Curriculum for UG & PG Programmes

(2024-25 Onwards)

असतो मा सद्गमय

Swami Keshvanand Institute of Technology, Management & Gramothan

(An Autonomous Institute, Affiliated to Rajasthan Technical University, Kota)
(Accredited by NAAC with A ++ Grade)
Approved by AICTE, Ministry of Education, Government of India
Recognized by UGC under Section 2(f) of the UGC Act, 1956

M. Tech. in CSE

Teaching and Examination Scheme
I Year I Semester: M. Tech. (CSE)

Sr. No.	Course Code	Course Name	Category	Teaching Scheme			Exam Hrs.	Marks			Credit
				L	T	P		CIE	SEE	Total	
1	CSPL101	Cyber Security	PCC	3	0	0	3	40	60	100	3
2	CSPL102	Machine Learning & Pattern Recognition	PCC	3	0	0	3	40	60	100	3
3	CSPL111	Artificial Neural Network	PEC	3	0	0	3	40	60	100	3
4	CSPL112	Image Processing and Computer Vision	PEC	3	0	0	3	40	60	100	
5	CSPL113	Computational Intelligence	PEC	3	0	0	3	40	60	100	3
6	CSPL114	Computer Forensics	PEC	3	0	0	3	40	60	100	
7	NP40.01	Optimization Techniques	MCC	3	0	0	3	40	60	100	3
8	CSPP130	Cyber Security Lab	PCC	0	0	4	2	60	40	100	2
9	CSPP131	Advanced Machine Learning with Python Lab	PCC	0	0	4	2	60	40	100	2
10	NP99.XX	Audit Course-I	MCC	2	0	0	0	0	0	0	0
11	CSPA100	Social Outreach, Discipline & Extra Curricular Activities (SODECA)	SODECA	0	0	0	0	0	0	100	1
Total Credit											**20**

Name of the Programme: M.Tech. in Computer Science and Engineering	**Year**: I	**Semester**: I
Course Name: Cyber Security	**Course Code**: CSPL101	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Introduction to Cyber Security:** Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control, Cryptography, and Social Engineering. **Web attacks:** Browser attacks, web attacks targeting users, obtaining user or website data, and email attacks. **Network Vulnerabilities:** Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Examples, OpenVAS, Metasploit. **Networks Vulnerability Scanning:** (Netcat, Socat), Network Sniffers, Injection Tools.	10
3	**Introduction to Cyber Crime:** law and Investigation of Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world. Internet Crime and Act: A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Data Destruction, Indian IT ACT 2000. Firewalls and Packet Filters, password Cracking, Key	10
4	**Network Defense tools:** Firewalls and Packet Filters: Firewall Basics, Packet Filter vs. firewall, how a Firewall Protects a Network, Packet Characteristic to Filter, Stateless vs. stateful Firewalls, Network Address Translation (NAT) and Port Forwarding. VPN: the basics of Virtual Private Networks. Firewall: Introduction, Linux Firewall, Windows Firewall. Snort: Introduction Detection System	9
5	**Web Application Tools:** Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel. Application Inspection tools – Zed Attack Proxy, Sqlmap, DVWA, Webgoat. Password Cracking and Brute-Force Tools: John the Ripper, L0htcrack, Pwdump, HTC-Hydra.	8
6	Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Viruses and Warms, Trojan and backdoors, Steganography, DOS and DDOS attacks, SQL injection, Buffer Overflow, Attacks on wireless Networks	7
	Total	**45**

Text Books:

1. C. P. Pleeger, S. L. Pleeger, and J. Margulies, *Security in Computing*, 5th ed. Pearson Education, 2015.
2. E. Ozkaya, *Cyber Security: A Comprehensive Guide to Getting Started in Cybersecurity*, 1st ed. Apress, 2019.
3. C. J. Brooks, C. Grow, and P. Craig, *Cyber Security Essentials*, Illustrated ed. Wiley, 2018.

Reference Books:

1. G. K. Kostopoulous, *Cyber Space and Cyber Security*. CRC Press, 2013.
2. M. Lehto and P. Neittaanmäki, Eds., *Cyber Security: Analytics, Technology and Automation*. Springer International Publishing, Switzerland, 2015.
3. N. Phillips and S. Eninger, *Computer Forensics and Investigations*. Cengage Learning, New Delhi, 2009.

Prerequisite:

Prerequisites for this course include basic knowledge of computer systems and networking (IP addressing, DNS, and firewall functions), familiarity with a programming language (e.g., Python or Java), and an introductory understanding of cyber security concepts (malware, phishing, digital privacy).

Name of the Programme: M. Tech. in Computer Science and Engineering	**Year**: I	**Semester**: I
Course Name: Machine Learning and Pattern Recognition	**Course Code**: CSPL102	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Introduction to Machine Learning:** Types of Machine Learning, **Supervised Learning:** Nearest Neighbour Classifier, Bayes Classifier, Decision Trees, Random Forest, Support Vector Machines, Linear Regression, Logistic Regression, Polynomial Regression.	9
3	**Unsupervised Learning:** Types of Clustering Techniques, K-means, Hierarchy, DBSCAN Clustering **Statistical Learning:** Feature extraction, Different approaches to Feature Selection, Dimensionality Reduction techniques.	9
4	**Model Evaluation and Optimization**: Evaluation Matrix (e.g., accuracy, precision, recall, F1 score), Bias-Variance Trade-off, Overfitting and Underfitting, Cross-Validation Techniques, Model Regularization (L1, L2), Model Selection, Hyperparameter Tuning.	9
5	**Introduction to Pattern Recognition:** Problem and application of Pattern Recognition, Probability theory, polynomial curve fitting, the curse of dimensionality, Probability Distribution: Binary Variable, Multinomial variable, Gaussian distribution, Bayesian Decision Theory: Bayes rule, discrimination function, loss function, Bayesian error analysis.	9
6	**Linear Models for classification:** Discriminant function, Probability generative models, Sequential Data, Markov Models, Hidden Markov Models, Linear Dynamical system. Combining Models: Tree-based Models.	8
	Total	**45**

Text Books:

1. Ethem Alpaydin, Machine Learning. Cambridge, MA: MIT Press, 2021.
2. Christopher M. Bishop, Pattern Recognition and Machine Learning. New York, NY: Springer, 2006.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning. Cambridge, MA: MIT Press, 2016.

