Semester-VI

S.No.	Course Type	Course Code	Course Title	Hrs./ Week			Credits
				L	T	P	
1	PCC	CS11	Internet of Things (IoT)	2	1	-	3
2	PCC	CS12	Foundation of Artificial Intelligence and Machine Learning	2	1	-	3
3	PCC	CS13	Compiler Design	2	1	-	3
4	PEC	CS01	Professional Elective Course -I	3	-	-	3
5	HSMC	HS05	Humanities and Social Sciences Open Courses - I	2	-	-	2
6	IOC	CS01	Interdisciplinary Open Course-I	2	1	-	3
7	LC	CS11(P)	Internet of Things (IoT) Lab	-	-	2	1
8	LC	CS12(P)	Foundation of Artificial Intelligence and Machine Learning Lab	-	-	2	1
9	PROJ	CS03	Project-I	-	-	4	2
10	PROJ	CS04	Evaluation of Internship-I	-	-	4	2
11	PROJ	–	Internship-II	Credits to be added in Seventh Semester.			
12	LLC	LLC03	Liberal Learning Course -III	-	-	2	1
13	MLC	MLC04	Intellectual Property Rights	1	-	-	Audit
						Total Credits	24

Professional Elective Course(PEC) –I,CS01(Any One Course)	Interdisciplinary Open Course(IOC)-I,CS01(Any One Course)	Humanities and Social Sciences Open Courses – I, HS05 (Any One Course)
(A) Digital Marketing & SEO	(A) Operation Research	(A) English Language Proficiency
(B) Cloud Computing	(B) Green Technology	(B) German Language
(C) Computer Graphics & Multimedia	(C) Scientific Aptitude	(C) French Language
(D) Advanced Computer Architecture	(D)Fundamentals of Fire and Safety	(D) Japanese Language
		(E) Soft Skills and Interpersonal Communication

Liberal Learning Course-III, LLC03 (Any One Course from NCC/NSO/NCA**)**
Note: pool of choices will be the same as in LLC01 and LLC02.

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PCC-CS11	Internet of Things	2L:1T:0P	3 credits

Prerequisite: Analog & Digital Communication

Course Objective:

Students will understand the concepts of Internet of Things and can able to build IoT applications.

Course Contents: (40 Hrs.)

Module1: (08 hrs)
Introduction: Definition, Characteristics of IOT, IOT Conceptual framework, IOT Architectural view, Physical design of IOT, Logical design of IOT, Application of IOT.

Module2: (08 hrs)
Machine-to-machine (M2M), SDN (software defined networking) and NFV (network function virtualization) for IOT, data storage in IOT, IOT Cloud Based Services.

Module3: (08 hrs)
Design Principles for Web Connectivity: Web Communication Protocols for connected devices, Message Communication Protocols for connected devices, SOAP, REST, HTTP Restful and Web Sockets. Internet Connectivity Principles: Internet Connectivity, Internet based communication, IP addressing in IOT, Media Access control.

Module4: (08 hrs)
Sensor Technology , Participatory Sensing, Industrial IOT and Automotive IOT , Actuator, Sensor data Communication Protocols ,Radio Frequency Identification Technology, Wireless Sensor Network Technology.

Module5: (08 hrs)
IOT Design methodology: Specification -Requirement, process, model, service, functional & operational view.IOT Privacy and security solutions, Raspberry Pi & Arduino devices. IOT Case studies: smart city streetlights control & monitoring.

Course Outcomes:

1. Understand the Fundamentals of IoT.
2. Analyze and Apply IoT Networking Concepts.
3. Implement Web and Internet Connectivity Principles.
4. Utilize Sensor and Wireless Communication Technologies.
5. Design and Develop IoT Solutions.

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List of Text / Reference Books:

1. Raj kamal, "Internet of Things", Tata McGraw Hill publication, 1st Edition, 2017.
2. Vijay Madisetti and Arshdeep Bahga, "Internet of things (A-Hand-on-Approach)" 1st Edition, Universal Press, 2014.
3. Hakima Chaouchi "The Internet of Things: Connecting Objects", Wiley publication, 1 edition, 2013.
4. Charless Bell "My SQL for the Internet of things", A press publications, 1st edition, 2016.
5. Francis dacosta "Rethinking the Internet of things: A scalable Approach to connecting everything", 1st edition, A press publications 2013.
6. Donald Norris "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black", McGraw Hill publication, 1st edition, 2015.

