"Education through self-help is our motto."

**Rayat Shikshan Sanstha's**

# YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

**(AUTONOMOUS)**

Lead college

of

**Karmaveer Bhaurao Patil University, Satara**

## Syllabus For

## Master of Science

## Part - II

## Computer Science

Syllabus to be implemented w.e.f. June 2024

## as Per NEP-2020

## 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.

## Credit Framework for M.Sc. II

### Structure of Course: M.Sc. – II Semester – III

| Level | Semester | Course Code | Course Title | No. of Lectures Per Week | Credits |
|---|---|---|---|---|---|
| | | Discipline Specific Courses (Mandatory) | | | |
| 6.5 | III | MCST 531 | Emerging Technologies | 4 | 4 |
| | | MCST 532 | Data Mining | 4 | 4 |
| | | MCST 533 | Data Visualization using Tools | 4 | 4 |
| | | Discipline Specific Elective (Choose Any one among two) | | | |
| | | MCST 534 E-I<br>MCST 534 E-II | E-I) Artificial Intelligence<br>E-II) Fundamentals of IOT | 2 | 2 |
| | | MCSP 535 | Research Project | 12 | 6 |
| | | MCSP 536 | LAB- III (Based on MCST 531, 532 and 533) | 4 | 2 |
| **Total** | | | | | **22** |

### Structure of Course: M.Sc. – II Semester –IV

| Level | Semester | Course Code | Course Title | No. of Lectures Per Week | Credits |
|---|---|---|---|---|---|
| | | Discipline Specific Courses (Mandatory) | | | |
| 6.5 | IV | MCST 541 | Big Data Analytics | 4 | 4 |
| | | MCST 542 | Machine Learning | 4 | 4 |
| | | MCST 543 | Deep Learning | 4 | 4 |
| | | Discipline Specific Elective (Choose Any one among two) | | | |
| | | MCST 544 E-I<br>MCST 544 E-II | E-I) Control Systems<br>E-II) Microcontrollers and IOT | 4 | 4 |
| | | MCSP 545 | On Job Training (OJT) | 8 | 4 |
| | | MCSP 546 | LAB- IV (based on MCST-541, 542 and 543) | 4 | 2 |
| **Total** | | | | | **22** |

# Semester III

## MCST 531: Emerging Technologies

**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

| Credits=4 | SEMESTER-III<br>MCST 531: Emerging Technologies | No. of hours: 60 |
|---|---|---|
| UNIT I | **Angular Java Script Basics** | 15 |
| | 1.1 Introduction to Angular JS – advantages, disadvantages, History and background, Features, Why Angular JS,<br>1.2 Setting Up Angular JS Environment- Installing AngularJS, Project structure, Hello World example<br>1.3 Introduction to Angular JS Directives- Understanding directives, ng-app, ng-model, ng-bind, etc., Creating custom directives<br>1.4 MVC-The Angular JS way, Features of Angular JS,Model-View-Controller,<br>1.5 My First Angular JS app,<br>1.6 All about Angular Expressions,<br>1.7 How to use expressions,<br>1.8 Angular vs JavaScript | |
| UNIT II | **Filters & Directives** | 15 |
| | 2.1 Understanding the role of filters in AngularJS, Overview of built-in filters such as currency, date, uppercase, lowercase, etc.<br>2.3 Built-In Filters- Demonstrating the usage of built-in filters with examples, Applying filters to expressions in templates<br>2.3 Using Angular JS Filters- Overview of custom filters, Writing custom filter functions, Registering custom filters with AngularJS, Creating Custom Filters,<br>2.4 Directives in AngularJS- Introduction to directives, Understanding the directive syntax: restrict, template, scope, etc.<br>2.5 Directive Lifecycle,<br>2.6 Binding controls to data,<br>2.7 Matching directives,<br>2.8 Using Angular JS built-in directives<br>2.9 Creating a custom directive. | |

