AC: 21/02/2026
Item No.:

SIES (Nerul) College of Arts, Science & Commerce (Autonomous)
RISE WITH EDUCATION

SIES (Nerul) College of Arts, Science and Commerce (Autonomous)
Syllabus for Approval
M.Sc. (Information Technology)

Sr. No.	Heading	Particulars
1	Title of the course	M. Sc.(Information Technology) Part I
2	Eligibility for admission	B.Sc(IT,CS,AI,DS),B.E(IT,CS,Electronics,A.I, D.S.), B.Sc(Physics), B.Sc(Maths), B.Sc(Stats), B.Sc(Electronics)
3	Minimum percentage for admission	40%
4	Passing Marks	40%
5	Semesters	I
6	Level	PG
7	Pattern	1-2 years & 2-4 semesters Choice Based Grading System
8	Status	New
9	To be implemented from	From Academic year 2023-24 in a progressive manner

Date: 28th January, 2026.

Signature:

Dr. Kool Roychoudhury
AC Chairperson

Dr. Meghna Bhatia
Head of the Department

Sri Chandrasekarendra Saraswati Vidyapuram,, Plot I-C, Sector V,
Nerul, Navi Mumbai – 400706 India
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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 (Information Technology)

(WITH EFFECT FROM THE ACADEMIC YEAR 2023-2024)

OBJECTIVES OF THE PROGRAMME:

- Ability to apply the knowledge of Information Technology with recent trends aligned with research and industry.
- Ability to apply IT in the field of Computational Research, Soft Computing, Big Data Analytics, Data Science, Image Processing, Artificial Intelligence, Networking and Cloud Computing.
- Ability to provide socially acceptable technical solutions in the domains of Information Security, Machine Learning, Infrastructure Services as specializations.
- Ability to apply the knowledge of Intellectual Property Rights and Cyber Forensics and various standards in interest of National Security and Integrity along with IT Industry.
- Ability to write effective project reports, research publications and content development and to work in a multidisciplinary environment in the context of changing technologies.

Programme Outcome:

PO1: Ability to apply the knowledge of Information Technology with recent trends aligned with research and industry.

PO2: Ability to write effective project reports, research publications and content development and to work in multidisciplinary environment in the context of changing technologies

PSO1: Ability to apply IT in the field of Computational Research, Soft Computing, Big Data Analytics, Data Science, Image Processing, Artificial Intelligence, Networking and Cloud Computing.

PSO2: Ability to provide socially acceptable technical solutions in the domains of Information Security, Machine Learning, Internet of Things and Embedded System, Infrastructure Services as specializations.

M.Sc. Information Technology Programme

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

No. of Courses	Course Code	Semester I	Credits
1	**Major**		
1	M23IT1MJ01	Introduction to Data Science	**4**
2	M23IT1MJ02	Cloud Computing	**4**
3	M23IT1MJP03 (Rev 26-27)	Practicals of Introduction to Data Science and Cloud Computing	**4**
4	M25IT1MJ04	Design and Analysis of Algorithms	**2**
2	**Electives(E)**		
5	M23IT1E01	Soft Computing Using Artificial Neural Networks	**4**
	M23IT1EP01	Soft Computing Using Artificial Neural Networks Practical	
	M23IT1E02	Cyber Security	
	M23IT1EP02	Cyber Security Practical	
3	**Research Methodology**		
6	M23IT1RM01	Research Methodology	**4**
Total Credits			**22**

Major (Credit 4)
Introduction to Data Science

COURSE CODE: M23IT1MJ01 **COURSE CREDIT: 04**

1 credit - 15 lectures **1 lecture is 60 minutes**

Course Objectives:
The objective of this course is to

1. Building the fundamentals of data science
2. Gaining practical experience in programming tools for data sciences
3. Empowering students with tools and techniques used in data science.
4. To develop critical thinking and innovative skills.

Course Outcomes:
On successful completion of the course learner will be able to:

1. Students will be able to implement data science framework
2. Students will become proficient in the statistical analysis of data and the use of computation tools.
3. Students will apply statistical and computational tools to applied problems, and clearly communicate the results.

UNIT	Topic	HRS
I	Introduction to Data Science- Introduction- Definition - Data Science in various fields - Examples - Impact of Data Science - Data Analytics Life Cycle - Data Science Toolkit - Data Scientist - Data Science Team Understanding data: Introduction – Types of Data: Numeric – Categorical – Graphical – High Dimensional Data – Classification of digital Data: Structured, Semi-Structured and UnStructured - Example Applications. Sources of Data: Time Series – Transactional Data – Biological Data – Spatial Data – Data Evolution. Data Science Processing Tools examples like Cassandra, Kafka, R ,Python.	15
II	Hypothesis development –Hypothesis testing with quantitative data.Null and Alternative Hypothesis. Simple and Composite Hypothesis. Type-1 and Type2 Errors. Univariate Data: Descriptive measures related to univariate metric data. Bivariate Data: Descriptive measures related to bivariate metric data: Correlations, linear and polynomial regressions. Descriptive measures related to bivariate categorical data: Measures of associations in a contingency table	15
III	Classification: Classification and Prediction – Basic concepts–Decision tree induction–Bayesian classification, Rule–based classification, Lazy learner. Clustering and Applications: Cluster analysis–Types of Data in Cluster Analysis–Categorization of Major Clustering Methods– Partitioning Methods, Hierarchical Methods– Density–Based Methods, Grid–Based	15

	Methods, Outlier Analysis.	
IV	Association Rule Mining: Mining Frequent Patterns–Associations and correlations – Mining Methods– Mining Various kinds of Association Rules– Correlation Analysis– Constraint based Association mining. Graph Pattern Mining, SPM. General Case Study Based on Data Science Model .	**15**

References:

1. Practical Data Science, Andreas François, Vermeulen, APress, 2018
2. Principles of Data Science, Sinan Ozdemir, PACKT, 2016
3. Data Science from Scratch, Joel Grus, O'Reilly, 2015
4. Data Science from Scratch,first Principle in python, Joel Grus, Shroff Publishers, 2017
5. Experimental Design in Data science with Least Resources, N C Das, Shroff Publishers, 2018
6. Data Science: Concepts and Practice, Vijay kotu and Bala Deshpande,Morgan Kaufmann,2019

Major (Credit 4)
Cloud Computing

COURSE CODE: M23IT1MJ02 **COURSE CREDIT: 04**

1 credit - 15 lectures **1 lecture is 60 minutes**

Course Objectives:

The objective of this course is to

1. Learn how to use Cloud Services.
2. Understand Cloud Security and new developments in cloud technology.
3. Comprehend the various architectures in cloud development.
4. Understand the economics behind a cloud-based service.