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VI-Semester

PCC CS12	Foundation of Artificial Intelligence And Machine Learning	2L:1T:0P	3 credits

Prerequisite: Engineering Mathematics.

Course Objective:

This course provides a concise introduction to the fundamental concepts in artificial intelligence and machine learning.

Course Contents: (40 hrs)

Module 1: (10 hrs)

Artificial Intelligence: Introduction, Various types of production systems, characteristics of production systems, breadth first search, depth first search techniques, other Search Techniques like hill Climbing, Best first Search, A* algorithm, AO* Algorithms and various types of control strategies. Knowledge representation issues, Propositional and Predicate Logic, Monotonic and Non-monotonic reasoning, Forward Chaining, and backward chaining in AI

Module 2: (06 hrs)

Machine Learning: Introduction to Machine Learning, Stages of ML, Types of Machine Learning, Cross-validation: K-fold technique, Evaluation metrics: Confusion Metrics, Over fitting, Under fitting, Linear regression, Decision trees

Module 3: (10 hrs)

Classification Algorithms in ML: Logistic Regression, Support Vector Machine, Naïve Bayes, KNN. Clustering Algorithms: types of clustering: hierarchical clustering, k-means, Association Rules: Content based Collaborative Filtering Based Recommendation

Module 4: (08 hrs)

Introduction to Neural network, ANN v/s BNN, Types of Neural network, Perceptron Model, Multilayer Neural Network, Back-propagation algorithm, Recurrent Neural Network, Introduction to Deep Neural Network. Convolution Neural Network

Module 5: (06 hrs)

Ensemble learning, Types of Ensemble learning, Instance Based Learning, KNN, Application of machine learning in computer vision, Speech Processing, Natural Language Processing,

Course Outcomes:

1. State the overview of Artificial intelligence.
2. Explain The Types of Learning, linear regression, and decision tree.
3. Discuss the various classification techniques and convolution neural network.

4. Discuss about Neural Network and Deep Neural Network
5. Explain the Ensemble Learning and Clustering techniques.

List of Text/Reference Books:

1. Rich and Knight, "Artificial Intelligence", The McGraw- Hill,.3rdEdition,2008
2. Tom Mitchell, "Machine Learning", McGraw-Hill, First Edition, 1997.
3. Ethem Alpaydin, "Introduction to Machine Learning Edition"2, MIT Press, Third Edition, 2014.

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VI-Semester

PCC-CS13	Compiler Design	2L: 1T: 0P (3 hrs.)	3 credits

Prerequisite: Theory of Computation

Course Objective: To explain the different stages in the process of compilation.

Course Contents: (40 hrs)

Module 1: (06 hrs)

Introduction to compiling & Lexical Analysis

Introduction of Compiler, Major data Structure in compiler, types of Compiler, Front-end and Backend of compiler, bootstrapping, Compiler structure: analysis-synthesis model of compilation, various phases of a compiler, Lexical analysis: Input buffering, Recognition of Tokens, Design of a Lexical Analyzer Generator, LEX.

Module 2: (15 hrs)

Syntax Analysis &Syntax Directed Translation

Syntax analysis: CFGs, Top down parsing, Brute force approach, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, operator precedence parsing, LR parsers (SLR,LALR, LR),Parser generation YACC.

Syntax directed definitions: Construction of Syntax trees, Bottom up evaluation of S-attributed definition, L attribute definition, Top down translation.

Module 3: (06 hrs)

Type checking: type system, specification of simple type checker, equivalence of expression, types, type conversion, overloading of functions and operations, Runtime Environment: storage organization, Storage allocation strategies, Parameter passing, dynamic storage allocation, Symbol table.

Module 4: (06 hrs)

Intermediate code generation: Declarations, Assignment statements, Boolean expressions, Case statements, back patching, Procedure calls Code Generation: Issues in the design of code generator, Basic block and flow graphs, Register allocation and assignment, DAG representation of basic blocks, peephole optimization, and generating code from DAG.

Module 5: (07 hrs)

Introduction to Code optimization: sources of optimization of basic blocks, loops in flow graphs, dead code elimination, loop optimization, Introduction to global data flow analysis, Code Improving transformations ,Data flow analysis of structure flow graph Symbolic debugging of optimized code.

