SIES College of Arts, Science and Commerce (Autonomous), Sion (W), Mumbai – 400 022

SIES College of Arts, Science & Commerce
RISE WITH EDUCATION
NAAC REACCREDITED - 'A' GRADE
BEST COLLEGE AWARD - UNIVERSITY OF MUMBAI
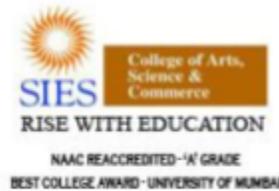
Faculty: Science

Program: M.Sc.-Part I

Subject: Computer Science

Academic Year: 2023-2024

Credit Based Semester and Grading Syllabi approved by Board of Studies in Computer Science to be brought into effect from June 2023

Preamble

This syllabus is an honest attempt to include following ideas, among other things, into practice:

- Bring a new approach to syllabus, not a revision of the existing syllabus.
- Create a unique identity for MSc in Comp Science distinct from similar degrees in other related subjects.
- Recommend provision for specialization in MSc Computer Science degree.
- Offers focus on core Computer Science subjects.
- Incorporate advanced and most recent trends.
- Identify and nurture research temper among students.
- Offer provision for internships with industry.
- Focus, as far as possible, only on open-source software.

This syllabus for the semester I and semester II has tried to initiate steps to meet these goals. By extending the syllabus to semester III and semester IV, it is assumed that these goals will be met to a larger extent.

The syllabus proposes to have four core compulsory courses in semester I. Semester II proposes three core compulsory courses and a field project or On job training for industry exposure . Semester 3 will have two tracks of courses based on a recent and emerging area. It is expected that a student continues to take that track and specializes in one of those in semester IV.

In order to give an impetus to research among students, one of the courses in semester I gives an overview on how to do research in Computer Science with a Research Methodology course. Provision for case study in the practical course of the elective in the semester II is an attempt to translate that theory into practice. It is assumed that, with this background, a student can take up a challenging research project in the semester III and semester IV.

In a nutshell, the core philosophy of the syllabus is to (i) give strong foundation on core Computer Science subjects;(ii) expose the student to emerging trends in a gradual and incremental way; (iii) offer specialization on a chosen area (iv) create a research temper among students in the whole process; (v) prepare student community for the demands of ICT industry.

We hope that the student and teaching community will appreciate the thrust, direction and treatment given to the courses in the syllabus. We sincerely believe that a student who takes up this course will be a better fit for industry as he or she will have a strong foundation on fundamentals and exposure to advanced and emerging trends. We earnestly believe that by focusing on student driven research, learning will be more interesting and stimulating.

We thank all the industry experts, senior faculties and our colleagues from the department of Computer Science of different colleges as well as University of Mumbai; who have given their valuable comments and suggestions, which we tried to incorporate. We thank the Chairperson and members of the Adhoc Board of Studies in Computer Science of University for their faith in us. Thanks to one and all who have directly or indirectly helped in this venture.

Structure of the syllabus

This is the syllabus for the semester –I and semester –II of MSc Computer Science program of SIES college of Arts Science and Commerce to be implemented from the year 2023-2024.   The syllabus offers four theory courses and two practical courses each in each semester. One noteworthy feature of the syllabus is the introduction of Electives in different tracks in semester II. It is assumed that a student will continue with that track in semester III and choose only one elective in semester IV, the subject in which he or she wants to specialize in.

Semester I

The syllabus proposes four subjects in semester -I. Each subject has theory and practical components.

Semester –I: Theory courses

The four theory courses offered in semester I are:
1. Algorithm for Optimization (Mandatory)
2. Software Defined Networking (Mandatory)
3. Web Mining -I (Mandatory)
4. Advanced Database Systems (Elective)
5. Research Methodology

Each of these courses is of four credits each and is expected to complete in 60 hours.
The following table gives the details of the theory courses in Semester -I.

Semester – I: Theory courses

Course code	Course Title	No of hours	Credits
SIPCSCC511	Algorithm for Optimization(Mandatory)	60	04
SIPCSCC512	Software Defined Networking (Mandatory)	60	04
SIPCSCC513	Web Mining -I(Mandatory)	30	01
SIPCSEL511	Advanced Database Systems (Elective)	30	02
SIPCSRM511	Research Methodology	15	03
Total Credits for Theory courses in Semester -I			**14**

Semester –I: Practical Lab courses

The syllabus proposes two laboratory courses of 2 credits each. The following table summarizes the details of the practical courses in semester I.

Semester I – Practical Laboratory courses

Course code	Course Title	No of hours	Credits
SIPCSCCP511	Practicals of Algorithm for Optimization	30	02
SIPCSCCP512	Practicals of Software Defined Networking	30	02
SIPCSCC513	Practicals of Web-Mining I	30	01
SIPCSELP511	Practicals of Advanced Database Systems (Elective)	30	02
SIPCSRMP511	Practicals of Research Methodology	15	01
Total Credits for Practical Laboratory courses in Semester –I			**08**

Semester –II

The syllabus proposes four subjects in semester –II also. As in the case of semester I, each subject has theory and practical components.

