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

M.Sc. Computer Science

<table>
<tr><th>Sr. No.</th><th>Heading</th><th>Particulars</th></tr>
<tr><td>1</td><td>Title of the course</td><td>M.SC. (Computer Science)</td></tr>
<tr><td>2</td><td>Eligibility for admission</td><td>The Bachelor’s degree in the Faculty of Science/ Technology of this University or equivalent degree of recognized Universities with Major and Ancillary Subjects at undergraduate level as detailed below:
<table>
<tr><th>Major</th><th>ANCILIARY</th></tr>
<tr><td>Mathematics</td><td></td></tr>
<tr><td>Physics</td><td>Mathematics (4 Units)</td></tr>
<tr><td>Statistics</td><td>Mathematics (4 Units)</td></tr>
<tr><td>Life Sciences</td><td>Biochemistry or Chemistry with Mathematics or Statistics in first and second year OR Computer Sciences OR Information Technology up to second year of Bachelor’s Degree</td></tr>
<tr><td>Medicine</td><td>Chemistry/ Microbiology</td></tr>
<tr><td>Bachelor’s degree in technology (B.Tech./B.E.) in Engineering / Computer Sciences / Information Technology</td><td></td></tr>
<tr><td>Bachelor’s degree in computer sciences B.C.A / B.C.S / Information Technology</td><td></td></tr>
</table></td></tr>
<tr><td>3</td><td>Minimum percentage</td><td>45%</td></tr>
<tr><td>4</td><td>Semester</td><td>I</td></tr>
<tr><td>5</td><td>Level</td><td>PG 1</td></tr>
<tr><td>6</td><td>Pattern</td><td>02 years & 04 semesters CBGS</td></tr>
<tr><td>7</td><td>To be implemented from</td><td>From Academic year 2023-24 in a progressive manner</td></tr>
</table>

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 2023-2024)

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.

Level	Semester	Major		RM	OE	VSC, SEC	IKS, AEC, VEC	OJT, FP	RP	Cum. Cr./ Sem.
		Mandatory	Elective							
	I	Algorithms for Optimization: 06 Credits	Software Defined Networking OR Wireless Networking: 04 Credits	Research Information Systems and Computing (04 Credits)	-	-	-	-	-	22
		Applied Signal and Image Processing: 06 Credits								
		Advanced Database Systems: 02 Credits								
Total of I		**14**	**04**	**04**	**-**	**-**	**-**	**-**	**-**	**22**

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

M. Sc. Computer Science Programme

(To be implemented from Academic Year- 2023-24)

No. of Courses	Course Code	Semester I	Credits
1	***Major***		
1	M23CS1MJ01	Applied Signal and Image Processing	**4**
2	M23CS1MJP01	Applied Signal and Image Processing Practical	**2**
3	M23CS1MJ02	Algorithm for Optimization	**4**
4	M23CS1MJP02	Algorithm for Optimization Practical	**2**
5	M23CS1MJ03	Advanced Database Techniques	**1**
6	M23CS1MJP03	Advanced Database Techniques Practical	**1**
2	***Electives(E) (Any one)***		
7	M23CS1E01	Software Defined Networking	**3**
8	M23CS1EP01	Software Defined Networking Practical	**1**
9	M23CS1E02	Wireless Networking	**3**
10	M23CS1EP02	Wireless Networking Practical	**1**
3	***Research Methodology***		
11	M23CS1RM01	Research Information Systems and Computing	**4**
		Total Credits	**22**

Applied Signal and Image Processing

COURSE CODE : M23CS1MJ01 **COURSE CREDIT: 04**

1 credit - 15 lectures

1 lecture is 60 minutes

Course Objectives:

- Understanding the terminologies of signal and digital image processing
- Learn about basic image processing techniques.
- Develop skills to design and implement algorithms for advanced image analysis.
- Apply image processing to design solutions to real-life problems

Course Objectives:

- Apply image processing algorithms in practical applications.
- Ability to apply various images, intensity transformations, and spatial filtering.
- Knowledge of Perform frequency domain operations on images.
- Ability to apply image segmentation and extract image features.

Unit	Syllabus	No. of lectures
1.	**Signals**: Periodic signals, Spectral decomposition, Signals, Reading and writing Waves, Spectrums, Wave objects, Signal objects **Harmonics**: Triangle Waves, Square Waves, Aliasing, Computing the Spectrum, **Noise**: Uncorrelated noise, Integrated spectrum, Brownian noise, Pink Noise, Gaussian noise; **Autocorrelation**: Correlation, Serial correlation, Autocorrelation, Autocorrelation of periodic signals, Correlation as a dot product **Case Study**	15
2.	**Introduction**: What is Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image types and files formats. **Intensity Transformations**- Log Transform, Power-law Transform, Contrast Stretching, Thresholding **Histogram Processing**- Histogram Equalization and Histogram Matching. Linear and Non-linear smoothing of Images, Sharpening of images. **Image Derivative**: Derivatives and gradients, Laplacian, the effect of noise on gradient computation **Case Study**	15
3.	**Edge Detection**: Sobel, Canny Prewitt, Robert edge detection techniques, LoG and DoG filters, Image Pyramids: Gaussian Pyramid, Laplacian Pyramid **Morphological Image Processing**: Erosion, Dilation, Opening and closing, Hit-or-Miss Transformation, Skeletonizing, Computing the convex hull, removing small objects, White and black top-hats, Extracting the boundary, Grayscale operations **Case Study**	15
4.	**Extracting Image Features and Descriptors**: Feature detector versus descriptors, Boundary Processing and feature descriptor, Principal Components, Harris Corner Detector, Blob detector, Histogram of Oriented Gradients, Scale-invariant feature transforms, Haar-like features **Image Segmentation**: Hough Transform for detecting lines and circles, Thresholding and Otsu's segmentation, Edge- based/region-based segmentation, Region growing, Region splitting and Merging, Watershed algorithm, Active Contours, morphological snakes, and GrabCut algorithms **Case Study**	15