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Course Outcomes:

1. Understand the overview of phase of compiler and Lexical analysis.
2. Design and implement various parsing techniques of compiler.
3. Apply type checking for semantic analysis and analyze Run time environment.
4. Design and implement different intermediate code generation techniques.
5. Analyze various code optimization techniques

List of Text / Reference Books:

1. A.V. Aho, R. Sethi, and J.D. Ullman. “Compilers: Principles, Techniques and Tools”, Pearson Education, 2nd Edition ,2007.
2. V Raghavan, “Principals of Compiler Design”, TMH Pub.,2017
3. Louden. “Compiler Construction: Principles and Practice”, Cengage Learning,1997
4. A. C. Holub. “Compiler Design in C” , Prentice-Hall Inc., 1993.
5. Ronald Mak, “Writing compiler & Interpreters”, Willey Pub.,3rd Edition,2009

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VI-Semester

PEC-CS-01(A)	**Professional Elective Course-1 Information Theory and Coding**	**2L: 1T: 0P (3 hrs.)**	**3 credits**

Course Objective:

The course aims to introduce information theory, fundamentals of error control coding techniques and their applications, importance of various communication channels, utilization of codes for error detection and correction as well as for practical applications.

Course Contents: (40 hrs.)

Module 1: **(8hrs.)**

Information Theory: Introduction to uncertainty, entropy and its properties, entropy of binary memoryless source and its extension to discrete memory-less source, Measure of information, Information content of message, Average Information content of symbols. Self information, Mutual information and its properties,

Module 2: **(6hrs.)**

Coding theorem: Source coding theorem, prefix coding, Shannon's Encoding Algorithm, Shannon Fanon Encoding Algorithm, Huffman coding, Extended Huffman coding, Arithmetic Coding, Lempel-Ziv Coding, Run Length Encoding.

Module 3: **(8hrs.)**

Information Channels: Communication Channels, Channel Models, Channel Matrix, Joint probability Matrix, Discrete memory less channels, Binary symmetric channel and its channel capacity, channel coding theorem, and its application to Binary Erasure Channel, Shannon's theorem on channel capacity, capacity of channel of infinite bandwidth, Continuous Channels.

Module 4: **(10hrs.)**

Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes, Probability of undetected error for linear block code in BSC, hamming Codes and their applications, Cyclic

Codes: Cyclic codes and its basic properties, Encoding using an (n-k) Bit Shift register, Generator & parity check matrix of cyclic codes, encoding & decoding circuits, syndrome computation, error detection and correction.

Module 5: **(8hrs.)**

Introduction to BCH codes, its encoding & decoding, error location & correction. Convolution Codes: Introduction to convolution codes, its construction, Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, Viterbi algorithm: Introduction of theorem for maximum likelihood decoding.

Course Outcome:

1. Acquire the knowledge in measurement of information and errors.
2. Know the application of coding theorem for efficient utilization of communication resources.
3. Understand the utilization of various communication channels for communication system.
4. Design the block and cyclic codes for error correction and detection in communication systems.
5. Know the significance of source and channel codes in various applications.

List of Text / Reference Books:

1. Digital Communication -by Haykins Simon Wiley Publ.
2. Error control Coding: Theory and Application, - by Shu Lin and Cosstlello, PHI.
3. Digital Communication - by Sklar, Pearson Education.
4. Error Correcting Codes - by Peterson W., MIT Press.
5. Digital Communication - by Proakis, TMH.
6. Information Theory, Coding and Cryptography – By Ranjan Bose, TMH.
7. Communication Systems – By Singh and Sapre, TMH.

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VI-Semester

PEC-CS01(B)	Professional Elective Course-1 Cloud Computing	3L: 0T: 0P (3 hrs.)	3 Credits

Prerequisite: Computer Networks, Network Security, Distributed Systems.

Course Objective:

The objective of this course is to provide students with the comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture and applications.

Course Contents: (40 hrs.)

Module 1: (07 hrs)

Introduction to Cloud Computing: Definition, Cloud Computing (NIST Model), Characteristics, Features and Applications, Cloud Architecture, Cloud Service Models: IaaS, PaaS, SaaS, Cloud Deployment Models: Public, Private, Hybrid, and Community Clouds, Cloud Providers and Platforms: AWS, Azure, Google Cloud, etc., Overview of Cloud Pricing and Cost Management Basics. Case study: Microsoft Azure, Hadoop, Amazon, Aneka, Eucalyptus.