Semester II- Theory courses
The three theory courses offered in semester II are.
1. Applied Machine and Deep Learning (Mandatory)
2. Natural Language Processing (Mandatory)
3. Web Mining -II(Mandatory)
4. Embedded and IoT Technology (Elective)

Two of these courses (compulsory as well as elective) is of four credits each and is expected to complete in 60 hours. Elective course is of 2 credits and Web- Mining II is of 1 credit. The details are shown in the following table.

Semester II – Theory courses

Course code	Course Title	No of hours	Credits
SIPCSCC521	Applied Machine and Deep Learning(Mandatory)	60	04
SIPCSCC522	Natural Language Processing (Mandatory)	60	04
SIPCSCC523	Web Mining -II(Mandatory)	15	01
SIPCSEL521	Embedded and IoT Technology(Elective)	30	02
Total Credits for Theory courses in Semester-II			**12**

Semester –II: Practical Laboratory courses

The syllabus proposes two laboratory courses of 2 credits each. The following table summarizes the details of the practical courses in the semester –II.

Semester II – Practical Laboratory courses

Course code	Course Title	No of hours	Credits
SIPCSCCP521	Practicals of Applied Machine and Deep Learning	30	02
SIPCSCCP522	Practicals of Natural Language Processing	30	02
SIPCSCC523	Practicals ofWeb Mining -II	15	01
SIPCSELP521	Practicals of Embedded and IoT Technology	15	01
SIPCSOJ521	Field Project/ internship	60	04
Total Credits for Practical Laboratory courses in Semester –II			**10**

PROGRAM OUTCOMES

PO	PO Description A student completing master's degree in computer science program will be able to:
PO-1	Demonstrate an in-depth understanding of the relevant science discipline. Recall, explain, extrapolate, and organize conceptual scientific knowledge for execution and application and to evaluate its relevance
PO-2	Critically evaluate, analyze, and comprehend a scientific problem. Think creatively, experiment and generate a solution independently, check and validate it and modify if necessary.
PO-3	Access, evaluate, understand, and compare digital information from various sources and apply it for scientific knowledge acquisition as well as scientific data analysis and presentation
PO-4	Articulate scientific ideas, put forth a hypothesis, design and execute testing tools and draw relevant inferences. Communicate the research work in appropriate scientific language.
PO-5	Demonstrate initiative, competence, and tenacity at the workplace. Successfully plan and execute tasks independently as well as with team members. Effectively communicate and present complex information accurately and appropriately to different groups.
PO-6	Use an objective, unbiased and non-manipulative approach in collection and interpretation of scientific data and avoid plagiarism and violation of Intellectual Property Rights. Appreciate and be sensitive to environmental and sustainability issues and understand its scientific significance and global relevance
PO-7	Translate academic research into innovation and creatively design scientific solutions to problems. Exemplify project plans, use management skills, and lead a team for planning and execution of a task.
PO-8	Understand cross-disciplinary relevance of scientific developments and relearn and reskill to adapt to technological advancements.

PROGRAM SPECIFIC OUTCOMES

PO	PSO Description A student completing master's degree in computer science program will be able to:
PSO-1	Develop keen interest in the emerging technologies in the industry.
PSO-2	Analyze, innovate, and solve real-life case studies using technology.
PSO -3	Work in teams with various disciplines; working on an interdisciplinary project.
PSO -4	Understand work culture in the industry and attain skills to become a successful entrepreneur.
PSO -5	Develop a skillset analyze, describe, and innovate various methodologies to solve a given problem
PSO -6	Understand the philosophy of the subject to apply to various fields of research.
PSO -7	Work in an industrial environment under expert supervision and develop expertise in various technologies
PSO -8	Effective utilization of available resources to overcome challenging tasks

Course Code	Course Title	Credits
SIPCSCC511	**Algorithm for Optimization (Mandatory)**	**04**

