



Karmaveer Bhaurao Patil University, Satara

**Syllabus for
M. Sc. II Computer Science**

**Under
Faculty of Science and Technology
(As per NEP 2020)**

With effect from Academic Year 2025-2026

Syllabus for Master of Science Part – II Computer Science

Preamble:

As per the NEP 2020 guidelines this updated syllabus is prepared for first year undergraduate students of Computer Science. Master of Science is an integrated academic degree in faculty of science. This is endeavor to initiate the process towards an era of knowledge. The students from science faculty should also be competent for this change in the technology. In this year, a student will able to understand Computer languages and technologies to build software with confidence. In the subject, the student will also get a basic and proper knowledge in the field of Artificial Intelligence and IOT.

General objectives of the course:

1. To gain advanced knowledge in key areas of computer science.
2. To develop the ability to do research and find new solutions to computing problems.
3. To improve problem-solving and analytical thinking skills.
4. To build strong practical and technical skills in programming and technology.
5. To understand and follow ethical and professional standards in computing.
6. To communicate ideas clearly and work well in teams.
7. To prepare for a career in the tech industry or further academic study.

Programme objectives

1. Provide students with a deep understanding of core areas in computer science such as algorithms, software engineering, artificial intelligence, data science, networking, and systems.
2. Enable students to apply theoretical foundations and practical techniques to solve complex computing problems.
3. Equip students with research skills for contributing to academic and industrial research.
4. Develop the ability to effectively communicate complex technical information to both technical and non-technical audiences.

Programme outcomes

After completing the M.Sc. program, graduates will:

1. Understand the fundamentals and advancements of Subject.
2. Study, plan and conduct experiments in the labs to validate the ideas principles and theories acquired in the classrooms.
3. Enhance scientific knowledge of the subject.
4. Define their area of focus in academia, research and development.
5. Pursue careers in various fields such as science, engineering, education, banking, business, public service etc. or become an entrepreneur with precision, analytical thinking, innovative ideas, clarity through, expression, and systematic approach.

Programme specific outcomes

After completing the M.Sc. (Computer Science) program, students will:

1. Understand the basics and advances topics of Computer Science.
2. Apply their programming knowledge to plan and perform experiments in the computer labs to prove the ideas, values and theories learned in the classrooms.
3. Prepare the students to take up career in highly competitive IT industry with research and development skills acquired through major project.
4. Design and develop computer programs in the area related to algorithms, networking, web design, cloud computing and artificial intelligence.
5. Provide freedom to choose subject of interest from the list of specialized courses and to allow the students to follow the career path they have dreamt of.

1. TITLE: **Computer Science**

2. YEAR OF IMPLEMENTATION: **2025-2026**

3. DURATION: **01 year**

4. PATTERN: **Semester examination**

5. MEDIUM OF INSTRUCTION: **English**

6. Structure of Course

Level	Sem	Major				RM	OJT	RP	Total
		DSC Mandatory		DSE Elective					
		T	P	T	P				
6	I	12 (3 Papers)	2	2 (1 paper out of two)	2	4	--	---	22
	II	12 (3 Papers)	2	2 (1 paper out of two)	2	---	--	4	22
6.5	III	12 (3 Papers)	2	2 (1 paper out of two)	-	---	--	6	22
	IV	12 (3 Papers)	2	2 (1 paper out of two)	2	---	4	---	22
Total		48	8	8	6	4	4	10	88
		70				8		10	88

DSE- 1 Paper out of two for each semester.

COURSE TITLE:**Semester III**

Nature of course	Paper Code	Paper Title	No. of Hours per week	credit
Theory	MCST 531	Emerging Technologies in Computer Science	4	4
	MCST 532	Data Mining	4	4
	MCST 533	Data Visualization using Tools	4	4
	MCST 534 EI	Artificial Intelligence	2	2
	MCST 534 E II	Fundamentals of IOT		
Practical	MCSP 535	Practical Lab V	4	2
	MCSP 536	Research Project	12	6

Semester IV

Nature of course	Paper Code	Paper Title	No. of Hours per week	credit
Theory	MCST 541	Big Data Analytics	4	4
	MCST 542	Machine Learning	4	4
	MCST 543	Deep Learning	4	4
	MCST 544 EI	Soft Computing	2	2
	MCST 544 E II	Microcontrollers for IOT		
Practical	MCSP 545	Practical Lab – VI	4	2
	MCSP 546	Practical Lab – VII	4	2
	MCSP 547	On Job Training		4

7. EVALUATION PATTERN:

Semester III

Course	Course Category	Course Code	Internal Evaluation			Activity	ESE	Total Marks	Credits
			CCE-I	Mid-Semester	CCE-II				
DSC	T	MCST 531	10	10	10	10	60	100	04
	T	MCST 532	10	10	10	10	60	100	04
	T	MCST 533	10	10	10	10	60	100	04
	P	MCSP 535	--	--	--	--	50	50	02
DSE (1 Theory Papers Out of Two)	T	MCST 534	05	05	05	05	30	50	02
	T	MCST 534	05	05	05	05	30	50	02
RP	P	MCSP 536	--	--	--	--	150	150	06
Total								550	22

- Semester IV

Course	Course Category	Course Code	Internal Evaluation			Activity	ESE	Total Marks	Credits
			CCE-I	Mid-Semester	CCE-II				
DSC	T	MCST 541	10	10	10	10	60	100	04
	T	MCST 542	10	10	10	10	60	100	04
	T	MCST 543	10	10	10	10	60	100	04
	P	MCSP 545	--	--	--	--	50	50	02
DSE (1 Theory Papers Out of Two)	T	MCST 544	05	05	05	05	30	50	02
	T	MCST 544	05	05	05	05	30	50	02
	P	MCSP 546	--	--	--	--	50	50	02
OJT	P	MCSP 547	--	--	--	--	100	100	04
Total								550	22

DSC: Discipline Specific Course; DSE: Discipline Specific Elective RM: Research Methodology; OJT: On Job Training; RP: Research Project; T: Theory; P: Practical

M. Sc. Part II, Semester III, Computer Science

MCST 531(DSC I): Emerging Technologies in Computer Science -Total Credits: 4

Course Objectives: Student should able to...

1. Learn the algorithms and to learn basic analysis techniques and understand the use of asymptotic notation.
2. Understand different design strategies and greedy method.
3. Identify classical problem and solutions and learn a variety of useful algorithms understand classification of problems
4. Explain the purpose and advantages of using AngularJS in modern web development.