References:

1. Digital Image Processing by Rafael Gonzalez & Richard Woods, Pearson; 4th edition, 2018
2. Think DSP: Digital Signal Processing in Python by Allen Downey, O'Reilly Media; 1st edition 2014

Additional References:

1. Understanding Digital Image Processing, Vipin Tyagi, CRC Press, 2018
2. Digital Signal and Image Processing by Tamal Bose, John Wiley 2010
3. Hands-On Image Processing with Python by Sandipan Dey,Packt Publishing, 2018
4. Fundamentals of Digital Images Processing by A K Jain, Pearson, 2010

Applied Signal and Image Processing - Practical

COURSE CODE : M23CS1MJP01 **COURSE CREDIT: 02**

1 credit - 30 lectures

1 lecture is 60 minutes

Sr. No.	List of Practical
1	Write program to demonstrate the following aspects of image processing on suitable data 1. Upsampling and downsampling on Image 2. Fast Fourier Transform to compute DFT
2	Write program to demonstrate the following aspects of signal on sound/image data 1. Convolution operation 2. Template Matching
3	Write program to implement point/pixel intensity transformations such as 1. Log and Power-law transformations 2. Contrast adjustments 3. Histogram equalization 4. Thresholding, and halftoning operations
4	Write a program to apply various enhancements on images using image derivatives by implementing Gradient and Laplacian operations.
5	Write a program to implement linear and nonlinear noise smoothing on suitable image or sound signal.
6	Write a program to apply various image enhancement using image derivatives by implementing smoothing, sharpening, and unsharp masking filters for generating suitable images for specific application requirements.
7	Write a program to Apply edge detection techniques such as Sobel and Canny to extract meaningful information from the given image samples
8	Write the program to implement various morphological image processing techniques.
9	Write the program to extract image features by implementing methods like corner and blob detectors, HoG and Haar features
10	Write the program to apply segmentation for detecting lines, circles, and other shapes/objects. Also, implement edge-based and region-based segmentation.

Algorithm for Optimization

COURSE CODE : M23CS1MJ02 **COURSE CREDIT: 04**

1 credit - 15 lectures

1 lecture is 60 minutes

Course Objectives:

- You will be able to effectively implement optimization techniques to the existing algorithm to improve its performance.
- You will be able to work in the areas of Machine Learning and Data Sciences Algorithms
- You will be able to perform sampling using different algorithms.
- You will be able to deal with Uncertainty in optimization.

Course Outcomes:

- Ability to understand the Optimization Process
- Optimization with a focus on practical algorithms for the design of engineering systems.
- Exposure to multivariable calculus, linear algebra, and probability concepts.
- Learn a wide variety of optimization topics, introducing the underlying mathematical problem formulations and the algorithms for solving them

Unit	Syllabus	No. of lectures
01	**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. **Case Study**	**15**
02	**Order Methods** First-Order Methods, Gradient Descent, Conjugate Gradient, Adagrad, RMSProp, Adadelta, Adam, Hypergradient Descent. Second-Order Methods, Newton's Method, Secant Method, QuasiNewton Methods **Case Study**	**15**
03	**Sampling and Surrogate Models** Sampling Plans, Full Factorial, Random Sampling, Uniform Projection Plans, Stratified Sampling, Space-Filling Metrics. Surrogate Models, Fitting Surrogate Models, Linear Models, Basis Functions, Fitting Noisy Objective Functions, Model Selection, Probabilistic Surrogate Models, Gaussian Distribution, Gaussian Processes, Prediction. **Case Study**	**15**
04	**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. **Case Study**	15

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

Algorithm for Optimization - Practical

COURSE CODE : M23CS1MJP02 **COURSE CREDIT: 02**

1 credit - 30 lectures

1 lecture is 60 minutes

Note:

- All the Practical's should be implemented using Julia Link: Julia:https://julialang.org/

Sr. No	List of practical
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 modeling.
8	Apply Random Forest in surrogate Model.
9	Implement Gaussian Process and its application.
10	Path finding using Ant Colony Optimization with an application.

Advanced Database Techniques

COURSE CODE : M23CS1MJ03 COURSE CREDIT: 02

1 credit - 15 lectures

1 lecture is 60 minutes

Course Objectives:

- To provide students with theoretical knowledge and practical skills in advanced topics in database systems, big data and modern data-intensive systems.

Course Objectives:

- To form professional competencies related to design and implementation of non-relational databases, including object-oriented, parallel and Distributed.

Unit	Syllabus	No. of lectures
01	**Spatial and Temporal Databases:** Temporal Databases: Overview of Temporal Databases- TSQL2, Spatial Databases- Spatial Data Types- Spatial Relationships- Spatial Data Structures- Spatial Access Methods- Spatial DB Implementation **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. **Basics 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 Understanding the storage architecture: Working with Column Oriented Databases, HBase Distributed Storage Architecture, Document Store Internals. **Case Study**	**15**

References:

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

Additional References:

1. Advanced Database Management System by byRini Chakrabarti and Shilbhadra Dasgupta, Dreamtech Press, 2017

2. SQL & NoSQL Databases, Andreas Meier · Michael Kaufmann, Springer Vieweg, 2019

3. Parallel and Distributed Systems by Arun Kulkarni, Nupur Prasad Giri, Wiley, Second edition, 2017

4. Practical Hadoop Migration: How to Integrate Your RDBMS with the Hadoop Ecosystem and Re-Architect Relational Applications to NoSQL By Bhushan Lakhe, Apress; 1st edition, 2016

Advanced Database Techniques-Practical

COURSE CODE : M23CS1MJP03 COURSE CREDIT: 01

1 credit - 30 lectures

1 lecture is 60 minutes

Note:

- All the Practical's should be implemented using Julia Link: Julia:https://julialang.org/

Sr. No	List of Practical
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.
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 21 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
10	Demonstrate the use of data management and operations using NoSQL in the Cloud.