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|---|---|---|
| **UNIT III** | **Controllers & 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,<br>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<br>3.3 Attaching Properties and functions to scope,<br>3.4 Nested Controllers,<br>3.5 Using Filters in Controllers<br>3.6 Controllers in External Files<br>3.7 Introduction to Angular JS Modules<br>3.8 Bootstrapping Angular JS<br>3.9MongoDB Relational vs NoSQL DB, MongoDB fundamentals, Data modeling, Aggregation pipeline, Grid FS, Performance | |
| **UNIT 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<br>4.2 Working with Angular Forms- Creating Basic Forms, Form Validation, Custom Validation, Angular JS Form Events, Handling Form Submission<br>4.3 Model Binding<br>4.4 Forms Events<br>4.5 Form Controller,<br>4.6 Validating Angular Forms,<br>4.7 $error object<br>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 Get familiar with client-side JavaScript frameworks and the Angular framework.
2. Use various Angular features including directives, components, and services.
3. Implement a functional front-end web application using Angular.
4. Increase your rental capacity through innovative and independent learning

## References:

1. S. Seshadri, Angular: Up and Running: Learning Angular, Step by Step, 2018
2. K. Rungta, Learn AngularJS in 1 Day: Complete Angular JS Guide with Examples, Kindle Edition, 2016
3. A. Hussain, Angular 5: From Theory to Practice, Kindle Edition 2017.
4. D. Uluca, Angular 6 for Enterprise-Ready Web Applications, Kindle Edition 2017.

# Semester III
# MCST 532: Data Mining

**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

| **Credits=4** | **SEMESTER-III**<br>**MCST 532: Data Mining** | **No. of hours: 60** |
|---|---|---|
| **UNIT I** | **Introduction to 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<br>1.2 Data Mining issues,<br>1.3 Stages of the Data Mining Process (KDD),<br>1.4 Data Mining Techniques/Tasks,<br>1.5 Knowledge Representation Methods,<br>1.6 Applications of Data mining,<br>1.7 Data Pre-processing,<br>1.8 Data Cleaning,<br>1.9 Data Transformation, | |
| **UNIT 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,<br>2.2 Data Modeling with OLAP,<br>2.3 Difference between OLTP and OLAP,<br>2.4 Data Mart, Fact Table,<br>2.5 Dimension Table, OLAP cube,<br>2.6 Different OLAP Operations, Schema Design,<br>2.7 Dimensional Modeling Techniques - Introduction to<br>2.8 Dimensional Modeling, Star Schema Design, Snowflake Schema Design, Conformed Dimensions, Junk Dimensions and Degenerate Dimensions<br>2.9 Introduction to Machine Learning,<br>Introduction to Pattern Matching,<br>Case study based on Schema Design | |
| **UNIT III** | **Classification in Data Mining** | **15** |

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|---|---|---|
| | 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<br>3.2 Decision Tree, Construction Principle, Attribute Selection Measures<br>3.3 Tree Pruning, Rule-Based Classification,<br>3.4 Using IF-THEN Rules for Classification<br>3.5 Rule Extraction from a Decision Tree<br>3.6 Bayes Classification Methods, Bayes‟ Theorem, Naive Bayesian Classification, Bayesian Networks,<br>3.7 Parameter and structure learning, | |
| **UNIT 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,<br>4.2 Applications of Association Rule Mining Requirements for Cluster Analysis,<br>4.3 Hierarchical Methods, Agglomerative Hierarchical Clustering,Divisive Hierarchical Clustering,<br>4.4 Partitioning Methods,k-Means:<br>4.5 A Centroid-Based Technique, k-Medoids:<br>4.6 A Representative Object-Based Technique, Introduction to Association Rule Mining<br>4.7 Market Basket Analysis,<br>4.8 Items, Itemsets and Large Itemsets<br>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. M. Dunham, S. Sridhar, "Introductory and Advanced Topics" ,Pearson Publication, 2002.
2. H. Jiawei and Micheline Kamber, ELSEVIER, "Data Mining Concepts and Techniques" ,Third Edition, 2011.
3. Y. Zhao, Elsevier Inc.,"R and Data Mining" ISBN-10: 0123969638, 2013.
4. H. Jiawei and Micheline Kamber, ELSEVIER, "Data Mining Concepts and Techniques", Third Edition, 2011.
5. J. Glenn Myatt John Wiley Publishers, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining 2007.