Unit	Content	No. of hours
I	Angular Java Script Basics	15
	1.1 Introduction to Angular JS – advantages, disadvantages, History and background, Features, Why Angular JS, 1.2 Setting Up Angular JS Environment- Installing AngularJS, Project structure, Hello World example 1.3 Introduction to Angular JS Directives- Understanding directives, ng-app, ng-model, ng-bind, etc., Creating custom directives 1.4 MVC-The Angular JS way, Features of Angular JS, Model-View-Controller, 1.5 My First Angular JS app, 1.6 All about Angular Expressions, 1.7 How to use expressions, 1.8 Angular vs JavaScript	
II	Filters and Directives	15
	2.1 Understanding the role of filters in AngularJS, Overview of built-in filters such as currency, date, uppercase, lowercase, etc. 2.3 Built-In Filters- Demonstrating the usage of built-in filters with examples, Applying filters to expressions in templates 2.3 Using Angular JS Filters- Overview of custom filters, Writing custom filter functions, Registering custom filters with AngularJS, Creating Custom Filters, 2.4 Directives in AngularJS- Introduction to directives, Understanding the directive syntax: restrict, template, scope, etc. 2.5 Directive Lifecycle, 2.6 Binding controls to data, 2.7 Matching directives, 2.8 Using Angular JS built-in directives 2.9 Creating a custom directive.	

III	Controllers and modules	15
	3.1 Introduction to Controllers and Modules- Overview of software architecture, Importance of modularity in software design, Principles of encapsulation and abstraction, Role of a Controller, 3.2 Design Patterns for Controllers and Modules- Common design patterns (e.g., MVC, MVVM), Application of design patterns to controllers and modules, Pros and cons of different design patterns 3.3 Attaching Properties and functions to scope, 3.4 Nested Controllers, 3.5 Using Filters in Controllers 3.6 Controllers in External Files 3.7 Introduction to Angular JS Modules 3.8 Bootstrapping Angular JS 3.9 MongoDB Relational vs NoSQL DB, MongoDB fundamentals, Data modeling, Aggregation pipeline, Grid FS, Performance	
IV	Angular Java Script Forms and Bootstrap	15
	4.1 Overview of Angular JS- Overview of Bootstrap, Setting up Angular JS and Bootstrap in a project 4.2 Working with Angular Forms- Creating Basic Forms, Form Validation, Custom Validation, Angular JS Form Events, Handling Form Submission 4.3 Model Binding 4.4 Forms Events 4.5 Form Controller, 4.6 Validating Angular Forms, 4.7 \$error object 4.8 Bootstrap: Bootstrap - Overview Environment Setup, Grid System, Typography, Code, Tables, Forms, Buttons, Badges and Labels, Progress Bars, List Groups, Panels, Dropdowns, Images, Helper Classes, Responsive utilities, navigation, modals, image Carousels	

Course Outcome: After completion of syllabus, student will be able to...

1. Used client-side JavaScript frameworks with a focus on the Angular framework to build dynamic web applications.
2. Implemented various Angular features such as directives, components, and services to enhance application functionality and structure.
3. Developed a functional front-end web application using Angular, integrating routing, data binding, and reusable components.
4. Enhanced problem-solving and self-learning capabilities through the independent application of Angular concepts to real-world scenarios.

References

1. Seshadri S. A. Up and Running: Learning Angular, Step by Step, 2018
2. Rungta K., Learn AngularJS in 1 Day: Complete Angular JS Guide with

Examples, Kindle Edition, 2016

3. Hussain A., Angular 5: From Theory to Practice, Kindle Edition 2017.
4. Uluca D., Angular 6 for Enterprise-Ready Web Applications, Kindle Edition 2017.
5. Lukas Ruebbelke. AngularJS in Action. Manning Publications, 2015.
6. Ken Williamson. “Learning AngularJS: A Guide to AngularJS Development.” O'Reilly Media, 2015.
7. Matt Frisbie. “AngularJS Web Application Development Cookbook.” Packt Publishing, 2014.

MCST 532 (DSC II): Data Mining -Total Credits: 4

Course Objectives: Student will be able to...

- 1) Understand the basics of Data Mining programming
- 2) Study facilities for performing data mining with Python packages
- 3) Learn python functionalities and features used for data mining
- 4) Explore Data analysis and Data Visualization using Python

Unit	Content	No. of hours
I	Data Mining	15
	1.1 Introduction of Data mining -Definition and Scope of Data Mining, Data Mining Process, Data Mining Techniques and Applications, Ethical and Privacy Issues in Data Mining 1.2 Data Mining issues, 1.3 Stages of the Data Mining Process (KDD), 1.4 Data Mining Techniques/Tasks, 1.5 Knowledge Representation Methods, 1.6 Applications of Data mining, 1.7 Data Pre-processing, 1.8 Data Cleaning, 1.9 Data Transformation,	
II	Data Warehousing	15
	2.1 Introduction to Data Warehouse- Definition and Scope of Data Warehousing, Data Warehousing Architecture, Types of Data Warehousing Systems, Data Warehousing Trends and Challenges Data Warehouse Architecture and its components, 2.2 Data Modeling with OLAP, 2.3 Difference between OLTP and OLAP, 2.4 Data Mart, Fact Table, 2.5 Dimension Table, OLAP cube, 2.6 Different OLAP Operations, Schema Design, 2.7 Dimensional Modeling Techniques - Introduction to 2.8 Dimensional Modeling, Star Schema Design, Snowflake Schema Design, Conformed Dimensions, Junk Dimensions and Degenerate Dimensions 2.9 Introduction to Machine Learning, Introduction to Pattern Matching, Case study based on Schema Design	

III	Classification in Data Mining	15
	3.1 Introduction- Definition and Scope of Classification, Types of Data in Classification, Classification Process Overview, Evaluation Metrics for Classification Models, Challenges and Ethical Issues in Classification 3.2 Decision Tree, Construction Principle, Attribute Selection Measures 3.3 Tree Pruning, Rule-Based Classification, 3.4 Using IF-THEN Rules for Classification 3.5 Rule Extraction from a Decision Tree 3.6 Bayes Classification Methods, Bayes' Theorem, Naive Bayesian Classification, Bayesian Networks, 3.7 Parameter and structure learning,	
IV	Clustering and Association Rule Mining	15
	4.1 Cluster Analysis, Introduction- Definition and Importance of Clustering, Types of Clustering Algorithms, Applications of Clustering, Definition and Importance of Association Rule Mining, 4.2 Applications of Association Rule Mining Requirements for Cluster Analysis, 4.3 Hierarchical Methods, Agglomerative Hierarchical Clustering, Divisive Hierarchical Clustering, 4.4 Partitioning Methods, k-Means: 4.5 A Centroid-Based Technique, k-Medoids: 4.6 A Representative Object-Based Technique, Introduction to Association Rule Mining 4.7 Market Basket Analysis, 4.8 Items, Item sets and Large Item sets 4.9 Apriori Algorithm, Kinds of Association Rules, Mining Multilevel association rules	

Course Outcome: After completion of syllabus, student will be able to...

