

AC: 29/06/2024  
Item No. 1.2.2



**SIES (Nerul) College of Arts, Science and  
Commerce (Autonomous)**

**(Affiliated to University of Mumbai)**

**RE-ACCREDITED GRADE "A" BY NAAC (3rd CYCLE) BOARD OF STUDIES  
SYLLABUS FOR M.SC (COMPUTER SCIENCE)**

**(WITH EFFECT FROM THE ACADEMIC YEAR 2024-2025)**

Sr. No.	Heading	Particulars
1	Title of the Programme	M Sc Computer Science
2	Year	Second Year
3	Semesters	III and IV
4	Level	UG
5	Pattern	2years & 4 semesters Choice Based Grading System
6	Status	New
7	To be implemented from	From Academic year 2024-25 in a progressive manner

Date: 29<sup>th</sup> June, 2024.

Signature:

Dr. Koel Roychoudhury  
AC Chairperson



Dr. Sheeja Ravi  
Head of the Department



**SIES (Nerul) College of Arts, Science and Commerce (Autonomous)**  
**(Affiliated to University of Mumbai)**  
**RE-ACCREDITED GRADE "A" BY NAAC (3rd CYCLE)**

**BOARD OF STUDIES**  
**SYLLABUS For M.Sc. Computer Science**  
**(WITH EFFECT FROM THE ACADEMIC YEAR 2024-2025)**

**OBJECTIVES OF THE PROGRAMME:**

- To be fundamentally strong at core subject of Computer Science.
- To apply programming and computational skills for industrial solutions.
- Broad understanding of latest technological trends.
- To identify opportunities for establishing an enterprise for immediate Employment.
- Able to understand and apply fundamental research concepts.

**PROGRAMME OUTCOMES:**

- An ability to apply the skills acquired in post-graduation to get better career prospects.
- An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computational systems.
- An ability to apply the knowledge for higher research in a specialized area of Computer Science.
- Ability to understand and apply the core concepts of Computer Science.
- Ability to provide socially acceptable technical solutions in various domains of specializations.



**SIES(Nerul) College of Arts, Science and  
Commerce (Autonomous) Department of Computer  
Science (MSC-Semester III)  
NEP Credit Structure for 2024 - 25**

Level	Semester	Major		R M	O E	VS C, SEC	IKS, AE C/V EC	O JT /F P	R P	Cum. Cr. / Sem.
		Mandatory	Elective (Through NPTEL)							
	III	Data Visualization Techniques (4 Credits)	TO BE DONE THROUGH NPTEL Wireless Networking OR Cyber security and risk assessment (04 Credits)	-	-	-	-	-	0 4	22
		Adv. Computer Networking (4 Credits)								
		Cryptology (4 Credits)								
		Advanced Cloud Computing (2 Credits)								
Total of III		14	04		-	-	-	-	0 4	22



**SIES Nerul College of Arts, Science and Commerce (Autonomous)**

**M. Sc. Computer Science Programme**

**(To be implemented from Academic Year- 2024-25)**

No. of Courses	Course Code	Semester III	Credits
1	Major		
1	M24CS3MJ01	Data Visualization Techniques	3
2	M24CS3MJP01	Data Visualization Techniques Practical	1
3	M24CS3MJ02	Adv. Computer Networking	3
4	M24CS3MJP02	Adv. Computer Networking Practical	1
5	M24CS3MJ03	Cryptology	3
6	M24CS3MJP03	Cryptology Practical	1
7	M24CS3MJ04	Advanced Cloud Computing	1
8	M24CS3MJP04	Advanced Cloud Computing Practical	1
2	Electives(E) (Any one)(To Be Done Thorough NPTEL)		
7	M24CS3E01	Wireless Networking	4
8	M24CS3E02	Cyber security and risk assessment	4
3	OJT / FP/ RP		
11	M24CS3RP01	Research Project	4
Total Credits			22



## Data Visualization Techniques

**Course Code :** M24CS3MJ01

**Course Credit : 3**

**1 credit - 15 lectures**

**lecture is 60 minutes**

Course Objectives:

- To Understand the fundamentals of Visualization.
- Knowledge on working with different Data Collection Structures.
- Designing and Developing practical Data Visualization can be performed using Tableau.

Course Outcome: -

- Familiarity with working with data analysis tools.
- Ability to perform data wrangling for practical purposes.
- Ability to solve real-world data analysis problems with thorough, detailed examples.
- Ability to use Tableau to handle data from various sources and perform analysis of data.

Unit	Syllabus	No. of lectures
1.	<p><b>Statistical Methods:</b> Mean, Mode, Median, Standard deviation, Regression.</p> <p><b>Preparing and Storing Data:</b> Series: Creating a Series with index, creating a Series from a Dictionary, Creating a Series from a Scalar Value, Vectorized Operations and Label Alignment with Series, Name Attribute. Accessing Data from a Series with a Position, Exploring and Analysing a Series, Operations on a Series.</p> <p><b>Data Frames:</b> Creating a Data Frame from a Dict of Series or Dicts, Creating Data Frames from a Dict of Ndarrays, Creating Data Frames from a Structured or Record Array, Creating Data Frames from a List of Dicts, Creating Data Frames from a Dict of Tuples, Selecting, Adding, and Deleting Data Frame Columns, Assigning New Columns in Method Chains, Row Selection, Row Addition, Row Deletion, Exploring and Analysing a Data Frame, Indexing and Selecting Data Frames, Transposing a Data Frame, Data Frame Interoperability with Numpy Functions.</p> <p>Visualizing Data: Data visualization in Business Intelligence, Data visualization techniques. Data visualization libraries in Python.</p>	15
2.	<p><b>Data Cleaning, Data Wrangling and Basics of Tableau:</b></p> <p><b>Data Gathering and Cleaning:</b> Cleaning Data, Checking for Missing Values, Handling the Missing Values, Reading and Cleaning CSV Data, Merging and Integrating Data, Reading Data from the JSON Format, HTML Format, XML Format.</p> <p><b>Data Transformation Removing Duplicates:</b> Replacing Values, Renaming Axis Indexes</p>	15