## Semester III
## MCST 533: Data Visualization using Tools

### 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 givenmanagerial situation whether a problem or an opportunity
4) Create viable solutions to decision making problems

| Credits=4 | MCST-533<br>Data Visualization using Tools | No. of hours : 60 |
|---|---|---|
| **UNIT I** | **Tableau Software** | **15** |
| | 1.1 Understanding Data ,<br>1.2 Introduction- Overview of Tableau, Importance of Data Visualization, Installation and Setup<br>1.3 What is data & Where to find data ,<br>1.4 Foundations for building Data Visualizations ,<br>1.5 Creating Your First visualization<br>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 | |
| **UNIT II** | **Tableau Calculations & Visualization and Data Manipulation** | **15** |
| | 2.1 Overview of SUM,<br>2.2 AVR, and Aggregate features<br>2.3 Creating custom calculations and fields<br>2.4 Applying new data calculations to your visualization<br>2.5 Formatting Visualizations Formatting Tools and Menus<br>2.6 Formatting specific parts of the view Editing and Formatting Axes,<br>2.7 Cleaning – up the data with the Data Interpreter Structuring your data Sorting and filtering Table audata Pivoting Tableau data | |
| **UNIT III** | **Advanced Tableau Visualizations** | **15** |

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|---|---|---|
| | 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<br>3.2 Using Filters<br>3.3 Using the Detail panel<br>3.4 Using the Size panels Customizing filters<br>3.5 Using and Customizing tool tips<br>3.6 Form at ting your data with colors | |
| **UNIT IV** | **Dashboards and Storytelling and Publishing your Visualization** | **15** |
| | 4.1 Using Story telling Creating your first dash board and Story, Design for different displays Adding inter activity to yourDashboard,<br>4.2 Tableau File Types,<br>4.3 Publishing to Tableau Online,<br>4.4 Sharing your Visualization.<br>4.5 Principles of Effective Storytelling with Data<br>4.6 Designing Story-driven Dashboards<br>4.7 Publishing Your Visualization: Tableau Public, Power BI Service<br>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 thatachieve stated objectives.
3. Demonstrate ethical decision-making in structured or unstructured andambiguous situations.
4. Communicate technical information to both technical and non-technicalaudiences in speech, in writing, and graphically.

**References:**

1. M. Alexander Loth , John Willie and Sons Visual Analytics with Tableau 1st Edition
2. Z. MasterOreilly ,Media Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau
3. J. N. MilliganLearning Tableau: Create effective data visualizations, build interactive visualanalytics, and transform your organization, 4th Edition, 2020

## Semester III

## MCSET 534: Elective I Artificial Intelligence

**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.

| Credits=2 | MCSET 534: Elective I Artificial Intelligence | No. of hours : 30 |
|---|---|---|
| **UNIT I** | **Introduction to AI** | **15** |
| | 1.1 Artificial Intelligence, AI Problems,<br>AI Techniques, The Level of the Model,<br>1.2 Criteria For Success. Defining the Problem as a State SpaceSearch,<br>Problem Characteristics,<br>1.3 Search and Game Playing: Breadth first search, depth first search,<br>hill climbing, heuristic search, Best first search,<br>A* algorithm, AO* algorithm,<br>1.4 Minmax & game trees, refining minmax,<br>Alpha – Beta pruning,<br>1.5 Constraint satisfaction. AI and python programming. | |
| **UNIT II** | **Knowledge Representation** | **15** |
| | 2.1 Introduction, Propositional Logic, Syntax and Semantics,<br>2.3 Interpretations, Properties, Predicate Calculus,<br>2.4 WFF, Free and Bound Variables,<br>2.6 Normal Forms, Inference Techniques,<br>2.7 Resolution, Unification, Modes Pones,<br>2.8 Frames, Frame Representation Language,<br>2.9 Conceptual Dependency, CD Theory, Script,<br>Semantic Net, Conceptual Graph, Rule Based Representation,<br>Forward and Backward Reasoning | |

**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 toUncertainty using Fuzzy Theory.
4. Define a NLP problem and find a suitable solution to it and to develop a goodunderstanding of all.