Course Outcomes:

On successful completion of the course learner will be able to:

1. Implement Virtualization.
2. Design the architecture for various cloud platform-based services.
3. Build a Private Cloud.
4. Prepare Service Level agreements using cloud delivery models with costing and quality metrics.

UNIT	Topic	HRS
I	Introduction to Cloud Computing: Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges. Virtualization Technology: Hardware Independence, Server Consolidation, Resource Replication, Operating System-based Virtualization, Hardware- Based Virtualization, Virtualization Management.	15
II	Fundamental concepts and models: Roles and boundaries, Cloud Characteristics, Cloud Delivery models, Cloud Deployment models. Cloud service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). Fundamental Cloud Security: Basics, Threat agents, Cloud security threats. Industrial Platforms and New Developments: Amazon Web Services, Google App Engine, Microsoft Azure.	15
III	Fundamental Cloud Architectures: Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant Storage Architecture. Advanced Cloud Architectures: Hypervisor Clustering Architecture, Load Balanced Virtual Server Instances Architecture, Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture, Cloud Balancing	15

	Architecture, Resource Reservation Architecture, Dynamic Failure Detection and Recovery Architecture, Bare-Metal Provisioning Architecture, Rapid Provisioning Architecture, Storage Workload Management Architecture	
IV	Cloud Delivery Model Considerations: Cloud Delivery Models: The Cloud Provider Perspective, Cloud Delivery Models: The Cloud Consumer Perspective, Cost Metrics and Pricing Models: Business Cost Metrics, Cloud Usage Cost Metrics, Cost Management Considerations, Service Quality Metrics and SLAs: Service Quality Metrics, SLA Guidelines	15

References:

1. Cloud Computing - Concepts, Technology and Architecture by Ricardo Puttini, Thomas Erl, and Zaigham Mahmood, 2013
2. Cloud Computing: A Practical Approach for Learning and Implementation 1st Edition by A. Srinivasan, 2014
3. Mastering Cloud Computing: Foundations and Applications Programming by Christian Vecchiola, Rajkumar Buyya, and S.Thamarai Selvi, 2013
4. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things by Geoffrey C. Fox, Jack Dongarra, and Kai Hwang, 2012

Major(Credit 4)
Practicals of Introduction to Data Science and Cloud Computing

COURSE CODE: M23IT1MJP03 **COURSE CREDIT: 04**

~~1 credit - 15 lectures~~ ~~1 lecture is 120 minutes~~

Course Objectives:

The objective of this course is to

1. Apply quantitative modeling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques.
2. Apply ethical practices in everyday business activities and make well- reasoned ethical business and data management decisions.
3. Analyze the Cloud computing setup with its vulnerabilities and applications using different architectures.
4. Apply and design suitable Virtualization concepts, Cloud Resource.

Course Outcomes:

On successful completion of the course learner will be able to:

1. Employ cutting edge tools and technologies to analyze Big Data.
2. Apply algorithms to build machine intelligence.
3. Demonstrate use of teamwork, leadership skills, decision making and organization theory.
4. Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application

Sr.No.	**Practicals of Data Science**
1	Create data model using Cassandra
2	Conversion from different formats to HOURS format. • Text-Delimited to HORUS • XML to HORUS
3	Utilities and Auditing • Fixers Utilities • Data Binning or Bucketing
4	Retrieving Data • Program to retrieve different attributes of data • Data Pattern
5	Assessing Data Perform error management on the given data using the pandas package. • Drop the Columns Where All Elements Are Missing Values • Drop the Columns Where Any of the Elements Is Missing Values

6	Processing Data • Forecasting
7	Transforming Data • Simple Linear Regression
8	Organising Data • Horizontal Style • Vertical Style
9	Generating Reports Data Visualisation with python
10	Data Visualisation with Power BI

Sr.No.	**Practicals of Cloud Computing**
1	Show the implementation of exchanging information between client and server using socket programming.
2	Develop a simple calculator application using RMI.
3	Show the implementation of web services.
4	Implementing Web Service that connects to MySQL database.
5	Implement Windows Hyper V virtualization.
6	Creating VMs using any Hosted Hypervisor.
7	Connecting VMs in a network.
8	Study and Implementation of Infrastructure as a Service.
9	Study and Implementation of Storage as a Service.
10	Study of Platform as a Service.

Major (Credit 2)
Design and Analysis of Algorithms

COURSE CODE: M25IT1MJ04 **COURSE CREDIT: 02**

~~1 credit - 15 lectures~~ ~~1 lecture is 60 minutes~~

Course Objectives:

1. To Understand and learn Basic concepts of algorithms and analyze the performance
2. of algorithms.
3. Algorithm design techniques for developing algorithms.
4. Searching and traversal algorithms for graphs.

Course Outcomes:

After successful completion of this course, students would be able to :

1. Analyze the asymptotic performance of algorithms.
2. Design and analyze divide-and-conquer based algorithms.
3. Devise and Synthesize greedy and dynamic-programming based algorithms.
4. Employ graphs to model problems solvable using traversal techniques.

Unit	Topic	Hours
I	**Introduction** What Is An Algorithm?, Algorithm Specification, Pseudocode Conventions, Recursive Algorithms, Complexity, Asymptotic Notation, Practical Complexities And Performance Measurement, Removal of recursion ,Sorting algorithms : insertion sort , bubble sort ,radix sort, Tree And Graph Representations, Binary Trees Basics, Heaps And Heap Sort. **Divide and Conquer strategy** General method, Binary search ,Finding Maximum and Minimum, Merge Sort, Quick Sort, Strassen"s Matrix Multiplication	15
II	**Greedy Method** General Method,Knapsack Problem ,Minimum-Cost Spanning Trees (Prim's & Kruskal's Algorithm), Huffman coding ,Single Source Shortest Path :Dijkstra"s Algorithm **Dynamic Programming** General Method,All pairs Shortest Path Floyd-Warshall Algorithm ,Matrix chain multiplication ,Longest Common sub Sequence,0/1 Knapsack Problem ,Travelling Salesperson problem .	15

Books and References:

1. Ellis Horowitz, SatrajSahni, SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", 2010, ISBN: 8175152575, Galgothia publications.
2. AnanyLevitin, "Introduction to the design and analysis of Algorithms", 2003, ISBN:

9788178089843, Pearson Education,

3. Parag H. Dave, Himanshu B. Dave, "Design and Analysis of Algorithms", 1st Edition, 2008, ISBN: 8177585959, Pearson Education.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, 2010, ISBN: 9788120340077, Prentice Hall of India.

Elective (Credit 2+2)
Soft Computing Using Artificial Neural Networks

COURSE CODE: M23IT1E01 **COURSE CREDIT: 02**

1 credit - 15 lectures 1 lecture is 60 minutes

Course Objectives:

1. Gain knowledge about biological neural networks and create equivalent models of neurons
2. Understand the structure, learning algorithms, and challenges associated with feed-forward and feedback neural networks.
3. Applications of neural networks to solve problems in varieties of application domains.