	<p><b>Hierarchical Indexing:</b> Reordering and Sorting Levels Summary' Statistics by Level Indexing with a DataFrame's columns. Combining and Merging Datasets Database-Style, DataFrame Joins Merging on Index Concatenating Along with an Axis Combining Data with Overlap</p> <p><b>Reshaping and Pivoting:</b> Reshaping with Hierarchical Indexing Pivoting "Long" to "Wide" Format Pivoting "Wide" to "Long" Format</p> <p><b>Statistical Analysis, Data Aggregation:</b> Data Grouping, Iterating Through Groups, Aggregations, Transformations, Filtration.</p> <p><b>Tableau:</b> Introduction, connecting to data, Visualizing Data using Tableau, Graphs, charts, and reports</p> <p><b>Connecting to Data:</b> Connecting various data sources, Managing data source metadata, Extract Data, Filtering data. Moving beyond basic visualization.</p> <p><b>Calculations:</b> Introduction to Calculation, Row-level Calculations, Aggregate calculations, parameters, Leveraging level of Detail Calculations.</p> <p><b>Telling Data Story with Dashboards:</b> Designing Dashboards in tableau, Designing for different displays and devices.</p>	
3.	<p><b>Data Visualization and Introduction to Power BI:</b></p> <p><b>Trend Visualization:</b> Trend Models, Analysing Trend Models. Clustering, Distributions, and Forecasting, Different Charts and Visualization.</p> <p><b>Dynamic Dashboards:</b> Sheet Swapping, Automatically Showing and hiding controls.</p> <p><b>Exploring Mapping and Advanced Geospatial Features:</b> Rendering maps with Tableau. Using Geospatial Data Creating custom territories.</p> <p>Structuring Messy Data to Work Well in Tableau: Structuring data for Tableau.</p> <p>Taming data with Tableau Prep: Cleaning, Transforming, Filtering, and Calculating data. Sharing Data story.</p> <p><b>Introduction to Power BI:</b> Overview of Power BI Desktop, Importing data into Power BI Desktop.</p>	15

REFERENCES:

TEXTBOOKS:

1. Dr. Ossama Embarak, Data Analysis and Visualization Using Python, Apress, 2018
2. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly, 2nd Edition, 2018.
3. Learning Tableau 2020, Create effective data visualizations, build interactive visual analytics, and transform your organization. Joshua Milligan, Fourth Edition, Packt, 2020.

ADDITIONAL REFERENCES:

1. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with



- Data”, O’Reilly, 2017
2. Visual Data Storytelling with Tableau, Linda Ryan, Pearson Addison Wesley Data & Analytics Series, 2018
  3. Visual Analytics with Tableau, Alexander Loth, Wiley, 2019

### Data Visualization Techniques Practical

**Course Code :** M24CS3MJP01

**Credit : 01**

**1 Credit – 2 lectures**

**1 lecture – 60 minutes**

Note: Practical can be implemented using Python / R studio/ Tableau

Sr. No	List of Practicals
1	Create one dimensional data using series and perform various operations on it.
2	Create Two-dimensional data with the help of data frames and perform different operations on it.
3	Write a code to read data from the different file formats like JSON, HTML, XML, and CSV files and check for missing data and outlier values and handle them.
4	Perform Reshaping of the hierarchical data and pivoting data frame data.
5	Connecting and extracting with various data resources in tableau.
6	Performing calculations and creating parameters in Tableau.
7	Designing Tableau Dashboards for different displays and devices.
8	Create a Trend model using data, Analyse-it and use it for forecasting.
9	Creating Geospatial feature maps in Tableau using Geospatial Data.
10	Create various reports in Tableau Dashboard
11	Create different types of graphs in tableau.
12	Create row-level calculations in tableau.
13	Create Dashboard and Storytelling using tableau.



## Advanced Computer Networking

**COURSE CODE:** M24CS3MJP02

**COURSE CREDIT:** 03

**1 credit - 15 lectures**

**1 lecture is 60 minutes**

Course Objective:

- Identify important requirements to design and support a data center
- Determine a data center environment's requirements including systems and network architecture as well as services.
- Design a data center infrastructure integrating features that address security, performance, and availability.
- Evaluate options for server farms, network designs, high availability, load balancing, data center services, and trends that might affect data center designs.

Course Outcome:

- Learners will be able to know basic concepts of Server and Data-Centric Networking
- Learners will be able to know about the infrastructure of Data Centers.
- Learners will be able to know about the security measures of Data Centers.
- Learners will be able to know about network designing and virtualization.