**References: -**

1. T. M. Hill, Elaine Rich and Kelvin Knight, Artificial Intelligence, 2002.
2. S. Francisco, California, Nils J Nilson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann Publishers,Inc., 2000.
3. R. Akerkar, Introduction to Artificial Intelligence, Prentice-Hall of India, 2005
4. P.H Winston, "Artificial Intelligence", Addision Wesley (1993)
5. B. Yegnanarayana, Artificial Neural Networks, Prentice-Hall of India, 2006
6. G. A. VijayalakshmiPai Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, , Prentice-Hall of India, 2003

# Semester III

## MCST 534: EII Fundamentals of IOT

**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

| Credits=2 | MCST 534: EII Fundamentals of IOT | No. of hours :30 |
|---|---|---|
| **UNIT I** | **Essentials of IOT** | **15** |
| | 1.1 Introduction, Definitions & Characteristics of IoT, IoT , Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT,<br>1.2 History of IoT, About Things in IoT,<br>1.3 The Identifiers in IoT, About the Internet in IoT,<br>IoT frameworks, IoT and M2M.<br>1.4 Home Automation, Smart Cities, Energy,<br>1.5 Retail Management, Logistics, Agriculture, Health and Lifestyle,<br>1.6 Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection. | |
| **UNIT II** | **Sensor Networks** | **15** |
| | 2.1 Definition, Types of Sensors,<br>2.2 Types of Actuators, Examples and Working,<br>2.3 IoT Development Boards: Arduino IDE and Board Types,<br>RaspberriPi Development Kit,<br>2.4 RFID Principles and components<br>2.5 Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.<br>2.6 WPAN Technologies for IoT: IEEE 802.15.4,<br>2.7 Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus.<br>IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT.<br>2.8 Edge connectivity and protocols | |

**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) Daniel Minoli, ― "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications

2) Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

3) Waher, Peter -Packt Publishing Ltd, 2015 'Internet of Things – From Research and Innovation to Market Deployment', Peter Friess, River Publishers, 2014

## Semester III

## MCSP 535 Practical III

## Emerging Technologies, Data Mining, Data Visualization using Tools

## (Based on MCSP 531, 532, 533 courses)

**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.

| Credits=2 | MCSP 535 Practical (Based on MCST 531, 532, 533 courses) | No. of hours: 30 |
|---|---|---|
| | 1. Creating Project, Formatting Data<br>2. Create Form to edit your data<br>3. Operations on Form – Binding, Saving, Validation, Refactor.<br>4. Create simple Testing Angular application.<br>5. Angello: Creating controllers to manage views<br>6. AngularJS: Declaring properties and methods in a controller<br>7. Binding to properties and expressions in an AngularJS template, creating views and controllers and how to test them<br>8. Directives uses in Angello<br>9. Write a program demonstrating NodeJs application.<br>10. Error handling in NodeJs.<br>11. Classification – Decision tree<br>a. Conversion of Categorical values in numeric format for a given dataset.<br>b. Perform Classification using Decision Tree algorithm<br>12. Association Rules and Clustering (Using inbuilt Data set)<br>13. Regression Analysis and Outlier detection<br>a. Perform Regression Analysis.<br>b. Perform Linear Regression.<br>14. Python programs for Clustering<br>a. Write a python program to implement k-nearest Neighbors ML.<br>b. Write algorithm to build prediction model (Use Forge Dataset)<br>c. Write a python program to implement k-means algorithms | |

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|---|---|---|
| | on a synthetic database<br>15. Introduction Of Tableau GUI<br>16. Create Bar Chart Using Given Data<br>17. Create line Chart Using Given Data<br>18. Create Tree map Using Given Data<br>19. Create Application for Data Sorting F. Create Application for Data filtering<br>20. 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. E. Horowitz, S. Sahni & S. Rajasekaran, "Computer algorithms",Silicon Pr Publication,2007.
2. T. Cormen, C. Leiserson, & R. Rivest, "Introduction to Algorithms", MIT Press, 2009.
3. S. Skiena,"The Algorithm Manual", Springer, 2020.
4. R. K. Shukla, "Analysis and Design of Algorithms: A Beginner's Approach",Wiley, 2025.
5. M. L. Scott, "Programming Language Pragmatics", Kaufmann Publishers, An Imprint of Elsevier, USA, 2025.
6. R. W. Sebesta, "Concepts of Programming Languages", Eighth Edition,Pearson Education,2026.
7. R. Chopra, "Principles of Programming Languages", I K International Publishing House, 2024.
8. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition, - PearsonEducation, 2008.
9. A. Narayanan, J. Bonneau, E. Felten, A. Miller and S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2026.
10. W. Stallings, "Cryptography and Network Security: Principle and Practice",Pearson, 5th Edition, 2027
11. B.M.Harwani , "Advanced Computer Networks", DT Editorial Services, Dreamtech New Delhi-2024.
12. A. S.Tanenbaum, , "Computer Networks", Prentice Hall, Upper Saddle River, New Jersey, 5 th Ed.,2023