Course Outcome: - **CO-1:** To effectively implement optimization techniques to the existing algorithm to improve its performance. **CO-2:** To work in the areas of Machine Learning and Data Sciences Algorithms.
UNIT 1: Introduction to Optimization: Process Basic Optimization Problem, Constraints, Critical Points, Conditions for Local Minima, Contour Plots. Unimodality, Fibonacci Search, Golden Section Search, Quadratic Fit Search.
UNIT 2: Order Methods: First-Order Methods-Gradient Descent, Adagrad, RMS Prop, Ada delta, Adam, Hypergradient Descent. Second-Order Methods, Newton's Method, Secant Method, Quasi Newton Methods.
UNIT 3: Sampling and Surrogate Models: Sampling Plans, Full Factorial, Random Sampling, Uniform Projection Plans, Stratified Sampling. **Surrogate Models:** Linear Models, Basis Functions, Fitting Noisy Objective Functions, Model Selection, Probabilistic Surrogate Models, Gaussian Distribution, Gaussian Processes.
UNIT 4: (Skill Enhancement) **Optimization and Uncertainty: Optimization** under Uncertainty, Uncertainty, Set-Based Uncertainty, Probabilistic Uncertainty. Uncertainty Propagation, Sampling Methods, Taylor Approximation, Polynomial Chaos, Bayesian Monte Carlo. Dynamic Programming, Ant Colony Optimization. Expression Optimization, Grammars, Genetic Programming, Grammatical Evolution, Probabilistic Grammars, Probabilistic Prototype Trees.
Text Books: 1. Algorithms for Optimization Mykel J. Kochenderfer, Tim A. Wheeler, The MIT Press 2019.
References: 1.   Think Julia: How to Think Like a Computer Scientist by Allen B. Downey and Ben Lauwens 1st Edition 2019 O'reilly. 2.   Decision Making Under Uncertainty: Theory and Application by Mykel J. Kochenderfer MIT Lincoln Laboratory Series 2015. 3.   Introduction to Algorithms, By Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein 3Ed. (International Edition) (MIT Press) 2009

Course Code	Course Title	Credits
SIPCSCC512	**Software Defined Networking**	**04**

Course Outcome: -
CO-1: To make the students capable of understanding computer network basics.
CO-2: To Obtain the knowledge of Software defined networks with understanding of data plane, control plane and application plane.
CO-3: To apply network virtualization for industry standard solutions.
CO-4: To improve skills in implementing network virtualization and Software Defined Network (SDN).

UNIT 1: Introduction to Computer Networking Basic Concepts and Definitions: LAN, MAN, WAN, AD-Hoc, Wireless Network, Understanding the layered architecture of OSI/RM and TCP-IP Model, Concepts, and implementation of IPV4 and IPV6, Study of various network Routing protocols, Introduction to Transport layer and Application layer protocols.

UNIT 2: Software Defined Networking : Elements of Modern Networking, Requirements and Technology, SDN: Background and Motivation, SDN Data Plane and OpenFlow, SDN Control Plane, SDN Application Plane

UNIT 3: Network Functions Virtualization Concepts and Architecture, NFV Functionality, Network Virtualization Quality of Service, MODERN NETWORK ARCHITECTURE: CLOUDS AND FOG, Cloud Computing, The Internet of Things: Components

UNIT 4: (Skill Enhancement) Design and implementation of Network: Understand and implement Layer 2/3 switching techniques (VLAN /TRUNKING/ Managing Spanning Tree), Implementation of OSPF V2 and V3, Implementation BGP, Implementation Multicast Routing, Implementation of MPLS, Implementation of Traffic Filtering by using Standard and Extended Access Control List.

Text Books:
1. Behrouz A Forouzan ―TCPIP Protocol Suite‖ Fourth Edition 2010
2. William Stallings, ―Foundations of Modern Networking‖, Pearson Ltd.,2016.
3. Software Defined Networks: A Comprehensive Approach by Paul Goransson and Chuck Black, Morgan Kaufmann Publications, 2014
4. SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013

References:
1. Network Programmability and Automation-Jason Edelman, Matt Oswalt First Edition 2018.

Course Code	Course Title	Credits
SIPCSCC513	**Web Mining - I (Mandatory Theory)**	01

Course Outcome: -
CO-1: To Understand the difference between Web Mining and Data mining.
CO-2: To Understand the Basics and Needs of Web Mining.
CO-3: To Understand Web-based Data.
CO-4: To Understand Opinion Mining and Sentiment classification.

UNIT 1:
Introduction to Web Mining: Basics of Data Mining, Text mining, Web Mining, Web and its version, Differences-Data mining and Web Mining, Web mining process, Taxonomy, Web Usage Mining phases, Web content mining techniques, Data Preprocessing for Web Data Mining, Applications of Web Mining.
Information Retrieval: Basic Concepts of Information Retrieval, Information Retrieval Models, IRS-Design and Structure, Search Strategy, Evaluation of IRS , Relevance feedback, Inverted Index and Its Compression, latent semantic indexing, Web Spamming.
Opinion Mining and Web Usage Mining: Web Information Retrieval, Characteristics of Web IR , Sentiment Classification, Feature based Opinion Mining, Summarization, Comparative Sentence and Relation Mining, Opinion Search and Opinion Spam.

Text Books:
1. Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data by Bing Liu (Springer Publications) 2017 publication

References:
1. Web Mining: Applications and Techniques by Anthony Scime,2010
2. Mining the Web: Discovering Knowledge from Hypertext Data by Soumen Chakrabarti 2010

Course Code	Course Title	Credits
SIPCSEL511	**Advanced Database Systems**	**02**

Course Outcome: -
CO-1: To cover advanced topics of databases to become more proficient.
CO-2: To provide students with theoretical knowledge and practical skills in advanced topics in database systems, big data, and modern data-intensive systems.
CO-3: To Expand Students, view and introduce advanced topics and Business Intelligence.

