - Globalization and Emerging Issues, The Fourth Revolution - Smart and Connected Business Perspective, Basics of Industrial IoT - Industrial Processes - Industrial Sensing & Actuation, Industrial Internet Systems - Basic principles of design and validation of CPS - Cyber-Physical Systems (CPS) in the real world- Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

UNIT2 EMBEDDED SYSTEMS MODELING AND DESIGN AND CPS

9Hrs.

Platform components - Embedded Systems definition, specification, and languages. Concepts, requirements, examples. Embedded system models at different abstraction levels. Test benches, design under test, Intellectual Property components. Discrete event simulation, semantics, algorithms. Design, analysis techniques for decentralized computer architectures, communication, and hardware-software systems. -Cyber Physical System Hardware Platform - Processors, Sensors, Actuators - Network - Wireless Hart, CAN, Automotive Ethernet – Software stack -Real-Time Operating system (RTOS) -Scheduling Real Time control tasks.

UNIT3 SENSORS, ACTUATORS AND SENSOR NETWORKS

9Hrs.

Sensors, Actuators and Sensor Networks & Real-Time and Distributed Systems - Fundamental principles and applications of sensors, actuators. Smart sensors and microsensor/microactuator array devices. Introduction to signal processing and sensor/actuator networks, deployment and architecture, wireless communication, multiple access control layer, data gathering, routing and querying, collaborating signal processing - Time dependent systems, clock synchronization, real-time communication protocols, specification of requirements, task scheduling. Validation of timelines, real-time configuration management. Middleware architecture for distributed real-time and secure services.

UNIT4 SECURITY OF CYBER PHYSICAL SYSTEMS

9Hrs.

Security of Cyber Physical Systems -Embedded and CPS security - attacks and countermeasures, authentication, identification, confidentiality, data integrity, authorization, access control, malware attacks and counter-measures, security protocols. Privacy issues - vehicular devices and smart metering. Applications of public key and symmetric cryptography, - digital certificates, credentials. Security and vulnerability of cyber-physical infrastructure networks - Mobile and wireless network security, Robust wireless infrastructure - Cloud computing and data security, Event Awareness and System Monitoring for Cyber Physical Infrastructure.

UNIT5 CYBER-PHYSICAL SYSTEMS CASE STUDIES AND PROJECTS

9Hrs.

Cyber-Physical Systems Case Studies and Projects - Automotive: SW controllers for Antilock braking system, Adaptive Cruise Control, Lane Departure Warning, Suspension Control - Healthcare: Artificial Pancreas/Infusion Pump/Pacemaker - Green Buildings: automated lighting, AC control - power distribution grid - robotics - civil infrastructure – avionics – Transportation.

Max.45Hours

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 : An ability to expose the student to real world problems in CPS and Industrial revolution 4.0 best practices.
- CO2 : Identify the limitations of some computational models.
- CO3 : Apply the theoretical knowledge the design of compilers.
- CO4 : Student can Analyze and verify the correctness of CPS implementations against system requirements and timing constraints.
- CO5 : Categorize the essential modeling formalisms of Cyber-Physical Systems (CPS)
- CO6 : Ability to understand cyber modeling system.

TEXT/REFERENCE BOOKS

1. "Industry4.0:TheIndustrialInternetofThings",AlasdairGilchrist(Apress)
2. "IndustrialInternetofThings:CybermanufacturingSystems"SabinaJeschke,ChristianBrecher,HoubingSong,DandaB. Rawat(Springer)
3. EdwardA.LeeandSanjitA.Seshia,IntroductiontoEmbeddedSystems,ACyber-PhysicalSystemsApproach,Second Edition,<http://LeeSeshia.org>,ISBN978-1-312-42740-2,2015.
4. RajeevAlur.PrinciplesofCyber-PhysicalSystems.MITPress.2015.
5. K.J.AstromandR.M.Murray.FeedbackSystems:AnIntroduction for ScientistsandEngineers.PrincetonUniversity Press, 2009.http://www.cds.caltech.edu/~murray/amwiki/index.php/Main_Page.