# MCSP 535: Research Project (6 Credits)

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.

# Semester IV
## MCST 541: Big Data Analytics

**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.

| Credits=4 | MCST 541: Big Data Analytics | No. of hours: 60 |
|---|---|---|
| **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,<br>1.2 Characteristics of Big Data, Applications of Big Data, Challenges in Big Data,<br>1.3 Big Data Analytics for –<br>1.4 Telecom/Banking/Retail/HealthCare/IT/Operations, RDBMS Vs Non-Relational Database | |
| **UNIT II** | **Application Architecture & Data Modelling For Big Data And Analytics** | **15** |
| | 2.1 Big Data Warehouse & Analytics,<br>Big data Warehouse System requirements & Hybrid Architectures,<br>2.2 Enterprise Data Platform Ecosystem,<br>Big Data and Master Data Management, understanding data integration Pattern,<br>2.3 Big Data Workload Design Approaches,<br>2.4 Map-Reduce patterns, Algorithms and Use Cases | |
| **UNIT III** | **The Hadoop Ecosystem** | **(15)** |
| | 3.1 Introduction to Hadoop- Big Data Technologies, Introduction to Hadoop ecosystem<br>3.2 MapReduce programming model<br>3.3 Apache Spark framework<br>Hadoop Architecture,<br>3.4 History of Hadoop-Facebook, Dynamo, Yahoo, Google<br>3.5 Hadoop Components: HDFS, Map reduce, Introduction to Pig, Hive, HBase, Mahout, Installation of single node cluster-installation | |

| | | |
|---|---|---|
| | of java Hadoop configuration | |
| **UNIT IV** | **Big Data Analytics Methodology** | **(15)** |
| | 4.1 Big Data Analytics Methodology-Analyze & evaluate business case<br>4.2 Develop Business Hypothesis –Analyze outcomes,<br>4.3 Build & Prepare Data Sets,<br>4.4 Select & Build Analytical Model,<br>4.5 Design for Big Data scale .<br>4.6 Build production ready system ,<br>4.7 Setting up the Big Data Analytics system ,<br>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 andanalyse it.
4. Evaluate business cases.

**References:**


1. M. J. Soumendra Mohanty,Harsha Srivatsa,"Big Data Imperatives: Enterprise Big Data Warehouse,BI Implementations and Analytics",1st Edition, Apress(2013)
2. F.J.Ohlhorst,"Big Data Analytics:Turning Big Data into Big Money",Wiley Publishers(2012)
3. C.Molaro,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.

## Semester IV

## MCST 542: Machine Learning

**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.

| Credits=4 | MCST 542: Machine Learning | No. of hours : 60 |
|---|---|---|
| **UNIT I** | **Outline to AI** | **15** |
| | 1.1 Introduction to Artificial Intelligence and Machine learning, Definition and applications of machine learning<br>1.2 Types of machine learning: supervised, unsupervised, and reinforcement learning<br>1.3 Overview of the machine learning pipeline<br>1.4 Essential concepts in Artificial Intelligence and Machine learning.<br>1.5 Machine learning basics: Key terminology,<br>Key tasks of machine learning,<br>1.6 Choosing the right algorithm,<br>1.7 Steps in developing a machine learning application. How we split data in Machine,<br>1.8 Best Python libraries for Machine Learning | |
| **UNIT II** | **Supervised Learning** | **15** |
| | 2.1Supervised Learning The k-Nearest Neighbours classification algorithm,<br>2.2 Linear regression<br>Logistic regression<br>2.3 Decision trees and ensemble methods (e.g., random forests)<br>Support Vector Machines (SVM)<br>2.4 Parsing and importing data from a text file, C. Creating scatter plots with Matplotlib,<br>2.5 Normalizing numeric values.<br>2.6 Decision tree, Tree construction, plotting trees in Python,<br>Testing and storing the classifier. | |
| **UNIT III** | **Naïve Theory and Unsupervised Learning** | **15** |