Course Outcomes:

1. Upon completion of this course, students will be able to:
2. Construct diverse neural networks with different architectures, including both feed-forward and feedback types.
3. Apply various learning rules to train neural networks effectively.
4. Test neural networks and analyze their performance for different pattern recognition tasks.

UNIT	Topic	HRS
I	**Introduction to Soft Computing And Artificial Neural Network**: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing and its applications. Types of soft computing -Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning Introduction: A Neural Network, Human Brain, Models of a Neuron, Network Architectures. Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning. Basic Models, McCulloh-Pitts Neuron, Linear Separability, Hebb Network.	15
II	**Learning Networks:** Supervised Learning Network: Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons, Backpropagation Network Associative Memory Networks: Training algorithm for pattern Association, Autoassociative memory network, hetero associative memory network, bi-directional associative memory, Hopfield networks. UnSupervised Learning Networks: Fixed weight competitive nets, Kohonen	15

	self-organizing feature maps, counter propagation networks. Third Generation Neural Networks: Spiking Neural networks, convolutional neural networks, Introduction to deep learning neural networks	

References:

1.Principles of Soft computing S.N.Sivanandam S.N.Deepa,Wiley 3 rd 2019

2. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.

3. Artificial Intelligence and Soft Computing Anandita Battacharya Das SPD 3rd 2018

Soft Computing Using Artificial Neural Networks Practical

COURSE CODE: M23IT1EP01 **COURSE CREDIT: 02**

1 credit - 15 lectures **1 lecture is 120 minutes**

Course Objectives:

1. Gain knowledge about biological neural networks and create equivalent models of neurons
2. Understand the structure, learning algorithms, and challenges associated with feed-forward and feedback neural networks.
3. Applications of neural networks to solve problems in varieties of application domains.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Construct diverse neural networks with different architectures, including both feed-forward and feedback types.
2. Develop models and apply various learning rules to train neural networks effectively.
3. Analyze the performance for different pattern recognition tasks.

Sr.No.	Practicals of Soft Computing Using Artificial Neural Networks
1	a) Design a simple linear neural network model.
	b) Calculate the output of the neural net using both binary and bipolar sigmoidal functions.
2	a) Create a perceptron with an appropriate number of inputs and outputs. Train it using a fixed increment learning algorithm until no change in weights is required. Output the final weights
	b) Implement basic logic gates using ANN
3	a) Implement Universal Logic gates using ANN
	b) Implement XNOR Logic gate using ANN
4	a) Generate AND/NOT function using McCulloch-Pitts neural net.
	b) Generate XOR function using McCulloch-Pitts neural net.
5	a) Write a program to implement Hebb's rule.
	b) Write a program to implement of delta rule.
6	a) Write a program for Back Propagation Algorithm
	b) Write a program for the error Backpropagation algorithm.
7	Write a program for Hopfield Network.
8	Write a program to implement the Kohonen Self-organizing map
9	Write a program for Linear separation.
10	Write a program for the Hopfield network model for associative memory

Elective (Credit 2+2)
Cyber Security

COURSE CODE: M23IT1E02 **COURSE CREDIT: 02**

1 credit - 15 lectures **1 lecture is 60 minutes**

Course Objectives:

1. To get the insight of the security loopholes in every aspect of computing.
2. To understand the threats and different types of attacks that can be launched on computing systems.
3. To know the countermeasures that can be taken to prevent attacks on computing systems.
4. To test the software against the attacks.

Course Outcomes:

On successful completion of the course learner will be able to:

1. Test the security policies, processes, procedures and activities through one central platform that monitors.
2. Evaluate the effectiveness of the individual elements and the overall security system of the organization.
3. Configure various use cases and detect various attacks across the network and report them in real time and also take appropriate actions.
4. Analyze data and events to identify security breaches and take counter measures to defend systems and maintain system integrity.

UNIT	Topic	HRS
I	**Introduction:**: Information Security, Threats and Attack vectors, Concepts of Hacking – Ethical and Unethical, Information Security Controls, Concepts of penetration Testing, Information Security Laws and Standards. **Breaching System Security**: Concepts, Cracking passwords, Escalating privileges, Executing Applications, Hiding files, covering tracks, penetration testing. Threats due to malware: Concepts, Malware Analysis, Network Sniffing, Social Engineering. **Vulnerability Management** Vulnerability Identification Finding Information about a Vulnerability Vulnerability Scan Penetration Assessment Product Vulnerability Management Vulnerability Analysis and Prioritization Vulnerability Remediation Patch Management . **Analysis of Vulnerability**: Concepts, Assessment Solutions, Scoring Systems, Assessment Tools, Assessment Reports. **Identity and Access Management** Phases of the Identity and Access Lifecycle Registration and Identity Validation Privileges Provisioning Access Review Access Revocation Password Management Password Creation Password Storage and Transmission Password Reset Password	15
	Incident Response Teams Computer Security Incident Response Teams	

	(CSIRTs) Product Security Incident Response Teams (PSIRTs) Security Vulnerabilities and Their Severity Vulnerability Chaining Role in Fixing Prioritization Fixing Theoretical Vulnerabilities Internally Versus Externally Found Vulnerabilities National CSIRTs and Computer Emergency Response Teams (CERTs) Coordination Centers Incident Response Providers and Managed Security Service Providers (MSSPs)	
II	**The Art of Data and Event Analysis** Normalizing Data Interpreting Common Data Values into a Universal Format Using the 5-Tuple Correlation to Respond to Security Incidents Retrospective Analysis and Identifying Malicious Files Identifying a Malicious File Mapping Threat Intelligence with DNS and Other Artifacts Deterministic Versus Probabilistic Analysis Intrusion Event Categories Diamond Model of Intrusion Cyber Kill Chain **Evaluating Security of IT Organization**: Concepts, Methodology, Tools, Countermeasures, Penetration Testing. Network Scanning: Concepts, Scanning beyond IDS and firewalls, Tools, Banner Grabbing, Scanning Techniques, Network Diagrams, penetration testing.	**15**

References:

1. CCNA Cyber security Operations Companion Guide 1st edition by CISCO ,2018
2. CCNA Cyber Ops SECOPS 210-255 Official Cert Guide Omar Santos, Joseph Muniz CISCO 1 st edition, 2017
3. CCNA Cyber Ops SECFND 210-250 Official Cert Guide Omar Santos, Joseph Muniz CISCO 1 st edition, 2017
4. CEH V10: EC-Council Certified Ethical Hacker Complete Training Guide I.P. Specialist IPSPECIALIST - 2018
5. CEHv10, Certified Ethical Hacker Study Guide Ric Messier Sybex - Wiley – 2019
6. All in One, Certified Ethical Hacker Matt Walker Tata McGraw Hill - 2012

Cyber Security Practical

COURSE CODE: M23IT1EP02 **COURSE CREDIT: 02**

1 credit - 15 lectures **1 lecture is 120 minutes**

Course Objectives:

1. To get hands-on training on using various system hacking tools.
2. To learn how to evaluate the security strength of systems.
3. To analyze various threats and devise countermeasures to protect against these.
4. To learn the steps of penetration testing .