Software Defined Networking

COURSE CODE : M23CS1E01 **COURSE CREDIT: 03**

1 credit - 15 lectures

1 lecture is 60 minutes

Course Objectives:

- To make the students capable of understanding computer network basics.
- To Obtain the knowledge of Software defined networks with understanding of data plane, control plane and application plane.
- To apply network virtualization for industry standard solutions.

Course Objectives:

- To improve skills in implementing network virtualization and Software Defined Network (SDN).
- Learners will be able to explore OpenFlow specifications to build Software defined networks.
- Learners will be able to analyze and implement theories and practical related to Network management and Virtualization

Unit	Syllabus	No. of lectures
01	**Introduction to Software Defined Networking** Understanding the layered architecture of OSI/RM and TCP-IP Model Study of various network Routing protocols, Introduction to Transport layer and Application layer protocols. Elements of Modern Networking, Requirements and Technology, SDN: Background and Motivation, SDN Data Plane and OpenFlow, SDN Control Plane, SDN Application Plane **Case Study**	**15**
02	**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 **Case Study**	**15**
03	**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, Implementation of Routing redistribution, Implementation of Policy Based Routing/Load Balancing /QOS/Natting /VRF **Case Study**	**15**

References:

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
5. Network Programmability and Automation-Jason Edelman, Matt Oswalt First Edition 2018.

Software Defined Networking - Practical

COURSE CODE : M23CS1EP01 COURSE CREDIT: 01

1 credit - 30 lectures

1 lecture is 60 minutes

Note:

- **All the Practical's should be implemented using GNS3/EVENG/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/virl-15-download**

Sr. No	Syllabus
1	1. Implement SPAN Technologies (Switch Port Analyzer) 2. Implement SNMP and Syslog 3. Implement Flexible NetFlow
2	1. Implement a GRE Tunnel 2. Implement VTP 3. Implement NAT
3	Implement Inter-VLAN Routing
4	Observe STP Topology Changes and Implement RSTP 1. Implement Advanced STP Modifications and Mechanisms 2. Implement MST
5	1. Implement EtherChannel 2. Tune and Optimize EtherChannel Operations
6	OSPF Implementation 1. Implement Single-Area OSPFv2 2. Implement Multi-Area OSPFv2 3. OSPFv2 Route Summarization and Filtering 4. Implement Multiarea OSPFv3
7	Implement BGP Communities 1. Implement MP-BGP 2. Implement eBGP for IPv4
8	Implement IPsec Site-to-Site VPNs 1. Implement GRE over IPsec Site-to-Site VPNs 2. Implement VRF Lite
9	Simulating SDN with 1. OpenDaylight SDN Controller with the Mininet Network Emulator 2. OFNet SDN network emulator
10	Simulating OpenFlow Using MININET

Wireless Networking

COURSE CODE : M23CS1E02 **COURSE CREDIT: 03**

1 credit - 15 lectures

1 lecture is 60 minutes

Course Objectives:

- To understand the basic concepts of Wireless Networking.
- To understand the various trends in Wireless Technology.
- To understand 5G technologies.

Course Objectives:

- To provide an insight on the advanced concepts of wireless technologies and Wireless Optical Communication.
- To implement the working of 4G Technologies.
- To understand applications of 5G technologies and its implementation.

Unit	Syllabus	No. of lectures
01	Introduction to Wireless Sensor Networks, Types, Advantages, Challenges and Applications, Mobile Ad-hoc Networks (MANETs), Enabling technologies for Wireless Sensor Networks. Introduction to wireless optical communication (WOC), wireless optical channels, atmospheric channel, underwater optical channel, atmospheric losses, WOC and Applications: Weather condition influence, atmospheric turbulence effects, wireless optical communication application areas, WOC challenges and applications. **Case Study**	**15**
02	4G Vision: 4G Features and Challenges, Applications of 4G; 4G Technologies - LTE FDD vs TDD comparison; frame structure and its characteristics; Smart Antenna Techniques, OFDM Trends in Wireless Technology: MIMO Systems, Adaptive Modulation and Coding with Time-Slot Scheduler - Bell Labs Layered Space Time (BLAST) System , Software- Defined Radio, Cognitive Radio **Case Study**	**15**
03	5G Technology: Understand 5GPP & NGMN, 5G architecture and design objective, 5G spectrum requirements, ITU-R IMT-2020 vision for 5G, 5G RAN & Dynamic CRAN Architecture and applications: 5G Mobile Edge Computing & Fog computing, 5G Protocol Stack, 5G Ultra-dense networks, 5G Air interface, Applications **Case Study**	**15**

References:

1. Anurag Kumar, D.Manjunath, Joy kuri, ―Wireless Networking‖, third Edition, Elsevier 2018

Additional References:

1. Jochen Schiller, ‖Mobile Communications‖, Second Edition, Pearson Education 2019.
2. Vijay Garg, ―Wireless Communications and networking‖, First Edition, Elsevier 2012..