1. Implement data mining tasks using Python
2. Use the python packages to carry out data mining tasks.
3. Perform data analysis and data visualization using python packages.
4. Perform Cluster Analysis using python packages.

References

1. Jiawei H. and Micheline Kamber, ELSEVIER, "Data Mining Concepts and Techniques", Third Edition, 2011.
2. Zhao Y, Elsevier Inc, "R and Data Mining" ISBN-10: 0123969638, 2013.
3. Jiawei H. and Micheline Kamber, ELSEVIER, "Data Mining Concepts and Techniques", Third Edition, 2011.
4. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, Morgan Kaufmann, 2022.
5. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, Introduction to Data

Mining, Pearson, 2018.

6. Ian H. Witten, Eibe Frank, Mark A. Hall, Christopher J. Pal, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, 2023.
7. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, Mining of Massive Datasets, Cambridge University Press, 2020.

MCST 533 (DSC III): Data Visualization using Tools -Total Credits: 4

Course Objectives: Student will able to...

- 1) Understand and critically apply the concepts and methods of business analytics
- 2) Identify, model, and solve decision problems in different settings
- 3) Interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity
- 4) Create viable solutions to decision making problems

Unit	Content	No. of hours
I	Tableau Software	15
	1.1 Understanding Data , 1.2 Introduction- Overview of Tableau, Importance of Data Visualization, Installation and Setup 1.3 What is data & Where to find data , 1.4 Foundations for building Data Visualizations , 1.5 Creating Your First visualization 1.6 Getting started with Tableau Software Using Data file formats Connecting your Data to Tableau Creating basic charts (line,bar charts, Treemaps) using the Show me panel	
II	Tableau Calculations & Visualization and Data Manipulation	15
	2.1 Overview of SUM, 2.2 AVR, and Aggregate features 2.3 Creating custom calculations and fields 2.4 Applying new data calculations to your visualization 2.5 Formatting Visualizations Formatting Tools and Menus 2.6 Formatting specific parts of the view Editing and Formatting Axes, 2.7 Cleaning – up the data with the Data Interpreter Structuring your data Sorting and filtering Table audata Pivoting Tableau data	

III	Advanced Tableau Visualizations	15
	3.1 Tableau Interface Overview, Connecting to Data Sources, Dimensions and Measures, Marks and Filters, Introduction to Dashboards, Combining Sheets into Dashboards, Dashboard Layout and Formatting, Dashboard Actions and Interactivity 3.2 Using Filters 3.3 Using the Detail panel 3.4 Using the Size panels Customizing filters 3.5 Using and Customizing tool tips 3.6 Formatting your data with colors	
IV	Dashboards and Storytelling and Publishing your Visualization	15
	4.1 Using Story telling Creating your first dashboard and Story, Design for different displays Adding inter activity to yourDashboard, 4.2 Tableau File Types, 4.3 Publishing to Tableau Online, 4.4 Sharing your Visualization. 4.5 Principles of Effective Storytelling with Data 4.6 Designing Story-driven Dashboards 4.7 Publishing Your Visualization: Tableau Public, Power BI Service Presentation of Visualization Project	

Course Outcome: After completion of syllabus, student will be able to...

1. Identify and describe complex business problems in terms of analytical models.
2. Apply appropriate analytical methods to find solutions to business problems that achieve stated objectives.
3. Demonstrate ethical decision-making in structured or unstructured and ambiguous situations.
4. Communicate technical information to both technical and non-technical audiences in speech, in writing, and graphically.

References

1. Alexander Loth .M, John Willie and Sons Visual Analytics with Tableau 1st Edition
2. Master Oreilly. Z, Media Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau
3. Milligan. N. J. Learning Tableau: Create effective data visualizations, build interactive visual analytics, and transform your organization, 4th Edition, 2020
4. Ben Fry, Visualizing Data: Exploring and Explaining Data with the Processing Environment, O'Reilly Media, 2008.
5. Nathan Yau, Data Points: Visualization That Means Something, Wiley, 2013.
6. Alberto Cairo, The Truthful Art: Data, Charts, and Maps for Communication, New Riders, 2016.
7. Cole Nussbaumer Knaflic, Storytelling with Data: A Data Visualization Guide for Business Professionals, Wiley, 2015.
8. Andy Kirk, Data Visualisation: A Handbook for Data Driven Design, Sage Publications, 2016.
9. Tamara Munzner, Visualization Analysis and Design, A K Peters/CRC Press, 2014.

MCST 534 (DSE I): Artificial Intelligence -Total Credits: 2

Course Objectives: Student will able to...

- 1) Gain a historical perspective of AI and its foundations.
- 2) Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- 3) Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
- 4) Experience AI development tools such as an „AI language“, expert system shell, and/or data mining tool.

Unit	Content	No. of hour
I	Fundamentals of AI	8
	1.1 Artificial Intelligence, AI Problems, 1.2 AI Techniques, The Level of the Model, 1.3 Criteria For Success. Defining the Problem as a State Space Search, Problem Characteristics, 1.4 Search and Game Playing: Breadth first search, depth first search, hill climbing, heuristic search, Best first search, 1.5 A* algorithm, AO* algorithm, 1.6 Minmax & game trees, refining minmax, Alpha –Beta pruning, 1.7 Constraint satisfaction. AI and python programming.	
II	Knowledge Representation	7
	2.1 Introduction, Propositional Logic, Syntax and Semantics, 2.2 Interpretations, Properties, Predicate Calculus, 2.3 WFF, Free and Bound Variables, 2.4 Normal Forms, Inference Techniques, 2.5 Resolution, Unification, Modes Pones, 2.6 Frames, Frame Representation Language, 2.7 Conceptual Dependency, CD Theory, Script, 2.8 Semantic Net, Conceptual Graph, Rule Based Representation, 2.9 Forward and Backward Reasoning	
III	Neural Networks	7
	3.1 Introduction, Basic Concepts of Neural Networks, 3.2 Model of an Artificial Neuron, Activation Functions, 3.3 Feedforward Network, Recurrent Network, 3.4 Learning Methods, 3.5 Deep learning and deep neural network. 3.6 Fuzzy Set Theory, Fuzzy Membership, 3.7 Fuzzy Operations, 3.8 Fuzzy Logic Systems	

IV	Natural Language Processing	8
	4.1 Introduction, Syntactic Processing, Semantic Analysis, 4.2 Discourse and Pragmatic Processing. Genetic Algorithm: Genetic Algorithm (GA), Genetic Representations, 4.3 (Encoding) Initialization and Selection, 4.4 Different Operators of GA, 4.5 Analysis of Selection Operations, 4.6 The Hypothesis of Building Blocks, 4.7 Schema Theorem and Convergence of Genetic Algorithm,	

Course Outcome: After completion of syllabus, student will be able to...