UNIT 1: Enhanced Database Models Object–Oriented Databases: Need of Object-oriented databases, Complex Data Types, Structured Types and Inheritance, Object Identity and Reference, Object-Oriented versus Object Relational, Example of Object oriented and object relational database implementation, comparison of RDBMS, OODBMS, ORDBMS . **XML Databases:** Structured Semi structure and unstructured data, XML hierarchical tree data model, Documents DTD and XML schema, XML Documents & Database, XML query and transformation, Storage of XML data, Xpath , XQuery, Join and Nesting Queries, XML database applications. **Spatial Databases:** Types of spatial data, Geographical Information Systems (GIS), Conceptual Data Models for spatial databases, Physical data models for spatial databases: Clustering methods (space filling curves), Storage methods (R-tree). Query processing.
Temporal Databases: Time ontology, structure, and granularity, Temporal data models, Temporal relational algebra.

UNIT 2: Cooperative Transaction Model Parallel and Distributed Databases: Architecture of parallel databases, Parallel query evaluation, Parallelizing individual operations, Sorting Joins. **Distributed Databases:** Concepts, Data fragmentation, Replication and allocation techniques for distributed database design, Query processing, Concurrency control and recovery in distributed databases, Architecture and Design: Centralised versus non centralized Databases, Homogeneous and Heterogeneous DDBMS, Functions and Architecture, Distributed database design, query processing in DDBMS. **Introduction to NoSQL:** Characteristics of NoSQL, NoSQL Storage types, Advantages and Drawbacks, NoSQL Products.
Interfacing and interacting with NoSQL: Storing Data In and Accessing Data from MongoDB, Redis, HBase and Apache Cassandra, Language Bindings for NoSQL Data Stores

Text books:
  1. Database Management Systems by Raghu Ramakrishnan and Johannes Gehrke, McGraw Hill, 3rd Edition, 2014
  2. Professional NoSQL By Shashank Tiwari, Wrox-John Wiley & Sons, Inc, 2011 3. Getting Started with NoSQL, Gaurav Vaish, Packt Publishing Ltd, 2013.
References:
1. Principles of Distributed Database Systems; 2nd Editied By M. Tamer Ozsu and Patrick Valduriez, Person Education Asia.
2. Database Systems: Concepts, Design and Applications, 2nd edition, Shio Kumar Singh, Pearson Publishing, (2011).
3. Multi-dimensional aggregation for temporal data. M. Böhlen, J. Gamper, and C.S. Jensen. In Proc. of EDBT-2006, pp. 257-275, (2006).
4. Moving objects databases (chapter 1 and 2), R.H. Güting and M. Schneider: Morgan Kaufmann Publishers, Inc., (2005)
5. Advanced Database Systems, (chapter 5, 6, and 7), Zaniolo et al.: Morgan Kaufmann Publishers, Inc., (1997).

Course Code	Course Title	Credits
SIPCSRM511	**Research Methodology**	**02**

CO-1: To develop the aptitude for research and the ability to explore research techniques to solve real world problems Learning Outcome:
CO-2: To critically analyze, synthesize and solve complex unstructured business and real-world problems with scientific approach.
CO-3: To develop analytical skills by applying scientific methods.

UNIT 1:

Introduction to Research: Objectives of research, Types of Research, Research approaches, Research methods versus methodology, Research Process. Formulation of the research problem: Selecting the problem, Technique involved in defining a problem.

Research Design: Meaning, Need and Features of a research design, Different research designs, Basic principles of Experimental Designs, Sampling Design: Implications and Steps in Sampling Design, Types of Sampling Designs.

UNIT 2:

Data Collection Methods: Primary data and Secondary data, Processing and Analysis of Data, Statistics in research, Sampling theory, Concept of Standard Error, Estimation, Sample size and its determination Testing of hypotheses: Procedure and flow diagram for hypothesis testing, Parametric Tests, Chi-Square Test, Analysis of Variance and Covariance, Non-parametric tests.

Multivariate analysis techniques: Classification, Variables, Factor Analysis, Path Analysis, Interpretation and Report Writing: Technique and Precaution in interpretation, Report Writing, Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Referencing styles.

Ethical Issues in Research: Plagiarism and Self Plagiarism, Avoiding plagiarism, Why cite? Basics of citation Fundamentals of Patents: What is a patent?, Conditions for grant of patent, Inventions that are not Patentable, Process and Product Patent, Procedure of the process of registration and grant of patents, Transfer and Infringement of Patent Rights, Surrender of Patents, Challenges in Patents.