Reference Books:

1. Tom M. Mitchell, Machine Learning. New York, NY: McGraw-Hill Education, 1997.
2. Richard O. Duda, Peter E. Hart, and David G. Stork, Pattern Classification. New York, NY: Wiley, 2001.
3. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective. Cambridge, MA: MIT Press, 2012.

Prerequisite:

1. Linear Algebra: Understanding of vectors, matrices, and linear transformations is crucial for many machine learning algorithms.
2. Probability and Statistics: Knowledge of probability distributions, statistical measures, and hypothesis testing is essential for data analysis and model evaluation.
3. Programming Skills: Proficiency in a programming language, preferably Python, is important for implementing algorithms and working with data

Name of the Programme: M.Tech. in Computer Science and Engineering	**Year**: I	**Semester**: I
Course Name: Artificial Neural Network	**Course Code**: CSPL111	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 0L+0T+3P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Artificial Neural Networks (ANN) and Paradigms:** Neuron Model, Neural Network Architecture, Learning Rules, Perceptrons, Single Layer Perceptrons, Multilayer Perceptrons	8
3	**Activation and Synaptic Dynamics:** Activation Dynamics Models, Synaptic Dynamics Models, and Learning Methods.	7
4	**Optimization and Learning in Neural Networks:** Gradient Descent and Its Variants, Optimizers (e.g., Adam, RMSprop), Learning Rates and Schedules, Loss Functions (e.g., Mean Squared Error, Cross-Entropy), Activation Functions (e.g., Sigmoid, ReLU, Tanh, Softmax)	9
5	**Feedforward Neural Networks:** Exploring Pattern Association Networks, Examining Pattern Classification Networks, and Related Concepts in Neural Computing.	9
6	**Applications of ANN:** Direct Applications in Real-World Scenarios and Their Impact Across Industries such as Education, Healthcare, and Automotive Technologies.	8
	Total	**42**

Text Books:

1. S. Raj sekaran, Vijayalakshmi Pari - Neural networks, Fuzzy logic and Genetic Algorithms
2. B. Yegnanrayana, “Artificial Neural Networks”, PHI.

Reference Books:

1. Kevin L. Priddy, Paul E. Keller – Artificial neural networks: An Introduction - SPIE Press, 2005
2. Mohammad H. Hassoun – Fundamentals of artificial neural networks - MIT Press ,1995

Prerequisite:

1. Understanding of linear algebra, multivariate calculus, and probability theory

Name of the Programme: M.Tech. in Computer Science and Engineering	**Year**: I	**Semester**: I
Course Name: Image Processing and Computer Vision	**Course Code**: CSPL112	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:**3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Fundamentals of Image Formation:** Radiometry, Geometric Transformations, Geometric Camera Models, Camera Calibration, Image Formation in a Stereo Vision Setup, Image Reconstruction from a Series of Projections	9
3	**Image Processing:** Fundamentals Steps in Image Processing, Elements of Digital Image Processing Systems, Sampling and quantization, Image Transforms- Walsh transforms, Hadamard Transform, Discrete cosine Transform, Discrete Wavelet Transform, Image Enhancement-Spatial Domain & Frequency Domain. Image Filtering, Color Image Processing, Image Segmentation	9
4	**Image Descriptors and Features**: Texture Descriptors, Color Features, Edges/Boundaries, Object Boundary and Shape Representations. Interest or Corner Point Detectors, Histogram of Oriented Gradients, Scale Invariant Feature Transform, Speeded up Robust Features, Saliency	9
5	**Introduction to Computer Vision:** Introduction and Goals of Computer Vision Fundamentals of Machine Learning: Linear Regression, Basic Concepts of Decision Functions, Elementary Statistical Decision Theory, Parameter Estimation, Clustering for Knowledge Representation, Dimension Reduction, Linear Discriminant Analysis.	9
6	**Case Studies:** Enhanced Gesture Recognition for Smart Home Automation, Autonomous Vehicle Object Detection, Medical Image Analysis for Disease Detection	8
	Total	**45**

Text Books:

1. Jayaraman, V. *Digital Image Processing*, 2nd ed. New Delhi, India: Tata McGraw-Hill Education, 2015.
2. Gonzalez, R. C., and Woods, R. E. *Digital Image Processing*, 4th ed. Upper Saddle River, NJ: Pearson, 2018.
3. Forsyth, D. A., and Ponce, J. *Computer Vision: A Modern Approach*, 2nd ed. Upper Saddle River, NJ: Pearson, 2012.

Reference Books:

1. Solomon, C., and Breckon, T. *Fundamentals of Digital Image Processing: A Practical Approach with Examples in MATLAB*, 2nd ed. New York, NY: Wiley, 2011.
2. Shih, F. Y. *Image Processing and Mathematical Morphology: Fundamentals and Applications*. New York, NY: Marcel Dekker, 2009.
3. Bhuyan, M. K. *Computer Vision and Image Processing: Fundamentals and Applications*. Boca Raton, FL: CRC Press, 2022.

Prerequisite:

1. Basic Programming Skills: Proficiency in Python, MATLAB, or C++ is essential for implementing algorithms and assignments.
2. Mathematics and Fundamentals: Understanding linear algebra, calculus, and probability theory is crucial for image processing concepts.
3. Data Structures and Algorithms: Familiarity with basic data structures and algorithms is necessary for efficient image processing implementations.