Course Outcomes:

On successful completion of the course learner will be able to:

1. Scan networks and systems for possible threats or vulnerabilities.
2. Use various system hacking tools to conduct efficient penetration testing.
3. Set firewall security rules that will protect networks and systems.
4. Analyze vulnerabilities and devise strong countermeasures to protect against exploitation.

Sr.No.	Practicals of Cyber Security
1	Using the tools for scanning network, IP fragmentation, war dialing countermeasures, SSl Proxy, Censorship circumvention
2	Using NETBIOS Enumeration Tool, SNMP Enumeration tool, LINUX/UNIX Enumeration tools, NTP Enumeration , DNS analyzing Enumeration .
3	Study of System hacking tools, backdoors and trojan tools, sniffing tools, Denial of service attack tools, wireless hacking tools.
4	Encrypting and Decrypting Data Using OpenSSL
5	Demonstrate the use of Snort and Firewall Rules
6	Demonstrate Extract an Executable from a PCAP
7	Demonstrate Analysis of DNS Traffic
8	Analysis of the Security Vulnerabilities of E-commerce services.
9	Study of the features of firewall in providing network security and to set Firewall Security in windows.
10	Steps to ensure Security of any one web browser (Mozilla Firefox/Google Chrome)

Research Methodology (Credit 4)
Research Methodology

COURSE CODE: M23IT1RM01 **COURSE CREDIT: 04**

1 credit - 15 lectures 1 lecture is 60 minutes

Course Objectives:

1. To conduct research with an understanding of all the latest theories.
2. To develop the ability to explore research techniques used for solving any real world or innovative problem.
3. To Promote good scientific practice

Course Outcomes:

On successful completion of the course learner will be able to:

1. Conduct research using various techniques.
2. Publish and present research work
3. Conduct interdisciplinary research using tools in IT.

UNIT	Topic	HRS
I	**Introduction**:The IS and computing disciplines, Evidence-based practice, The Internet and research, What is research?,Rigour and relevance in research, The 6Ps of research **The Purpose and Products of Research**:Reasons for doing research, Possible products —the outcomes of research, Finding and choosing research topics, Evaluating the purpose and products of research **Overview of the Research Process** :A model of the research process, Alternative models of the research process,Evaluating the research process	15
II	**Internet Research** :Background to the Internet and World Wide Web, Internet research topics, The Internet and a literature review, The Internet and research strategies and methods, Internet research, the law and ethics **Participants and Research Ethics**:The law and research, Rights of people directly involved, Responsibilities of an ethical researcher, Design and creation:projects and ethics, Internet research and ethics, Evaluating research ethics **Reviewing the Literature** : Purpose of a literature review, Literature resources, The Internet and literature reviews, Conducting a literature review, Evaluating literature reviews	15

	Design and Creation : Defining design and creation,Planning and conducting design and creation research, Creative computing and digital art, The Internet and design and creation research, Examples of design and creation research in IS and computing, Evaluating design and creation research	
III	**Experiments** : Defining experiments,Planning and conducting experiments, The Internet and experiments, Examples of experiments in IS and computing research, Evaluating experiment-based research **Quantitative Data Analysis** : Defining quantitative data analysis,Types of quantitative data,Data coding,Visual aids for quantitative data analysis ,Using statistics for quantitative data analysis, Interpretation of data analysis results, Evaluating quantitative data analysis	**15**
IV	**Presentation of the Research** :Writing up the research, Conference paper presentations, Posters and exhibitions, Software demonstrations, Presenting yourself, PhD vivas, Evaluating presentations **Case Studies** • Recidivism predictions with COMPAS • Facial recognition • Facebook advertisement targeting	**15**

References:

1. Researching Information Systems and Computing, Second Edition,Briony J Oates,Marie Griffiths,Rachel McLean ,SAGE Publications
2. Big Data and Social Science:Data Science Methods and Tools for Research and Practice, Ian Foster, Rayid Ghani, Ron S. Jarmin, Frauke Kreuter, Julia Lane,2nd Edition,CRC Press
3. Research Methodology, Methods and Techniques, Kothari, C.R.,1985, Third edition, New Age International.
4. Business Research Methods William G.Zikmund, B.J Babin, J.C. Carr,Cengage, 8th Ed

Revised Scheme of Examination
Faculty of Science
(Postgraduate Programme)

SCHEME OF EXAMINATION (for 100 marks and 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
An internal test of 20 marks	20
One Project And Viva Voce/Presentation/Case Studies/Assignments	15
Attendance and Class Participation	5
Total	40

B) Semester End examination 60 marks

PAPER PATTERN

Duration: 2½ hours	
Total Marks:60	
Q.1 15 marks OR 15 marks (7 and 8 marks)-Unit 1	15
Q.2 15 marks OR 15 marks (7 and 8 marks)-Unit 2	15
Q.3 15 marks OR 15 marks (7 and 8 marks)-Unit 3	15
Q.4 15 marks OR 15 marks (7 and 8 marks)-Unit 4	15
Total	60

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

SCHEME OF EXAMINATION (for 50 marks, 2 credits Theory)

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
An internal test of 20 marks	10
Assignment/Presentation/Case Studies	05
Attendance and Class Participation	05
Total	20

B) Semester End examination 30 marks

PAPER PATTERN

Duration: 1 hour	
Total Marks:30	
Q.1 15 marks OR 15 marks (7 and 8 marks)-Unit 1	15
Q.2 15 marks OR 15 marks (7 and 8 marks)-Unit 2	15
Total	30

Passing criteria: Minimum 40% in Internal (08 out of 20) and 40% (12 out of 30) in semester-end examination.

SCHEME OF PRACTICAL EXAMINATION (for 50 marks , 2 credits)

Semester end examination 50 marks

PAPER PATTERN

Duration: 2.5 hours	
Total Marks:50	
Q.1 Practical Q1	20
Q.2 Practical Q2	20
Viva	05
Journal	05
Total	50

Passing criteria: Minimum 40% in Internal (08 out of 20) and 40% (12 out of 30) in the semester-end examination.

Passing Standard

The learners to pass a course shall have to obtain a minimum of 40% marks in each head of passing, consisting of Internal Assessment and Semester End Examination. The learners shall obtain a minimum of 40% marks (i.e. 16 out of 40 or 8 Out of 20) in the Internal Assessment and 40% marks in the Semester End Examination (i.e. 24 Out of 60 or 12 Out of 30) separately, to pass the course and a minimum of Grade D, wherever applicable, to pass a particular semester. A learner will be said to have passed the course if the learner passes the Internal Assessment and Semester End Examination together.