1. Apply problem solving by intelligent search approach.
2. Represent knowledge using AI techniques.
3. Design Machine learning solution to real life problems and solutions to Uncertainty using Fuzzy Theory.
4. Define a NLP problem and find a suitable solution to it and to develop a good understanding of all.

References

1. Hill M. T., Elaine Rich and Kelvin Knight, Artificial Intelligence, 2002.
2. Francisco.S., California, Nils J Nilson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann Publishers, Inc., 2000.
3. Akerkar R., Introduction to Artificial Intelligence, Prentice-Hall of India, 2005
4. Winston. H. P., "Artificial Intelligence", Addison Wesley (1993)
5. Yegnanarayana. B., Artificial Neural Networks, Prentice-Hall of India, 2006
6. Vijayalakshmi Pai. A. G. Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, , Prentice-Hall of India, 2003
7. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson, 2021.
8. Elaine Rich, Kevin Knight, Shivashankar B. Nair, Artificial Intelligence, McGraw Hill Education, 2019.
9. Nils J. Nilsson, The Quest for Artificial Intelligence: A History of Ideas and Achievements, Cambridge University Press, 2009.
10. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson, 2008.

MCST 534(DSE II): Fundamentals of IOT -Total Credits: 2

Course Objectives: Student will be able to...

1. Study fundamental concepts of IoT
2. Understand roles of sensors in IoT
3. Study of different protocols used for IoT design
4. Understand data handling and analytics tools in IoT

Unit	Content	No. of hours
I	Essentials of IOT	8
	1.1 Introduction, Definitions & Characteristics of IoT, IoT , Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, 1.2 History of IoT, About Things in IoT, 1.3 The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M. 1.4 Home Automation, Smart Cities, Energy, 1.5 Retail Management, Logistics, Agriculture, Health and Lifestyle, 1.6 Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.	
II	Sensor Networks	7
	2.1 Definition, Types of Sensors, 2.2 Types of Actuators, Examples and Working, 2.3 IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, 2.4 RFID Principles and components 2.5 Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT. 2.6 WPAN Technologies for IoT: IEEE 802.15.4, 2.7 Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus. IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. 2.8 Edge connectivity and protocols	
III	Wireless technologies for IOT	7
	3.1 WPAN Technologies for IoT: IEEE 802.15.4, 3.2 Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus. 3.3 IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. 3.4 Edge connectivity and protocols	

IV	Applications of IOT	8
	4.1 Home Automation, Smart Cities, Energy, 4.2 Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, 4.3 IoT design Ethics, 4.4 IoT in Environmental Protection	

Course Outcome: After completion of syllabus, student will be able to:

1. Understand the various concepts, terminologies, and architecture of IoT systems.
2. Use sensors and actuators for design of IoT.
3. Understand and apply various protocols for design of IoT systems
4. Use various techniques of data storage and analytics in IoT.

References

1. 'Internet of Things – From Research and Innovation to Market Deployment', Peter Friess, River Publishers, 2014.
2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, VPT, 2014.
3. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley, 2014.
4. Raj Kamal, Internet of Things: Architecture and Design Principles, McGraw Hill Education, 2017.
5. Pethuru Raj, Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press, 2017.
6. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley, 2021.
7. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatios Karnouskos, Stefan Avesand, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Academic Press, 2014.

MCSP 536 Lab V (DSC IV): Practical based MCST 531, 532, 533 - Total Credits: 2

Course Objectives: Student will be able to...

1. Understand how to implement different algorithms.
2. Use the basics of SQL and construct queries using SQL.
3. Study the basics of Computer Networks
4. Understand implementation of Object-Oriented concepts.

Sr. No	Content	No. of hours
1.	Creating Project, Formatting Data	60
2.	Create Form to edit your data	
3.	Operations on Form – Binding, Saving, Validation, Refactor.	
4.	Create simple Testing Angular application.	
5.	AngularJS: Declaring properties and methods in a controller	
6.	Binding to properties and expressions in an AngularJS template, creating views and controllers and how to test them.	
7.	Directives uses in Angello	
8.	Write a program demonstrating NodeJs application.	
9.	Error handling in NodeJs.	
10.	Express.js Installation	
11.	Develop Website : Saving Time with Express	
12.	Quality Assurance: Page Testing	
13.	Classification – Decision tree a. Conversion of Categorical values in numeric format for a given dataset. b. Perform Classification using Decision Tree algorithm	
14.	Association Rules and Clustering (Using inbuilt Data set Regression Analysis and Outlier detection a. Perform Regression Analysis. b. Perform Linear Regression.	
15.	Python programs for Clustering a. Write a python program to implement k-nearest Neighbors ML. b. Write algorithm to build prediction model (Use Forge Dataset) c. Write a python program to implement k-means algorithms on a synthetic database.	
16.	Introduction Of Tableau GUI	
17.	Create Bar Chart Using Given Data	
18.	Create line Chart Using Given Data	
19.	Create Tree map Using Given Data	
20.	Create Application for Data Sorting.	
21.	Create Application for Data Filtering	
22.	Create Dash Board	

Course Outcomes: After completion of syllabus, student will be able to:

1. Understand and implement different algorithms.
2. apply cryptographic algorithms of encryption and description
3. Perform the programs on Classes and Objects to implement Object Oriented concepts.
4. Study of cursor, trigger and database.

References

1. Horowitz E., Sahni S. & S. Rajasekaran, “Computer algorithms”, Silicon Pr Publication, 2007.
2. Cormen .T., Leiserson .C., & R. Rivest, “Introduction to Algorithms”, MIT Press, 2009.
3. Skiena S., “The Algorithm Manual”, Springer, 2020.
4. Shukla K. R., “Analysis and Design of Algorithms: A Beginner's Approach”, Wiley, 2025.
5. Scott. L. M., “Programming Language Pragmatics”, Kaufmann Publishers, An Imprint of Elsevier, USA, 2025.
6. Sebesta W. R., “Concepts of Programming Languages”, Eighth Edition, Pearson Education, 2026.
7. Chopra R., “Principles of Programming Languages”, I K International Publishing House, 2024.
8. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Third Edition, - Pearson Education, 2008.

MCSP 536: Research Project -Total Credits: 6

Students will undertake research in specific area of his Major/Core with an advisory supported by a teacher/Faculty member. Students are required to take 6 credit Research Project for semester III under the guidance of faculty members.

Credit 6	Content	No. of hours
4	Project Work: Topic Applicability Practical work and result Presentation of Dissertation Publication	120
2	Research training	60

M. Sc. Part II, Semester IV, Computer Science
MCST 541(DSC V): Big Data Analytics -Total Credits: 4

Course Objectives: Student will be able to...