Name of the Programme: M.Tech. in Computer Science and Engineering	**Year**: I	**Semester**: I
Course Name: Computational Intelligence	**Course Code**: CSPL113	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Introduction to Computational Intelligence:** Definitions and scope of computational intelligence, Historical development of computational intelligence techniques, Applications in real-world scenarios, Key concepts in computational intelligence, Comparison with traditional artificial intelligence	9
3	**Fuzzy Logic Systems:** basic concepts and terminology, Fuzzy sets and membership functions, Fuzzy rules and inference systems, Fuzzy control systems and applications, Comparison of fuzzy logic with classical logic	9
4	**Evolutionary Algorithms:** evolutionary computing concepts; Genetic algorithms: representation, selection, crossover, and mutation; Other techniques: genetic programming, evolutionary strategies, and differential evolution; Applications of evolutionary algorithms in optimization problems, Case studies highlighting practical implementations	9
5	**Swarm Intelligence:** swarm intelligence and biological inspirations, Ant colony optimization principles and applications, Particle swarm optimization mechanisms and uses, Utilization of swarm intelligence for optimization and control, Case studies in robotics and network optimization	9
6	**Applications of Computational Intelligence:** Examination of various applications across different domains, Case studies illustrating real-world problem-solving with computational intelligence, Focus on fields such as finance, healthcare, and manufacturing, Current trends and future possibilities in computational intelligence technologies	8
	Total	**45**

Text Books:

1. A. P. Engelbrecht, Computational Intelligence: An Introduction, 2nd ed., Wiley, 2007.
2. S. N. Sivanandam and S. N. Deepa, Principles of Soft Computing, 3rd ed., Wiley India, 2018.
3. R. Jensen and Q. Shen, Computational Intelligence and Feature Selection: Rough and Fuzzy Approaches, Wiley-IEEE Press, 2008.

Reference Books:

1. G. J. Klir and T. A. Folger, Fuzzy Sets, Uncertainty, and Information, Prentice Hall, 1988.
2. D. E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, Addison-Wesley, 1989.
3. H. Fujita and A. E. Hassanien, Eds., Applications of Computational Intelligence in Biomedical Technology, Springer, 2015.

Prerequisite:

1. Knowledge of machine learning basics and control systems provides context for computational intelligence applications.
2. Understanding linear algebra, calculus, and statistics supports understanding optimization and fuzzy systems.

Name of the Programme: M. Tech. in Computer Science and Engineering	**Year**: I	**Semester**: I
Course Name: Computer Forensics	**Course Code**: CSPL114	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Fundamentals of Computer Forensics:** Computer forensics, digital evidence, file systems, data storage, operating systems forensics, network forensics, and the forensic investigation process.	8
3	**Data Recovery and Evidence Collection:** Data recovery fundamentals, understanding storage devices, recovery techniques, data acquisition, forensic imaging tools, file system analysis, data carving and reconstruction, SSD forensics, mobile device data recovery, and evidence collection procedures.	9
4	**File Management Systems and Database Models:** File management systems, discussing file organization, access methods, and the role of file systems in data management. Database models, including relational, hierarchical, and NoSQL databases, emphasizing data structuring, querying, and storage mechanisms.	9
5	**Blockchain Basics and Hash Functions:** Blockchain technology, including concepts of decentralization, various types of blockchains, consensus approaches, proof of work, and proof of stake mechanisms. Hash functions, covering hashing techniques, message authentication codes, secure hash algorithms, and their applications in blockchain mining and data integrity.	9
6	**Forensic Tools and Processing of Electronic Evidence:** Various forensic tools used in investigations, including imaging, analysis, network forensics, mobile forensics, memory forensics, data recovery, and steganography. Processing electronic evidence, covering evidence identification and collection, data acquisition and imaging, data analysis, reporting findings, and the legal considerations involved in electronic evidence processing.	9
	Total	**45**

Text & References:

1. B. Nelson, A. Phillips, and C. Steuart, Guide to Computer Forensics and Investigations, 6th ed. Boston, MA, USA: Cengage Learning, 2019.
2. M.-H. Maras, Computer Forensics: Cybercriminals, Laws, and Evidence, 2nd ed. Burlington, MA, USA: Jones & Bartlett Learning, 2014.
3. I. Bashir, Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, 3rd ed. Birmingham, UK: Packt Publishing, 2020.
4. B. Carrier, File System Forensic Analysis. Boston, MA, USA: Addison-Wesley, 2005.

Reference Books:

1. H. Carvey, Windows Forensic Analysis Toolkit, 4th ed. Waltham, MA, USA: Syngress, 2018.
2. C. Pogue, UNIX and Linux Forensic Analysis. Indianapolis, IN, USA: Pearson IT Certification, 2008.

3. M. H. Ligh, A. Case, J. Levy, and A. Walters, The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory. Hoboken, NJ, USA: Wiley, 2014.
4. H. Mahalik, R. Tamma, and S. Bommisetty, Practical Mobile Forensics, 4th ed. Birmingham, UK: Packt Publishing, 2021.
5. D. Tapscott and A. Tapscott, Blockchain Revolution: How the Technology Behind Bitcoin is Changing Money, Business, and the World. New York, NY, USA: Portfolio, 2018

Prerequisite:

1. Basic Computer Science Knowledge: Understanding computer systems, programming, and operating systems is essential for effective digital investigations.
2. Networking Fundamentals: Familiarity with networking concepts, protocols, and security principles is crucial for analyzing digital evidence.
3. Cybersecurity Awareness: Knowledge of cybersecurity principles, legal aspects, and ethical considerations is critical in forensic practices.