SBSA5302	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	L	T	P	Credits	Total Marks
		3	0	0	3	100

- To know the principles and approaches of artificial intelligence(AI).
- To develop a basic understanding of the building blocks of AI.
- To identify the solution to a problem through reasoning and planning.
- To learn various types and concepts of machine learning.
- To list out various domains and applications of AI.

UNIT 1 AI: FOUNDATIONS

9 Hrs.

Introduction – History – Intelligent Agents – Environment – Good behavior – Structure of an Agent – Concept of rationality – Types of agents – Search strategies and its types: BFS and DFS – Uniform Cost Search

UNIT 2 AI: SEARCHING AND SOLVING

9 Hrs.

Agents for problem solving – Informed search strategy – heuristic functions – Optimization: local and global search – Constraint Satisfaction Problems – Pruning - Case Study: Backtracking for CSP

UNIT 3 AI: KNOWLEDGE, REASONING AND PLANNING

9 Hrs.

Logical agents – Propositional Logic – Inference rules - First Order Logic – Syntax and Semantics – Building a knowledge base – Probabilistic reasoning – Classical Planning and its algorithm

UNIT 4 AI: LEARNING CONCEPTS

9 Hrs.

Types of learning: Supervised, Unsupervised and Reinforcement Learning – Theory of learning – Classification and Regression problems – Model selection and optimization – Case Study: Linear Regression for Classification

UNIT 5 AI: APPLICATIONS

9 Hrs.

Speech Processing: NLP basics and tasks – Chatbot applications and its types – Computer Vision: Classifying images and Detecting objects – Robotics: Hardware – Perception – Planning – Control

Max.45 Hours

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 :** Identify and analyze various search algorithms for solving the AI problems.
- CO2 :** Apply search algorithms for various AI related problems.
- CO3 :** Use various logical forms to represent knowledge.
- CO4 :** Discriminate between different types of learning techniques
- CO5 :** Recognize the working behind chatbot applications
- CO6 :** Design user centric applications that use AI concepts

TEXT/REFERENCE BOOKS

1. Stuart J.Russel, Peter Norvig, "Artificial Intelligence A Modern Approach", 4thEdition, Pearson Education, 2020.
2. Kevin Warwick, "Artificial Intelligence: the basics", Routledge Publishers, 2011.
3. Elaine Rich, Kevin Knight, "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2009.
4. M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc., First Edition, 2008

SBSA5303	DATA SCIENCE	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES:

- To study the basic concepts of Data Science and data life cycle
- To understand the theoretical and mathematical aspects of Data Science models
- To learn common random variables and their uses, and with the use of empirical distributions
- To obtain the knowledge in data management tools

UNIT 1 INTRODUCTION TO DATA SCIENCE

9 Hrs.

What is Data Science? –The data life cycle: pre-processing, analysis, post-processing – Preprocessing: Data gathering, cleansing, visualization, and understanding (Mean, Variance, Standard Deviation, Percentiles.)–Data Storage (Relational databases, e.g. MySQL)

UNIT 2 APPROACHING ANALYTICS PROBLEMS

9 Hrs.

Key roles for successful Analytics project- Discovery- Business domain, Resources, Problem framing, Key stakeholders, Analytics sponsors, Initial hypotheses, Data sources- Data Preparation- Learning about the data, conditioning- Model Planning- Data exploration, Model selection- Model Building- Common tools for model building- Communicate Results- Analysis over the different models- Operationalize- Moving the model to deployment environment-Analytics Plan

UNIT 3 INTRODUCTION TO R

9 Hrs.

Introduction to R- R Graphical user interfaces- Data Import and Export- Attributes and Data Types- Vectors- Arrays and Matrices- Data Frames- Lists- Factors- Contingency Tables- Descriptive statistics- Model building, Evaluation and Deployment- Hypotheses Testing- Null hypotheses and Alternative hypotheses- Probability distributions- Statistical models in R- Data distribution

UNIT 4 MODELING METHODS

9 Hrs.

Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods.