1. Understand the Big Data challenges & opportunities, its applications
2. study of concepts of map and reduce and functional programming
3. Understand conceptual understanding of Hadoop Distributed File System.
4. Understand the gap between academics and industry needs.

Unit	Content	No. of hours per unit
I	Big Data Essentials	15
	1.1 Big Data: - Definition and characteristics of big data, Importance and applications of big data analytics, Challenges in big data analytics Sources of Big Data, 3V's of Big Data (need for Hadoop), Varying data structures, 1.2 Characteristics of Big Data, Applications of Big Data, Challenges in Big Data, 1.3 Big Data Analytics for – 1.4 Telecom/Banking/Retail/HealthCare/IT/Operations, RDBMS Vs Non-Relational Database	
II	Application Architecture & Data Modelling For Big Data And Analytics	15
	2.1 Big Data Warehouse & Analytics, Big data Warehouse System requirements & Hybrid Architectures, 2.2 Enterprise Data Platform Ecosystem, Big Data and Master Data Management, understanding data integration Pattern, 2.3 Big Data Workload Design Approaches, 2.4 Map-Reduce patterns, Algorithms and Use Cases	
III	Hadoop Ecosystem	15
	3.1 Introduction to Hadoop- Big Data Technologies, Introduction to Hadoop ecosystem 3.2 MapReduce programming model 3.3 Apache Spark framework Hadoop Architecture, 3.4 History of Hadoop-Facebook, Dynamo, Yahoo, Google 3.5 Hadoop Components: HDFS, Map reduce, Introduction to Pig, Hive, HBase, Mahout, Installation of single node cluster-installation of java Hadoop configuration	

IV	Big Data Analytics Methodology	15
	4.1 Big Data Analytics Methodology-Analyze & evaluate business case 4.2 Develop Business Hypothesis –Analyze outcomes, 4.3 Build & Prepare Data Sets, 4.4 Select & Build Analytical Model, 4.5 Design for Big Data scale . 4.6 Build production ready system , 4.7 Setting up the Big Data Analytics system , 4.8 Gathering data ,measure & monitor	

Course Outcomes: After completion of syllabus, student will be able to:

1. Understand the characteristics, applications of big data that make it useful to real-world problems.
2. Study of data using big data tools hadoop file system and predict outcomes to solve given problem.
3. Design various case studies using big data tools/commands and analyse it.
4. Evaluate business cases.

References

1. Soumendra. J. M. Mohanty, Harsha Srivatsa, "Big Data Imperatives: Enterprise Big Data Warehouse, BI Implementations and Analytics", 1st Edition, Apress (2013)
2. Ohlhorst. J. F., "Big Data Analytics: Turning Big Data into Big Money", Wiley Publishers (2012)
3. Molaro C., Surekha Parekh, Terry Purcell, "DB2 11: The Database for Big Data & Analytics", MC Press, (2013)
4. DT Editorial Services, "Big Data, Black Book-Covers Hadoop2, MapReduce, Hive, YARN, Pig, R and Data Visualization" Dreamtech Press, (2015).
5. Big Data Case Study by Bernard Marr – Willey Publications.
6. Seema Acharya, Subhashini Chellappan, Big Data and Analytics, Wiley, 2015.
7. Viktor Mayer-Schönberger, Kenneth Cukier, Big Data: A Revolution That Will Transform How We Live, Work, and Think, Houghton Mifflin Harcourt, 2013.
8. Thomas Erl, Wajid Khattak, Paul Buhler, Big Data Fundamentals: Concepts, Drivers & Techniques, Pearson, 2016.
9. Jules J. Berman, Principles of Big Data: Preparing, Sharing, and Analyzing Complex Information, Morgan Kaufmann, 2018.
10. Arvind Sathi, Big Data Analytics: Disruptive Technologies for Changing the Game, IBM Press, 2012.
11. Michael Minelli, Michele Chambers, Ambiga Dhiraj, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley, 2013.

MCST 542 (DSC VI): Machine Learning -Total Credits: 4

Objectives: Student will able to...

1. Understand the basic theory underlying machine learning.
2. Study of machine learning problems corresponding to different applications.
3. Understand a range of machine learning algorithms along with their strengths and weaknesses.
4. Study of machine learning algorithms to solve problems of moderate complexity.

Unit	Content	No. of hours per unit
I	Outline to AI	15
	1.1 Introduction to Artificial Intelligence and Machine learning, Definition and applications of machine learning 1.2 Types of machine learning: supervised, unsupervised, and reinforcement learning 1.3 Overview of the machine learning pipeline 1.4 Essential concepts in Artificial Intelligence and Machine learning. 1.5 Machine learning basics: Key terminology, Key tasks of machine learning, 1.6 Choosing the right algorithm, 1.7 Steps in developing a machine learning application. How we split data in Machine, 1.8 Best Python libraries for Machine Learning	
II	Supervised Learning	15
	2.1 Supervised Learning The k-Nearest Neighbours classification algorithm, 2.2 Linear regression Logistic regression 2.3 Decision trees and ensemble methods (e.g., random forests) Support Vector Machines (SVM) 2.4 Parsing and importing data from a text file, C. Creating scatter plots with Matplotlib, 2.5 Normalizing numeric values. 2.6 Decision tree, Tree construction, plotting trees in Python, Testing and storing the classifier.	

III	Naïve Theory and Unsupervised Learning	15
	3.1 A Naïve Bayesian decision theory, 3.2 K-means clustering 3.3 Hierarchical clustering 3.4 Principal Component Analysis (PCA) 3.5 Conditional probability, 3.6 Classifying with conditional probabilities, 3.7 Document classification with naïve Bayes, Classifying text with python, 3.8 Case study: classifying spam email with naïve Bayes. Unsupervised learning: Clustering, 3.9 Grouping unlabeled data using K-Means clustering, K-means algorithm.	
IV	Recommender System	15
	4.1 Recommender System: Introduction, 4.2 Understanding Recommendation Systems, 4.3 Content Based Filtering 4.4 User Based Collaborative Filtering 4.5 Item Based Collaborative Filtering 4.6 Methods and tricks of the trade, Issues in Recommendation Systems, 4.7 Recommender System in Python	

Course Outcome: After completion of syllabus, student will be able to:

1. Implement machine learning techniques and AI computing environment that are suitable for the applications under consideration.
2. Understand and apply scaling up machine learning techniques and associated computing techniques and technologies.
3. Used different machine learning techniques to design AI machine and enveloping applications for real world problems.
4. Analyze the basic principles, techniques, and applications of Artificial Intelligence.

References

1. Joshi. V., Springer, Cham. Machine Learning and Artificial Intelligence,
2. Harrington. P., April, Manning publications, Machine Learning in Action, 2012.
3. Nagy. Z. Artificial Intelligence and Machine Learning Fundamentals
4. Han .J. and M. Kamber, Data Mining Concepts and Techniques.
5. Tom M. Mitchell, Machine Learning, McGraw Hill, 1997.
6. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 2020.
7. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
8. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.