Name of the Programme: M. Tech Computer Science and Engineering	**Year**: I	**Semester**: I
Course Name: Optimization Techniques	**Course Code**: NP40.01	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Introduction to optimization:** Engineering applications of optimization, Mathematical Modeling and simulation, Formulation of structural optimization problems as programming problems. Graphical method.	7
3	**Linear Programming:** Theory of Simplex Method, Standard form of LPP, feasible solution and basic feasible solution, Improving BFS, Optimality condition, Unbounded solution, Alternative optimal solution, Simplex method, Big M Method, Two phase method.	9
4	**Metaheuristics in Optimization:** Genetic algorithms, Tabu search, particle swarm intelligence and their applications in Engineering	8
5	**PERT & CPM:** Objective of CPM & PERT, elements of network, network rules, constraints, error in network, Critical Path Analysis, Activity time and floats, optimization through CPM techniques, PERT and three estimates, critical path analysis of a PERT network, probability of completion of project, controlling and monitoring.	9
6	**Non-linear Programming:** Local and global minima of one and two variables, constraints optimization, Lagrange's Method, K-T conditions, Steepest descent method, Conjugate gradient method.	11
	Total	**45**

Text Books:

1. S. S. Rao, Engineering Optimization: Theory and Practice, Wiley, 2008.
2. K. Deb, Optimization for Engineering design algorithms and Examples, Prentice Hall, 2nd edition 2012.

Reference Books:

1. H. L. Hira and S. K. Gupta, Operations Research, 1st ed. New Delhi, India: S. Chand & Company, 2015.
2. R. Saravanan, Manufacturing Optimization through Intelligent Techniques, Taylor & Francis Publications, 2006.
3. D. E. Goldberg, Genetic algorithms in Search, Optimization, and Machine Learning, Addison-Wesley Longman Publishing, 1989.

Prerequisite:

1. Basic knowledge of calculus.

Name of the Programme: M.Tech. in Computer Science and Engineering	**Year**: I	**Semester**: I
Course Name: Cyber Security Lab	**Course Code**: CSPP130	**Credit**: 2
Max Marks: 100	**CIE:** 60	**SEE:** 40
End Term Exam Time: 2 Hrs	**Teaching Scheme:** 0L+0T+4P	

No.	List of Experiments
1	Set up a honeypot to attract and analyze malicious activity on the network.
2	Use Snort for real-time traffic analysis and packet logging to detect suspicious activities.
3	Perform port scanning using Nmap to identify open ports and services on a target machine.
4	Conduct vulnerability scanning on a target system using OpenVAS to identify security weaknesses.
5	Test for SQL injection vulnerabilities in a web application to understand exploitation techniques.
6	Analyze the Windows registry for malicious activity using Process Monitor and boot time logging.
7	Capture and analyze system memory using FTK Imager to identify malicious processes.
8	Use Autopsy to detect file types in disk images during a forensic investigation.
9	Perform network analysis with Network Miner to extract information from captured network traffic.
10	Simulate a Denial of Service (DoS) attack to observe its impact on a target service.

Text Books:

1. E. P. Dorothy, Real Digital Forensics for Handheld Devices. Auerbach Publications, 2013.
2. J. Sammons, The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics. Syngress Publishing, 2012.

Reference Books:

1. E. Casey, Handbook of Digital Forensics and Investigation, Academic Press, 2010.
2. C. H. Malin, E. Casey, and J. M. Aquilina, Malware Forensics Field Guide for Windows Systems: Digital Forensics Field Guides, Syngress, 2012.
3. J. Wiles and A. Reyes, The Best Damn Cybercrime and Digital Forensics Book Period, Syngress, 2007.

Prerequisite:

1. Understanding of Networking Basics: Grasp TCP/IP protocols, port functionality, and traffic analysis for effective cybersecurity practices.
2. Legal and Ethical Considerations: Ensure compliance with laws surrounding digital forensics to avoid potential legal repercussions.

Name of the Programme: M.Tech. in Computer Science and Engineering	**Year**: I	**Semester**: I
Course Name: Advanced Machine Learning with Python Lab	**Course Code**: CSPP131	**Credit**: 2
Max Marks: 100	**CIE:** 60	**SEE:** 40
End Term Exam Time: 2 Hrs	**Teaching Scheme:** 0L+0T+4P	

S.No.	List of Experiments
1.	Predict the price of the Uber ride from a given pickup point to the agreed drop-off location. Perform following tasks: a. Pre-process the dataset. b. Identify outliers. c. Check the correlation it d. Implement linear regression and random forest regression models f. Evaluate the models and compare their respective scores like R2, RMSE, etc. Read the values of the variables from the user through console. Dataset link: https://www.kaggle.com/datasets/yasserh/uber-fares-dataset
2.	Write a program to. Classify the email using the binary classification method. Email Spam detection has two states: a) Normal State – Not Spam, b) Abnormal State – Spam. Use K-Nearest Neighbors and Support Vector Machine for classification. Analyze their performance. Dataset link: The emails.csv dataset on the Kaggle https://www.kaggle.com/datasets/balaka18/email-spam-classification-dataset-csv
3.	Given a bank customer, build a neural network-based classifier that can determine whether they will leave or not in the next 6 months. Dataset Description: The case study is from an open-source dataset from Kaggle. The dataset contains 10,000 sample points with 14 distinct features such as CustomerId, CreditScore, Geography, Gender, Age, Tenure, Balance, etc. Link to the Kaggle project: https://www.kaggle.com/barelydedicated/bank-customer-churn-modeling Perform following steps: 1. Read the dataset. 2. Distinguish the feature and target set and divide the data set into training and test sets. 3. Normalize the train and test data. 4. Initialize and build the model. Identify the points of improvement and implement the same. 5. Print the accuracy score and confusion matrix (5 points).
4.	Implement Gradient Descent Algorithm to find the local minima of a function. For example, find the local minima of the function $y=(x+3)^2$ starting from the point x=2
5.	Implement K-Nearest Neighbors algorithm on diabetes.csv dataset. Compute confusion matrix, accuracy, error rate, precision and recall on the given dataset. Dataset link: https://www.kaggle.com/datasets/abdallamahgoub/diabetes
6.	Implement K-Means clustering/ hierarchical clustering on sales_data_sample.csv dataset. Determine the number of clusters using the elbow method. Dataset link: https://www.kaggle.com/datasets/kyanyoga/sample-sales-data