AC: 21/02/2026
Item No.:

SIES (Nerul) College of Arts, Science and Commerce
RISE WITH EDUCATION

SIES (Nerul) College of Arts, Science and Commerce (Autonomous)
M.Sc.(Information Technology)

Sr. No.	Heading	Particulars
1	Title of the course	M. Sc.(Information Technology) Part I
2	Eligibility for admission	B.Sc(IT,CS,AI,DS),B.E(IT,CS,Electronics,DS),B.Sc(Physics),B.Sc (Maths),B.Sc(Stats), B.Sc(Electronics)
3	Minimum Percentage for admission	40%
4	Passing Marks	40%
5	Semesters	II
6	Level	PG
7	Pattern	1-2 years & 2-4 semesters Choice Based Grading System
8	Status	New
9	To be implemented from	From Academic year 2023-24 in a progressive manner

Date: 28th January, 2026.
Signature:

Dr. Koel Roychoudhury
AC Chairperson

Dr. Meghna Bhatia
Head of the Department

Sri Chandrasekarendra Saraswati Vidyapuram,, Plot I-C, Sector V,
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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 (Information Technology)

(WITH EFFECT FROM THE ACADEMIC YEAR 2023-2024)

OBJECTIVES OF THE PROGRAMME:

- Ability to apply the knowledge of Information Technology with recent trends aligned with research and industry.
- Ability to apply IT in the field of Computational Research, Soft Computing, Big Data Analytics, Data Science, Image Processing, Artificial Intelligence, Networking and Cloud Computing.
- Ability to provide socially acceptable technical solutions in the domains of Information Security, Machine Learning, Infrastructure Services as specializations.
- Ability to apply the knowledge of Intellectual Property Rights and Cyber Forensics and various standards in interest of National Security and Integrity along with IT Industry.
- Ability to write effective project reports, research publications and content development and to work in a multidisciplinary environment in the context of changing technologies.

M.Sc. Information Technology Programme

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

No. of Courses	Course Code	Semester II	Credits
1	**Major**		
1	M23IT2MJ01	Introduction to Machine Learning	**4**
2	M23IT2MJ02	Microservice Architecture	4
3	M23IT2MJP03	Practical of Machine Learning and Practical of Microservice Architecture	**4**
4	M23IT2MJ04	Technical Writing	**2**
2	**Electives(E)**		
5	M23IT2E01	Autonomous Systems and Knowledge Representation	**4**
	M23IT2EP01	Autonomous Systems and Knowledge Representation Practical	
	M23IT2E02	Modern Networking	
	M23IT2EP02	Modern Networking Practical	
3	M23IT2OJT01	On Job Training	**4**
Total Credits			**22**

Major (Credit 4)

Introduction to Machine Learning

Course Code: M23IT2MJ01 **Course Credit: 4**

1 credit - 15 lectures **1 lecture is 60 minutes**

Course Objectives:

1. To understand the basic concepts of machine learning along with decision trees.
2. To comprehend regression techniques and Support Vector Machines.
3. To obtain knowledge about various applications of machine learning.

Course Outcomes:

1. After the completion of the course, the students will be able to:
2. Explicate the learning techniques along with basic knowledge on machine learning.
3. Acquire knowledge on decision tree learning.
4. Apply and comprehend neural network and genetic algorithms techniques.
5. Attain knowledge about classifier and algorithms.
6. Elucidate various machine learning applications.

Unit	Topic	Hrs
I	**An Introduction to Machine Learning :** Introduction - classic and adaptive machines, Only learning matters, Supervised learning, Unsupervised learning, Reinforcement learning, Beyond machine learning - deep learning and bio-inspired adaptive systems, Machine learning and big data. **Important Elements in Machine Learning :** Data formats, Multiclass strategies, One-vs-all,One-vs-one, Learnability, Underfitting and overfitting, Error measures, PAC learning, Statistical learning approaches, MAP learning, Maximum-likelihood learning, Elements of information theory. **Feature Selection and Feature Engineering :** scikit-learn toy datasets, Creating training and test sets, Managing categorical data, Managing missing features, Data scaling and normalization, Feature selection and filtering, Principal component analysis, Non-negative matrix factorization, Sparse PCA, Kernel PCA, Atom extraction and dictionary learning.	**15**

II	**Linear Regression** : Linear models, A bidimensional example, Linear regression with scikit-learn and higher dimensionality, Regressor analytic expression, Ridge, Lasso, and ElasticNet, Robust regression with random sample consensus, Polynomial regression, Isotonic regression **Logistic Regression** : Linear classification, Logistic regression, Implementation and optimizations, Stochastic gradient descent algorithms, Finding the optimal hyperparameters through grid search, Classification metrics, ROC curve. **Naive Bayes** : Bayes' theorem, Naive Bayes classifiers, Naive Bayes in scikit-learn, Bernoulli naive Bayes, Multinomial naive Bayes, Gaussian naive Bayes.	**15**
III	**Support Vector Machines** : Linear support vector machines, scikit-learn implementation, Linear classification, Kernel-based classification, Radial Basis Function, Polynomial kernel, Sigmoid kernel, Custom kernels, Non-linear examples, Controlled support vector machines, Support vector regression. **Decision Trees and Ensemble Learning :** Binary decision trees, Binary decisions, Impurity measures, Gini impurity index, Cross-entropy impurity index, Misclassification impurity index, Feature importance, Decision tree classification with scikit-learn, Ensemble learning, Random forests, Feature importance in random forests, AdaBoost, Gradient tree boosting, Voting classifier. **Clustering Fundamentals :** Clustering basics, K-means, Finding the optimal number of clusters, Optimizing the inertia, Silhouette score, Calinski-Harabasz index, Cluster instability, DBSCAN, Spectral clustering, Evaluation methods based on the ground truth, Homogeneity, Completeness, Adjusted rand index.	**15**
IV	**Hierarchical Clustering :** Hierarchical strategies, Agglomerative clustering, Dendrograms, Agglomerative clustering in scikit-learn, Connectivity constraints. **Introduction to Recommendation Systems :** Naive user-based systems, User-based system implementation with scikit-learn, Content-based systems, Model-free (or memory-based) collaborative filtering, Model-based collaborative filtering, Singular Value Decomposition strategy, Alternating least squares strategy, Alternating least squares with Apache Spark MLlib. **Creating a Machine Learning Architecture :** Machine learning architectures, Data collection, Normalization, Dimensionality reduction, Data augmentation, Data conversion, Modeling/Grid search/Cross-validation, Visualization, scikit-learn tools for machine learning architectures, Pipelines, Feature unions.	**15**

Text Book :