MCST 543 (DSC VII): Deep Learning -Total Credits: 4

Course Objectives: Student will be able to...

1. Understand the context of neural networks and deep learning
2. Study of how to use a neural network
3. Understand the data needs of deep learning
4. Study of working knowledge of neural networks and deep learning

Unit	Content	No. of hours
I	Essentials in deep learning	15
	1.1 Definition, Need, and Relationship between Artificial intelligence, machine learning, and deep learning, B. Deep learning Process. 1.2 Deep Learning Network: Convolutional neural networks (CNN), 1.3 Deep learning applications, Advantages and Limitations of deep learning. 1.4 Deep learning Libraries /Frameworks: Keras, Tensor Flow, F. PyTorch	
II	Neural Networks	15
	2.1 Introduction- History and evolution of deep learning, Applications and importance of deep learning 2.2 Neural Network Fundamentals- Perceptrons and multilayer perceptrons (MLPs), Activation functions, Backpropagation algorithm Model of an Artificial Neuron, 2.3 Activation Functions 2.4 Feed forward Network 2.5 Recurrent Network 2.6 Convolutional Neural Networks (CNNs) Architecture of CNNs 2.7 Convolutional layers, pooling layers, and fully connected layers 2.8 Training CNNs for image classification	

III	Deep Learning with Keras / PyTorch	15
	3.1 Overview of deep learning concepts and applications Introduction to neural networks: perceptrons, activation functions, and basic architectures 3.2 Installing Keras and PyTorch Understanding Keras backend: TensorFlow vs. Theano Building your first neural network model with Keras 3.3 Training and evaluating models in Keras 3.4 Introduction to Keras layers and activation function Deep Learning with Keras / PyTorch: Setting up Project, PyTorch tensors and operations 3.5 Automatic differentiation and dynamic computation graphs Building and training a simple neural network in PyTorch 3.6 GPU acceleration with PyTorch 3.7 Starting Jupyter 3.8 Importing Libraries 3.9 Creating Deep Learning Model.	
IV	Convolutional Neural Networks	15
	4.1 Overview of neural networks and their limitations with image data 4.2 Introduction to the convolution operation and its role in CNNs 4.3 Understanding the basic architecture of CNNs: convolutional layers, pooling layers, and fully connected layers 4.4 Foundations of Convolutional Neural Networks, Training a convent from scratch on a small dataset, using a pretrained convent, 4.6 Visualizing what convents learn. 4.7 Deep Convolutional Models: Case Studies	

Course Outcome: After completion of syllabus, student will be able to:

1. Understand the fundamental techniques and principles of Neural Networks
2. Apply the different models in ANN and their applications
3. Understand the concepts of deep learning with Convolution Neural Network case studies and Apply deep learning mechanisms to various learning problems.
4. Understand the open issues in deep learning, and have a grasp of the current research directions.

References

1. Chollet. F., Deep Learning with Python,
2. Zhang. A., Zachary C. Lipton, Mu Li, and Alexander J. Smola Dive into Deep Learning,
3. Goodfellow. I., Y. Bengio, Aaron Courville Deep Learning,
4. Nielsen's. M., Neural Networks and Deep Learning,
5. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
6. Francois Chollet, Deep Learning with Python, Manning Publications, 2021.
7. Josh Patterson, Adam Gibson, Deeplearning4j Team, Deep Learning: A Practitioner's Approach, O'Reilly Media, 2017.

MCST 544 (DSE III) Soft Computing -Total Credits: 2

Course Objectives: Student will be able to...

1. Understand the fundamental concepts of soft computing.
2. Learn key soft computing techniques: Fuzzy Logic, Neural Networks, and Genetic Algorithms.
3. Apply soft computing methods to solve real-world problems.
4. Explore hybrid systems and their applications.

Unit	Content	No. of hours
I	Soft Computing and Fuzzy Logic	7
	1.1 Introduction to Soft Computing 1.2 Characteristics and Applications 1.3 Comparison with Hard Computing 1.4 Fuzzy Logic. 1.5 Fuzzy Sets and Membership Functions. 1.6 Applications of Fuzzy Logic	
II	Artificial Neural Networks – Fundamentals	7
	2.1 Biological and Artificial Neurons 2.2 Perceptron Model 2.3 Multilayer Perceptron (MLP) and Feedforward Networks. 2.4 Backpropagation Algorithm. 2.5 Activation Functions. 2.6 Applications of ANN.	
III	Genetic Algorithms	7
	3.1 Basics of Evolutionary Computing. 3.2 Chromosome Representation. 3.3 Fitness Function, Selection, Crossover, Mutation 3.4 Simple Genetic Algorithm Flow 3.5 Applications in Optimization	
IV	Hybrid Systems and Applications	9
	4.1 Introduction to Hybrid Systems 4.2 Neuro-Fuzzy Systems. 4.3 Genetic-Neural Systems. 4.4 Soft Computing in Real-world Scenarios 4.5 Case Studies and Applications (e.g., robotics, control systems, pattern recognition) 4.6 Overview of Tools: MATLAB, Python Libraries (e.g., scikit-fuzzy, TensorFlow)	

Course Outcome: After completion of syllabus, student will be able to:

1. Understand the principles and characteristics of soft computing and distinguish it from conventional computing techniques.
2. Apply fuzzy logic concepts to handle uncertainty and reasoning in complex systems.
3. Analyze and implement basic neural network architectures and learning algorithms.
4. Employ genetic algorithms for optimization problems and understand their evolutionary mechanisms

References

1. Sivanandam. N. S. & Deepa. N. S. Principles of Soft Computing, Wiley.
2. J.-S. R. Jang, C.-T. Sun, and E. Mizutani Neuro-Fuzzy and Soft Computing, Pearson Education
3. Simon Haykin Neural Networks and Learning Machines,
4. Kashyap, M.M. Neural Networks, Fuzzy Logic, and Genetic Algorithm: Synthesis and Applications.
5. David E. Goldberg Genetic Algorithms in Search, Optimization and Machine Learning, Pearson Education.
6. Sivanandam S. N., Deepa S. N., Principles of Soft Computing, Wiley, 2011.
7. Jang J.-S. R., Sun C.-T., Mizutani E., Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, Prentice Hall, 1997.

MCST 544 (DSE IV): Microcontrollers for IOT -Total Credits: 2

Course Objective: Student will be able to...

1. Understand hands-on experience using different IoT architectures.
2. Study of skills for interfacing sensors and actuators with different IoT architectures.
3. Study of data collection and logging in the cloud.
4. Understand Arduino Uno boards and programming.