7.	Implementing Feed-forward neural networks with Keras and TensorFlow/ Pytorch a. Import the necessary packages b. Load the training and testing data (MNIST/CIFAR10) c. Define the network architecture using Keras d. Train the model using SGD e. Evaluate the network f. Plot the training loss and accuracy
8.	Build the Image classification model by dividing the model into the following four stages: a. Loading and preprocessing the image data b. Defining the model's architecture c. Training the model d. Estimating the model's performance

Virtual Laboratory: -

http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/index.php

Text books:

1. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.
2. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 2nd ed. O'Reilly Media, 2019.
3. Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.

Reference books:

1. Iain Murray and David J.C. MacKay, *Introduction to Statistical Machine Learning*, 2016.
2. François Chollet, *Deep Learning with Python*, 2nd ed. Manning Publications, 2021.

Prerequisite:

1. Programming and Libraries: Proficiency in Python and familiarity with libraries like Pandas and NumPy are essential.
2. Machine Learning Concepts: Understand machine learning fundamentals, including regression, classification algorithms, and neural networks for modeling.
3. Data Preprocessing and Evaluation: Knowledge of data cleaning, normalization, and evaluation metrics is vital for model performance assessment.

Teaching and Examination Scheme
I Year II Semester: M. Tech. (CSE)

Sr. No.	Course Code	Course Name	Category	Teaching Scheme			Exam Hrs.	Marks			Credit
				L	T	P		CIE	SEE	Total	
1	CSPL201	Advanced Data Structure	PCC	3	0	0	3	40	60	100	3
2	CSPL202	High-Performance Computing	PCC	3	0	0	3	40	60	100	3
3	CSPL211	Cyber-Physical Systems	PEC	3	0	0	3	40	60	100	3
4	CSPL212	IoT Fundamentals & Architecture	PEC	3	0	0	3	40	60	100	
5	CSPL213	Soft Computing	PEC	3	0	0	3	40	60	100	3
6	CSPL214	Natural Language Processing & Information Retrieval	PEC	3	0	0	3	40	60	100	
7	CSPP230	High-Performance Computing Lab	PCC	0	0	4	2	60	40	100	2
8	CSPP231	IoT-based System Design Lab	PCC	0	0	4	2	60	40	100	2
9	CSPD250	Mini Project with Seminar	REW	0	0	4	2	60	40	100	2
10	NP99.XX	Audit Course-II	MCC	2	0	0	0	0	0	0	0
11	CSPA200	Social Outreach, Discipline & Extra Curricular Activities (SODECA)	SODECA	0	0	0	0	0	0	100	1
Total Credit											**19**

Name of the Programme: M. Tech Computer Science and Engineering	**Year**: I	**Semester**: II
Course Name: Advanced Data Structure	**Course Code:** CSPL201	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Amortized Analysis and Advanced Complexity**: Amortized analysis techniques (aggregate analysis, accounting method, potential method), Applications in data structures, Complexity classes for data structures.	9
3	**Heaps and Advanced Priority Queues**: Heap structures (Fibonacci heaps, binomial heaps, pairing heaps, D-ary heaps), Advanced priority queues (soft heaps, lazy binomial heaps), Applications in the shortest path and MST algorithms.	9
4	**Self-Balancing Trees**: Balanced binary search trees (AVL trees, Red-Black trees, Splay trees), Multi-way trees (B-trees, B+ trees), Interval and range trees, database Applications and search optimization.	9
5	**Graph Data Structures**: Dynamic graph representation techniques, Specialized graph data structures (Link/Cut trees, Euler tour trees), Advanced graph algorithms (Dijkstra's, A*, Johnson's), Applications in network flow and routing.	9
6	**Number Theoretic Algorithm:** Number theoretic notation, Division theorem, GCD recursion, Modular arithmetic, Solving Linear equations, Chinese remainder theorem, power of an element, RSA public key Cryptosystem, primality Testing and Integer Factorization.	8
	Total	**45**

Text Books:

1. Cormen, T.H., Leiserson, C.E., Rivest, R.L., and Stein, C. - *Introduction to Algorithms*, 3rd Edition, MIT Press, 2009.
2. Mark Allen Weiss - *Data Structures and Algorithm Analysis in C++*, 4th Edition, Pearson Education, 2013.
3. Goodrich, M.T., Tamassia, R. - *Data Structures and Algorithms in Java*, 6th Edition, Wiley, 2014.

Reference Books:

1. Sedgewick, R., Wayne, K. - *Algorithms*, 4th Edition, Addison-Wesley, 2011.
2. Mehlhorn, K., Sanders, P. - *Algorithms and Data Structures: The Basic Toolbox*, Springer, 2008.
3. Bender, M.A., Farach-Colton, M. - *Data Structures and Algorithmic Thinking*, CRC Press, 2013.
4. Tarjan, R.E. - *Data Structures and Network Algorithms*, Society for Industrial and Applied Mathematics, 1983

Prerequisite:

1. Fundamentals of Data Structures: Essential knowledge of basic data structures, supporting advanced topics like heaps and trees.
2. Basic Algorithm Analysis: Understanding time and space complexity to grasp amortized analysis and complexity classes.