- Machine Learning Algorithms, Reference guide for popular algorithms for data science and machine learning, **Giuseppe Bonaccorso, BIRMINGHAM –**
- ~~Machine Learning A Probabilistic Perspective, P. Murphy, The MIT Press, 2012.2.~~

Reference Books :

1. Introduction to Machine Learning (Second Edition): Ethem Alpaydın, The MIT Press (2010).
2. Introduction to Machine Learning, Ethem Alpaydin, 2nd Ed., PHI Learning Pvt. Ltd.,2013.2.
3. Pattern Recognition and Machine Learning: Christopher M. Bishop, Springer (2006)
4. Machine Learning: The Art and Science of Algorithms that Make Sense of Data: Peter Flach, Cambridge University Press (2012) Machine Learning for Hackers: Drew Conway and John Myles White, O'Reilly (2012)
5. Machine Learning in Action: Peter Harrington, Manning Publications (2012).
6. Machine Learning - Tom M. Mitchell, McGraw Hill Education, International Edition
7. Machine Learning with R: Brett Lantz, Packt Publishing (2013)
8. The Elements of Statistical Learning: Data Mining, Inference, and Prediction - Trevor Hastie, Robert Tibshirani, and Jerome Friedman - Springer, 2nd edition
9. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly, Media, Inc. 2nd Edition.

Major (Credit 4(2+2))

Microservice Architecture

Course Code: M23IT2MJ01 **Course Credit: 04**

1 credit - 15 lectures **1 lecture is 60 minutes**

Course Objectives:

1. Gain a thorough understanding of the philosophy and architecture of Web applications using ASP.NET Core MVC;
2. Gain a practical understanding of.NET Core;
3. Acquire a working knowledge of Web application development using ASP.NET Core MVC 6 and Visual Studio
4. Create HTTP services using ASP.NET Core Web API;

Learning Outcomes:

On successful completion of the course learner will be able to:

1. Students will be able to understand web applications using ASP.NET
2. Students will become proficient in adopting Microservices
3. Students will become proficient in building Microservices with ASP.NET Core

UNIT	Topic	HRS
I	**Microservices**: Understanding Microservices, Adopting Microservices, The Microservices Way. Microservices Value Proposition: Deriving Business Value, defining a Goal-Oriented,Layered Approach, Applying the Goal-Oriented, Layered Approach. **Designing Microservice Systems**: The Systems Approach to Microservices, A Microservices Design Process, **Establishing a Foundation**: Goals and Principles.	15
II	**Service Design**: Microservice Boundaries, API design for Microservices, Data and Microservices, Distributed Transactions and Sagas, Asynchronous Message-Passing and Microservices, dealing with Dependencies, System **Design and Operations**: Independent Deployability, More Servers, Docker and Microservices, Role of Service Discovery, Need for an API Gateway, Monitoring and Alerting.	15

III	**Running Microservices :** Deploying microservices, Ways to deploy microservices: Single machine, multiple processes, Multiple machines and processes, Deploy microservices with containers, Containers on servers, Serverless containers, Orchestrators, Deploy microservices as serverless functions. Which method is best to deploy microservices?. **Release management for microservices:** A common approach: one microservice, one repository. Maintaining multiple microservices releases. Managing microservices releases with monorepos	15
IV	**Building Microservices with ASP.NET Core:** Introduction,Installing .NET Core, Building a Console App, Building ASP.NET Core App. Delivering Continuously: Introduction to Docker,Continuous integration with Wercker, Continuous Integration with Circle CI, Deploying to Docker Hub. **Building Microservice with ASP.NET Core:** Microservice, Team Service, API First Development,Test First Controller, Creating a CI pipeline, Integration Testing, Running the team service Docker Image. **Backing Services:** Microservices Ecosystems, Building the location Service, Enhancing Team Service.	15

References:

1.Microservice Architecture: Aligning Principles,Practices, and Culture by Irakli Nadareishvili, Ronnie Mitra, Matt McLarty, and Mike Amundsen,O'Reilly,First edition,2016

2.Building Microservices with ASP.NET Core by Kevin Hoffman,O'Reilly,First edition,2017

3.Building Microservices:Designing Fine-GrainedSystems by Sam Newman,O'Reilly

4.Production-ready Microservices by Susan J. Fowler,O'Reilly,2017

Major(Credit 4)

Practicals of Introduction to Machine Learning and Microservice Architecture

Course Code: M23IT2MJP03 **Course Credit: 4**

1 credit - 15 lectures **1 lecture is 120 minutes**

Course Objectives:

1. To teach the students the implementation of Machine Learning as per the concepts learnt.
2. To create HTTP services using ASP.NET Core Web API
3. To work with Docker swarm

Course Outcomes :

1. Understand the key issues in machine learning and its associated applications in intelligent business and scientific computing.
2. Acquire fundamental enabling techniques and scalable algorithms like Regression, SVM in Machine Learning.
3. Understand the Working with Docker
4. Acquire the knowledge of Building micro services

Sr.No.	**Practicals of Introduction to Machine LEarning**
1.	Extract the data from the database using python.
2.	Perform Clustering algorithms for unsupervised classification.
3	Plot the cluster data using visualization techniques.
4	CLASSIFICATION MODEL a. Install relevant packages for classification. b. Choose a classifier for classification problems. c. Evaluate the performance of the classifier. d. Implement Decision tree classification techniques.
5	Implement k-nearest neighbors classification using python.

6	Implement Naïve Bayes theorem to classify the English text.
7	Implement SVM classification techniques.
8	Implement linear regression using python.
9	Import data from web storage. Name the dataset and now do Logistic Regression to find out relation between variables that are affecting the admission of a student in an institute based on his or her GRE score, GPA obtained and rank of the student. Also check if the model is fit or not. require (foreign), require(MASS).
10	MULTIPLE REGRESSION MODEL Apply multiple regressions if data have a continuous independent variable. Apply on the above dataset.

Sr.No.	**Practicals of Microservice Architecture**
1	Building APT.NET Core MVC Application
2	Building ASP.NET Core REST API
3	Working with Docker, Docker Commands, Docker Images and Containers.
4	Installing software packages on Docker, Working with Docker Volumes and Networks.
5	Working with Docker Swarm.
6	Creating Micro service with ASP.Net Core
7	Building Microservices
8	Microservice-Inter service communication
9	Creating Service Discovery
10	Microservice-API Gateway

Major(Credit 2)

Technical Writing

Course Code: M23IT1MJ04 **Course Credit: 2**

1 credit - 15 lectures **1 lecture is 60 minutes**

Course Objectives:

The objectives of this course are

1. To convey complex information to readers in a way that they can understand and apply, even if they have no prior knowledge of the subject
2. To provide conceptual understanding of developing a strong foundation in general writing, including research proposals and reports.
3. To cover the technological developing skills for writing Article, Blog, E-Book, Commercial web Page design, Business Listing Press Release, E-Listing and Product Description.