Unit	Content	No. of hours per unit
I	Internet of Things	7
	1.1 Introduction and its components, 1.2 IoT building blocks 1.3 Sensors and Actuators 1.3 IoT Devices 1.4 IoT boards (Arduino Uno, ESP 8266-12E Node MCU and Raspberry Pi 3).	
II	Arduino Uno	7
	2.1 Arduino Uno – getting started with the Uno boards, blink program, 2.2 Connection of sensors to the Uno board, reading values of sensors from the Uno board, 2.3 Interrupts. Case study: Temperature/Humidity Control; 2.4 Case Study: Sending values Temperature/Humidity values to the Internet via GSM module.	
III	ESP 8266-12E Node MCU	9
	3.1 ESP 8266-12E Node MCU – getting started with the ESP board, 3.2 Micropython and Esplorer IDE 3.3 Flushing the ESP8266 board with micropython 3.4 Connecting sensors to the ESP board, Connecting ESP board to WiFi 3.5 Interfacing ESP with the Cloud (REST API-GET, POST, MQTT), interrupts, Comparison of ESP 32 board with the ESP 8266 board. Case Study: Switching light on /off remotely. 3.6 Case Study: Voice-based HomeAutomation for switching lights on/of (Android phone – Google Assistant (Assistant <- > IFTTT), MQTT (ESP <-> IFTTT), ESP 8266 <-> Lights).	
IV	Raspberry Pi 3	7
	4.1 Raspberry Pi 3 - Rpi3 introduction and installing the Raspbian Stretch OS 4.2 Headless - Computer and Rpi3 configuration to connect through SSH via Ethernet 4.3 Headless - connecting Rpi3 remotely without Ethernet cable via SSH IP address, Rpi 3 - Testing the GPIO pins through Scripts	

Course Outcome: After completion of syllabus, student will be able to:

1. Use Arduino Uno, NODE MCU 8266.
2. Use Raspberry PI along with critical protocols and its communication to cloud.
3. Apply commonly used IOT protocols such as REST API, MQTT through IOT based demonstration.
4. Solve analog sensor and digital sensor interfacing with IOT devices.

References

1. Sivanandam, S. N., & Deepa, S. N., Principles of Soft Computing. Wiley, 2007.
2. Jang, J.-S. R., Sun, C.-T., & Mizutani, E., Neuro-Fuzzy and Soft Computing. Pearson Education, 1997.
3. Haykin, S., Neural Networks and Learning Machines. Pearson Education, 2009.
4. Kashyap, M. M., Neural Networks, Fuzzy Logic, and Genetic Algorithm: Synthesis and Applications. PHI Learning, 2014.
5. Goldberg, D. E., Genetic Algorithms in Search, Optimization and Machine Learning. Pearson Education, 1989.
6. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson, 2011.
7. Arshdeep B ahga, Vijay Madiseti, Internet of Things: A Hands-On Approach, VPT, 2014
Simon Monk, Programming Arduino: Getting Started with Sketches, McGraw Hill Education, 2016.

MCSP 545 LAB VI (DSC II): Practical Based on MCST 541, MCST 542 and MCST 543

Total Credits: 2

Course Objectives: Student will be able to...

1. Understand the context of neural networks and deep learning
2. Study of working knowledge of neural networks and deep learning
3. Understand the Big Data challenges & opportunities, its applications
4. Study of conceptual understanding of Hadoop Distributed File System.

Sr No	Content	No. of hours
1.	Downloading and Installing JDK 8.1	60
2.	Downloading and installing Hadoop; Understanding different Hadoop modes.	
3.	Perform different HDFS commands in hadoop	
4.	Implement Word count program using Mapreduce	
5.	Perform CRUD Operations using MongoDB	
6.	Install, Deploy & configure Apache Spark Cluster. Run apache spark applications	
7.	Sentiment analysis of YouTube comments	
8.	Olympics Data Analytics using Python	
9.	Develop a MapReduce program to find the maximum temperature in each year.	
10.	Develop a MapReduce program to find the grades of student's.	
11.	Machine Learning and its application-oriented algorithms.	
12.	Introduction to Machine Learning using Python and its libraries.	
13.	Installation of pandas and use of pip command.	
14.	Python program using NumPy for some basic mathematical operations	
15.	Implementing KNN- classification algorithm using Python on IRIS dataset.	
16.	Python script using Scipy for image manipulation.	
17.	Python program using Theano for computing a Logistic Function.	
18.	Python program using TensorFlow for multiplying two arrays.	
19.	Python program using Pandas for arranging a given set of data into a table.	
20.	Python program using Matplotlib for forming a linear plot.	

Course Outcome: After completion of syllabus, student will be able to:

1. Understand the fundamental techniques and principles of Neural Networks 2) study of different models in ANN and their applications
2. Apply deep learning mechanisms to various learning problems.

3. Understand the characteristics, applications of big data that make it useful to real-world problems.

References:

1. Zhang. A., Zachary. C. Lipton, Mu Li, and Alexander J. Smola Dive into Deep Learning
2. Bengio. Y., Courville. Deep Learning, Ian Goodfellow
3. Nielsen's M. Neural Networks and Deep Learning
4. M. Jagdeesh, S. Mohanty, H. Srivatsa "Big Data Imperatives: Enterprise Big Data Warehouse, BI Implementations and Analytics", 1st Edition, Apress (2013)
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6. Molaro C., S., T. Purcell MC "DB2 11: The Database for Big Data & Analytics", Press, (2013)
7. Hadoop-The Definitive Guide, Storage and analysis at internet scale", Tom White SPD, O'Really.
8. Big Data, Black Book-Covers Hadoop2, MapReduce, Hive, YARN, Pig, R and Data Visualization", DT Editorial Services Dreamtech Press, (2015).
9. Joshi. V. A. Machine Learning and Artificial Intelligence, , Springer, Cham
10. Rich E. and Knight K., Artificial Intelligence, Tata

MCSP 546 (DSE I): Practical Based on MCST 544 EI -Total Credits: 2

Course Objectives: Student will be able to...

1. Understand and implement basic fuzzy logic systems and inference models.
2. Apply neural networks to perform classification and prediction tasks.
3. Develop simple Genetic Algorithms for solving optimization problems.
4. Explore hybrid systems such as neuro-fuzzy models.
5. Compare various soft computing techniques through mini-projects and real-world problems.