Wireless Networking – Practical

COURSE CODE : M23CS1EP02 COURSE CREDIT: 01

1 credit - 30 lectures

1 lecture is 60 minutes

Note:

- **Practical can be implemented using GNS3, CISCO packet tracer 7.0 and above**

Sr. No	Practical
1	Configuring WEP on a Wireless Router
2	Demonstrating Distribution Layer Functions
3	Placing ACLs
4	Planning Network-based Firewalls
5	Configure Auto Profiles ACU Utilities
6	Creating an Adhoc Network
7	Configuring Basic AP Settings
8	Configure Ethernet/Fast Ethernet Interface
9	Configure Radio Interfaces through the GUI
10	Configure Site-to-Site Wireless Link

Research Information Systems and Computing

COURSE CODE : M23CS1RM01 COURSE CREDIT: 04

1 credit - 15 lectures

1 lecture is 60 minutes

Course Objectives:

- The research methodology course is proposed to assist students in planning and carrying out research projects.
- The course starts with an introduction to research and carries on the various methodologies involved.
- Able to understand and define research, formulate problems.
- Understand and apply basic research methods including research design, data analysis and interpretation.

Course Outcomes:

- The students are exposed to the principles, procedures, and techniques of implementing research project.
- It continues with finding out the literature using technology, basic statistics required for research and finally report writing.
- Understand ethical issues in research, write research reports, research paper and publish the paper.
- Describe the research process and research methods.

Unit	Syllabus	No. of lectures
01	**Introduction:** Role of Business Research, Information Systems and Knowledge Management, Theory Building, Organization ethics and Issues. **Beginning Stages of Research Process**: Scientific Research: Definition, Characteristics, types, need of research. Identification of the problem, assessing the status of the problem, formulating the objectives, preparing design (experimental or otherwise), Actual investigation, Determining the mode of attack. Problem definition, Qualitative research tools, Secondary data research. **Literature survey:** References, Abstraction of a research paper, Possible ways of getting oneself abreast of current literature. **Case Study**	**15**
02	**Research Methods and Data Collection:** Survey research, communicating with respondents, Observation methods, Experimental research. **Measurement Concepts, Sampling and Field work:** Levels of Scale measurement, attitude measurement, questionnaire design, sampling designs and procedures, determination of sample size. **Data Analysis and Presentation:** Editing and Coding, Basic Data Analysis, Univariate Statistical Analysis and Bivariate Statistical analysis and differences between two variables. Multivariate Statistical Analysis. **Case Study**	**15**

03	**Documentation and scientific writing:** Results and Conclusions, Preparation of manuscript for Publication of Research paper, Presenting a paper in scientific seminar, Thesis writing. Structure and Components of Research Report, Types of Report: research papers, thesis, Research Project Reports, Pictures and Graphs, citation styles, writing a review of paper, Bibliography. **Publishing the Paper**: Rights and Permissions, How to Submit the Manuscript, How and When to Use Abbreviations, How to Write a thesis, Outcome of Research, Ethical issues in research **Case Study**	**15**
04	**Statistical analysis and fitting of data :** Introduction to Statistics – Probability Theories - Conditional Probability, Poisson Distribution, Binomial Distribution and Properties of Normal Distributions, Estimates of Means and Proportions; Chi-Square Test, Association of Attributes - t-Test –Anova- Standard deviation - Co-efficient of variations. Co-relation and Regression Analysis. **Case Study**	15

References:

1. Business Research Methods William G.Zikmund, B.J Babin, J.C. Carr, Atanu Adhikari, M.Griffin Cengage 8e 2016.
2. Business Analytics Albright Winston Cengage 5e 2015.
3. Research Methods for Business Students Fifth Edition Mark Saunders 2011.
4. Multivariate Data Analysis Hair Pearson 7e 2014.
5. Thesis & Assignment Writing–J Anderson, B.H. Dursten & M.Poole, Wiley Eastern, 1977
6. A Hand Book of Methodology of Research – P. Rajammal and P. Devadoss, R. M. M. Vidya Press, 1976.
7. Research Methodology by R. Panneerselvam, PHI, New Delhi 2005.
8. Practical Research Methods, by Dawson, Catherine, 2002, UBS Publishers' Distributors New Delhi.
9. Research Methodology- A step by step Guide for Beginners, (2nd ed.) Kumar Ranjit, 2005, Pearson Education.

SCHEME OF EXAMINATION

I. FOR MAJOR PAPERS WITH 6 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	Two 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	20
	Total	40

Note : Average of Two internal tests will be considered for 20 Marks

(B) Semester end examination 60 marks

PAPER PATTERN

Duration : 2 hours	
Total Marks: 60	
Q.1 15 marks OR 15 marks	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: 1. Q.1, 2, 3 and 4 - 15 marks questions 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.

II. . FOR MAJOR PAPERS WITH 2 CREDITS

The scheme of examination shall be divided into two parts:

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

(A) Internal Assessment 20 marks

	Description	**Marks**
Internal Test	Two Internal tests of 10 marks each Q.1 Multiple choice Questions/True or False - 05 Marks Q.2. Attempt 1 question out of 3 questions - 05 Marks	10
Project	One Mini-Project with presentation	10
	Total	20

Note : Average of Two internal tests will be considered for 20 Marks

(B) Semester end examination 30 marks

PAPER PATTERN

Duration : 1 hours	
Total Marks: 30	
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: 1. Q.1, 2, 3 - 10 marks questions may be divided into sub questions if required.	

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

III. 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	Two 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

Note : Average of Two internal tests will be considered for 20 Marks

(B) Semester end examination 60 marks

PAPER PATTERN

Duration : 2 hours	
Total Marks: 60	
Q.1 15 marks OR 15 marks	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: 1. Q.1, 2, 3 and 4 - 15 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.