Course Outcomes:

On successful completion of the course learner will be able to:

1. Develop technical documents that meet the requirements with standard guidelines.
2. Understanding the essentials and hands-on learning about Content Writing and Blog Creation.
3. Develop a skill to write correct technical English in proposal preparation, ,report, research papers and reports.

Unit	Details	Lectures
I	**Introduction to Technical Communication**: What Is Technical Communication? : The Challenges of Producing Technical Communication, Characteristics of a Technical Document, Measures of Excellence in Technical Documents, Brief Introduction to Ethics in Technical Writing , Your Ethical Obligations, The Role of Corporate Culture in Ethical and Legal Conduct, Understanding Ethical and Legal Issues Related to Social Media .*Case Study: The Cost of Poor Communication* **Writing Technical Documents:** Planning, Drafting, Revising, Editing, Proofreading. Common Document Types and Correspondence: Text Messages, Emails, Memos, and Letters **Introduction to Content Writing**: Types of Content (Article, Blog, E-Books, Press Release, Newsletters Etc), Exploring Content Publication Channels.	15

	Document Design: Designing Reader-Centered Pages and Documents, Document Formatting, Headings **Blog Creation**: Understand the psychology behind your web traffic, Creating killing landing pages which attract users, Using Landing Page Creators, Setting up Accelerated Mobile Pages, Identifying UI, UX Experience of your website or blog.	
II	**Research and Documentation:** Literature Reviews, Interviewing for Information, Documenting Sources, Copyright, Paraphrasing, Questionnaires. Technical papers, book chapters, Manuals, Posters. Structure of a technical document. Copyright issues in technical writing, Proper procedure in citing already published works, Referencing styles, figures and tables. Writing a good review paper. Writing of abstract, synopsis, cover letters, responses, discussion and keywords. Conducting Primary Research, Conducting secondary research. **Writing Proposals:** Writing a Proposal, The Structure of the Proposal. Case study on writing an ideal proposal. **Report Components:** Abstracts, Introductions, Tables of Contents, Executive Summaries, Feasibility Reports, Investigative Reports, Laboratory Reports, Test Reports, Technical writing case study on AI Powered Solutions.	15

References:

1. Technical Communication, Mike Markel, Bedford/St. Martin's 11th Edition, 2014.
2. Handbook of Technical Writing, Gerald J. Alred, Charles T. Brusaw, Walter E. Oliu, Bedford/St. Martin's 9th Edition, 2008.
3. Technical Writing 101: A Real-World Guide to Planning and Writing Technical Content, Alan S. Pringle and Sarah S. O'Keefe, Scriptorium Publisher, 3rd Edition, 2009.
4. Technical Writing Essentials Introduction to Professional Communications in the Technical Fields, Suzan Last.
5. Technical Writing AT LBCC Will Fleming Linn-Benton Community College Albany, Oregon ,Free Open Education Resource (OER) e-textbook for.Technical Writing at Linn-Benton Community College.

Electives(E)

Autonomous Systems and Knowledge Representation

Course Code: M23IT2E01 **Course Credit: 02**

1 credit - 15 lectures **1 lecture is 60 minutes**

Course Objectives:

1. Understand AI's basics and its journey through history.
2. Learn different search algorithms and heuristic techniques used in AI problem-solving.
3. Explore intelligent systems like expert systems and agents in AI.

Learner Outcomes:

1. Explain AI's history, key concepts, and real-world applications.
2. Apply various heuristic search algorithms (like Hill Climbing, Simulated Annealing, A*) for problem-solving.
3. Analyse how expert systems are built and understand the role of agents in different AI setups.

Unit	Topic	Lectures
I	**AI Fundamentals:** What is Artificial Intelligence? Foundations of AI, history, foundation and Applications. Timelines of Artificial Intelligence. **Heuristic search techniques:** Generate and test, Hill climbing,Simulated annealing, Problem reduction, AO* algorithm, Constraints satisfaction, Means - Ends analysis **Search Techniques:** Graph search, Depth First Search, Breadth First Search, Iterative Deepening search, Uniform cost search, Greedy method, Best first search, Beam search, Branch and Bound search, A* algorithm.	15

II	**Problem Solving:** Production Systems, State space representation. **Expert System and Applications:** Phases in Building Expert System, Expert System Architecture, Expert System versus Traditional Systems, Rule based Expert Systems, Blackboard Systems, Truth Maintenance System, Application of Expert Systems.	**15**
	Intelligent Agents: Agents vs software programs, classification of agents, working of an agent, single agent and multiagent systems, performance evaluation, architecture, agent communication language, applications	

References:

1. Stuart Russell and Peter Norvig - "Artificial Intelligence: A Modern Approach", 3rd Edition Pearson, Chennai, 2015

2. Artificial Intelligence: Saroj Kaushik, Cengage Publisher 2nd Edition 2023.

3. Artificial Intelligence: A Modern Approach A. Russel, Peter Norvig, Pearson Publisher, 3rd Edition 2023.

4. Artificial Intelligence: Kevin Knight, Elaine Rich, Shivashankar B. Nair, McGraw Hill Publisher, 3rd Edition 2017.

Practicals of Autonomous Systems And Knowledge Representation

Course Code: M23IT2EP01 **Course Credit: 02**

1 credit - 15 lectures **1 lecture is 120 minutes**

Course Objectives:

1. Master foundational principles of AI algorithms and methodologies.
2. Develop practical skills in building intelligent systems and applications.
3. Apply AI techniques to solve diverse real-world challenges.

Learner Outcomes:

1. Acquire a deep understanding of AI fundamentals and their applications.
2. Demonstrate proficiency in developing AI-based solutions.
3. Apply AI knowledge creatively to solve complex problems.

Sr.No.	**Practicals of Autonomous Systems And Knowledge Representation**
1.	Design an Expert system for responding to the patient query for identifying the flu.
2.	Design an Expert system using AIML for Restaurant Recommender.
3.	Design an E-commerce Chatbot using AIML.
4.	Design a Game bot(Rock, Paper, Scissors Bot) using AIML.
5.	Implement the following algorithms and methods: • Backtracking techniques. • Depth-First search and Breadth First Search.
6.	Implement the following algorithms and methods: • Iterative Deepening Search. • Uniform Cost Search.
7.	Implement the following algorithms and methods: • Greedy Method. • Best First Search.
8.	Implement the following algorithms and methods: • Beam Search. • Branch and Bound Search.
9.	Implement the A* Algorithm using Python.
10.	Write a program for to implement Automatic Sprinkler Rule based system.