Unit	SYLLABUS	No Of lectures
I	Virtualization History and Definitions Data Center: Essential Definition, Data Center Evolution, thernet Protocol, The Humble Beginnings of Network Virtualization,Resource Sharing Control and Management Plane, Concepts from the Routing World, Overlapping Addresses in a Data Center. Virtual Routing and Forwarding:Defining and Configuring VRFs, VRFs and Routing Protocols, VRFs and the Management Plane VRF-Awareness, VRF Resource Allocation Control, Use Case: Data Center Network Segmentation.	15
II	ACE Virtual Contexts: Application Networking Services: The Use of Load Balancers, Load-Balancing Concepts, Security Policies, Suboptimal Traffic, Application Environment Independency, ACE Virtual Contexts, Application Control Engine Physical Connections, Connecting an ACE Appliance, Bridged Design, One-Armed Design. Managing and Configuring ACE: Virtual Contexts, Allowing Management Traffic to a Virtual Context, Allowing Load Balancing Traffic Through a Virtual Context, Controlling	15





	Management Access to Virtual Contexts, ACE Virtual Context Additional Characteristics, Sharing VLANs Among Contexts, Virtual Context Fault Tolerance, Instant Switches, MPLS Basic Concepts.	
III	Virtualization in Server Technologies : Server virtualization: Operational Policies, Configuration, External IPMI Management Configuration, Management IP Address, The Virtual Data Center and Cloud Computing, The Virtual Data Center. Automation and Standardization: Cloud Implementation Example, Journey to the Cloud, Networking in the Clouds, Software-Defined Networks, OpenStack, Network Overlays.	15

**TEXTBOOKS:**

1. Data Center Virtualization Fundamentals by Gustavo Alessandro Andrade Santana, Cisco Press, 2018
2. Storage Networks Explained Wiley Publishing, 2019

**REFERENCE BOOKS:**

1. Information Storage and Management Wiley Publishing, 2016



## Advanced Computer Networking Practical

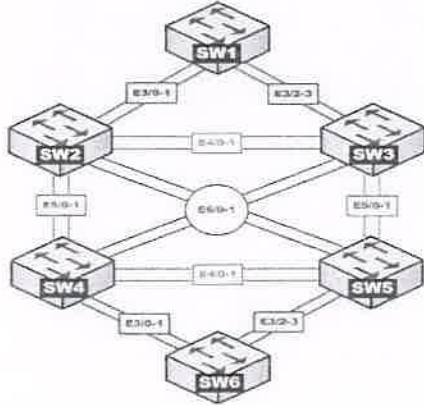
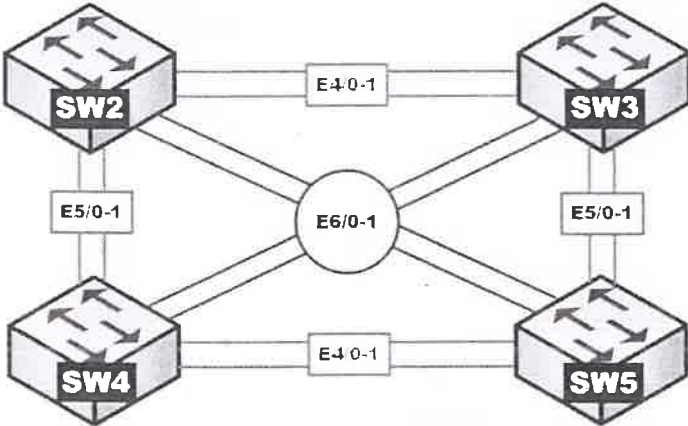
**COURSE CODE** :M24CS3MJP02

**COURSE CREDIT: 01**

**1 credit - 15 lectures**

**1 lecture is 60 minutes**

Note: Practical can be implemented using GNS3, CISCO packet tracer 7.0 and above

Sr. No	List of Practicals
01	Installation of Vmware Esxi Citrix Xen Microsoft Hyper-V
02	Create and manage the inter connectivity of Virtual Machine on Vmware Esxi Citrix Xen Microsoft Hyper-V
03	Configuring Trunks between switches and VTP Pruning Suggested Topology  
04	Configuring EtherChannels Suggested Topology  



05	Configure Secure DMVPN Tunnels Implement a DMVPN Phase 1 Hub-to-Spoke Topology Implement a DMVPN Phase 3 Spoke-to-Spoke Topology
06	Implement BGP Path Manipulation Implement BGP Communities
07	Control Routing Updates Path Control Using PBR
08	Implement Route Redistribution Between Multiple Protocols
09	Configure Route Redistribution Within the Same Interior Gateway Protocol
10	Implement GLBP (Load Balance Protocol (GLBP) Configuration Process and Commands
11	Implement VRRP (Configure VRRP commands (Virtual Router Redundancy Protocol))
12	Implement HSRP ( How to Configure HSRP with L3 Switching)
13	Implement MPLS ( Configure a Basic MPLS VPN Network )



## Cryptology

**COURSE CODE:**M24CS3MJ02

**COURSE CREDIT:** 03

**credit - 15 lectures**

**1 lecture is 60 minutes**

### Course Objectives:

- To develop the foundation for the study of cryptography and its use in security.
- To understand the role of cryptography in communication over an insecure channel.
- To analyze and compare symmetric-key encryption and public-key encryption schemes based on different security models

### Course Outcomes:

- Insights related to cryptography and cryptanalysis.
- Analyze and use methods for cryptography. Implement some of the prominent techniques for public-key cryptosystems and digital signature schemes.
- Understand the notions of public-key encryption and digital signatures and sketch their formal security definitions.