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

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

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

**References:**

1. V. Joshi, Springer, Cham. Machine Learning and Artificial Intelligence,
2. P. Harrington, April, Manning publications, Machine Learning in Action,2012.
3. Z. Nagy Artificial Intelligence and Machine Learning Fundamentals
4. J. Han and M. Kamber, Data Mining Concepts and Techniques.

## Semester IV

## MCST 543: Deep Learning

**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

| Credits=4 | MCST 543: Deep Learning | No. of hours : 60 |
|---|---|---|
| **UNIT I** | **Neural Networks** | **15** |
| | 1.1 Introduction- History and evolution of deep learning, Applications and importance of deep learning<br>1.2 Neural Network Fundamentals- Perceptrons and multilayer perceptrons (MLPs), Activation functions, Backpropagation algorithm Model of an Artificial Neuron,<br>1.3 Activation Functions<br>1.4 Feed forward Network<br>1.5 Recurrent Network<br>1.6 Convolutional Neural Networks (CNNs)<br>Architecture of CNNs<br>1.7 Convolutional layers, pooling layers, and fully connected layers<br>Training CNNs for image classification | |
| **UNIT II** | **Introduction to deep learning** | **15** |
| | 2.1 Definition, Need, and Relationship between Artificial intelligence, machine learning, and deep learning, B. Deep learning Process.<br>2.3 Deep Learning Network: Convolutional neural networks (CNN),<br>2.4 Deep learning applications, Advantages and Limitations of deep learning.<br>2.5 Deep learning Libraries /Frameworks: Keras, Tensor Flow, F. PyTorch | |
| **UNIT III** | **Deep Learning with Keras / PyTorch** | **15** |

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|---|---|---|
| | 3.1 Overview of deep learning concepts and applications<br>Introduction to neural networks: perceptrons, activation functions, and basic architectures<br>3.2 Installing Keras and PyTorch<br>Understanding Keras backend: TensorFlow vs. Theano<br>Building your first neural network model with Keras<br>3.3 Training and evaluating models in Keras<br>3.4 Introduction to Keras layers and activation function<br>Deep Learning with Keras / PyTorch: Setting up Project,<br>PyTorch tensors and operations<br>3.5 Automatic differentiation and dynamic computation graphs<br>Building and training a simple neural network in PyTorch<br>3.6 GPU acceleration with PyTorch<br>3.7 Starting Jupyter<br>3.8 Importing Libraries<br>3.9 Creating Deep Learning Model. | |
| **UNIT IV** | **Introduction to convents** | **(15)** |
| | 4.1 Overview of neural networks and their limitations with image data<br>4.2 Introduction to the convolution operation and its role in CNNs<br>4.3 Understanding the basic architecture of CNNs: convolutional layers, pooling layers, and fully connected layers<br>4.4 Foundations of Convolutional Neural Networks,<br>Training a convent from scratch on a small dataset, using a pretrained convent,<br>4.6 Visualizing what convents learn.<br>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. F. chollet, Deep Learning with Python,
2. A. Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola Dive into Deep Learning,
3. I. Goodfellow, Y. Bengio, Aaron Courville Deep Learning,
4. M. Nielsen's , Neural Networks and Deep Learning,

## Semester IV

## MCST 544 EI: Control Systems

**Course Objectives: Student will be able to…**

1. Study of systems theory to complex real-world problems to obtain models that are expressed using differential equations, transfer functions, and state space equations.
2. Understand system behavior based on the mathematical model of that system where the model may be expressed in time or frequency domain.
3. Study of the behavior of closed loop systems using various methods.
4. Understand controllers using classical PID methods, root locus methods, and frequency domain methods.