Module2: (08 hrs)

Cloud Infrastructure, Virtualization, Types of Virtualization, Virtualization Architecture, CPU Virtualization, Network and Storage Virtualization. Virtualization Technologies: Hypervisors, Containers (Docker, Kubernetes), Infrastructure as a Service (IaaS) Essentials. Networking in the Cloud: Virtual Networks, Load Balancers, DNS Storage in the Cloud: Object Storage, Block Storage, File Storage, Creating virtual machines, configuring networking, deploying containerized applications. Case Studies: Xen: Para-virtualization, VMware: Full Virtualization, Microsoft Hyper-V

Module 3: (07 hrs)

Security in Cloud Computing: Risks in Cloud Computing: Risk Management, Enterprise-Wide Risk Management, Types of Risks in Cloud Computing. Data Security in Cloud: Security Issues, Challenges, advantages, Disadvantages, Cloud Digital persona and Data security, Content Level Security. Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing. Case Studies: Cloud Security Tool: Acunetix.

Module 4: (10 hrs)

Cloud Platforms and Cloud Applications: Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB). Microsoft Cloud Services: Azure core concepts, SQL Azure, Windows Azure Platform Appliance. Cloud Computing Applications: Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking, Google Cloud Application: Google App Engine, Overview of Open Stack architecture.

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Module 5: (08 hrs)

Advanced Techniques in Cloud Computing

Future Tends in cloud Computing, Mobile Cloud, Automatic Cloud Computing: Comet Cloud. Multimedia Cloud: IPTV, Energy Aware Cloud Computing, Jungle Computing, Distributed Cloud Computing Vs Edge Computing, Containers, Docker, and Kubernetes, Introduction to DevOps. IOT and Cloud Convergence: The Cloud and IoT in your Home, The IOT and cloud in your Automobile, PERSONAL: IoT in Healthcare.

Course Outcomes:

1. Understand the different Cloud Computing environment, Use appropriate data storage technique on Cloud, based on Cloud application.
2. Analyze virtualization technology and install virtualization software.
3. Apply security in cloud applications.
4. Develop and deploy applications on Cloud.
5. Use advance techniques in Cloud Computing.

List of Reference Books/Text Books:

1. S. Chand,R.Buyya, C. Vecchiola, S.T. Selvi, “Mastering Cloud Computing,” McGraw Hill Education
2. T. Velte, A. Velte and R. Estenpeter, “Cloud Computing –A practical approach, McGraw Hill Education.
3. A. Srinivasan, J. Suresh, “Cloud Computing: A Practical Approach for Learning and Implementation”, Pearson
4. K. Chandrasekaran, “Essentials of Cloud Computing”, CRC Press.
5. Thomas Erl, Zaigham Mahmood, RichardoPuttini, Cloud Computing: Concepts, Technology & Architecture, ServiceTech press.
6. K Jayaswal, J Kallakurchi, Donald Houde, Deven Shah, Cloud Computing Black Book, Dreamtech Press.
7. James Bond, “The Enterprise Cloud”, O'Reilly Media, Inc.
8. Dr. Kris Jamsa, “Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more”, Wiley Publications.
9. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, 2010, The McGraw-Hill.
10. Gautam Shrof, “ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications”, Cambridge University Press.
11. Tim Mather, Subra K, Shahid L.,”Cloud Security and Privacy”, Oreilly.
12. Dr. Kumar Saurabh, “Cloud Computing, 4ed: Architecting Next-Gen Transformation Paradigms”, Wiley publication.

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VI-Semester

PEC-I-CS01(C)	Professional Elective Course-1 Computer Graphics & Multimedia	3L: 0T:0P (3hrs.)	3 credits

Prerequisite: Engineering Mathematics

Course Objective:

To equip students with the fundamental knowledge and basic technical competence in the field of computer graphics.

Course Contents: (40 hrs.)

Module 1: (06 hrs)

Introduction to Raster Scan displays, Pixels, Frame buffer, Vector & Character generation, Random Scan systems, Display devices, Scan Conversion techniques, Line Drawing algorithms: simple DDA, Bresenham's Algorithm, Circle Drawing Algorithms: Midpoint Circle drawing and Bresenham's Algorithm, Polygon fill algorithm: Boundary- fill and Flood-fill algorithms.