IV. For RM Paper

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	Two 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

Note : Average of Two internal tests will be considered for 20 Marks

(B) Semester end examination 60 marks

PAPER PATTERN

Duration : 2 hours	
Total Marks: 60	
Q.1 15 marks OR 15 marks	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: 1. Q.1, 2, 3 and 4 - 15 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

I. FOR MAJOR PAPERS WITH 6 CREDITS

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.1. 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)

II. **FOR MAJOR PAPERS WITH 2 CREDITS**

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
Q1. 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)

.

III. **FOR MAJOR PAPER WITH 4 CREDITS**

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.1 Two questions of practical's (20marks each)	40
Journal	5
Viva	5
Total	50

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

AC: 22/12/2023

Item No. :1.2.2

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

Syllabus for Approval

M.SC (COMPUTER SCIENCE)

Sr. No	Heading	Particulars
1	Title of the Programme	M.Sc. (Computer Science)
2	Eligibility for admission	The Bachelor's degree in the Faculty of Science/ Technology of this University or equivalent degree of recognized Universities with Major and Ancillary Subjects at undergraduate level as detailed below: A learner who has either passed Bachelor's Degree Examination of University of Mumbai in Science or equivalent degree of any other university recognized as equivalent thereto with one of the following as major subject MAJOR — ANCILIARY Mathematics OR _____ Mathematics OR Statistics Mathematics OR Physics OR The Bachelor of Engineering (B.E.) degree examination OR The B.Sc. (Computer Science) / BCS / B.Sc. (I.T.) Degree Examination
3	Minimum Percentage for admission	45%
4	Semesters	II
5	Level	PG I
6	Pattern	02 years & 04 semesters CBGS
7	To be implemented from	From Academic year 2023-24 in a progressive manner

Date: 22nd December, 2023.

Signature:

Dr. Koel Roychoudhury
AC Chairperson

Dr. Sheeja Ravi
Head of the Department

Sri Chandrasekarendra Saraswati Vidyapuram,, Plot I-C, Sector V,
Nerul, Navi Mumbai – 400706 India
Tel No: 61196409, 61196410, 61196402, 61196413, 61196414, 61196415, 27708371
Fax No: 022-27713356, **Email:** ascnsies@sies.edu.in / siesascn@yahoo.in **Website:** www.siesascn.edu.in

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 2023-2024)

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.

Level	Sem	Major		RM	OE	VSC, SEC	IKS, AEC, VEC	OJT, FP	RP	Cum. Cr./ Sem.
		Mandatory	Elective							
	II	Machine Learning: 06 Credits	Bioinformatics OR Embedded and IoT Technology : 04 Credits		-	-	-	04	-	22
		Compiler Designing 06 Credits								
		Cloud Computing: 02 Credits								
Total of II		14	04		-	-	-	04	-	22

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

M. Sc. Computer Science Programme
(To be implemented from Academic Year- 2023-24)

No. of Courses	Course Code	Semester II	Credits
1	***Major***		
1	M23CS2MJ01	Machine Learning	**4**
2	M23CS2MJP01	Machine Learning Practical	**2**
3	M23CS2MJ02	Compiler Designing	**4**
4	M23CS2MJP02	Compiler Designing Practical	**2**
5	M23CS2MJ03	Cloud Computing	**1**
6	M23CS2MJP03	Cloud Computing Practical	**1**
2	***Electives(E) (Any one)***		
7	M23CS2E01	Bioinformatics	**3**
8	M23CS2EP01	Bioinformatics Practical	**1**
9	M23CS2E02	Embedded and IoT Technology	**3**
10	M23CS2EP02	Embedded and IoT Technology Practical	**1**
3	***OJT / FP***		
11	M23CS2OJT01	On -the-job-training	**4**
		Total Credits	**22**

Machine Learning

COURSE CODE : M23CS2MJ01 COURSE CREDIT: 04

1 credit - 15 lectures

1 lecture is 60 minutes

Course Objectives:

- To Understand the importance and concepts of Machine Learning.
- Knowledge on various learning techniques, performance measure, and Artificial Neural Network (ANN).
- Applying algorithms available for the machine learning.
- Designing and developing practical Machine Learning and Machine Learning based applications.

Course Outcomes:

- The ability to describe the basic pragmatics of machine learning.
- Discover various projects in machine learning for industrial applications.
- Assess and Evaluate semantics of ML based systems.
- Analyse Machine Learning with visualization techniques and develop real-time applications.

Unit	Syllabus	No. of lectures
1.	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. Case Study	15
2.	Regression Analysis 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. Case Study	15
3.	Supervised Learning 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. Case Study	15

4.	Unsupervised Learning Introduction to Unsupervised Learning, Association rule mining (Apriori algorithm), Clustering: K-means, Hierarchical cluster analysis (agglomerative clustering AGNES, Divisive Hierarchical clustering DIANA), Principal Component Analysis (PCA). Case Study	15

References:

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

Additional References:

1. Introduction to Machine with Python - A Guide for Data Scientists by Andreas C. Müller & Sarah Guido O'reilly 20

Machine Learning - Practical

COURSE CODE : M23CS2MJP01 **COURSE CREDIT: 02**
1 credit - 30 lectures
1 lecture is 60 minutes

Sr. No.	List of Practical 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	Write a program to implement Linear Regression (Diabetes Dataset)
2	Write a program to Implement Logistic Regression (Iris Dataset)
3	Write a program to Implement Multinomial Logistic Regression (Iris Dataset)
4	Write a program to Implement SVM classifier (Iris Dataset)
5	Write a program to Train and fine-tune a Decision Tree for the Moons Dataset
6	Write a program to Train an SVM regressor on the California Housing Dataset
7	Write a program to Implement Batch Gradient Descent with early stopping for Softmax Regression
8	Write a program to Implement MLP for classification of handwritten digits (MNIST Dataset)
9	Write a program to implement customer segmentation using Unsupervised Learning.
10	Write a program to implement association rules from the frequent item sets and calculate their support and confidence.