Text Books:
1.Research Methodology – Methods and Techniques C.R.Kothari, Gaurav Garg New Age 4e
2.Research Methodology – a step by step guide for beginners Ranjit Kumar Sage Publications 3e 2011
References:
1. Research Methodology Panneerselvam PHI Learning 2e 2014
2. Business Research Methods William G.Zikmund, B.J Babin, J.C. Carr, Atanu Adhikari, M.Griffin Cengage 8e 2016

List of practical Experiments for Semester – I

Course Code	Course Title	Credits
SIPCSCCP511	**Practicals of Algorithm for Optimization**	**02**
Note: All the Practical's should be implemented using Julia Link: Julia:https://julialang.org/		
1	Implement Contour Plots.	
2	Implement Fibonacci and Golden section search.	
3	Implement Quadratic Fit Search.	
4	Implement Gradient descent.	
5	Implement quasi-Newton methods to find the local maxima.	
6	Implement the Adagrad method with application, RMSprop and Adadelta.	
7	Implement radial basis functions using surrogate modelling.	
8	Apply Random Forest in surrogate Model.	
9	Implement Gaussian Process and its application.	
10	Path finding using Ant Colony Optimization with an application.	

Course Code	Course Title		Credits
SIPCSCCP512	**Practical Course on Software Defined Networking**	**02**	
Note: All the Practical's should be implemented using GNS3/EVE-NG/CISCO VIRL **Link: GNS3 :https://www.gns3.com/software/download** **EVE-NG: https://www.eve-ng.net/index.php/download/ CISCO** **VIRL:https://learningnetwork.cisco.com/s/question/0D53i00000Kswpr/virl15-download**			
1	Implement IP SLA (IP Service Level Agreement)		
2	Implement IPv4 ACLs a. Standard b. Extended		
3	a. Implement SPAN Technologies (Switch Port Analyzer) b. Implement SNMP and Syslog c. Implement Flexible NetFlow		
4	Implement Inter-VLAN Routing		
5	OSPF Implementation 1. Implement Single-Area OSPFv2 2. Implement Multi-Area OSPFv2 3. OSPFv2 Route Summarization and Filtering		
6	Implement BGP Communities 1. Implement EBGP 2. Implement IBGP		
7	Implement IPsec Site-to-Site VPNs connections		
8	Simulating OpenFlow Using MININET		
9	Simulating SDN with OpenDaylight SDN Controller with the Mininet Network Emulator		

Course Code	Course Title	Credits
SIPCSCC513	Practical Course on Web Mining I	01
Note: - The following set of practical's should be implemented in python Link:-Python : https://www.python.org/downloads/		
1	Write a program for Pre-processing of a Text Document: stop word removal.	
2	Write a program to Create a inverted index for file	
3	Write a program to implement Latent Semantic Analysis	
4	Write a program to find the weight of specific term in a given documents	
5	Implement hands on experience store and retrieve information from www using semantic approaches	
6	Write a program on Sentiment analysis	

Course Code	Course Title	Credits
SIPCSELP511	Practical Course on Advanced Database Systems	02
Note: All the Practical's should be implemented using NoSQL Link: https://www.oracle.com/database/technologies/nosql-databaseserver-downloads.html		
1	Create different types that include attributes and methods. Define tables for these types by adding a sufficient number of tuples. Demonstrate insert, update and delete operations on these tables. Execute queries on them	
2	Create an XML database and demonstrate insert, update and delete operations on these tables. Issue queries on it.	
3	Demonstrate distributed databases environment by dividing given global conceCreate a table that stores spatial data and issue queries on it. ptual schema, into vertical and Horizontal fragments and place them on different nodes. Execute queries on these fragments	
4	Create a table that stores spatial data and issues queries on it.	
5	Create a temporal database and issue queries on it.	
6	Demonstrate the Accessing and Storing and performing CRUD operations in 1. MongoDB 2. Redis	
7	Demonstrate the Accessing and Storing and performing CRUD operations in 1. HBase 2. Apache Cassandra	
8	Demonstrating MapReduce in MongoDB to count the number of female (F) and male (M) respondents in the database.	
9	Demonstrate the indexing and ordering operations in 1. MongoDB 2. CouchDB 3. Apache Cassandra	

Course Code	Course Title	Credits
SIPCSRMP511	**Practical Course on Research Methodology**	**02**
(Using Google scholar/SPSS/Mendeley/End note etc)		
1	Defining a research problem	
2	Literature Review using search tools like google scholar	
3	Research design	
4	Sampling Design	
5	Usage of measurement and scaling techniquest	
6	Testing of Hypothesis	
7	Implement data analysis techniques	
8	Writing a research report	

Detailed syllabus of semester – II

Course Code	Course Title	Credits
SIPCSCC521	**Applied Machine and Deep Learning**	**04**

Course Outcome: -
CO-1: Developing projects in machine learning for industrial applications.
CO-2: Understanding and implementing algorithms and techniques of Machine Learning useful in the field of Data Science, Image Processing, NLP, etc.

UNIT 1: (Ability Enhancement) The Fundamentals of Machine Learning What is Machine Learning? Why use Machine Learning? Types of Machine Learning, Supervised Learning, Unsupervised Learning & Reinforcement Learning. Challenges of Machine Learning, Testing and Validation A First Application: Classification, MNIST Dataset, Performance Measures, Confusion Matrix, Precision and Recall, Precision/Recall Tradeoff, The ROC Curve, Multiclass Classification, Error Analysis.