UNIT	Syllabus	No. of lectures
01	<p>Classic Cryptography Techniques: Cryptosystems and Basic Cryptographic Tools: Introduction, Secret-key Cryptosystems, Public-key Cryptosystems, Block and Stream Ciphers, Hybrid Cryptography, Hybrid Cryptography, Message Integrity, Message Authentication Codes, Signature Schemes, Nonrepudiation, Certificates, Hash Functions, Cryptographic Protocols, Security</p> <p>Classical Cryptography: Introduction to Some Simple Cryptosystems, Shift Cipher, Substitution Cipher, Affine Cipher, Vigenere Cipher, Hill Cipher, Permutation Cipher, Stream Ciphers, Cryptanalysis, Cryptanalysis of the Affine Cipher, Cryptanalysis of the Substitution Cipher, Cryptanalysis of the Vigenere Cipher, Cryptanalysis of the Hill Cipher, Cryptanalysis of the LFSR Stream Cipher.</p> <p>Perfect Secrecy: Introduction, Perfect Secrecy, Entropy, Properties of Entropy, Spurious Keys, and Unicity Distance</p>	15
02	<p>Advanced Encryption, Integrity, and Authentication: Block Ciphers and Stream Ciphers: Substitution-Permutation Networks, Linear Cryptanalysis, Differential Cryptanalysis, Data Encryption Standard, Advanced Encryption Standard, Modes of Operation, Stream Ciphers</p> <p>Hash Functions and Message Authentication: Hash Functions and Data Integrity, Security of Hash Functions, Iterated Hash Functions, Sponge Construction, Message Authentication Codes, Unconditionally Secure MACs</p>	15



	RSA Cryptosystem and Factoring: Public-key Cryptography, Number Theory-Euclidean Algorithm, Chinese Remainder Theorem, Other Useful Facts, RSA Cryptosystem, Primality Testing, Square Roots Modulo n, Factoring Algorithms, Rabin Cryptosystem, Semantic Security of RSA	
03	Public-Key Cryptography and Identity Verification: Public-Key Cryptography and Discrete Logarithms: Introduction, ElGamal Cryptosystem, Shanks' Algorithm, Pollard Rho Discrete Logarithm Algorithm, Finite Fields, Elliptic Curves, Discrete Logarithm Algorithms in Practice, Security of ElGamal Systems Signature Schemes: Introduction to RSA Signature Scheme, Security Requirements, ElGamal Signature Scheme, Variants of the ElGamal Signature Scheme, Full Domain Hash, Certificates, Signing and Encrypting Identification Schemes and Entity Authentication: Passwords and Secure Identification Schemes, Challenge-and-Response in the Secret-key Setting, Challenge-and-Response in the Public-key Setting, Schnorr Identification Scheme, Feige-Fiat-Shamir Identification Scheme	15

TEXTBOOKS:

1. Cryptography Theory and Practice Douglas R. Stinson, , Fourth Edition, CRC Press, 2019
2. Applied Cryptanalysis, Breaking Ciphers in Real World, John Wiley, 2015

REFERENCE BOOKS:

1. Implementing Cryptography, Shannon W. Bray, John Wiley, 2020
2. Algorithmic Cryptanalysis, Antoine Joux, CRC Press, 2017
3. Modern Cryptography: Applied Mathematics for- Encryption and Information Security, William Easttom, Springer, 2021





## Cryptology Practical

**COURSE CODE:** M24CS3MJ02

**COURSE CREDIT:** 01

**1 credit - 2 lectures**

**1 lecture is 60 minutes**

Note: The practical can be performed in C/C++/Java/Python

Sr. No.	List of Practicals
1	Program to implement password salting and hashing to create secure passwords.
2	Program to implement Substitution Cipher
3	Program to implement Vigenère Cipher
4	Program to implement Affine cipher
5	Program to demonstrate cryptanalysis (e.g., breaking Caesar or Vigenere Cipher)
6	Program to implement AES algorithm for file encryption and decryption
7	Program to implement various block cipher modes
8	Program to implement Steganography for hiding messages inside the image file.
9	Program to implement HMAC for signing messages.
10	Program to implement Sending Secure Messages Over IP Networks
11	Program to implement RSA encryption/decryption
12	Program to implement El-Gamal Cryptosystem
13	Program to implement Elliptic Curve Cryptography





### Advance Cloud Computing Practical

COURSE CODE : M24CS3MJP03

COURSE CREDIT: 01

1 credit - 2 lectures

1 lecture is 60 minutes

Sr.No.	List of Practicals
1	Study and implementation of Infrastructure as a Service
2	Study and implementation of Storage as a Service
3	Study and implementation of identity management
4	Study Cloud Security management
5	Write a program for web feed.
6	Study and implementation of Single-Sign-On.
7	User Management in Cloud
8	Installing and configuring the required platform for Google App Engine
9	Hosting a website on google app engine
10	Creating an application in Dropbox to store data securely. Develop a source code using Dropbox API for updating and retrieving files.
11	Installing and Configuring Dockers in localhost and running multiple images on a Docker Platform.
12	Developing an ASP.NET based web application on the Azure platform
13	Installing Cloud Foundry in localhost and exploring CF commands.



## Research Project

**Course Code:** M24CS3RP01

**Course Credits:** 4

**1 credit - 15 lectures**

**1 lecture is 60 minutes**

### Course Objectives:

The syllabus is aimed to achieve the following objectives:

- To facilitate substantial data collection for the proposed research work
- To carry out research following ethical aspects of research activities.
- To compile and communicate the findings/conclusions / results obtained in the science community through various means of communication.
- To enable students to put together a research paper that can be published or presented at conferences.

### Learning Outcome:

The learners will be able to:

- Carry out a substantial research-based project
- Capacity development to analyze data and process research findings
- Use research findings to advance education theory and practice.
- Focus on quality review of the research papers and may be published in peer reviewed journals or may be presented in conferences / seminars.