UNIT 5 DELIVERING RESULTS

9 Hrs.

Documentation and deployment – producing effective presentations – Introduction to graphical analysis – plot() function – displaying multivariate data – matrix plots – multiple plots in one window - exporting graph - using graphics parameters. Case studies.

Max.45 Hours

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 : Understand the key concepts in data science, including tools and approaches.
- CO2 : Apply a suitable data science technique to solve an information analytics problem.
- CO3 : Able to comprehend basic methods of processing data from real world problems
- CO4 : Analyze and validate the models using appropriate performance metrics
- CO5 : Understand the various techniques in data science
- CO6 : Present the results using effective visualization techniques

TEXT/REFERENCE BOOKS

1. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big Data Analytics” , EMC Education Services,2015
2. NinaZumel,JohnMount,“PracticalDataSciencewithR”,ManningPublications,2014
3. JureLeskovec,AnandRajaraman,JeffreyD.Ullman,“MiningofMassiveDatasets”,Cambridge University Press,2014
4. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, John Wiley & Son Publication, Second Edition, 2014.

SCSA6301	CYBER PHYSICAL SYSTEMS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To introduce basics of cyber-physical system and Industrial revolution 4.0 concepts
- To develop an exposition of the challenges in implementing a cyber-physical system
- To analyze the functional behaviour of CPS based on standard modeling formalisms.
- To design CPS requirements based on operating system and hardware architecture constraints.

SUGGESTED LIST OF EXPERIMENTS

1. Study about embedded components such as sensors and actuators
2. Study about Industrial Revolution and Cyber physical system opportunities and challenges
3. Create a program that blinks the LED on the development board using MBED software
4. Pick one-one from the available sensors and actuators and find or create code that will display the sensed data on the PC
5. Create a program that displays data from the sensor in regular intervals in a compact format.
6. To Design Basic weather station using embedded components using Lab view software.
7. Login to devicehub.net and create a project then create a virtual device. Add the corresponding sensor and actuator to the virtual device.
8. Study the MQTT protocol. Examine the components of the protocol.
9. Create a connection from an MQTT capable device/software with an MQTT broker then send and receive data using it.
10. To configuring the gateways and exchange the data to local database using Dream factory
11. To configuring the gateways and upload the data to cloud server using Dream factory or Ubidots
12. To configuring the gateways and upload the data to cloud server using Dream factory or Ubidots

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : An ability to expose the student to real world problems in CPS and Industrial revolution 4.0 best practices.

CO2 : Identify the limitations of some computational models

CO3 : Apply the theoretical knowledge the design of compilers.

CO4 : Student can Analyze and verify the correctness of CPS implementations against system requirements and timing constraints.

CO5 : Categorize the essential modeling formalisms of Cyber-Physical Systems (CPS)

CO6 : Implement the real time use case and problem statements

TEXT/REFERENCE BOOKS

1. wa, O'Reilly Media 2015.
2. Zero to Block chain - An IBM Redbooks course, by Bob Dill, David Smits.

SBSA1401	DATABASE MANAGEMENT SYSTEM	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To gain knowledge in fundamentals of data models using ER diagram.
- To understand about Query processing, optimization and Concurrency control technique
- To understand terms related to database design and management
- To gain knowledge in relational model and relational database management system
- To understand database security and performance issues

UNIT 1

9 Hrs.

Basic Concepts: Database and Database users – Database system concepts and architecture – Data modeling using Entity Relationship model – Enhanced entity relationship and object modeling – Record storage and file organizations – Index Structures for files

UNIT 2

9 Hrs.

Relational Model, Languages and Systems: The Relational Data Model, Relational Constraints, and the relational Algebra – SQL – The Relational Database Standard – ER and EER to Relational Mapping and Other Relational Languages – Examples of Relational Database Management Systems: Oracle and Microsoft Access.