UNIT 2: Training Models Linear Regression, Gradient Descent, Batch Gradient Descent, Stochastic Gradient Descent, Mini-batch Gradient Descent, Polynomial Regression, Learning Curves, The Bias/Variance Tradeoff, Ridge Regression, Lasso Regression, Early Stopping, Logistic Regression, Decision Boundaries, Softmax Regression, Cross Entropy.

UNIT 3: Support Vector Machines
Linear SVM Classification, Soft Margin Classification, Nonlinear SVM Classification, Polynomial Kernel, Gaussian RBF Kernel, SVM Regression, Decision Trees, Training and Visualizing a Decision Tree, Making Predictions, The CART Training Algorithm, Gini Impurity vs Entropy, Regularization Hyperparameters.

UNIT 4: (Skill Enhancement)
Fundamentals of Deep Learning
What is Deep Learning? Need Deep Learning? Introduction to Artificial Neural Network (ANN), Core components of neural networks, Multi-Layer Perceptron (MLP), Activation functions, Sigmoid, Rectified Linear Unit (ReLU), Introduction to Tensors and Operations, Tensorflow framework.

Text Books:

1. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow Concepts, Tools, and Techniques to Build Intelligent Systems by AurélienGéron, Second Edition, O'reilly 2019

2. Deep Learning with Python by François Chollet Published by Manning 2018 3. Reinforcement Learning: An Introduction by Richard S. Sutton and Andrew G. Barto, Second Edition 2014

References:
1. Introduction to Machine with Python - A Guide for Data Scientists by Andreas C. Müller & Sarah Guido O'reilly 2016
2. Artificial Neural Networks with TensorFlow 2 ANN Architecture Machine Learning Projects Poornachandra Sarang by Apress 2021

Course Code	Course Title	Credits
SIPCSCC522	**Natural Language Processing**	04

Course Outcome: -
 CO-1: To Understand the importance and concepts of Natural Language Processing (NLP)
 CO-2: Applying algorithms available for the processing of linguistic information and computational properties of natural languages.
 CO-3: Knowledge on various morphological, syntactic, and semantic NLP tasks.
 CO-4: Introducing various NLP software libraries and data sets publicly available.
 CO-5: Designing and developing practical NLP based applications

UNIT 1: Introduction to Natural Language Processing (NLP) and Language Modelling
Introduction to NLP: Introduction and applications, NLP phases, Difficulty of NLP including ambiguity; Spelling error and Noisy Channel Model; Concepts of Parts-of speech and Formal Grammar of English. Language Modelling: N-gram and Neural Language Models Language Modelling with N-gram, Simple N-gram models, smoothing (basic techniques), Evaluating language models; Neural Network basics, Training; Neural Language Model, Case study: application of neural language model in NLP system development Python Libraries for NLP: Using Python libraries/packages such as Natural Language Toolkit (NLTK), spaCy, genism

UNIT 2: Morphology & Parsing in NLP
Computational morphology & Parts-of-speech Tagging: basic concepts; Tagset; Lemmatization, Early approaches: Rule-based and TBL; POS tagging using HMM, Introduction to POS Tagging using Neural Model. Parsing Basic concepts: top-down and bottom-up parsing, treebank; Syntactic parsing: CKY parsing; Statistical Parsing basics: Probabilistic Context-Free Grammar (PCFG); Probabilistic CKY Parsing of PCFGs.

UNIT 3: Semantic and Word Embedding Semantics
Vector Semantics: Words and Vector; Measuring Similarity; Semantics with dense vectors; SVD and Latent Semantic Analysis Embeddings from prediction: Skip-gram and Continuous Bag of words; Concept of Word Sense; Introduction to WordNet

UNIT 4: (Skill Enhancement) NLP Applications and Case Studies
Intelligent Work Processors: Machine Translation; User Interfaces; man-machine Interfaces: Natural language Querying Tutoring and Authoring Systems. Speech Recognition Commercial use of NLP: NLP in customer Service, Sentiment Analysis, Emotion Mining, Handling Frauds and SMS, Bots, LSTM & BERT models, Conversations

Text Books:
 1. Speech and Language Processing‖, Jurafsky Dan and Martin James H., 3rd Edition, Pearson, 2018.
 2. Natural Language Processing with Python‖, Steven Bird, Ewan Klein, and Edward Loper, 2nd Edition, O'Reilly, 2016.
 References:
 1. Natural Language Processing with Python‖, Mathangi Sri, Apress, 2021 .
 2. "Handbook of Computational Linguistics and Natural Language Processing, Martin Whitehead, ClanryeInternational, 2020 .
  3.Handbook of Natural Language Processing‖, Nitin Indurkhya, and Fred J. Damerau, Pearson; 2nd edition, 2008.