Compiler Designing

COURSE CODE : M23CS2MJ02 **COURSE CREDIT: 04**

1 credit - 15 lectures

1 lecture is 60 minutes

Course Objectives:

- Provide an understanding of the fundamental principles in compiler design.
- Provide the skills needed for building compilers for various situations.
- Learn the process of translating a modern high-level language to executable code required for compiler construction.
- To apply the optimization techniques to have a better code for code generation.

Course Outcomes:

- Familiar with fundamentals of compiler and identify the relationships among different phases of the compiler. •
- Interpret the application of finite state machines, recursive descent, production rules, parsing, and language semantics.
- Analyze & implement required module, which may include front-end, back-end, and a small set of middle-end optimizations.
- Apply tools and technologies for designing new compiler.

Unit	Syllabus	No. of lectures
1.	**Introduction, Lexical Analysis** Language Processors, The structure of a Compiler, The evolution of Programming Languages, The science of building a Compiler, Applications of Compiler Technology, Programming Language Basics Role of Lexical Analyzer, Specification of Tokens, Token Recognition, Nondeterministic Finite Automata (NFA), Deterministic Finite Automata (DFA), NFA to DFA, Regular Expression to NFA, Optimization of DFA, DFA Minimization Algorithm **Case Study:** Lexical Analysis Tool-Lex	15
2.	**Syntax Analysis, Syntax Directed Translation** Role of Parser, Error Handling, Grammar, Top-Down Parsing, Bottom-up Parsing, LR Parsing, What is SDT, Attributes, Evaluating Attributes in SDD, Classes of SDD, Side Effects in SDD, Syntax- Directed Translation (SDT) Schemes, Postfix SDT, Infix SDT, Converting SDD to SDT **Case Study:** LALR Parser Generator-yacc	15
3.	**Type Checking, Symbol Tables and Runtime Environment Management** Static vs. Dynamic Checking, Type Expressions, Type Checking, Type Equivalence, Type Conversion Information in Symbol Table, Operations on Symbol Tables, Simple & Scoped Symbol Table Introduction, Activation Record, Environment without Local Procedures, Environment with Local Procedures, Display **Case Study**	15

4.	**Code Generation & Code Optimization** Intermediate Languages, Intermediate Language Design Issues, Intermediate Representation Techniques, Statements in Three-Address Code, Implementation of Three-Address Instructions, Three-Address Code Generation Factors Affecting Code Generation, Basic Block, Code Generation for Trees, Register Allocation, Cache Management, Code generation using dynamic Programming. Need of Optimization, Problems in Optimizing Compiler Design, Classification of Optimization, Factors Influencing Optimization, Themes Behind Optimization Techniques **Case Study**	15

References:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, J. D. Ullman, "Compilers: Principles, Techniques, & Tools", 2nd Edition, Pearson Education, 2013, ISBN: 978-9332518667.
2. Santanu Chattopadhyay, "Compiler Design", PHI Learning Pvt. Ltd., 2015.

Additional References:

1. Dick Grune, Henry E. Bal, Ceriel J. H. Jacobs, Koen G. Langendoen, "Modern Compiler Design", John Wiley & Sons Publisher, 2000, ISBN: 978-0471976974
2. Barret, Couch, Compiler Construction Theory and Practice, , Asian Student Edition.
3. Dhamdhere D.M, "Compiler Construction Principle and Practice", McMillan India;

Compiler Designing - Practical

COURSE CODE : M23CS2MJP02 COURSE CREDIT: 02

1 credit - 30 lectures

1 lecture is 60 minutes

Sr. No.	List of Practical
1	Program to count the number of vowels and consonants in a given string.
2	Program to count the number of characters, words, spaces, end of lines in a given input file.
3	Program to count no of: a) +ve and –ve integers b) +ve and –ve fractions
4	Program to count the no of comment line in a given C program. Also eliminate them and copy that program into separate file
5	Program to count the no of 'scanf' and 'printf' statements in a C program. Replace them with 'readf' and 'writef' statements respectively.
6	Program to recognize a valid arithmetic expression and identify the identifiers and operators present. Print them separately.
7	Program to recognize whether a given sentence is simple or compound.
8	Program to recognize and count the number of identifiers in a given input file.
9	Program to test the validity of a simple expression involving operators +, -, * and /.
10	Program to recognize nested IF control statements and display the levels of nesting.
11	Program to check the syntax of a simple expression involving operators +, -, * and /.
12	Program to recognize a valid variable, which starts with a letter, followed by any number of letters or digits.
13	Program to evaluate an arithmetic expression involving operating +, -, * and /.
14	Program to recognize strings 'aaab', 'abbb', 'ab' and 'a' using grammar (a^nb^n, n>=0)
15	Program to recognize the grammar (a^nb, n>=10)

Cloud Computing

COURSE CODE: M23CS2MJ03 **COURSE CREDIT: 01**

1 credit - 15 lectures

1 lecture - 60 minutes

Course Objectives:

- Understand the basics of cloud computing, including types of clouds, deployment models, and essential characteristics of cloud platforms

Course Outcomes:

- Demonstrate a comprehensive understanding of cloud computing concepts, including different types of clouds and their characteristics