UNIT 3

9 Hrs.

Database Design, Theory and Methodology: Functional dependencies and normalization for relational database – Relational database design algorithms and further dependencies – Practical database design and tuning

UNIT 4

9 Hrs.

System Implementation Techniques: Database system architectures and the system catalog – Query processing and optimization

UNIT 5

9 Hrs.

Transaction processing concepts – Concurrency control techniques – Database recovery techniques – Database security and Authorization. Introduction to Emerging Database Technologies and Application

Max. 45 hours

COURSE OUTCOMES

CO1 - Design ER-models to represent simple database application scenarios

CO2 - Ability to understand and design data modelling using Entity-Relationship model CO3 -

Implement SQL to a broad range of query and data update problems

CO4 - Articulate socio-economic applications of distributed databases and use database recovery mechanisms CO5 -

Familiar with data warehousing and data mining applications

CO6 - Apply Normalization techniques to normalize and improve the database design

Text / Reference books:

1. Elmasri & Navathe, Fundamentals of Database Systems, 6th Edition, Addison Wesley, 2010
2. Korth, Silberschatz & Sudarshan, Database System Concepts, 5th Edition, Tata McGraw Hill, 2010
3. Raghu Ramakrishnan & Johannesgerhrke, Data Base Management Systems, 3rd Edition, Tata Mc Graw Hill, 2002.
4. Abraham Silberschatz, Henry.F.Korth and S.Sudharshan, "Database System Concepts", 4th Edition, 2002.
5. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", 3rd Edition, Elsevier, 2012
6. Jan L. Harrington, "Object oriented database design", Harcourt India private limited 2000.

SBSA1404	INTRODUCTION TO ROBOTICS	L	T	P	Credits	TotalMarks
		3	0	0	4	100

COURSE OBJECTIVES

- To develop the student's knowledge in various aspects of robotic system.
- To develop student's skills in perform kinematics analysis of robot systems.
- To develop student's skills in selecting various sensors associated with the robotic operations.
- To provide the student with some knowledge and skills associated with robot control.
- To understand the mechanical movements of the robots and its applications.

UNIT 1

12 Hrs.

Types and components of a robot, Classification of robots, closed-loop and open- loop control systems.
Kinematics systems; Definition of mechanisms and manipulators, Social issues and safety.

UNIT 2 12 Hrs.

Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Jacobian, Singularity, and Statics Dynamic Modelling: Equations of motion: Euler-Lagrange formulation

UNIT 3 12 Hrs.

Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc. Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations.

UNIT 4 12 Hrs.

Basics of control: Transfer functions, Control laws: P, PD, PID Non-linear and advanced controls

UNIT 5 12 Hrs.

Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators. Control Hardware and Interfacing: Embedded systems: Architecture –Robotic applications.

Max. 60 Hours

COURSE OUTCOMES

On completion of the course the student will be able to

- CO1: Perform kinematic and dynamic analyses with simulation.
- CO2: Design control laws for a robot.
- CO3: Integrate mechanical and electrical hardware for a real prototype of robotic device.
- CO4: Select a robotic system for given application.
- CO5 : Simulate Real time Robot for Industrial applications.
- CO6: Create an AI based Robot for any real time applications.

TEXT/REFERENCE BOOKS

1. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.
2. Ghosal, A., "Robotics", Oxford, New Delhi, 2006.

SBSA3091	SOCIETY 5.0	L	T	P	Credits	TotalMarks
		3	0	0	4	100

COURSEOBJECTIVE

- To understand the society 5.0, Cyberspace and Physical Space to solve
- To provide knowledge and overview about big data, IoT and Artificial Intelligence for Society 5.0.
- Discuss to understand Augmented Reality and Virtual Reality, Next Generation Sensors
- To discuss about Challenges and Technologies towards Society 5.0, Security of Cyber Physical Systems
- Discuss to apply society 5.0 Innovation with Future Trends with Applications

UNIT I INTRODUCTION TO SOCIETY 5.0

(9hrs)

Introduction – Schema of society 5.0- Characteristics of Society 5.0. Introduction to communication technologies: Artificial Intelligence – robotics - 3D Printing. People: Centric Society - Knowledge Sharing- Physical space- Cyberspace – Humanity VS Society 5.0 – Elements of Society 5.0- Data Driven to Society- Modeling real world Issues.