Sr. No	Content	No. of hours
1	Installation of python libraries for deep learning.	60
2	Download and install Python SciPy and get the most useful package for machine learning in Python.	
3	Keras: Feature extraction on large datasets with Deep Learning.	
4	How does pandas fit into the data science toolkit?	
5	Creating Data Frames from scratch using Pandas.	
6	How to read in data (from CSVs ,JSON and SQL database)	
7	Write a program to converting back to a CSV, JSON, or SQL	
8	Plotting the Graphs using Matplotlib libraries.	
9	Load a dataset and understand its structure using statistical summaries and data visualization.	
10	Create 6 machine learning models, pick the best and build confidence that the accuracy is reliable.	
11	How to Use Feature Extraction on Tabular Data for Machine Learning	
12	Feature Extraction: a mental model for search and recommendation	
13	Create program using NumPy for Deep learning (pip install numpy)	
14	Implementation of Fuzzy Sets and Membership Functions using Python (scikit-fuzzy) or MATLAB	
15	Fuzzy System for Fan Speed Control (Mamdani method).	
16	Create a Sugeno-type system to predict student performance based on test score and attendance.	
17	Implement a perceptron in Python or MATLAB to simulate AND/OR gate.	
18	Build a small neural network model for MNIST (can use 1000 samples subset) using TensorFlow/Keras.	
19	Train a neural network to classify basic images (e.g., cats vs dogs using small dataset).	
20	Function Optimization using Genetic Algorithm - Maximize or minimize a mathematical function like: $f(x) = x \cdot \sin(10\pi x) + 1$, where $x \in [0,1]$. - Implement basic GA steps: population, fitness, crossover mutation.	

Course Outcome: After completion of syllabus, student will be able to:

1. Understand the principles and differences of soft computing vs hard computing.
2. Apply fuzzy logic to model uncertainty in systems using fuzzy sets and rules.
3. Build and train neural networks for solving classification and prediction tasks.
4. Apply genetic algorithms to optimization problems using evolutionary principles.
5. Understand and apply hybrid systems (e.g., neuro-fuzzy) and compare techniques.
6. Understand the various concepts, terminologies and architecture of IoT systems.
7. Use sensors and actuators for design of IoT.
8. Understand and apply various protocols for design of IoT systems
9. Use various techniques of data storage and analytics in IoT

References

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications
2. Jang et al., Neuro-Fuzzy and Soft Computing
3. Simon Haykin, Neural Networks and Learning Machines.
4. Sivanandam & Deepa – Neural Network Chapter.
5. Baichtal, J. (2013). Arduino for beginners: essential skills every maker needs. Pearson Education.
6. Schwartz, M. (2016). Internet of Things with ESP8266. Packt Publishing Ltd.
7. Richardson, M., & Wallace, S. (2012). Getting started with raspberry PI. "O'Reilly Publisher Media, Inc."
8. Zhang. A., C.Zachary Lipton, Mu Li, and Alexander J. Smola Dive into Deep Learning
9. Bengio. Y., A. Courville Deep Learning, Ian Goodfellow

MCSP 546 (DSE I): Practical Based on MCST 544 EII -Total Credits: 2

Course Objectives: Student will be able to...

1. understand hands-on experience using different IoT architectures.
2. Study of skills for interfacing sensors and actuators with different IoT architectures.
3. Study of data collection and logging in the cloud.
4. Understand Arduino Uno boards and programming.

Sr. No	Content	No. of hours
1	Installation of python libraries for deep learning.	60
2	Download and install Python SciPy and get the most useful package for machine learning in Python.	
3	Keras: Feature extraction on large datasets with Deep Learning.	
4	How does pandas fit into the data science toolkit?	
5	Creating Data Frames from scratch using Pandas.	
6	How to read in data (from CSVs ,JSON and SQL database)	
7	Write a program to converting back to a CSV, JSON, or SQL	
8	Plotting the Graphs using Matplotlib libraries.	
9	Load a dataset and understand its structure using statistical summaries and data visualization.	
10	Create 6 machine learning models, pick the best and build confidence that the accuracy is reliable.	
11	How to Use Feature Extraction on Tabular Data for Machine Learning	
12	Feature Extraction: a mental model for search and recommendation	
13	Create program using NumPy for Deep learning (pip install numpy)	
14	To Blink an On-Board LED on Node MCU.	
15	To design and implement a circuit to detect Gas using MQ-135 with the help of NODEMCU.	
16	To know the amount pressure using BMP180 with the help of ESP32.	
17	To control the servo motor using ESP-32(BLUETOOTH MODULE).	
18	To send a message through webpage with ESP as server.	
19	To interface servo motor to ESP32 and control from webpage.	
20	To monitor Temperature and Humidity using esp32 in cloud platform.	
21	To build a WiFi weather station using ESP8266 (NodeMCU) & Blynk app.	
22	To open a window by using DTH11 sensor at certain temperature by using servo motor.	

Course Outcome: After completion of syllabus, student will be able to:

1. Install and configure essential Python libraries (NumPy, SciPy, Pandas, Keras, Matplotlib) required for machine learning and deep learning development.

2. Perform data manipulation, cleaning, and preprocessing using Pandas for efficient analysis.
3. Import and export datasets using various formats such as CSV, JSON, and SQL, and handle data pipelines.
4. Visualize data using Matplotlib and gain insights through statistical summaries and plots.
5. Implement deep learning feature extraction techniques using Keras on large-scale datasets.
6. Interface and program NodeMCU and ESP32 microcontrollers for basic input/output control such as blinking LEDs.
7. Design and implement sensor-based IoT circuits to detect environmental parameters like gas (MQ-135), pressure (BMP180), temperature, and humidity (DHT11).
8. Interface and control actuators (e.g., servo motors) using ESP32 via Bluetooth and web-based interfaces.
9. Create a simple IoT server using ESP microcontrollers to display and transmit data over a web interface.
10. Monitor environmental data (temperature and humidity) on a cloud platform using ESP32 and IoT protocols.

References

1. Géron, A. (2019). Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow (2nd ed.). O'Reilly Media.
2. Chollet, F. (2018). Deep Learning with Python. Manning Publications.
3. McKinney, W. (2022). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython (3rd ed.). O'Reilly Media.
4. VanderPlas, J. (2016). Python Data Science Handbook. O'Reilly Media.
5. Pedregosa, F., Varoquaux, G., Gramfort, A., Michel, V., et al. (2011). Scikit-learn: Machine Learning in Python. *Journal of Machine Learning Research*, 12, 2825–2830.
6. Banzi, M., & Shiloh, M. (2014). Getting Started with Arduino (3rd ed.). Maker Media, Inc.
7. Monk, S. (2017). Programming Arduino: Getting Started with Sketches (2nd ed.). McGraw-Hill Education.
8. Raj, P. (2020). Internet of Things Using ESP8266 with Arduino. BPB Publications.
9. Kurniawan, A. (2017). Getting Started with ESP32 Programming and Development. PE Press.

MCSP 547: On Job Training (OJT) -Total Credits: 4

Credits	Content	Contact Hours
4	OJT will provide the opportunities for internship with local/regional industries, business organization, health and allied areas, local government etc. so that students may actively engaged with the employability opportunities. Students will undergo 4 credit work-based learning/OJT/internship.	120