Sr. No	Syllabus	No. of lectures
01	**Parallel and Distributed Computing** Elements of parallel computing, elements of distributed computing, Technologies for distributed computing: RPC, Distributed object frameworks, Service oriented computing Virtualization – Characteristics, taxonomy, virtualization and cloud computing. **Computing Platforms** Cloud Computing definition and characteristics, Enterprise Computing, The internet as a platform, Cloud computing services: SaaS, PaaS, IaaS, Enterprise architecture, Types of clouds.	15

Text Book(s):

1. Enterprise Cloud Computing Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
2. Mastering In Cloud Computing, Rajkumar Buyya, Christian Vecchiola And Thamari Selvi S, Tata Mcgraw-Hill Education, 2013
3. Cloud Computing: A Practical Approach, Anthony T Velte, Tata Mcgraw Hill, 2009

Additional Reference(s):

1. Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS), Michael J. Kavis, Wiley CIO, 2014
2. Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More, Kris Jamsa, Jones & Bartlett Learning, 2013

Cloud Computing Practical

COURSE CODE: M23CS2MJP03 **COURSE CREDIT: 01**

1 credit - 2 lectures

1 lecture - 60 minutes

Sr.No.	**List of Practicals**
1	Execute & check the performance of existing algorithms using CloudSim.
2	Install a Cloud Analyst and Integrate with Eclipse/Netbeans. Monitor the performance of an Existing Algorithms.
3	Build an application on private cloud.
4	Demonstrate any Cloud Monitoring tool.
5	Evaluate a Private IAAS Cloud using TryStack.
6	Implement FOSS-Cloud Functionality - VDI (Virtual Desktop Infrastructure)
7	Implement FOSS-Cloud Functionality VSI (Virtual Server Infrastructure) Infrastructure as a Service (IaaS)
8	Implement FOSS-Cloud Functionality - VSI Platform as a Service (PaaS)
9	Implement FOSS-Cloud Functionality - VSI Software as a Service (SaaS)
10	Explore FOSS-Cloud Functionality- Storage Cloud

Embedded and IoT Technology

COURSE CODE: M23CS2E02 **COURSE CREDIT: 03**

1 credit - 15 lectures

1 lecture is 60 minutes

Pre requisite:

- Basic electronics knowledge (components, microcontrollers), understanding of wireless sensor networks, familiarity with IoT concepts and architectures.

Course Objectives:

- Understand embedded systems design and basics of IoT components.
- Learn about electronics and microcontrollers in embedded systems.
- Gain knowledge of IoT building blocks, sensors, and wireless sensor networks.

Course Outcomes

- Explore advanced IoT technologies, including gateway architecture and cloud computing.
- Understand IoT security, communication, and design connected IoT systems using Packet Tracer.

Sr. No	Syllabus	No. of lectures
01	Module I Embedded System Basics Introduction to Embedded Systems- Design of Embedded Systems, Memory Architecture, Input/Output. Basic electronics: Semiconductors, Transistors, BJT, Flip Flops, Resistors, Capacitors. Microcontrollers, UART Communications, SPI-peripherals interface, I2C communication, Wireless Sensor Network (WSN) Case Study	15
02	Module II Basics of IOT- Introduction IoT, 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 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, 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. Case Study	15
03	Module III Security, Communication and Data analytics in IOT-IoT Security: Security constraints in IoT systems, security requirements of IoT systems,	15

	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. Case Study	

References:

1. Introduction to Embedded Systems – Cyber physical systems Approach Edward Ashford Lee & Sanjit Arun kumar 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
3. Introduction Embedded Systems by K.V. Shibu Second Edition McGraw Hills–2017
4. Build your own IoT Platform Develop a Fully Flexible and Scalable Internet of Things Platform in 24 Hours by AnandTamboli, 2019 ,Apress

Embedded and IoT Technology Practical

COURSE CODE: M23CS2EP02 **COURSE CREDIT: 01**

1 credit - 2 lectures

1 lecture is 60 minutes

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/

Sr.No.	**List of Practicals**
1	Design and implement basics embedded circuits 1. Automatic Alarm system- Alarm should get trigger by senor 2. Timer based buzzer 3. Sensor based Counting device
2	Demonstrate communication between two embedded devices using UART port
3	Built an IoT system to send ticket before entering the bus.
4	Demonstrate an IoT based game which can be played between two player who are physically at a considerable distance.
5	Develop a IoT application which will record the movement and orientation of your phone and give the data back to the PC
6	Develop an IoT application that will raise an alarm whenever with going to rain outside based on the weather prediction data.
7	Deploy an IoT application which will alert you by beeping or vibrating your phone whenever you get someone call your name.
8	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.
9	Develop an IoT module to which measure the intensity of light and send the same to your PC/ Phone
10	Develop an IoT application for Motion detection.

Bioinformatics

COURSE CODE: M23CS2E01 **COURSE CREDIT: 03**
1 credit - 15 lectures
1 lecture is 60 minutes
Pre requisite:
Basic concepts of Biology, Data Structures and Algorithms, Data Analysis and Visualization.

Course Objectives:

- Gain a solid understanding of fundamental concepts and principles in bioinformatics, including sequence analysis, genome analysis, protein structure prediction, and gene expression analysis
- Acquire the ability to analyze and interpret biological data, such as DNA or protein sequences, microarray data, or next-generation sequencing data
- Learn statistical methods and techniques for extracting meaningful insights from large datasets.