Following are the areas from which students can select the topic of research project:

- I. Interdisciplinary Collaboration
- II. Applied real-world problems
- III. Innovation
- IV. Ethical Issues
- V. Open-Source
- VI. Community Engagement
- VII. Sustainable Solutions

### Evaluation

- I. Internal evaluation will be of 60 marks and external evaluation will be of 90 marks.
- II. Students will be allowed to work individually or in groups (maximum number of 02 students in each group).
- III. The pattern of evaluation will be as follows:

### Internal Assessment

Sr. No.	Parameter	Marks
1	Continuous Assessment of day-to-day work	08
2	Record keeping	08



3	Design of System	08
4	Outline of the study and possible future plans	08
5	Research Potential of the work	08
6	Troubleshooting Skills	08

### External Assessment

Sr. No.	Parameter	Marks
1	Documentation (Abstract, Review of Literature, etc.)	20
2	Quality / Significance	10
3	Working (Methodology, Implementation)	10
4	Presentation	10
5	Viva	10

### Project Report Format

A Student should submit project implementation report with following details:

- Cover Page
- Title Page
- Certificate
- Declaration by Student(s)
- Self-attested copy of Plagiarism Report.
- Abstract
- Table of Contents
- List of Figures
- List of Tables
- List of Abbreviations
- Chapters
- References
- Appendices

Chapters – The main text will be divided into several chapters and each chapter may further be divided into sections and subsections. The following are suggested chapters and what they could contain.

a) Introduction

- brief statement of the problem,
- importance/novelty of the problem,
- related literature





- scope of the project
- brief statements on what subsequent chapters contain.

#### b) Approach Used

This could be in one or more chapters. It should give the details of the approaches used by the student for arriving at results. The approach could be theoretical, computational, experimental, or a combination of these. The description should be detailed enough to enable someone else with the author's background to use the same approach and get the same results. Detailed part of the description, parameter values used, etc can be presented in Appendices.

#### c) Results and Discussion

This chapter include the specific details of data generated and results obtained, in graphical and/or tabular form. Based on the analysis and interpretation of data and results, major findings should be pointed out unambiguously. It should be noted that the findings are to be summarized according to the significance to the stated objectives and should complement the latter. Detailed aspects can be presented in Appendices.

#### d) Conclusions and Recommendations

Conclusions are to be drawn with reference to the previously stated objectives of the project. This should highlight the major results. Recommendations should be given for any further changes or work that would better accomplish the project objectives or can extend them.

Note: It is very important to draw the figures and prepare the tables yourself. If any figure or table or data or result or opinion is not yours



**SIES(Nerul) College of Arts, Science and  
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Science (MSC-Semester IV)**

**NEP Credit Structure for 2024 - 25**

Level	Semester	Major		R M	O E	VS C, SEC	IKS, AE C/V EC	O JT /F P	R P	Cum. Cr. / Sem.
		Mandatory	Elective (Through NPTEL)							
	IV	Deep Learning (4-Credits)	TO BE DONE THROUGH NPTEL Web 3 Tech OR System Network Architecture (04 Credits)	-	-	-	-	-	0 6	22
		Fund. Of Robotics and Applications (4 Credits)								
		Natural Language Processing (4 Credits)								
Total of IV		12	04		-	-	-	-	0 6	22



**SIES Nerul College of Arts, Science and Commerce (Autonomous)**  
**M. Sc. Computer Science Programme**  
**(To be implemented from Academic Year- 2024-25)**

No. of Courses	Course Code	Semester IV	Credits
1	Major		
1	M24CS4MJ01	Deep Learning	3
2	M24CS4MJP01	Deep Learning Practical	1
3	M24CS4MJ02	Fundamentals of Robotics and Applications	3
4	M24CS4MJP02	Fundamentals of Robotics and Applications Practical	1
5	M24CS4MJ03	Natural Language Processing	3
6	M24CS4MJP03	Natural Language Processing Practical	1
2	Electives(E) (Any one)(To Be Done Thorough NPTEL)		
7	M24CS4E01	Web 3 Tech	4
8	M24CS4E02	System Network Architecture	4
3	OJT / FP		
11	M24CS4RP01	Research Project	6
Total Credits			22



**SEMESTER IV**  
**Deep Learning**

**COURSE CODE** : M24CS4MJ01

**COURSE CREDIT: 03**

**1 credit - 15 lectures**

**1 lecture is 60 minutes**

Course objective:

- Understand the context and use of neural networks and deep learning
- Understand the tools and libraries for deep learning
- Have a working knowledge of neural networks and deep learning
- Explore the parameters for neural networks
- Identify emerging applications of deep learning

Course Outcome:

- Knowledge of implementing neural network architectures for deep learning.
- Skill to implement regularization and optimization of neural network
- Ability to implement advanced networks like CNN, RNN and GAN
- Implement deep learning for advanced applications like object identification, speech, and Language

Unit No	Syllabus	No. of lectures
1.	<p>Neural Network for Deep Learning: Optimization and Neural Network: Review of Neural Network fundamentals, the problem of Learning, Implementing single Neuron-Linear and Logistic Regression, Deep Learning: Fundamentals, Deep Learning Applications, Popular open-source libraries for deep learning Feed-Forward Networks: Networks architecture and Matrix notation, Overfitting, Multiclass Classification with Feed-Forward Neural Networks, Estimating Memory requirement of Models.</p>	15
2.	<p>Convolutional and Recurrent Networks for Deep Learning: Regularization: Complex Network and Overfitting, Regularization and related concepts, Hyperparameter tuning Convolutional Neural Networks:Kernels and Filters, Write a program for object detection using pre-trained models to use object detection. Building Blocks of CNN, Inception Network, Transfer Learning Recurrent Neural Network: Notation and Idea of recurrent neural networks, RNN Topologies, backpropagation through time, vanishing and exploding gradients</p>	15