UNIT II EMERGING TECHNOLOGIES WITH SOCIETY 5.0

(9hrs)

Introduction to Big Data – Issues and Challenges in the traditional systems – Intelligent Data Analysis – Big Data Storage Statistical Concepts: Sampling Distributions - Re-Sampling - Prediction Error – Random Sampling– Artificial Intelligence – Foundations of AI - Intelligent agent - Types of agents - Structure - Problem solving agents - Internet of Things- Introduction to IoT- Basic Architecture of an IoT, From M2M to IoT, M2M towards IoT- Robotics- Robotics system components - Robot classification Coordinate frames - degree of freedom - dynamic stabilization of robots.

UNIT III INTRODUCTION TO INDUSTRY 4.0

(9hrs)

Introduction- Globalization and Emerging Issues, LEAN Production Systems, Smart and Connected Business Perspective, Cyber Physical Systems and Next Generation Sensors, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis- An emerging industrial structure for IoT - Cyber security in Industry 4.0- Basics of Industrial IoT. Common Issues in Industry 4.0 and Society 5.0.

UNIT IV CHALLENGES AND TECHNOLOGIES TOWARDS SOCIETY 5.0

(9hrs)

Overcome with Economic Development and Solution to Social Problems in Society 5.0- Security of Cyber Physical Systems - Embedded and CPS security - attacks and countermeasures, authentication, identification, confidentiality, data integrity, authorization, access control, malware attacks and counter-measures, security protocols- Social Issues in Society 5.0 - human-centered society (Society 5.0)- Sustainable Development Goals- Economic Advancement- Resolution to Social Problems..

UNIT V INNOVATION WITH FUTURE TRENDS WITH APPLICATIONS

(9hrs)

Mobility – Health Care – Agriculture- Food Products – Disaster Prevention.

Max 45hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Able to understand the Social Problems By A System That Highly Integrates Cyberspace and Physical Space to solve

CO2 - Ability to get skills For Economic Development And A Human-Centered Society That Balances Economic Advancement

CO3 - Achieve A High Degree Of Convergence Between Cyberspace (Virtual Space) And Physical Space (Real Space)

CO4 - Able to Use Of Emerging Technologies With Society 5.0 To Achieve The More Production / Avoid Loss Of Productions

CO5 - Able Internet and IoT , Big data for production lines to be adaptive, intelligent, and flexible enough to meet the updated requests.

CO6 - Design and apply in Health Care , Agriculture, Food Products, Disaster Prevention

TEXT/REFERENCE BOOKS:

1. Society 5.0 A People-Centric Super-Smart Society, Hitachi-Utokyo Laboratory, Springer, 2020.
2. Society 5.0 Industry of the Future Technologies Methods and Tools By Bruno Salgues, Wiley, 2018
3. Stuart J. Russel, Peter Norvig, "Artificial Intelligence A Modern Approach", 3rd Edition, Pearson Education, 2009
4. The Internet of Things: Applications and Protocols, Wiley publications. Author(s): Oliver Hersent, David Boswarthick, Omar Elloumi., 2012.
5. McKerrow P.J. "Introduction to Robotics", Addison Wesley, USA, 1991.

SBSA1405	FOG AND CLOUD COMPUTING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the basic concepts of cloud computing and cloud enables.
- To understand cloud services and Multi-tenancy computing.
- To study about various models of cloud environments and virtualization.
- To understand the basic concepts of Fog computing.
- To gain knowledge of cloud and to Fog, IoT and its security

UNIT 1 UNDERSTANDING CLOUD COMPUTING

9 Hrs.

Basic Concepts and Terminology - Cloud Computing Architectural Framework - Types of Clouds - pros and cons of cloud computing – Cloud Characteristics - difference between web 2.0 and cloud - key challenges in cloud computing - Major Cloud players - Virtualization in Cloud Computing .

UNIT 2 CLOUD SERVICE MODELS

9 Hrs.

Software as a Service (SaaS) - Infrastructure as a Service (IaaS)- Platform as a Service (PaaS)- Web services - Service Oriented Architecture (SoA) - Elastic Computing - On Demand Computing- Service Management in Cloud Computing - Multitenancy computing , architecture.