Course Code	Course Title	Credits
SIPCSCC523	**Web Mining -II (Mandatory)**	**01**

Course outcomes:
CO-1: Develop deep understanding of mining techniques exclusively for the Internet.
CO-2: Understand and develop analytics for social media data.
CO-3: Design and implementation of various web analytical tool to understand complex
unstructured data on the Internet for aiding individuals and Businesses to grow their business

Unit I:
Social Network & Link Analysis: Link Analysis, Scrapy using python (without pipelining), Social Network Analysis, Co-Citation and Bibliographic Coupling, PageRank, HITS, Community Discovery.
Webpage crawlers and usage mining: Basic Crawler Algorithm, Implementation Issues, Universal Crawlers, Focused Crawlers, Topical Crawlers, Crawler Ethics and Conflicts, Data modeling and webpage usage mining., Discovery and analysis of web usage patterns, Recommender systems and collaborative filtering, query log mining

Text books:
1. Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data by Bing Liu (Springer Publications) 2017 publication

Reference:
1.Data Mining: Concepts and Techniques, Second Edition Jiawei Han, Micheline Kamber (Elsevier Publications),2017
2.Web Mining: Applications and Techniques by Anthony Scime,2010
3.Mining the Web: Discovering Knowledge from Hypertext Data by Soumen Chakrabarti 2010

Course Code	Course Title	Credits
SIPCSEL521	**Embedded and IoT Technology**	**02**

Course Outcome: -

CO-1: The course is designed to enable students, to understand and implement IoT in industry.

CO-2: Design and executive projects in IoT with Automatic Identification and Data Capture

UNIT 1:

Embedded System Basics: Introduction to Embedded Systems, Design of Embedded Systems, Memory Architecture, Input/Output. Basic electronics: Semiconductors, Transistors, BJT, Flip Flops, Resistors, Capacitors, CMOS, MOSFET, FPGA, Relays. Microcontrollers, UART Communications, SPI-peripherals interface, I2C communication, Wireless Sensor Network (WSN)

  Basics of IOT: Introduction IoT: Evolution of the IoT concept, vision and definition of IoT, basic characteristics of IoT, distinguish the IoT from other related technologies, IoT enablers, IoT architectures, pros and cons of IoT, IoT architecture concepts for specific IoT applications.

IoT Building Blocks -Hardware and Software: The basic IoT building blocks, smart thing components and capabilities, basics of Packet Tracer with reference to IoT, basics of IoT gateway, Cloud, and analytics .

Sensing Principles and Wireless Sensor Network: Sensor fundamentals and classification of sensors, physical principles of some common sensors, basics of WSNs, WSN architecture and types, layer-level functionality of WSN protocol stack.

UNIT 2:

Advanced IOT Technologies IoT Gateway : IoT architecture domains, IoT gateway architecture, IoT gateway functionalities, IoT gateway selection criteria, IoT gateway and edge computing, edge computing-based solution for specific IoT applications IoT Protocol Stack:Mapping of IoT protocols to layered IoT architecture, functionality of infrastructure, service discovery, and application layer protocols of IoT protocol stack IoT

Cloud and Fog Computing : Components of IoT Cloud architecture, usage of application domains of IoT Cloud platforms, layered architecture of Fog computing, distinguish Fog computing from other related terms

IoT Applications : Main applications of IoT, Implementation details of various IoT application domains

IoT Security: Security constraints in IoT systems, security requirements of IoT systems, IoT attacks, security threats at each layer of IoT architecture, design secure IoT system for specific

application

Social IoT: Nature of social relationships among IoT Devices, functionality of different components of social IoT architecture, social aspects of smart devices in IoT applications

Packet Tracer and IoT: Basics of Packet Tracer and Blockly programming language, design simple IoT projects in Packet Tracer.

Text books:

1. Introduction to Embedded Systems – Cyber physical systems Approach Edward Ashford Lee & Sanjit Arunkumar Seshia Second Edition — MIT Press — 2017

 2. Enabling the Internet of Things Fundamentals, Design and Applications by Muhammad Azhar Iqbal, Sajjad Hussain, Huanlai Xing, Muhammad Ali Imran Wiley Pub.1st Edition 2021

References:

1.Introduction Embedded Systems by K.V. Shibu Second Edition McGraw Hills–2017 2. Build your own IoT Platform Develop a Fully Flexible and Scalable Internet**1**

List of Practical Experiments for Semester –II

Course Code	Course Title	Credits
SIPCSCCP521	Practical Course on Applied Machine and Deep Learning	02
Note: All the Practical's should be implemented using Python and TensorFlow. Link:Python :https://www.python.org/downloads/ TensorFlow:https://www.tensorflow.org/install		
1	Implement Linear Regression (Diabetes Dataset)	
2	Implement Logistic Regression (Iris Dataset)	
3	Implements Multinomial Logistic Regression (Iris Dataset)	
4	Implement SVM classifier (Iris Dataset)	
5	Train and fine-tune a Decision Tree for the Moons Dataset	
6	Train an SVM regressor on the California Housing Dataset	
7	Implement Batch Gradient Descent with early stopping for Softmax Regression	
8	Implement MLP for classification of handwritten digits (MNIST Dataset) .	
9	Classification of images of clothing using Tensorflow (Fashion MNIST dataset)	
10	Implement Regression to predict fuel efficiency using Tensorflow (Auto MPG dataset)	