	Deep Learning for AI Games: AI Game Playing, Reinforcement learning, Maximizing future rewards, Q-learning, The deep Q-network as a Q-function, Balancing exploration with exploitation, Experience replay, or the value of experience.	
3.	<p>Advanced Concepts for Deep Learning:</p> <p>Autoencoders: Introduction, Network Design, Regularization in Autoencoders, Denoising autoencoders, Feed-Forward Autoencoders, sparse and Contractive autoencoders</p> <p>Unsupervised Feature Learning: Hopfield networks and Boltzmann machines, restricted Boltzmann machine, Deep belief networks</p> <p>Generative Adversarial Networks (GANs): Introduction, training algorithms, Conditional GANs, applications, Deep convolutional generative adversarial networks</p> <p>Deep Learning for Object Localization and classification: Intersect Over Union (IoU), Sliding Window Approach, Region-Based CNN (R-CNN)</p> <p>Deep Learning for Language Modelling and Speech Recognition.</p>	15

#### TEXTBOOKS:

1. Python Deep Learning, Valentino Zocca, Packt Publication, 2017
2. Applied Deep Learning, with TensorFlow 2, Umberto Michelucci, Apress, 2022
3. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress, 2017

#### REFERENCE BOOKS:

1. Advanced Deep Learning with Keras, Rowel Atienza, Packt Publication, 2018
2. Python Deep Learning Cookbook, Indra den Bakker, Packt Publication, 2017
3. Deep Learning with Keras, Antonio Gulli, Packt Publication, 2017





## Deep Learning Practical

COURSE CODE :M24CS4MJP01

COURSE CREDIT: 01

1 credit - 15 lectures

1 lecture is 60 minutes

Note: Following practical can be performed using python

Sr. No	List of Practicals
1	Implement Feed-forward Neural Network and train the network with different optimizers and compare the results.
2	Write a Program to implement regularization to prevent the model from overfitting
3	Implement deep learning for recognizing classes for datasets like CIFAR-10 images for previously unseen images and assign them to one of the 10 classes.
4	Implement deep learning for the Prediction of the autoencoder from the test data (e.g. MNIST data set)
5	Implement Convolutional Neural Network for Digit Recognition on the MNIST Dataset
6	Write a program to implement Transfer Learning on the suitable dataset (e.g. classify the cats versus dogs dataset from Kaggle).
7	Write a program for the Implementation of a Generative Adversarial Network for generating synthetic shapes (like digits)
8	Write a program to implement a simple form of a recurrent neural network. E.g. (4-to-1 RNN) to show that the quantity of rain on a certain day also depends on the values of the previous day
9	Write a program to implement a simple form of a recurrent neural network. LSTM for sentiment analysis on datasets like UMICH SI650 for similar.
10	Write a program for object detection from the image/video.
11	Write a program to recognised hand gesture to operate music activity.
12	Write a program to use of Convolutional Neural Network.
13	Write a program for object detection using pre-trained models to use object detection.



## Natural Language Processing

COURSE CODE: M24CS4MJ02

COURSE CREDIT: 03

1 credit - 15 lectures

1 lecture is 60 minutes

### Course Objectives:

- To Understand the importance and concepts of Natural Language Processing (NLP)
- To Apply algorithms available for the processing of linguistic information and computational properties of natural languages.
- To gain Knowledge on various morphological, syntactic, and semantic NLP tasks.
- To introduce various NLP software libraries and data sets publicly available.
- To Design and develop practical NLP based applications

### Course Outcomes:

- The ability to describe the concepts of morphology, syntax, semantics, discourse & pragmatics of natural language
- Discover various linguistic and statistical features relevant to the basic NLP task, namely, spelling correction, morphological analysis, parts-of speech tagging, parsing, and semantic analysis
- Assess and Evaluate NLP based systems
- Ability to choose appropriate solutions for solving typical NLP subproblems (tokenizing, tagging, parsing)
- Analyse NLP problems to decompose them inadequate independent components and develop real-life applications.

Sr. No	Syllabus	No. of lectures
01	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 NaturalLanguage Toolkit (NLTK)	15



02	<p>Morphology &amp; Parsing in NLP</p> <p>Computational morphology &amp; 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.</p> <p>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</p>	15
03	<p>Semantics and Word Embedding</p> <p>Semantics Vector Semantics: Words and Vector; Measuring Similarity; Semantics with dense vectors; SVD and Latent Semantic Analysis</p> <p>Embeddings from prediction: Skip-gram and Continuous Bag of words; Concept of Word Sense; Introduction to WordNet.</p> <p>NLP Applications and Case Studies</p> <p>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 &amp; BERT models, Conversations</p>	15

**Text book:**

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.