| Credits=4 | MCST 544: E1: Control Systems | No. of hours : 60 |
|---|---|---|
| **UNIT I** | **Introduction to Control Theory** | **15** |
| | 1.1 Basic Concepts of Control System,<br>Open loop and Closed loop systems,<br>1.2 Classifications, effect of feedbacks on Control System performance.<br>Transfer function modeling and representation of Control system, pole & zero concept,<br>1.3 Mathematical modeling of linear mechanical and Electrical systems,<br>Electrical analogy, Block reduction techniques,<br>1.4 Signal flow graph, Mason's gain formula. | |
| **UNIT II** | **Time Domain Analysis and stability** | **15** |
| | 2.1 Type and Order of Control system,<br>Typical tests signal, Time Response of first and second order systems to unit step input, Steady state errors,<br>2.2 Time Domain Specifications of Second Order System, E. Dominant Closed loop Poles of Higher Order Systems.<br>2.3 Concept of Stability: absolute, relative and marginal, nature of system response, stability analysis using Hurwitz's criterion, Routh's criterion,<br>2.4 Basic properties of Root Loci, Construction of Root loci<br>2.5 Angle and magnitude condition for stable systems,<br>Concept of inverse root locus and root contour. | |
| **UNIT III** | **Frequency Domain and State Variable Analysis** | **15** |

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|---|---|---|
| | 3.1Steady state response of a system to sinusoidal input,<br>Relation between time and frequency response for second order systems,<br>3.2 Frequency response specifications, D. Stability Analysis with Bode Plots,<br>3.3 Nyquist stability criterion.<br>3.4 Introduction to state space analysis,<br>3.5 State space representation for i) Electrical Network ii) nth order differential equation iii) Transfer function. | |
| **UNIT IV** | **Control system components and controllers** | **15** |
| | 4.1 Modeling and transfer function of control system components-Potentiometer,<br>4.2 DC and AC Servomotors, gear trains,<br>Tacho-generators.<br>4.3 Design concepts of P, PI, PD, PID controllers, Compensator Networks-lag and lead. | |

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

1. Understand the modelling of discrete systems in state space 2. apply programming strategies in the domain of control systems
2. Understand the systems in Time and frequency domain.
3. Design modern control systems with computer simulation

**References:**


1. I. J. Nagrath, M. Gopal "Control Systems Engineering", 5th Edition, New Age International Publication
2. O. Katsuhiko, "Modern Control Engineering", 4th Edition, PHI.
3. B.C. Kuo Automatic Control System, PHI, New Delhi, Third Edition
4. S. Ghosh, "Control Systems Theory & Applications", 1st Pearson education.
5. S.K. Bhattacharya, "Control Systems Engineering", 1st edition, Pearson education.
6. N. S. Nise, "Control System Engineering", 5th Edition, Wiley.
7. U.A.Bakshi, V.U.Bakshi "Control System Engineering",First Edition 2008 , Technical Publications, Pune .

# Semester IV

## MCST 544: EII: Microcontrollers and IOT

**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.

| Credits=4 | MCST 524: EII: Microcontrollers and IOT | No. of hours: 60 |
|---|---|---|
| **UNIT I** | **Internet of Things** | **15** |
| | 1.1 Introduction and its components,<br>1.2 IoT building blocks<br>1.3 Sensors and Actuators<br>1.3 IoT Devices<br>1.4 IoT boards (Arduino Uno, ESP 8266-12E Node MCU and Raspberry Pi 3). | |
| **UNIT II** | **Arduino Uno** | **15** |
| | 2.1 Arduino Uno – getting started with the Uno boards, blink program,<br>2.2 Connection of sensors to the Uno board, reading values of sensors from the Uno board,<br>2.3 Interrupts. Case study: Temperature/Humidity Control;<br>2.4 Case Study: Sending values Temperature/Humidity values to the Internet via GSM module. | |
| **UNIT III** | **ESP 8266-12E Node MCU** | **15** |
| | 3.1 ESP 8266-12E Node MCU – getting started with the ESP board,<br>3.2 Micropython and Esplorer IDE<br>3.3 Flushing the ESP8266 board with micropython<br>3.4 Connecting sensors to the ESP board, Connecting ESP board to WiFi<br>3.5 Interfacing ESP with the Cloud (REST API-GET, POST, MQTT), interrupts,<br>Comparison of ESP 32 board with the ESP 8266 board. Case Study: Switching light on /off remotely.<br>3.6 Case Study: Voice-based HomeAutomation for switching lights on/off (Android phone – Google Assistant (Assistant <- > IFTTT), MQTT (ESP <-> IFTTT), ESP 8266 <-> Lights). | |