Module2: (08 hrs)

2-D Transformation: Translation, Rotation, Scaling, Shearing, Reflection. Inverse Transformation, Homogeneous coordinate system, Matrice Transformation, Composite Transformation. Windowing & Clipping: World Coordinate System, Screen Coordinate System, Viewing Transformation, Line Clipping & Polygon Clipping Algorithms

Module 3: (08 hrs)

3-D Transformations: Translation, Rotation and Scaling. Parallel & Perspective Projection: Types of Parallel & Perspective Projection, Hidden Surface elimination: Depth comparison, Back face detection algorithm, Painter's Algorithm, Z- Buffer Algorithm. Curve generation, Bezier and B-spline methods. Basic Illumination Model: Diffuse reflection, Specular reflection, Phong Shading, Gouraud shading, Ray Tracing, Color models like RGB, YIQ, CMY, HSV.

Module 4: (08 hrs)

Visualization: Visualization of 2D/3D scalar fields: color mapping, ISO surfaces. Direct volume data rendering: ray-casting, transfer functions, segmentation. Visualization of Vector fields and flow data, Time-varying data, High-dimensional data: dimension reduction, parallel coordinates, Non-spatial data: multi-variate, tree/graph structured, text Perceptual and cognitive foundations, Evaluation of visualization methods, Applications of visualization, Basic Animation Techniques like traditional, key framing

Module 5: (10 hrs)

Multimedia :Basic of multimedia, application of Multimedia, Text-Types, Unicode Standard ,text Compression, Text file formats, Audio Components, Digital Audio, Digital Audio processing, Sound cards, Audio file formats ,Audio Processing software ,Video- Video color spaces, Digital Video,

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Digital Video processing, Video file formats. Animation: Uses of Animation, Principles of Animation, Computer based animation, 3D Animation, Animation file formats, Animation software, Special Effects in animation, Storyboarding for Animation, Compression: Lossless/Lossy Compression techniques, Image, Audio & Video Compression, MPEG Standards, Multimedia Architecture, Multimedia databases.

Course Outcomes:

1. Understand the basic concepts of Computer Graphics.
2. Demonstrate various algorithms for scan conversion and filling of basic objects and their comparative analysis.
3. Apply geometric transformations, viewing and clipping on graphical objects.
4. Explore solid model representation techniques and projections.
5. Understand visible surface detection techniques and illumination models

List of Text/Reference Books:

1. Donald Hearn and M.Pauline Baker, “Computer Graphics C Version”, Pearson Education, 2003.
2. Foley, Van Dam, Feiner , Hughes , “ Computer Graphics : Principles and Practice” Pearson Education India, Third Edition,2013
3. Rogers, "Procedural Elements of Computer Graphics", Tata McGraw Hill
4. Ranjan Parekh “Principles of Multimedia”, Tata McGraw-Hill Education, 2006
5. Rajesh K Maurya, “Computer Graphics with Virtual Reality System “, Wiley India, 2009
6. Pakhira,”Computer Graphics, Multimedia & Animation”, PHI learning
7. Khalid Sayood , “Introduction to Data Compression”, Morgan Kaufmann, Fourth Edition,2012
8. Prabat K Andleigh and Kiran Thakrar, “Multimedia Systems and Design”, PHI Learning, 1996.
9. Tay Vaughan, “Multimedia making it work”, Tata McGraw Hill edition,8th edition 2010.
10. Amarendra N Sinha & Arun D Udai, “Computer Graphics”, McGraw Hill publication,1st edition,2008.
11. Mukherjee, “Fundamental of Computer Graphics and Multimedia”, PHI Learning.

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VI-Semester

PEC-CS01(D)	Professional Elective Course-1 Advance Computer Architecture	3L: 0T: 0P (3hrs.)	3 credits

Prerequisite: Computer Organization & Architecture

Course Objective:

This course provides a foundation to advance computer architecture concepts and techniques.

Course Contents: (42 hrs.)

Module 1: (06 hrs)

Evolution of Computer Architecture, Flynn's Classification, Parallel computer models - Multiprocessors and multicomputers, Multivector and SIMD Computers. Hardware and software parallelism, Program partitioning and scheduling, Grain size and latency, Control flow, data flow and Demand driven mechanisms. Static interconnection networks, Dynamic interconnection Networks: Bus Systems, Crossbar Switch, Multiport Memory, Multistage and Combining Networks

Module2: (08 hrs)

Memory hierarchy-cache and shared memory concepts-Cache memory organization-cache addressing models, Aliasing problem in cache, cache memory mapping techniques-Shared memory organization-Interleaved memory organization, virtual memory, memory coherence, cache coherence protocols (e.g., MESI protocol), and memory consistency models. Lower-order interleaving, Higher order interleaving. Back plane bus systems-Bus addressing, arbitration and transaction.