**Reference book:**

- 1 Practical NaturalLanguage Processing with Python, Mathangi Sri, Apress, 2021
- 2 Handbook of Computational Linguistics and Natural Language Processing, Martin Whitehead, Clanrye International, 2020
- 3 Handbook of Natural Language Processing, Nitin Indurkhya, and Fred J. Damerau, Pearson; 2nd edition, 2008
- 4 Foundations of Statistical Natural Language Processing, Manning, Christopher and Heinrich, Schutze, MIT Press, 1997



## Natural Language Processing Practicals

**COURSE CODE :M24CS4MJ02**

**COURSE CREDIT: 01**

**1 credit - 2 lectures**

**1 lecture is 60 minutes**

**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/>**

Sr. No.	List of Practicals
1	Write a program to implement sentence segmentation and word tokenization
2	Write a program to Implement stemming
3	Write a program to Implement lemmatization
4	Write a program to Implement a tri-gram model
5	Write a program to Implement PoS tagging using HMM & Neural Model
6	Write a program to Implement syntactic parsing of a given text
7	Write a program to Implement dependency parsing of a given text
8	Write a program to Implement Named Entity Recognition (NER)
9	Write a program to Implement Text Summarization for the given sample text
	CASE STUDIES
10	Consider a scenario of applying NLP in Customer Service. Design and develop an application that demonstrates NLP operations for working with tasks and data like voice calls, chats, Ticket Data, Email Data. Process the data to understand the voice of the Customer (intent mining, Top words, word cloud, classify topics). Identify issues, replace patterns and gain insight into sales chats.



11	Consider a scenario of Online Review and demonstrate the concept of sentiment analysis and emotion mining by applying various approaches like lexicon-based approach and rule-based approaches.
12	Apply NLP in Banking, Financial Services, and Insurance. Design Application to detect frauds and work with SMS data.
13	Demonstrate the use of NLP in designing Virtual Assistants. Apply LSTM, build conversational Bots.

### Fundamentals of Robotics and Applications

**COURSE CODE:** M24CS4MJ03

**COURSE**

**CREDIT:** 03

**1 credit - 15 lectures**

**1 lecture is 60 minutes**

Course Objective:

- Leverage the features of the Raspberry Pi OS
- Discover how to configure a Raspberry Pi to build an AI-enabled robot
- Interface motors and sensors with a Raspberry Pi
- Code robot to develop engaging and intelligent robot behaviour
- Explore AI behaviour such as speech recognition and visual processing

Course Outcome:

- Knowledge about the fundamentals of Robotics and its applications
- Ability to use Raspberry Pi for programming Robotics
- Ability to apply robotics in speech and vision problems

Unit No	SYLLABUS	No Of Lectures
1	Introduction to Robotics Introduction to Robotics: What is a robot? Examples of Advanced and impressive robots, Robots in the home, Robots in industry Robotics in Action: Exploring Robot Building Blocks - Code and Electronics Technical requirements, Introducing the Raspberry Pi - Starting with Raspbian Technical requirements, Raspberry Pi controller on a robot.	15





2	<p><b>Building Robot Basics</b></p> <p>Technical requirements: Robot chassis kit with wheels and motors, a motor controller, Powering the robot, Test fitting the robot, Assembling the base.</p> <p>Robot Programming: Programming technique, adding line sensors to our robot, creating line-sensing behaviour, and Programming RGB Strips in robot.</p> <p>Servo Motors: Use and control of servo motors, pan, and tilt mechanism.</p> <p>Distance sensors, Introduction to distance sensors and their usage.</p> <p>Connecting distance sensors to robot and their testing. Creating a smart object avoidance behaviour. Creating a menu to select different robot behaviours, Distance and speed measuring sensors—encoders and odometry.</p>	15
3	<p><b>Robotics setup: Setting up a Raspberry Pi Camera on the robot (software and hardware),</b></p> <p>Check the robot vision on a phone or laptop, Mask images with RGB strips.</p> <p>Robotics for Vision and Voice Applications: Colors, masking, and filtering – chasing colored objects, Detecting faces with Haar cascades, Finding objects in an image, Voice Communication with a robot.</p>	15

**TEXTBOOKS:**

1. Danny Staple, Robotics Programming, Packt Publishing, 2nd edition, Feb 2021

**REFERENCE BOOKS:**

1. Saeed B. Niku, Introduction to Robotics: Analysis, Control, Applications, Wiley, 3rd Edition, 2019
2. D. K. Pratihar, FUNDAMENTALS OF ROBOTICS. Narosa Publication, 2016
3. Lentin Joseph, Learning Robotics Using Python, Packt Publishing Ltd., May 2015



### Fundamentals of Robotics and Applications Practical

COURSE CODE :M24CS4MJP01

COURSE CREDIT: 01

1 credit - 15 lectures

1 lecture is 60 minutes.

Note: Following practical can be performed using Python and simulators, Raspberry Pi, and other hardware devices

Sr. No	List of Practicals
1	Making a Raspberry Pi headless, and reaching it from the network using WiFi and SSH.
2	Using sftp upload files from PC.
3	Write Python code to test motors.
4	Write a script to follow a predetermined path.
5	Develop Python code for testing the sensors.
6	Add the sensors to the Robot object and develop the line-following behaviour code.
7	Using the light strip develop and debug the line follower robot.
8	Add pan and tilt service to the robot object and test it.
9	Pan/tilt face tracking with a Raspberry Pi and OpenCV.
10	Create an obstacle avoidance behaviour for robot and test it.
11	Detect faces with Haar cascades.
12	Use the robot to display its camera as a web app on a phone or desktop, and then use the camera to drive smart color and face-tracking behaviours.
13	Use a Raspberry Pi to run the Mycroft environment and connect it to a speaker/microphone combination



## Research Project

Course Code: M24CS4RP01

Credits: 6

1 credit - 15 lectures

1 lecture is 60 minutes

Course Objectives:

The syllabus is aimed to achieve the following objectives:

- To facilitate substantial data collection for the proposed research work
- To carry out research following ethical aspects of research activities.
- To compile and communicate the findings/conclusions / results obtained in the science community through various means of communication.
- To enable students to put together a research paper that can be published or presented at conferences.