Course Code	Course Title	Credits
SIPCSCCP522	Practical Course on Natural Language Processing	02
Note: - The following set of practicals can be performed using any Python Libraries for NLP such as NLTK, spaCy, genism: Link:-https://www.python.org/downloads/		
1	Write a program to implement sentence segmentation and word tokenization.	
2	Write a program to Implement stemming and lemmatization.	
3	Write a program to Implement a tri-gram model.	
4	Write a program to Implement PoS tagging using HMM & Neural Model.	
5	Write a program to Implement syntactic parsing of a given text.	
6	Write a program to Implement dependency parsing of a given text.	
7	Write a program to Implement Named Entity Recognition (NER).	
8	Write a program to Implement Text Summarization for the given sample text.	

Course Code	Course Title	Credits
SIPCSCC523	**Practical Course on Web Mining II**	**01**

Note: - The following set of practical's should be implemented in Scrape, python
Link:-Python : https://www.python.org/downloads/

1	Implement Page rank Algorithm
2	Scrape an online Social Media Site for Data. Use python to scrape information from twitter.
3	Develop a basic crawler for the web search for user defined keywords.
4	Develop a focused crawler for local search.
5	Write a program to Implement Text Summarization for the given sample text

Course Code	Course Title	Credits
SIPCSELP521	**Practical Course on Embedded and IoT Technology**	**01**

Note: - The following set of practicals should be implemented in CodeVisionAVR, Proteus8, Cisco Packet Tracer, Keli V5, Python
Link: -Python:https://www.python.org/downloads/ CodeVisionAVR :https://www.codevision.be/
Proteus8:https://www.labcenter.com/downloads/ Cisco Packet
Tracer:https://www.netacad.com/courses/packet-tracer Keli V5: https://www.keil.com/download/

1	Design and implement basics embedded circuits a.Automatic Alarm system- Alarm should get trigger by senor b. Timer based buzzer c. Sensor based Counting device
2	Demonstrate communication between two embedded devices using UART port
3	Demonstrate an IoT based game which can be played between two player who are physically at a considerable distance.
4	Develop a IoT application which will record the movement and orientation of your phone and give the data back to the PC
5	Develop an IoT application that will raise an alarm whenever with going to rain outside based on the weather prediction data.
6	Deploy an IoT application which will alert you by beeping or vibrating your phone whenever you get someone call your name.
7	Develop an IoT application for monitoring water levels in tanks and automatically start the motor to fill the tank if the level goes below the critical level.
8	Develop an IoT module to which measure the intensity of light and send the same to your PC/ Phone
9	Develop an IoT application for Motion detection.

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Course Codes and Examination Pattern							
Course Category	Course Name	Course Code	Total Credits	Exam Conduction Type	Internal Evaluation Marks Out Of	Semester End Marks Out Of	Semester End Practical Marks Out Of
MSc-I Semester I							
Core Course-1	Algorithm for Optimization (Mandatory)	SIPCSCC511/ SIPCSCCP511	4Th + 2Pr	Internal, Semester End, Practical	40	60	50
Core Course-2	Software Defined Networking (Mandatory)	SIPCSCC512/ SIPCSCCP512	4Th + 2Pr	Internal, Semester End, Practical	40	60	50
Core Course-3	Web Mining -I(Mandatory)	SIPCSCC513	1Th+1 Pr	Semester End, Internal	20	30	NA
DSE	Advanced Database Systems (Elective)	SIPCSEL511/ SIPCSELP511	3Th + 1Pr	Internal, Semester End, Practical	25	50	25
RM	Research Methodology	SIPCSRM511/ SIPCSRMP511	3Th + 1Pr	Internal, Semester End	40	60	-
MSc -I Semester II							
Core Course-1	Applied Machine and Deep Learning(Mandatory)	SIPCSCC521/ SIPCSCCP521	4Th + 2Pr	Internal, Semester End, Practical	40	60	50
Core Course-2	Natural Language Processing (Mandatory)	SIPCSCC522/ SIPCSCCP522	4Th + 2Pr	Internal, Semester End, Practical	40	60	50
Core Course-3	Web Mining -II(Mandatory)	SIPCSCC523	1Th+1Pr	Semester End, Internal	20	30	NA
DSE	Embedded and IoT Technology (Elective)	SIPCSEL521/ SIPCSELP521	3Th + 1Pr	Internal, Semester End, Practical	25	50	25
OJT/Field Project		SIPCSOJ521	4C	Internal and External; (Performance-based, Presentation and Viva voce + Report)	40	NA	60 (Industry/ External evaluation)