Module 3: (10 hrs)

Instruction set architecture, CISC Scalar Processors, RISC Scalar Processors, VLIW architecture, Multivector and SIMD computers, Vector processing principles, system interprocess communication.

Module 4: (08 hrs)

Linear pipeline processor, Nonlinear pipeline processor, Instruction pipeline design, Mechanisms for instruction pipelining, pipeline hazards, Dynamic instruction scheduling - score boarding and Tomosulo's algorithm, Branch handling techniques, Arithmetic Pipeline Design, Static arithmetic pipeline, Multifunctional arithmetic pipelines. Superscaler pipeline design, Super pipeline processor design.

Module 5: (10 hrs)

Parallel Programming Models, Shared-Variable Model, Message-Passing Model, Data Parallel Model, Object-Oriented Model, Functional and Logic Models, Parallel Languages and Compilers, Language Features for Parallelism, Parallel Programming Environment, Software Tools and Environments. MIME, IMAP), DNS, Network Management (SNMP).

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Course Outcomes:

1. Discuss the classes of computers, and new trends and developments in computer architecture
2. Apply memory hierarchy concepts and cache memory techniques in parallel computing systems.
3. Analyze various instruction set architectures and their impact on parallel processing performance.
4. Design and evaluate pipeline processors and dynamic instruction scheduling algorithms for parallelism exploitation.
5. Develop parallel programs using different programming models and tools, considering network protocols and management in parallel computing environments.

List of Text / Reference Books:

1. Kai Hwang, “Advanced computer architecture”, TMH.
2. J.P.Hayes, “computer Architecture and organization”; MGH.
3. V.Rajaranam & C.S.R.Murthy, “Parallel computer”; PHI Learning.
4. Kain,”Advance Computer Architecture: - A System Design Approach”, PHI Learning
5. M.J Flynn, “Computer Architecture, Pipelined and Parallel Processor Design”; Narosa Publishing.
6. Hwang and Briggs, “Computer Architecture and Parallel Processing”; MGH.
7. David E. Callav & Jaswinder Pal Singh Marge Kaufmann”Advance Computer Architecture”, EIS India.
8. Sajjan G. Shiva, Taylar & Francis, “Advance Computer Architecture

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VI-Semester

LC-CS11(P)	Internet Of Things (IoT) Lab	0L: 0T: 2P (2 hrs.)	1 credit

Prerequisite: Fundamental electronics concepts such as voltage, current, resistance, and basic circuit design, Familiarity with common electronic components like resistors, capacitors, LEDs, and transistors, Basic proficiency in programming, preferably in C or C++.

Course Objective:

The course aims to provide students with comprehensive knowledge and practical skills in the field of embedded systems and Internet of Things (IoT) using the Arduino platform.

Course Contents:

Module 1:
Overview of Arduino Platform, Study of Arduino Uno Board, Understanding the components and functionalities of the board, Power supply and pin configurations, Getting Started with Arduino IDE: Installation and setup of Arduino IDE, Writing and uploading the first program ("Blink" example), Basic Programming and Digital I/O: Structure of an Arduino program (setup and loop functions), Basics of digital input and output, Interfacing LED with Arduino (Turn ON and OFF LED)

Module 2:
Interfacing Buzzers and LEDs: Working with buzzers: generating sound, Controlling multi-color LEDs (RGB LED Color Mixing), Push Buttons and Digital Input: Interfacing push buttons with Arduino Reading digital inputs and controlling outputs.

Module 3:
Advanced Sensor Interfacing
Ultrasonic Sensors: Principles of ultrasonic distance measurement, Interfacing and programming an ultrasonic sensor with Arduino, Temperature and Humidity Sensing, Understanding temperature sensors (e.g., LM35, DHT11), Reading sensor data and displaying it.

Module 4:
Serial Communication and Data Handling
Serial Communication Basics: Understanding Arduino serial communication, Sending and receiving data through the serial port, Controlling Devices via Serial Port: Writing programs to control LEDs using serial commands, Reading sensor data and sending it to a computer

Module 5:
Analog Input and Motion Detection
Analog Output and PWM: Understanding Pulse Width Modulation (PWM), Fading an LED using analog output, Motion Detection with PIR Sensors: Principles of motion detection using PIR sensors,

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VI-Semester

Interfacing and programming a PIR sensor.