Name of the Programme: M.Tech. in Computer Science and Engineering	**Year**: I	**Semester**: II
Course Name: High-Performance Computing	**Course Code**: CSPL202	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Introduction to HPC and Parallel Computing:** High-Performance Computing (HPC), Grand Challenge Problems Computational and communication intensive, Parallel Architectures Classifications SMP, MPP, NUMA, Applications of HPC in various fields. **Parallel Computing:** Types of parallelism: Data parallelism, Task parallelism, Parallel computing models: Shared memory, Distributed memory, Hybrid models.	9
3	**Cluster Computing:** Cluster Architecture, Resource Management and Scheduling, Programming Environments and Tools, Representative Cluster Systems, Security, Fault Tolerance, Evolution of Meta computing.	9
4	**Load Sharing and Balancing**: Job and Resource Management Systems, Communication-Based Scheduling, Batch Scheduling, Fault Tolerance, Dynamic Load Balancing, Task Granularity and Partitioning, Static and Dynamic Scheduling.	9
5	**Grid Computing:** Grid Architecture Characteristics, Grid types, Components and Layers, Grid standards: OGSA & WSRF, Semantic Grid & Autonomic Computing, Metadata & Ontology, Grid security infrastructure.	9
6	**Cloud Computing:** Characteristics, Cloud provider models: SAAS, PAAS, IAAS, Organizational scenarios of clouds, Administering & Monitoring cloud services, Benefits and limitations.	8
	Total	**45**

Text Books:

1. R. Rajkumar, High Performance Cluster Computing: Architectures and Systems, vol. 1, Pearson Education, 2018.
2. Berman, A. J. Fox, and T. Hey, Grid Computing: Making the Global Infrastructure a Reality, Wiley India, 2018.
3. R. Buyya, C. Vecchiola, and S. T. Selvi, Mastering Cloud Computing: Foundations and Applications Programming, Morgan Kaufmann, Elsevier, 2013.

Reference Books:

1. B. Wilkinson, Grid Computing: Techniques and Applications, 2nd ed. CRC Press, 2018.
2. C. S. R. Prabhu, Grid and Cluster Computing, 1st ed. PHI Learning, 2021.
3. A. Velte, T. Velte, and R. Elsenpeter, Cloud Computing: A Practical Approach, 3rd ed. McGraw-Hill, 2020.

Prerequisite:

1. Foundational Computing Knowledge.
2. Networking and Cloud Computing Understanding

Name of the Programme: M.Tech. in Computer Science and Engineering	**Year**: I	**Semester**: II
Course Name: Cyber-Physical Systems	**Course Code**: CSPL211	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Introduction to Cyber-Physical Systems (CPS):** Motivation and Examples of CPS: Energy systems, Medical systems, Transportation systems, Key Design Drivers and Quality Attributes of CPS, Overview of Hardware and Software Components Integration with the Internet	8
3	**Core Components of Cyber-Physical Systems:** Processors, Sensors, Actuators, CPS Network, CPS Software Stack: Real-Time Operating Systems (RTOS), Scheduling Real-Time Control Tasks	8
4	**Algorithms and Modeling in Cyber-Physical Systems:** Cyber-Physical Systems Algorithms, Dynamical Systems and Stability, Controller Design Techniques, Attributes of High-Confidence CPS, Continuous Systems Modeling, Discrete-Time System Modeling, Finite State Machines and Extended State Machines, Hybrid System Modeling, Classes of Hybrid Systems	10
5	**Verification and Security in Cyber-Physical Systems:** Model Development and Verification: Development of Models from Specifications, Reachability Analysis, Model Checking, Security Considerations: Basic Concepts of Embedded Systems, Embedded Processors, Attack Models, Secure Task Mapping and Partitioning, State Estimation for Attack Detection	9
6	**Interfacing, Logic, and Case Studies:** Interfacing to the External World: Through Sensors and Actuators, Temporal Logic: Invariants and Temporal Logic, Linear Temporal Logic, Equivalence and Refinement, Case Studies: Low-End Systems: Medical Devices, Smart Cards, Sensors, High-End Systems: Automobiles, Home Electronics, Robotics	9
	Total	**45**

Text Books:

1. R. Rajkumar, D. de Niz, and M. Klein, Cyber-Physical Systems, 1st ed. Addison-Wesley, 2017.
2. E. A. Lee and S. A. Sheshia, Embedded System Design: A Cyber-Physical Approach, 2nd ed. MIT Press, 2018.
3. A. Platzer, Logical Foundations of Cyber-Physical Systems, 1st ed. Springer, 2017.

Reference Books:

1. H. K. Khalil, Cyber-Physical Systems: From Theory to Practice, Wiley, 2020.
2. R. Alur, Principles of Cyber-Physical Systems, MIT Press, 2015.
3. S. S. Intille, *Introduction to Cyber-Physical Systems: A Multidisciplinary Approach*, Cambridge University Press, 2021

Prerequisite:

Knowing how sensors gather data from the physical world and how actuators act is fundamental to designing and implementing cyber-physical systems. Specific domain knowledge may be necessary depending on the application domain (e.g., automotive, healthcare, industrial automation).

Name of the Programme: M.Tech. in Computer Science and Engineering	**Year**: I	**Semester**: II
Course Name: IoT Fundamentals and Architecture	**Course Code**: CSPL212	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:**3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite.	1
2	**Evolution of IoT:** Introduction to IoT, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations Humidity sensors, Ultrasonic sensor, Temperature Sensor, Proximity Sensors, Infrared sensors, Actuators, Actuator Types, Actuators Characteristics, IoT Processing Topologies and Types, Raspberry Pi in IoT	10
3	**IoT Connectivity Technologies:** IEEE 802.15.4, Zigbee, Thread, WiFi, Bluetooth, LoRa, NB -IoT, RFID, NFC, Sigfox, Z-Wave, Cellular Network (4G LTE, 5G).	9
4	**IoT Communication Protocols:** Infrastructure Protocols- IPv6, RPL, LoWPAN, Data Protocols- MQTT, CoAP, AMQP, XMPP, SOAP, REST, WebSocket. Discovery Protocols- Physical Web, Multicast DNS, Universal Plug and Play. IoT Interoperability Standards and Frameworks.	8
5	**Associated IoT Technologies:** Introduction to SDN, SDN for IoT**,** Cloud Computing, Virtualization, Cloud Models, Cloud Implementation, Fog Computing.	8
6	**Case study of IoT Applications:** Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Agriculture, Healthcare, Activity Monitoring.	9
	Total	**45**

Text Books:

1. S. Misra, A. Mukherjee, and A. Roy, Introduction to IoT, Cambridge University Press, 2021.
2. S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0, CRC Press, 2020.
3. A. Bahga and V. Madisetti, Internet of Things: A Hands-On Approach, Orient Blackswan Private Limited, New Delhi, 2019.