Electives(E)

Modern Networking

Course Code:M23IT1E02 **Course Credits: 2**

1 credit - 15 lectures **1 lecture is 60 minutes**

Course Objectives:

- Gain fundamental knowledge of computer and telecommunications networks .
- Compare various tradeoffs and choices in current networking technologies .
- Comprehend basics of network programming .
- Prepare for studying advanced topics (e.g. CSE 620, CSE 630, CSE 646), and a career in the field of computer networking.

Learner Outcomes:

- Pragmatic understanding of how the networking components work and how they support the Internet.
- Perform network programming using C/C++ .
- Analyze the functionality of popular networking protocols.
- Operate popular networking tools such as WireShark and iperf.

Unit	Topic	Lectures
I	**Computer Networks and the Internet:**What Is the Internet? 2 The Network Edge ,The Network Core, Protocol Layers and Their Service Models . **Application Layer:** Principles of Network Applications ,The Web and HTTP ,Electronic Mail in the Internet ,DNS—The Internet's Directory Service ,Socket Programming: Creating Network Applications. **Transport Layer :**Transport-Layer Services, Multiplexing and Demultiplexing, Connectionless Transport: UDP,Principles of Reliable Data Transfer ,Connection-Oriented Transport: TCP,TCP Congestion Control **The Network Layer: Data Plane** :Overview ,What's Inside a Router? ,The Internet Protocol (IP): IPv4, Addressing, IPv6, and More, Generalized Forwarding and SDN.	**15**

II	**The Network Layer: Control Plane:** Control Plane:Routing Algorithms,Intra-AS Routing in the Internet: OSPF ,Routing Among the ISPs: BGP ,The SDN Control Plane,ICMP: The Internet Control Message Protocol ,Network Management and SNMP, NETCONF/YANG . **The Link Layer and LANs :**Introduction to the Link Layer , Error-Detection and -Correction Techniques ,Switched Local Area Networks ,Link Virtualization: A Network as a Link Layer,Data Center Networking. **Wireless and Mobile Networks:**WiFi: 802.11 Wireless LANs,Cellular Networks: 4G and 5G,Mobility Management: Principles,Mobility Management in Practice. **Security in Computer Networks :**Securing TCP Connections: TLS, Network-Layer Security: IPsec and Virtual Private Networks,Securing Wireless LANs and 4G/5G Cellular Networks, Operational Security: Firewalls and Intrusion Detection Systems	**15**

References:

1. "***Computer Networking: A Top-Down Approach Featuring the Internet***" by James F. F. Kurose and Keith W. Ross, 5th edition, Addison Wesley.
2. W. Richard Stevens, "UNIX Network Programming : Networking APIs : Sockets and XTI : Volume 1, Second Edition", Prentice Hall, Oct 1997, ISBN: 013490012X.
3. Larry L. Peterson and Bruce S. Davie, **Computer Networks: A Systems Approach**,4th edition, The Morgan Kaufmann Series in Networking.

Practicals of Modern Networking

Course Code:M23IT1E02 **Course Credits: 2**

1 credit - 15 lectures **1 lecture is 120 minutes**

Course Objectives:

- Gain fundamental knowledge of computer and telecommunications networks .
- Compare various tradeoffs and choices in current networking technologies .
- Comprehend basics of network programming .
- Prepare for studying advanced topics (e.g. CSE 620, CSE 630, CSE 646), and a career in the field of computer networking.

Learner Outcomes:

- Pragmatic understanding of how the networking components work and how they support the Internet.
- Perform network programming using C/C++ .
- Analyze the functionality of popular networking protocols.
- Operate popular networking tools such as WireShark and iperf.

Sr.No	Practicals of Modern Networking
1.	Overview of Networks and layered communications, understanding of Network equipment, wiring in details
2.	Linux OS (Ubuntu/CentOS) installation, practice on basic Linux commands and Networking commands (ifconfig, tcpdump, netstat, dnsip, hostname, route)
3.	Introduction to Packet Tracer, creation of a LAN and connectivity test in the LAN, creation of VLAN and VLAN trunking.
4.	Basic Router Configuration, Static Routing Implementation.
5.	Implementation of Dynamic/interior/exterior routing (RIP, OSPF, BGP)
6.	Firewall Implementation, Router Access Control List (ACL)
7.	Packet capture and header analysis with wire-shark (TCP,UDP,IP)
8.	Testing UDP and TCP throughput with iperf.
9.	Write a program to implement connection oriented and connectionless client for well known services (standard ports)
10	Program to demonstrate the use of advanced socket sytem calls : readv(),writev() getsockname(),setsockname(),getpeername().

Revised Scheme of Examination
Faculty of Science
(Postgraduate Programme)

SCHEME OF EXAMINATION (for 100 marks and 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
An internal test of 20 marks	20
One Project And Viva Voce/Presentation/Case Studies/Assignments	15
Attendance and Class Participation	5
Total	40

B) Semester End examination 60 marks

PAPER PATTERN

Duration: 2½ hours	
Total Marks:60	
Q.1 15 marks OR 15 marks (7 and 8 marks)-Unit 1	15
Q.2 15 marks OR 15 marks (7 and 8 marks)-Unit 2	15
Q.3 15 marks OR 15 marks (7 and 8 marks)-Unit 3	15
Q.4 15 marks OR 15 marks (7 and 8 marks)-Unit 4	15
Total	60

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

SCHEME OF EXAMINATION (for 50 marks, 2 credits Theory)

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
An internal test of 20 marks	10
Assignment/Presentation/Case Studies	05
Attendance and Class Participation	05
Total	20

B) Semester End examination 30 marks

PAPER PATTERN

Duration: 1 hour	
Total Marks:30	
Q.1 15 marks OR 15 marks (7 and 8 marks)-Unit 1	15
Q.2 15 marks OR 15 marks (7 and 8 marks)-Unit 2	15
Total	30

Passing criteria: Minimum 40% in Internal (08 out of 20) and 40% (12 out of 30) in semester-end examination.

SCHEME OF PRACTICAL EXAMINATION (for 50 marks , 2 credits)

Semester end examination 50 marks

PAPER PATTERN

Duration: 2.5 hours	
Total Marks:50	
Q.1 Practical Q1	20
Q.2 Practical Q2	20
Viva	05
Journal	05
Total	50

Passing criteria: Minimum 40% in Internal (08 out of 20) and 40% (12 out of 30) in the semester-end examination.

Passing Standard

The learners to pass a course shall have to obtain a minimum of 40% marks in each head of passing, consisting of Internal Assessment and Semester End Examination. The learners shall obtain a minimum of 40% marks (i.e. 16 out of 40 or 8 Out of 20) in the Internal Assessment and 40% marks in the Semester End Examination (i.e. 24 Out of 60 or 12 Out of 30) separately, to pass the course and a minimum of Grade D, wherever applicable, to pass a particular semester. A learner will be said to have passed the course if the learner passes the Internal Assessment and Semester End Examination together.