Course Outcomes:

1. Understand and use the Arduino development environment effectively.
2. Interface various sensors and actuators with Arduino and write programs to control them.
3. Implement serial communication between Arduino and other devices.
4. Develop practical skills in reading and processing data from sensors.
5. Apply PWM techniques for analog control applications.

List of Text / Reference Books:

1. Raj kamal, "Internet of Things", Tata McGraw Hill publication, 1st Edition, 2017.
2. Vijay Madisetti and Arshdeep Bahga, "Internet of things (A-Hand-on-Approach)" 1st Edition, Universal Press, 2014.
3. Hakima Chaouchi "The Internet of Things: Connecting Objects", Wiley publication, 1 edition, 2013.
4. Charless Bell "My SQL for the Internet of things", A press publications, 1st edition, 2016.
5. Francis dacosta "Rethinking the Internet of things: A scalable Approach to connecting everything", 1st edition, A press publications 2013.
6. Donald Norris "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black", McGraw Hill publication, 1st edition, 2015.

List of Experiments:

1. Study of Arduino Uno Board, and Installation of Arduino IDE
2. To interface LED with Arduino and write a program to turn ON and OFF LED.
3. To interface Buzzer with Arduino and write a program to turn ON and OFF Buzzer.
4. To interface Multi Color LED with Arduino and write a program for RGB LED Color Mixing.
5. To interface Push button with Arduino and write a program to turn ON LED when push button is pressed (Digital Input with a Push button).
6. To measure distance using ultrasonic sensor with the help of Arduino
7. To interface Temperature sensor with Arduino and write a program to print temperature readings on LCD.
8. To interface LED with Arduino and write a program to control it using Arduino Serial Port.
9. Write a program to read temperature and humidity
10. Write a program of Fading LED with Arduino Analog Output.
11. To interface PIR (Passive InfraRed) Motion Sensor with Arduino and write a program to check motion.

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Scheme Based on AICTE Flexible Curriculum

Department of Computer Science & Engineering

Bachelor of Technology (CSE/CSE-RL)

VI-Semester

LC-CS12(P)	Foundation of Artificial Intelligence and Machine Learning Lab	0L: 0T:2P (2hrs)	1 credit

Prerequisite: None.

Course Objective:

This course provides a concise introduction to the fundamental concepts in artificial intelligence and machine learning.

Course Contents:

Module 1:
Artificial Intelligence Programs Using PROLOG: Study of PROLOG Programming language and its Functions. Write simple facts for the statements using PROLOG. Implementation of Uniformed Search algorithm Depth First Search, Breadth First Search, Implementation of informed search algorithm Best First Search, A* and AO* algorithms.

Module 2:
Machine Learning with Python: Familiarizing with Anaconda and Jupyter for importing modules and dependencies for ML, Familiarization with NumPy, Panda and Matplotlib by Loading Dataset in Python, Forward and backward chaining.

Module 3:
Classification: Logistic Regression, naïve bayes, Clustering: k-means, KNN, adaptive hierarchical clustering.

Module 4:
Decision trees, Evaluation parameters, Confusion Matrix, Natural Language Processing,

Module 5:
Introduction to Neural network, Introduction to Deep Neural Network. Convolution Neural Network.

Course Outcomes:

1. Learn Prolog language for implementation of AI Programs
2. Understand the usage of .csv files for organizing data in the form of datasets
3. Identify suitable machine learning algorithms for solving real world problems
4. Explain the decision tree and evaluation parameters.
5. Discuss the Neural network and deep neural network.

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VI-Semester

List of Text/Reference Books:

1. Rich and Knight,"Artificial Intelligence",The McGraw- Hill,.3rdEdition,2008
2. Tom Mitchell, "Machine Learning" ,McGraw-Hill, First Edition, 1997.
3. Ethem Alpaydin, "Introduction to Machine Learning Edition"2, MIT Press, Third Edition,2014.

List of Experiments:

1. Study of PROLOG Programming language and its Functions. Write simple facts for the statements using PROLOG.
2. Implementation of Depth First Search for Water Jug problem
3. Implementation of Breadth First Search for Tic-Tac-Toe problem
4. Solve 8-puzzle problem using Best First Search. Write a program to Implement A*.
5. Implementation of Python Basic Libraries such as Statistics, Math, NumPy and SciPy
6. Implementation of forward and backward chaining
7. Implementation of Logistic Regression using sklearn.
8. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
9. Write a program to implement k-NN algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.
10. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

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VI-Semester

PROJ-CS03(P)	Minor Project	0L: 0T: 4P (4 hrs.)	2 credits

Prerequisite: Basic understanding of programming concepts, data structures, software development principles, and familiarity with relevant programming languages and tools.