Reference Books:

1. R. Buyya and A. V. Dastjerdi, Eds., Internet of Things: Principles and Paradigms. Elsevier, 2016.
2. D. Hanes, G. Salgueiro, P. Grossetete, R. Barton, and J. Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things. Cisco Press, 2017.
3. S. Greengard, The Internet of Things, Revised ed. MIT Press, 2021.

Prerequisite:

1. Fundamental Knowledge: Understanding basic electronics, programming, and data structures is essential.
2. Networking and Communication: Grasp networking concepts, wireless technologies, and IoT communication protocols effectively.
3. Cloud and Edge Computing: Know cloud computing, virtualization, and Software-Defined Networking for deployment.

Name of the Programme: M.Tech. in Computer Science and Engineering	**Year**: I	**Semester**: II
Course Name: Soft Computing	**Course Code**: CSPL213	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:**3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Introduction to soft computing:** Difference between Hard and Soft Computing, Requirement of Soft Computing, Major Areas of Soft Computing, Various Types of Soft Computing Techniques, Applications of Soft Computing	8
3	**Fuzzy Logic Systems:** Fuzzy Set Theory, Fuzzy Set versus Crisp Set, Crisp Relations & Fuzzy Relations, Introduction & Features of Membership Functions, Crisp Logic, Fuzzy Logic, Fuzzy Propositions, Fuzzy Implications, Fuzzy Inferences, Decomposition & Aggregation of Fuzzy Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Defuzzification Techniques-I, Defuzzification Techniques-II, Fuzzy Logic Controller-I, Fuzzy Logic Controller-II, Applications of Fuzzy Logic	11
4	**Genetic algorithm (GA):** Concepts of GA, Solving Optimization Problems, GA Operations: Encoding, GA Operators: Selection-I, GA Operators: Selection-II, GA Operators: Crossover-I, GA Operators: Crossover-II, GA Operators: Mutation	9
5	**Evolutionary Computation (EC):** EC-I, EC-II, Multi-Objective Evolutionary Algorithm (MOEA) Approaches: Non-Pareto, MOEA Approaches: Pareto-1, MOEA Approaches: Pareto-II	8
6	**Advanced Topics in Soft Computing:** Hybrid Soft Computing Techniques, Soft Computing in Data Mining, Applications of Soft Computing in Machine Learning, Challenges and Future Directions in Soft Computing, Comparative Analysis of Soft Computing Techniques	8
	Total	**45**

Text Books:

1. S. N. Sivanandam and S. N. Deepa, Principles of Soft Computing, 2nd ed. Wiley Publications, 2011.
2. S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications, 1st ed. PHI Learning, 2009.
3. C. T. Lin and C. S. G. Lee, Neuro-Fuzzy Systems. PHI Learning, 2011.

Reference Books:

1. N. K. Bose and P. Liang, Neural Network Fundamentals with Graphs, Algorithms & Applications, 1st ed. Tata McGraw-Hill, 1998.
2. B. Kosko, Neural Networks and Fuzzy Systems, 1st ed. Prentice Hall of India, 2009.
3. E. Rich and K. Knight, Artificial Intelligence, 3rd ed. Tata McGraw-Hill, 2012.
4. M. T. Hagen, Neural Network Design, 2nd ed. Nelson Canada, 2008.

Prerequisite:

1. Basic knowledge of computing, programming, and algorithms.
2. Understanding of mathematical concepts such as linear algebra, calculus, and probability.
3. Basic concepts of AI, including machine learning and neural networks

Name of the Programme: M.Tech. in Computer Science and Engineering	**Year**: I	**Semester**: II
Course Name: Natural Language Processing and Information Retrieval	**Course Code**: CSPL214	**Credit**: 3
Max Marks: 100	**CIE:** 40	**SEE:** 60
End Term Exam Time: 3 Hrs	**Teaching Scheme:** 3L+0T+0P	

Module No.	Contents	Hours
1	**Introduction:** Objective, Scope, Outcome of the Course and Prerequisite	1
2	**Introduction to Natural Language Processing (NLP):** Conepts, Applications, Ambiguities in language, Empirical Laws-Heap's law, Ziff's Law, Type Token Ratio, Text Preprocessing Basics-Word Tokenization and Segmentation, Lemmatization, Stemming, Term Weighting	8
3	**Language Models and Morphology:** Language Model, Computational Morphology, finite State Methods for Morphology, Part of Speech Tagging, Hidden Markov Model, Viterbi Decoding for HMM, Maximum Entropy, Conditional Random Field, Named Entity Recognition, Keyphrase Extraction	9
4	**Syntax and Parsing:** Syntax, Parsing-Top-Down Parsing, Bottom UP Parsing, CKY Parsing, Earley Parsing, Probabilistic Context free Parsing (PCFG), Inside-Outside Probabilities, Grammar, Transition Based Parsing, MST-Based Dependency Parsing	9
5	**Semantic Analysis:** WordNet, Wordnet Similarity, Lexical Relations, Word Sense Disambiguation, Distributional Sementics, Sementic Relatedness, Word Vectors, SVD, Word Embeddings, Vector offsets for Analogy Reasoning, CBow, SkipGram, Cohesion, Reference Resolution, Discourse Cohesion	9
6	**Information Retrieval:** Information Retrieval, Design Features, Models-Classical, Non-Classical, Alternate Models, Inverted Index, Querying Using Inverted Index, Web Scrapping, Data Set Generation and Validation Evaluation of IR System, Relation between IR and NLP	9
	Total	**45**