| UNIT IV | **Raspberry Pi 3** | **15** |
|---|---|---|
| | 4.1 Raspberry Pi 3 - Rpi3 introduction and installing the Raspbian Stretch OS<br>4.2 Headless - Computer and Rpi3 configuration to connect through SSH via Ethernet<br>4.3 Headless - connecting Rpi3 remotely without Ethernet cable via SSH<br>4.4 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. R. M. ,Internet of Things with Raspberry Pi 3: Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects. Packt Publishing Ltd, (2018).
2. B. J. Arduino for beginners: essential skills every maker needs. Pearson Education, (2013)..
3. S. M. Internet of Things with ESP8266. Packt Publishing Ltd., (2016).
4. M. Richardson & S. Wallace, ,Getting started with raspberry PI. " O'Reilly Publisher Media, Inc.", (2012).

# MCSP 545: On Job Training (OJT) (4 Credits)

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.

of Instrumental Analysis

## Semester IV

## MCSP 546 Practical IV

## Big Data Analytics, Machine Learning and Deep Learning

## (Based on MCSP 541, 542, 543 courses)

**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.

| Credits=4 | MCSP 535 Practical (Based on MCST 541, 542, 543 courses) | No. of Hours : 60 |
|---|---|---|
| | 1. Installation of python libraries for deep learning.<br>2. Download and install Python SciPy and get the most useful package for machine learning in Python.<br>3. How does pandas fit into the data science toolkit?<br>4. Creating Data Frames from scratch using Pandas.<br>5. Keras: Feature extraction on large datasets with Deep Learning.<br>6. How to read in data (from CSVs, JSON, and SQL database) Write a program to converting back to a CSV, JSON, or SQL<br>7. Plotting the Graphs using Matplotlib libraries.<br>8. Downloading and installing Hadoop; Understanding different Hadoop modes.<br>9. Perform different HDFS commands in hadoop<br>10. Implement Word count program using Mapreduce<br>11. Perform CRUD Operations using MongoDB Install, Deploy & configure Apache Spark Cluster. Run apache spark applications<br>12. Olympics Data Analytics using Python<br>13. Machine Learning and its application-oriented algorithms.<br>14. Introduction to Machine Learning using Python and its libraries.<br>15. Installation of pandas and use of pip command.<br>16. Python program using NumPy for some basic mathematical operations<br>17. Implementing KNN- classification algorithm using Python on IRIS dataset.<br>18. Python script using Scipy for image manipulation.<br>19. Python program using Theano for computing a Logistic | |

| | | |
|---|---|---|
| | Function.<br>20. Python program using TensorFlow for multiplying two arrays. | |

**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 toreal-world problems.

**References:**


1. A. Zhang, C.Zachary Lipton, Mu Li, and Alexander J. Smola Dive into Deep Learning
2. Y. Bengio, A. Courville Deep Learning, Ian Goodfellow
3. M. Nielsen's 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)
5. F. J.OhlhorstWiley Big Data Analytics:Turning Big Data into Big Money", Publishers(2012)
6. C. Molaro,S. Parekh,T. PurcellMC"DB2 11:The Database for Big Data & Analytics", Press,(2013)
7. Hadoop-The Definitive Guide,Storage and analysis at internet scale",TomWhiteSPD, O'Really.
8. Big Data, Black Book-Covers Hadoop2, MapReduce,Hive,YARN, Pig, R and Data Visualization" ,DT Editorial Services Dreamtech Press,(2015).
9. A. V. Joshi Machine Learning and Artificial Intelligence, , Springer, Cham
10. E. Rich and K. Knight, Artificial Intelligence, Tata McGraw Hill, 2002.