Course Objective:

To provide computer science and engineering students with hands-on experience in project development, enhancing their technical, problem solving, teamwork, and project management skills while applying theoretical knowledge to real-world challenges.

Course Contents:

Module 1:

Project Initiation and Proposal: Introduction to minor project. Emphasis on real-world applications and problem-solving. Brainstorming session for project ideas, followed by feasibility studies. Students will write detailed proposals covering objectives, scope, methodology, and expected outcomes. Proposal presentation to faculty for approval and feedback.

Module 2:

Project Planning and Design: Focus on project planning, task definition, and resource allocation. Students will form teams, assign roles, and develop detailed project plans with milestones and timelines. System design concepts will be covered, including UML diagrams for architectural planning and database design principles.

Module 3:

Development and Implementation: Environment setup, coding standards adherence, and module development using appropriate technologies. Integration of front-end and back-end components, emphasizing user interface design and experience. Comprehensive testing phases, including unit testing, integration testing, and system testing.

Module 4:

Documentation and Quality Assurance: Preparation of technical documentation, progress reports, and final project reports. Quality assurance practices focusing on compliance with standards, peer reviews, and effective bug tracking. Submission of regular progress reports to track project development and ensure quality deliverables.

Module 5:

Presentation and Final Submission: Preparation and delivery of project presentations, live demonstrations, and Q&A sessions. Collection of feedback from evaluators and peers.

Submission of the final project report, reflecting on the project journey, lessons learned, and future scope for improvement.

Course Outcomes:

1. Recognize real-world problems, generate feasible ideas, and develop comprehensive proposals with effective communication for approval.
2. Plan projects, manage resources, and create detailed system designs with clear timelines and milestones.
3. Expand hands-on experience in development, adhere to coding standards, integrate modules, and perform comprehensive testing.
4. Produce high-quality technical documentation, prepare detailed reports, and ensure project quality through peer reviews and bug tracking.
5. Develop presentation skills, effectively demonstrate project outcomes, handle feedback, complete submissions, and reflect on learning experiences.

List of Text / Reference Books:

1. Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 13th Edition, Harold Kerzner, ISBN: 978-1-119-80537-3
2. "Software Engineering: A Practitioner's Approach" by Roger S. Pressman.
3. "Software Engineering" by Ian Sommerville.
4. “Software Quality Assurance: Principles and Practice" by Nina S. Godbole.

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VI-Semester

PROJ-CS04(P)	Evaluation of Internship-I	0L: 0T: 4P (4 hrs.)	2 credits

Prerequisite: None.

Course Objective:

To provide computer science and engineering students with hands-on industry experience, enhancing technical skills, professional competencies, and exposure to industry practices. Through practical projects, students will apply academic knowledge, gain insights into latest technologies, and develop problem-solving abilities, preparing them for future careers.

Course Contents:

1. Orientation and Goal Setting:
   - Introduction to the internship, setting goals, and defining learning objectives.
   - Understanding the expectations and responsibilities during the internship.
2. Workplace Skills Development:
   - Professional behavior and workplace ethics.
   - Communication skills, both written and verbal, in a professional setting.
3. Technical Skills Application:
   - Applying theoretical knowledge in practical, real-world projects.
   - Utilizing specific tools, technologies, and methodologies relevant to the industry.
4. Project Management:
   - Engaging in project planning, execution, and monitoring.
   - Documenting and reporting project progress.
5. Evaluation and Feedback:
   - Receiving and acting on feedback from supervisors.
   - Reflecting on personal and professional growth during the internship.
6. Final Report and Presentation:
   - Preparing a comprehensive report detailing the internship experience.
   - Presenting findings and learning outcomes to peers and faculty.

Course Outcomes:

Upon completion of the Computer Science Engineering internship, students will be able to:

1. Apply Academic Knowledge: Demonstrate the application of classroom learning to real-world projects and problems.
2. Develop Professional Skills: Exhibit improved professional skills such as teamwork, communication, and problem-solving.
3. Exhibit Technical Proficiency: Show proficiency in using industry-standard tools and technologies.

4 Develop Project Management skills: Manage and document projects effectively, meeting deadlines and quality standards.

5 Prepare Career path & reflective learning: Gain practical insights into career paths and professional development in the field of computer science engineering. Reflect on their learning experiences, identifying strengths and areas for improvement.