Text Books:

1. D. Jurafsky and J. H. Martin, Speech and Language Processing, 3rd ed. Pearson Education, 2018.
2. C. D. Manning and H. Schütze, Foundations of Statistical Natural Language Processing. MIT Press, 2020.
3. U. S. Tiwary and T. Siddiqui, Natural Language Processing and Information Retrieval. Oxford University Press, 2008.
4. G. J. Kowalski and M. T. Maybury, Information Storage and Retrieval Systems: Theory and Implementation. Springer, 2000.

Reference Books:

1. C. D. Manning, P. Raghavan, and H. Schütze, An Introduction to Information Retrieval, Cambridge University Press, 2009.
2. R. M. Reese, Natural Language Processing with Java, O'Reilly Media, 2015.
3. R. Mitkov, Ed., The Oxford Handbook of Computational Linguistics, MIT Press, 2021.
4. S. Vajjala, B. Majumder, A. Gupta, and H. Surana, Practical Natural Language Processing, 1st ed. O'Reilly Media, 2020.
5. G. J. Kowalski and M. T. Maybury, Information Storage and Retrieval Systems: Theory and Implementation, Springer, 2004.

Prerequisite:

1. Familiarity with machine learning algorithms and information retrieval models enhances understanding of NLP applications effectively.
2. Strong understanding of probability, statistics, and basic linguistic concepts is crucial for NLP.
3. Proficiency in Python and data preprocessing techniques like tokenization and lemmatization are essential.

Name of the Programme: M.Tech. in Computer Science and Engineering	**Year**: I	**Semester**: II
Course Name: High Performance Computing Lab	**Course Code**: CSPP230	**Credit**: 2
Max Marks: 100	**CIE:** 60	**SEE:** 40
End Term Exam Time: 2 Hrs	**Teaching Scheme:** 0L+0T+3P	

SN	List of Experiments
The laboratory will require systems with OpenMP installed. The students will be encouraged to configure the system. In the beginning, the students may undertake the following preliminary exercises as below:	
1	Analysis of Parallel Algorithms
2	Implementation using OpenMP
3	GPU kernel implementation for the given application.
4	Performance analysis using GPU memories.
5	Kernel reduction.
6	Profiling an application
Once the students are well versed in the environment, the exercises on the following may be taken. Datasets may be downloaded and used for the exercises:	
8	Multiplication of Huge Matrices using CUDA
9	Sorting large data sets
10	Text Processing
11	Video Processing/ Image Analysis using CUDA

Text Books:

1. D. H. Bailey and J. G. Swidenbank, Parallel Computing: Theory and Practice. Cambridge University Press, 2018.
2. B. J. DeSantis, OpenMP: An Industry Standard for Shared Memory Parallel Programming. MIT Press, 2020.
3. W. J. Dally and J. A. Poulton, Digital Design: A Systems Perspective. Morgan Kaufmann, 2019.

Reference Books:

1. K. A. Yelick and J. A. Bennett, Introduction to High-Performance Computing for Scientists and Engineers. CRC Press, 2016.
2. J. A. Fisher, CUDA Programming: A Developer's Guide to Parallel Computing with GPUs. Morgan Kaufmann, 2018.
3. H. H. Huang, GPU Computing Gems: Emerald Edition. Morgan Kaufmann, 2012.

Prerequisites:

1. Understanding of parallel computing concepts, including threads and synchronization.
2. Basic knowledge of algorithms and data structures.

Name of the Programme: M.Tech. in Computer Science and Engineering	**Year**: I	**Semester**: II
Course Name: IoT based System Design Lab	**Course Code**: CSPP231	**Credit**: 2
Max Marks: 100	**CIE:** 60	**SEE:** 40
End Term Exam Time:2Hrs	**Teaching Scheme:0L+0T+4P**	

SN	List of Experiments
1	To simulate & design an 8x8 Led matrix using an ESP32 controller.
2	To simulate & design a stepper motor driver using Embedded C programming.
3	To design a temperature controller using Python and trigger room fan according to temperature range using Raspberry Pi.
4	Study and implement MQTT protocol using Raspberry Pi.
5	Interface a 16×2 LCD using I2C protocol with the Raspberry Pi.
6	Design a system using Arduino to monitor Soil Moisture.
7	Write a program in Python to drive a servo motor at different angles, starting from 30 degrees and ending around 180 degrees. Also, provide negative angle rotation using different delays on the Raspberry Pi.
8	Design a real-time clock circuit (RTC) using ESP32.
9	Design a system using Arduino that blinks an LED when you detect a motion in an area using a PIR sensor.
10	Design a system using Arduino to measure the distance of an object using an Ultrasonic sensor and trigger an object for a particular distance.

Text Books:

1. M. McKinney, *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython*. O'Reilly Media, 2018.
2. D. J. Steinberg, *Programming Embedded Systems: With C and GNU Development Tools*. O'Reilly Media, 2016.
3. B. J. H. Johnson and H. F. O. R. Shill, *Arduino: A Quick-Start Guide*. Apress, 2018.

Reference Books:

1. W. W. Gay, Mastering the Raspberry Pi. Apress, 2014.
2. G. J. M. Hart, *Hands-On MQTT: A Beginner's Guide to MQTT Protocol with Real-Time IoT Applications*. Packt Publishing, 2020.

Prerequisites:

1. Basic knowledge of Python and Embedded C programming.
2. Understanding of microcontroller concepts and interfacing techniques.
3. Familiarity with electronic components and circuits for project design.