UNIT 3 CLOUD DEPLOYMENT MODELS AND VIRTUALIZATION

9 Hrs.

Deployment models: Public cloud – Private Cloud –Hybrid cloud – Community cloud - Need for virtualization – Types of Virtualization – VMware – Process VM - Virtual Machine Monitor – Properties - Xen, Hyper V, Virtual Box, Eucalyptus .

UNIT 4 UNDERSTANDING FOG COMPUTING

9 Hrs.

Fog Computing: The Next Evolution of Cloud Computing -Goal Of Fog Computing - Pros and Cons of Fog computing - Fog computing vs. edge computing - Fog computing and the Internet of Things - , Connecting IoT to cloud, Cloud Storage for IoT.

UNIT 5 FOG COMPUTING ARCHITECTURE & APPLICATIONS

9 Hrs.

From Cloud to Fog - Fog Computing architecture - fog networks Fog Computing in the IoT Environment: Principles, Features, and Models - Role of Cloud Computing in IoT- Applications of fog computing - Security and privacy in Fog.

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze the Cloud computing setup with its vulnerabilities and applications using different architectures.

CO2 - Implement and install the cloud tools to make enable the cloud computing infrastructures.

CO3 - Apply and design suitable Virtualization concept, Cloud Resource Management and collaboration services.

CO4 - Create combinatorial auctions for cloud resources and services for computing clouds Develop and make cloud services as commercial.

CO5 - Assess cloud and cloud to Fog with IoT.

CO6 - Ability to, understand fog computing architecture.

TEXT/REFERENCEBOOKS

1. Cloud computing concepts, technology and Architecture – Thomas Erl, ZaighamMahmood, Ricardo Puttini , Pearson ,

2017.

2. Instant Guide to Cloud Computing, AnandNayar(Ed), Ashokkumar, sudeepTanwar, BPB, 2019.

3. Cloud computing a practical approach - Anthony T.Velte, Toby J. Velte Robert Elsenpeter TATA McGraw - Hill, New Delhi – 2010.

4. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008.

5. Fog Computing Concepts, Frameworks and Technologies ,Mahmood, Zaigham (Ed.), Springer , 2018.

	DATABASE MANAGEMENT	L	T	P	Credits	TotalMarks
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SBS2401	SYSTEMS LAB	0	0	4	2	100
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LIST OF EXPERIMENTS

1. Data Definition Language(DDL).
2. Data Manipulation Language(DML)
3. Data Control Language(DCL)
4. Constraints and Built-in functions.
5. Joins and Group-by functions.
6. PL/SQL programs using functions
7. PL/SQL programs using procedures
8. PL/SQL programs using triggers
9. Developing GUI applications using PHP.
10. Student Information System.
11. Inventory Management.
12. Payroll Processing

SBSA2402	ROBOTICS LAB	L	T	P	Credits	TotalMarks
		0	0	4	2	100

List of Experiments:

1. Determination of maximum and minimum position of links.
2. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
3. Estimation of accuracy, repeatability and resolution.
4. Robot programming and simulation for pick and place
5. Robot programming and simulation for Color identification
6. Robot programming and simulation for Shape identification
7. Robot programming and simulation for machining (cutting, welding)
8. Robot programming and simulation for writing practice
9. Robot programming and simulation for any industrial process (Packaging, Assembly)
10. Robot programming and simulation for multi process.

S734ADPROJ	DESIGN THINKING AND INNOVATIONS	L	T	P	EL	Credits	TotalMarks
		0	0	4	0	2	100

COURSE OBJECTIVES

- To apply knowledge in Real time problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to Engineering /Non Engineering problems.

Activity 1

Design thinking introduction

- Phases of design thinking- a study approach.
- Group Discussion on Ideation- Users perspective.
- Formation of team – Thinking skills- Brain storming.

Activity 2

Problem identification (phase I)

- Selecting user requirements.
- Survey on various user's applications.
- Specific Problem selection to proceed with the work – Team presentation on identified problems and various possible solutions.