Learning Outcome:

The learners will be able to:

- Carry out a substantial research-based project
- Capacity development to analyze data and process research findings
- Use research findings to advance education theory and practice.
- Focus on quality review of the research papers and may be published in peer reviewed journals or may be presented in conferences / seminars.

Following are the areas from which students can select the topic of research project :

- I. Interdisciplinary Collaboration
- II. Applied real-world problems
- III. Innovation
- IV. Ethical Issues
- V. Open-Source
- VI. Community Engagement
- VII. Sustainable Solutions

### Evaluation

- I. Internal evaluation will be of 60 marks and external evaluation will be of 90 marks.
- II. Students will be allowed to work individually or in groups (maximum number of 02 students in each group).
- III. The pattern of evaluation will be as follows:

### Internal Assessment

Sr. No	Parameter	Marks
1	Continuous Assessment of day-to-day work	10



2	Record keeping	10
3	Design of System	10
4	Outline of the study and possible future plans	10
5	Research Potential of the work	10
6	Troubleshooting Skills	10

### External Assessment

Sr. No	Parameter	Marks
1	Documentation (Abstract, Review of Literature, etc.)	30
2	Quality / Significance	15
3	Working (Methodology, Implementation)	15
4	Presentation	15
5	Viva	15

### Project Report Format

A Student should submit project implementation report with following details:

- Cover Page
- Title Page
- Certificate
- Declaration by Student(s)
- Self-attested copy of Plagiarism Report.
- Abstract
- Table of Contents
- List of Figures
- List of Tables
- List of Abbreviations
- Chapters
- References
- Appendices

Chapters – The main text will be divided into several chapters and each chapter may further be divided into sections and subsections. The following are suggested chapters and what they could contain.

- a) Introduction
- brief statement of the problem,
  - importance/novelty of the problem,
  - related literature



- scope of the project
- brief statements on what subsequent chapters contain.

#### b) Approach Used

This could be in one or more chapters. It should give the details of the approaches used by the student for arriving at results. The approach could be theoretical, computational, experimental, or a combination of these. The description should be detailed enough to enable someone else with the author's background to use the same approach and get the same results. Detailed part of the description, parameter values used, etc can be presented in Appendices.

#### c) Results and Discussion

This chapter include the specific details of data generated and results obtained, in graphical and/or tabular form. Based on the analysis and interpretation of data and results, major findings should be pointed out unambiguously. It should be noted that the findings are to be summarized according to the significance to the stated objectives and should complement the latter. Detailed aspects can be presented in Appendices.

#### d) Conclusions and Recommendations

Conclusions are to be drawn with reference to the previously stated objectives of the project. This should highlight the major results. Recommendations should be given for any further changes or work that would better accomplish the project objectives or can extend them.

Note: It is very important to draw the figures and prepare the tables yourself. If any figure or table or data or result or opinion is not yours, cite relevant reference.



**SCHEME OF EXAMINATION**  
**FOR MAJOR PAPER WITH 4 CREDITS**

The scheme of examination shall be divided into two parts:

- Internal assessment 40% i.e. 40 marks
- Semester end examination 60% i.e. 60 marks

(A) Internal Assessment 40 marks

	Description	Marks
Internal Test	One Internal tests of 20 marks each Q.1 Multiple choice Questions/True or False - 10 Marks Q.2. Attempt 2 questions out of 3 questions (5 marks each)- 10 Marks	20
Project	One Mini-Project with presentation	15
Attendance	Attendance and Class behavior	5
	Total	40

B) Semester end examination 60 marks

PAPER PATTERN

Duration : 2 hours	
Total Marks: 60	
Q.1 15 marks OR 15marks	15
Q.2 15 marks OR 15 marks	15
Q.3 15 marks OR 15 marks	15
Q.4 15 marks OR 15 marks	15
Total	60
Note: Q.1, 2, 3 and 4 - 12 marks question may be divided into sub questions if required.	

Passing criteria: Minimum 40% in Internal (16 out of 40) and 40% (24 out of 60) in semester end examination





## SCHEME OF PRACTICAL EXAMINATION

The scheme of examination shall be

- Practical assessment carries 50 Marks : 40 marks + 05 marks (journal)+ 05 marks(viva)
- Minimum 75 % practical are required to be completed and written in the journal. (Certified Journal is compulsory for appearing at the time of Practical Exam)

(A) Practical Assessment 50 marks

Description	Marks
Q.2. Two questions of practical's (20 marks each)	40
Journal	5
Viva	5
Total	50

Passing criteria: Minimum 40% in Internal (20 out of 50)

### Major with 2 credits

The scheme of examination shall be divided into two parts:

- Practical assessment 40% i.e. 20 marks
- Semester end examination 60% i.e. 30 marks

Practical Assessment 20 marks

Description	Marks
One question of 10 marks practical	10
Journal	5
Viva	5
Total	20

B) Semester end examination 30 marks PAPER PATTERN

Duration: 1 hours	
Total Marks: 30	
Description	Marks
Q.1 10 marks OR 10 marks	10



Q.2 10 marks OR 10 marks	10
Q.3 10 marks OR 10 marks	10
Total	30
Note: Q.1, 2, 3 may be divided into sub questions if required. Q.3 May include theory (short notes) /Case Study in one of the options.	

Passing criteria: Minimum 40% in Internal (8 out of 20) and 40% (12 out of 30) in semester end examination.