Course Outcomes:

- Develop skills in using bioinformatics tools and software packages commonly used in the field, such as BLAST, EMBOSS and Biopython
- Awareness of Ethical and Legal Considerations Develop the ability to stay updated with the latest advancements and emerging trends in bioinformatics research and technologies

Sr. No	Syllabus	No. of lectures
01	Module I Biological Data Analysis Biological Foundations: Introduction to molecular biology concepts and terminology, DNA, RNA, and protein structure and function, Genetic variation and mutation Introduction to Bioinformatics: Overview of bioinformatics and its applications in biology and medicine, Introduction to biological databases and data formats, Introduction to sequence analysis, structure analysis Sequence Analysis: Sequence alignment algorithms (pairwise and multiple sequence alignment), Sequence database searching (BLAST, FASTA), Hidden Markov Models (HMMs) for sequence analysis, Phylogenetic analysis and evolutionary tree construction Case Study	15

02	**Module II** **Structure Analysis:** Protein structure prediction methods (homology modeling, ab initio methods), Protein structure visualization and analysis tools, Drug discovery **Computational Tools and Methods** **Genomics and Transcriptomics:** Analyzing and manipulating genomic sequences, working with genome annotations and gene features, Analyzing gene expression data (RNA-Seq, microarray), Identifying differentially expressed genes **Data Visualization and Reporting:** Visualizing bioinformatics data, Creating interactive visualizations of biological data **Case Study**	**15**
03	**Module III** **Analytics and Business:** Introduction to machine learning algorithms and techniques, Feature selection and dimensionality reduction in biological data, Predictive modeling for biological data (classification, regression) **Ethical, Legal, and Social Implications:** Ethical considerations in bioinformatics research, Privacy and data security in genomic data, social and policy issues in bioinformatics and personalized medicine **Case Study**	**15**

References:

1. Bioinformatics: Sequence and Genome Analysis by David W. Mount Publisher: Cold Spring Harbor Laboratory Press Publication (4th edition), 2021,
2. Python for Bioinformatics by Tiago Antao, Packt Publishing Publication, 2015
3. Python for Biologists: A complete programming course for beginners" by Martin Jones CreateSpace Independent Publishing Platform, 2013,
4. Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases, and Analytical Tools by SupratimChoudhuri, Academic Press Publication, 2014
5. Bioinformatics Programming Using Python: Practical Programming for Biological Data by Mitchell L. Model, O'Reilly Media, 2009

Bioinformatics Practical

COURSE CODE : M23CS2EP01 COURSE CREDIT: 01

1 credit - 2 lectures

1 lecture is 60 minutes

Sr No	List of Practicals
1	Sequence Manipulation Read and parse sequence data from files Perform basic sequence manipulations (e.g., reverse complement, translation)
2	Sequence Alignment Perform pairwise sequence alignment using algorithms like Needleman- Wunsch or Smith-Waterman Implement multiple sequence alignment using methods such as ClustalW or MUSCLE
3	Database Searching Perform sequence searches against databases (e.g., BLAST or FASTA) Retrieve and analyze search results
4	Protein Structure Analysis Retrieve protein structures from databases like PDB Calculate structural properties (e.g., secondary structure, solvent accessibility) Perform structure visualization and analysis
5	Genomic Data Analysis Retrieve genomic data from databases (e.g., NCBI) Analyze gene annotations, promoter regions, or regulatory elements Perform genomic variant analysis
6	Data Preprocessing Cleaning and preprocessing biological data (e.g., gene expression data, DNA sequences) Handling missing values, outliers, and normalization of data Feature selection and dimensionality reduction techniques
7	Classification Applying machine learning algorithms (e.g., decision trees, random forests, support vector machines) to classify biological samples or sequences Evaluating model performance using metrics such as accuracy, precision, recall, and F1-score
8	Regression Building regression models to predict quantitative biological properties (e.g., protein structure, gene expression levels) Assessing model performance using metrics such as mean squared error or R-squared
9	Clustering Applying clustering algorithms (e.g., k-means, hierarchical clustering) to group similar biological samples or sequences Assessing clustering quality using metrics such as silhouette coefficient or Rand index
10	Visualizing clusters and analyzing their health care significance Data Visualization: Generate plots, graphs, and figures to visualize health care results Use libraries like Matplotlib, Seaborn, or ggplot in Python or R for visualization Create interactive visualizations using tools like D3.js or Plotly

SCHEME OF EXAMINATION

I. FOR MAJOR PAPERS WITH 6 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	20
	Total	40

(B) Semester end examination 60 marks PAPER PATTERN

Duration : 2 hours	
Total Marks: 60	
Q.1 15 marks OR 15 marks	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: 1. Q.1, 2, 3 and 4 - 15 marks questions 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.

II. . FOR MAJOR PAPERS WITH 2 CREDITS

The scheme of examination shall be divided into two parts:

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

(A) Internal Assessment 20 marks

	Description	**Marks**
Internal Test	One Internal tests of 10 marks each Q.1 Multiple choice Questions/True or False - 05 Marks Q.2. Attempt 1 question out of 3 questions - 05 Marks	10
Project	One Mini-Project with presentation	10
	Total	20

(B) Semester end examination 30 marks PAPER PATTERN

Duration : 1 hours	
Total Marks: 30	
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: 1. Q.1, 2, 3 - 10 marks questions may be divided into sub questions if required.	

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

III. 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 15 marks	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: 1. Q.1, 2, 3 and 4 - 15 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

I. FOR MAJOR PAPERS WITH 6 CREDITS

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.1. 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)

II. FOR MAJOR PAPERS WITH 2 CREDITS

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
Q1. 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)

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III. FOR MAJOR PAPER WITH 4 CREDITS

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.1 Two questions of practical's (20marks each)	40
Journal	5
Viva	5
Total	50

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