Activity 3

Problem identification (Phase II)

- Study of an application and its importance to end user.
- Various models of an applications.
- Finalize the identified problem.

Activity 4

Design ideation and various stages

- Sketch design diagram.
- Architecture or full diagrammatic study.

Activity 5

Review and upgradation

- Review of the ideation (one to one interaction).
- Feedback.

•Upgradation plan.

Activity 6

Implementation (Phase I)

- Build the prototype using available resources.
- Record Module diagrams.

Activity 7

Implementation(Phase II)

- Display and review of the prototype.
- Record its functionality and its Usage-Technical manual.

Activity 8

Testing

- To test the product design with real time environment.
- Record Process-user manual.

Activity 9

IPR-Activity I

- To study various IPR activities.
- To prepare for IPR Process.
- To file an IPR.

Activity 10

Start-ups Formation

- To exhibit the product to public: feedback approach.
- To prepare full documentation.
- Start-ups registration/apply patent/publish paper/submit model/prototype/Apply for seed/submit as research proposal.

COURSE OUTCOMES

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

- CO1** - Solve real world problems by applying knowledge across domains.
- CO2** - Develop various design products, processes or technologies for sustainable and socially relevant applications.
- CO3** - Demonstrate knowledge of resource utilization/budgets to Implement appropriate methodologies.
- CO4** - Execute tasks by application of engineering standards/ requirements/ design criteria, within timelines.
- CO5** - Conduct extended investigation that results in the translation of idea to product / production of a research thesis/ developing a proof of concept.
- CO6** - Communicate well organized technical and scientific findings effectively in written and oral forms, following ethical and professional norms.

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/>.

COURSE ASSESSMENT METHODS

Direct Methods	Design innovation Reviews Report Submission IPR Registration
Indirect Methods	Course Exit Survey

Assessment Method	Rubrics	Marks allotted	Assessment Type
Review1	1	30	CAE
InternaGuide	2	10	CAE
IPR Process and Registration	5	10	ESE
Total- Internal		50	
FinaReview	3	30	ESE
Report Submission	4	20	ESE
Total-Externa		50	

SCHOOL OF SCIENCE AND HUMANITIES

DEPARTMENT OF COMPUTER SCIENCE

Minutes of meeting

Date: 22.6.2022

Time: 10:00AM

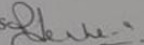
Venue: COMPUTER SCIENCE LAB

Agenda:

- Newly added courses for the following courses for B.Sc CS Specialization in AI:
 - Block Chain Technology - SBSA1306
 - Computer Communication - SBSA1307
- Newly added courses for the following courses for M.Sc CS:
 - Cyber Physical Systems – SBSA5301
 - Data Science – SBSA5303
 - Cyber Physical Systems Lab – SBSA6301
- Updating the course contents for the following courses for B.Sc CS :
 - Object Oriented Analysis and Design – SBSA1403

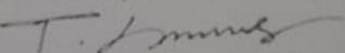
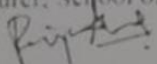
Minutes:

- Block Chain Technology and Computer Communications are newly added courses for the B.Sc CS specialization in AI students, to enrich their knowledge in bit coins and various communication models and communication layers
- Cyber Physical Systems, Data Science and Cyber Physical Systems are newly added courses for M.Sc CS students to delve deep into radically developing technologies
- Based on the staff and students feedback, Object Oriented Analysis and Design course is modified to include more key topics.
- The updates and new courses were well-received by all the external members as beneficial for the students.

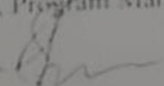
Convener: Dr.Rekha Chakravarthi, Dean of Science and Humanities 

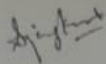
External Members:

Academic Expert

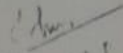
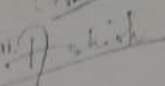
- Dr. I. G. Sambanthan, Professor & Head, Department of Computer Science & Engineering NITTTR, Chennai. 
- Dr. Riyaz Ahamed, Senior lecturer, School of Computer Science and Engineering, Taylor's University, Malaysia. 

Industry Experts

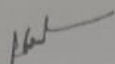
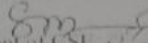
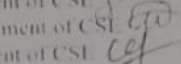
- Dr. V. Sankaran, Program Manager, Engineering and R&D Services, HCL Technologies 

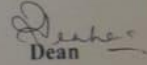
- Mr. Ajay Kumar, CTO, Cognibot Robotics, Chennai. 

Alumni

- Mr. Johnson S, Project Test Manager, TCS, Chennai. 
- Mr. Ashish Chopra, Senior BDI, Freshworks, Chennai. 

Internal Members:

- Dr. L. Lakshminan, HoD, Department of CSE. 
- Dr. S. Vigneswari, HoD of CSE. 
- Dr. Ulaganathan, Associate Professor, Department of CSE. 
- Dr. S. Murugan, Professor, Department of CSE. 
- Dr. Prem Jacob, Associate Professor, Department of CSE. 
- Dr. Usha Nandini, Associate Professor, Department of CSE. 
- Dr. Ramya Franklin, Asst. Professor, Department of CSE. 

Dr. REKHA CHAKRAVARTHI, M.E., Ph.D.
 DEAN, ARTS AND SCIENCES
SATHYABAMA
 INSTITUTE OF SCIENCE AND TECHNOLOGY
 (DEEMED TO BE UNIVERSITY)
 Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119.

 Dean



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SCHOOL OF SCIENCE AND HUMANITIES
DEPARTMENT OF COMPUTER SCIENCE

Minutes of meeting

Date: 8.12.2022

Time: 10:00AM

Venue: COMPUTER SCIENCE LAB

Agenda:

- Newly added courses for the following courses for B.Sc CS Specialization in AI:
 - Introduction to Robotics- SBSA1404
 - Society 5.0- SCSA3091
 - Fog and Cloud Computing - SBSA1405
 - Robotics Lab - SBSA2402
- Updating the course contents for the following courses for M.Sc CS:
 - Design Thinking - SBSA5201
- Updating the course contents for the following courses for B.Sc CS :
 - Web Technology - SBSA1503

Minutes:

- In order to improve' problem-solving, analytical, and spatial thinking abilities of the students, the Design Thinking theory course will be converted into a practical course.
- Web Technology course is updated to make it more aligned towards full stack web development course.
- All the external members appreciated the updates made in the above course

Convener: Dr. Rekha Chakravarthi, Dean of Science and Humanities

External Members:

Academic Expert

- Dr. T.G. Sambanthan, Professor & Head, Department of Computer Science & Engineering NITTTR, Chennai.
- Dr. Riyaz Ahamed, Senior Lecturer, School of Computer Science and Engineering, Taylor's University, Malaysia.

Industry Experts

- Dr. V. Sankaran, Program Manager, Engineering and R&D Services, HCL Technologies

- Mr. Aray Kumar, CTO, Cognibot Robotics, Chennai. *Aray Kumar*

Alumni

- Mr. Johnson S, Project Test Manager, TCS, Chennai. *Johnson S*
- Mr. Ashish Chopra, Senior BDI, Freshworks, Chennai. *Ashish Chopra*

Internal Members:

- Dr. L. Lakshmanan, HoD, Department of CSE. *Lakshmanan*
- Dr. S. Vigneswari, HoD of CSE. *S. Vigneswari*
- Dr. U. Laganuthalvi, Associate Professor, Department of CSE. *U. Laganuthalvi*
- Dr. S. Marugan, Professor, Department of CSE. *S. Marugan*
- Dr. Prem Jacob, Associate Professor, Department of CSE. *Prem Jacob*
- Dr. Usha Nandini, Associate Professor, Department of CSE. *Usha Nandini*
- Dr. Ramya Franklin, Asst. Professor, Department of CSE. *Ramya Franklin*

Dr. REKHA CHAKRAVARTI, M.E., Ph.D.
 DEAN, ARTS AND SCIENCES
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 Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119.

Rekha Chakravarti
 Dean